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J. D. B.	James David Bourchier, M.A., F.R.G.S. King's College, Cambridge. Correspondent of *The Times* in South-Eastern Europe. Commander of the Orders of Prince Danilo of Montenegro and of the Saviour of Greece, and Officer of the Order of St Alexander of Bulgaria.	**Macedonia.**

J. F.-K.	James Fitzmaurice-Kelly, Litt.D., F.R.Hist.S. Gilmour Professor of Spanish Language and Literature, Liverpool University. Norman McColl Lecturer, Cambridge University. Fellow of the British Academy. Member of the Council of the Hispanic Society of America. Knight Commander of the Order of Alphonso XII. Author of *A History of Spanish Literature.*	**Lull, Raimon;** **Maupassant.**
J. Ga.	James Gairdner, C.B., LL.D. See the biographical article: Gairdner, James.	**Mary I., Queen.**
J. G. Sc.	Sir James George Scott, K.C.I.E. Superintendent and Political Officer, Southern Shan States. Author of *Burma*; *The Upper Burma Gazetteer.*	**Mandalay.**
J. Hn.	Justus Hashagen, Ph.D. Privatdozent in Medieval and Modern History, University of Bonn. Author of *Das Rheinland unter die französische Herrschaft.*	**Louis I. and II. of Bavaria.**
J. H. F.	John Henry Freese, M.A. Formerly Fellow of St John's College, Cambridge.	**Lycaon.**
J. H. R.	John Horace Round, M.A., LL.D. (Edin.). Author of *Feudal England*; *Studies in Peerage and Family History*; *Peerage and Pedigree.*	**Lord Great Chamberlain;** **Mar, Earldom of;** **Marquess.**
J. Hl. R.	John Holland Rose, M.A., Litt.D. Christ's College, Cambridge. Lecturer on Modern History to the Cambridge University Local Lectures Syndicate. Author of *Life of Napoleon I.*; *Napoleonic Studies*; *The Development of the European Nations*; *The Life of Pitt*; chapters in the *Cambridge Modern History.*	**Lowe, Sir Hudson;** **Maret.**
J. I.	Jules Isaac. Professor of History at the Lycée of Lyons.	**Louis XII. of France.**
J. J. T.	Sir Joseph John Thomson, D.Sc., LL.D., Ph.D., F.R.S. Cavendish Professor of Experimental Physics and Fellow of Trinity College, Cambridge. President of the British Association, 1909–1910. Author of *A Treatise on the Motion of Vortex Rings*; *Application of Dynamics to Physics and Chemistry*; *Recent Researches in Electricity and Magnetism*; &c.	**Magneto-Optics;** **Matter.**
J. L. W.	Jessie Laidlay Weston. Author of *Arthurian Romances unrepresented in Malory.*	**Malory, Sir Thomas;** **Map, Walter.**
J. M. Gr.	James Moncrieff Grierson, C.B., C.M.G., C.V.O. Major-General, R.A. Commanding 1st Division Aldershot Command. Director of Military Operations at Headquarters, 1904–1906. Served through South African War, 1900–1901. Author of *Staff Duties in the Field*; &c.	**Manœuvres, Military.**
J. M. M.	John Malcolm Mitchell. Sometime Scholar of Queen's College, Oxford. Lecturer in Classics, East London College (University of London). Joint-editor of Grote's *History of Greece.*	**Mandeville, Bernard de;** **Marcus Aurelius Antoninus.**
J. P. P.	John Percival Postgate, M.A., Litt.D. Professor of Latin in the University of Liverpool. Fellow of Trinity College, Cambridge. Fellow of the British Academy. Editor of the *Classical Quarterly.* Editor-in-chief of the *Corpus Poetarum Latinorum*; &c.	**Lucan** (*in part*).
Jno. S.	Sir John Scott, K.C.M.G., D.C.L. (1841–1904). Deputy Judge Advocate-General to the Forces, 1898–1904. Judicial Adviser to the Khedive of Egypt, 1890–1898. Hon. Fellow of Pembroke College, Oxford.	**Martial Law.**
J. Si.*	Rev. James Sibree, F.R.G.S. Principal Emeritus, United College (L.M.S. and F.F.M.A.), Antanànarivo, Madagascar. Membre de l'Académie Malgache. Author of *Madagascar and its People*; *Madagascar before the Conquest*; *A Madagascar Bibliography*; &c.	**Madagascar;** **Mauritius.**
J. S. Bl.	John Sutherland Black, M.A., LL.D. Assistant-editor of the 9th edition of the *Encyclopaedia Britannica.* Joint-editor of the *Encyclopaedia Biblica.*	**Mary: Mother of Jesus** (*in part*). **Mazzini.**
J. S. Co.	James Sutherland Cotton, M.A. Editor of the *Imperial Gazetteer of India.* Hon. Secretary of the Egyptian Exploration Fund. Formerly Fellow and Lecturer of Queen's College, Oxford. Author of *India*; &c.	**Mahrattas** (*in part*).
J. S. F.	John Smith Flett, D.Sc., F.G.S. Petrographer to the Geological Survey. Formerly Lecturer on Petrology in Edinburgh University. Neill Medallist of the Royal Society of Edinburgh. Bigsby Medallist of the Geological Society of London.	**Marble;** **Marl.**
J. T. Be.	John Thomas Bealby. Joint-author of Stanford's *Europe.* Formerly Editor of the *Scottish Geographical Magazine.* Translator of Sven Hedin's *Through Asia*, *Central Asia and Tibet*; &c.	**Maritime Province** (*in part*).
J. T. C.	Joseph Thomas Cunningham, M.A., F.Z.S. Lecturer on Zoology at the South-Western Polytechnic, London. Formerly Fellow of University College, Oxford. Assistant Professor of Natural History in the University of Edinburgh and Naturalist to the Marine Biological Association.	**Mackerel** (*in part*).
J. T. M.	John Theodore Merz, LL.D., Ph.D., D.C.L. Chairman of the Newcastle-upon-Tyne Electric Supply Co., Ltd. Author of *History of European Thought in the XIXth Century*; &c.	**Lotze** (*in part*).

J. T. S.*	James Thomson Shotwell, Ph.D. Professor of History in Columbia University, New York City.	**Louis VI., VII., IX., X. and XI. of France.**
J. V.*	Jules Viard. Archivist at the National Archives, Paris. Officer of Public Instruction, France. Author of *La France sous Philippe VI de Valois*; &c.	**Lore, Ambroise de;** **Louvet, Jean;** **Marcel, Étienne.**
J. V. B.	James Vernon Bartlet, M.A., D.D. (St Andrews). Professor of Church History, Mansfield College, Oxford. Author of *The Apostolic Age*; &c.	**Mark, St** (*in part*); **Matthew, St; Luke, St.**
K. G. J.	Kingsley Garland Jayne. Sometime Scholar of Wadham College, Oxford. Matthew Arnold Prizeman, 1903. Author of *Vasco da Gama and his Successors*.	**Malay Archipelago.**
K. K.	Konrad Kessler, Ph.D. Formerly Professor of Semitic Languages at the University of Greifswald.	**Mandaeans** (*in part*).
K. L.	Rev. Kirsopp Lake, M.A. Lincoln College, Oxford. Professor of Early Christian Literature and New Testament Exegesis in the University of Leiden. Author of *The Text of the New Testament*; *The Historical Evidence for the Resurrection of Jesus Christ*; &c.	**Mary, Mother of Jesus** (*in part*).
K. S.	Kathleen Schlesinger. Editor of *Portfolio of Musical Archaeology*. Author of *The Instruments of the Orchestra*.	**Lute** (*in part*); **Lyre** (*in part*); **Mandoline.**
L. J. S.	Leonard James Spencer, M.A., F.G.S. Assistant, Department of Mineralogy, Natural History Museum, South Kensington. Formerly Scholar of Sidney Sussex College, Cambridge, and Harkness Scholar. Editor of the *Mineralogical Magazine*.	**Manganite;** **Marcasite.**
L. V.*	Luigi Villari. Italian Foreign Office (Emigration Dept.). Formerly Newspaper Correspondent in East of Europe. Author of *Italian Life in Town and Country*; &c	**Mazzini:** *Bibliography*.
L. W. V-H.	L. W. Vernon-Harcourt (d. 1909). Barrister-at-Law. Author of *His Grace the Steward and the Trial of Peers*.	**Lord High Steward.**
M. A. W.	Mary A. Ward (Mrs Humphry Ward). See the biographical article: Ward, Mary Augusta.	**Lyly.**
M. Br.	Margaret Bryant.	**Louis VIII. and XVII. of France.**
M. Ja.	Morris Jastrow, Jr., Ph.D. Professor of Semitic Languages, University of Pennsylvania. Author of *Religion of the Babylonians and Assyrians*; &c.	**Marduk.**
M. N. T.	Marcus Niebuhr Tod, M.A. Fellow and Tutor of Oriel College, Oxford. University Lecturer in Epigraphy. Joint-author of *Catalogue of the Sparta Museum*.	**Lycurgus:** *Spartan Lawgiver*; **Lysander.**
M. O. B. C.	Maximilian Otto Bismarck Caspari, M.A. (Oxon.). Reader in Ancient History at London University. Lecturer in Greek at Birmingham University, 1905–1908.	**Mantineia** (*in part*); **Manuel I., Comnenus;** **Marathon** (*in part*).
M. P.	Mark Pattison, LL.D. See the biographical article: Pattison, Mark.	**Macaulay.**
N. D. M.	Newton Dennison Mereness, A.M., Ph.D. Author of *Maryland as a Proprietary Province*.	**Maryland.**
N. V.	Joseph Marie Noel Valois. Member of Académie des Inscriptions et Belles-Lettres, Paris. Honorary Archivist at the Archives Nationales. Formerly President of the Société de l'Histoire de France, and of the Société de l'École des Chartes.	**Marsilius of Padua;** **Martin I.-V.:** *Popes*.
N. W. T.	Northcote Whitridge Thomas, M.A. Government Anthropologist to Southern Nigeria. Corresponding Member of the Société d'Anthropologie de Paris. Author of *Thought Transference*; *Kinship and Marriage in Australia*; &c.	**Lycanthropy;** **Magic.**
O. R.	Osborne Reynolds, M.A., LL.D., F.R.S. M.Inst.C.E. Formerly Professor of Engineering, Victoria University, Manchester Honorary Fellow of Queens' College, Cambridge.	**Lubrication.**
P. A. A.	Philip A. Ashworth, M.A., Doc. Juris. New College, Oxford. Barrister-at-Law.	**Lübeck** (*in part*).
P. A. K.	Prince Peter Alexeivitch Kropotkin. See the biographical article: Kropotkin, Prince, P. A.	**Maritime Province** (*in part*).
P. G.	Percy Gardner, M.A., Litt.D., LL.D. See the biographical article: Gardner, Percy.	**Lysippus.**
P. Gi.	Peter Giles, M.A., LL.D., Litt.D. Fellow and Classical Lecturer of Emmanuel College, Cambridge, and University Reader in Comparative Philology. Formerly Secretary of the Cambridge Philological Society.	**M.**

P. G. T.	Peter Guthrie Tait, LL.D. See the biographical article: Tait, Peter Guthrie.	**Maxwell, James Clerk.**
P. Vi.	Paul Vinogradoff, D.C.L., LL.D. See the biographical article: Vinogradoff, Paul.	**Manor** (*in part*).
R. A.*	Robert Anchel. Archivist to the Department de l'Eure.	**Louis XVI.; Marat.**
R. B. McK.	Ronald Brunlees McKerrow, M.A. Trinity College, Cambridge. Editor of *The Works of Thomas Nashe*; &c.	**Marprelate Controversy.**
R. C. J.	Sir Richard Claverhouse Jebb, D.C.L., LL.D. See the biographical article: Jebb, Sir Richard Claverhouse.	**Lysias** (*in part*).
R. G.	Richard Garnett, LL.D., D.C.L. See the biographical article: Garnett, Richard	**Lucan** (*in part*); **Max Müller.**
R. H. C.	Rev. Robert Henry Charles, M.A., D.Litt. Grinfield Lecturer on the Septuagint at Oxford, 1905–1907. Fellow of the British Academy. Professor of Biblical Greek at Trinity College, Dublin, 1898–1906. Hibbert Lecturer at Oxford, 1898; Jowett Lecturer, 1898–1899. Author of *Critical History of a Future Life*; &c.	**Manasses, Prayer of.**
R. J. M.	Ronald John McNeill, M.A. Christ Church, Oxford. Barrister-at-law. Formerly Editor of the *St James's Gazette*, London.	**Lundy, Robert;** **Macdonnell, Sorley Boy;** **McNeile, Hugh;** **Manchester, Earls and Dukes of;** **March, Earls of;** **Margaret, Queen of Scotland;** **Masham, Abigail.**
R. K. D.	Sir Robert Kennaway Douglas. Formerly Professor of Chinese, King's College, London. Keeper of Oriental Printed Books and MSS. at British Museum, 1892–1907. Member of the Chinese Consular Service, 1858–1865. Author of *The Language and Literature of China*; *China*; *Europe and the Far East*; &c.	**Manchuria.**
R. L.*	Richard Lydekker, F.R.S., F.G.S., F.Z.S. Member of the Staff of the Geological Survey of India, 1874–1882. Author of *Catalogues of Fossil Mammals, Reptiles and Birds in the British Museum*; *The Deer of all Lands*; *The Game Animals of Africa*; &c.	**Loris; Macaque;** **Machaerodus;** **Mammalia** (*in part*); **Mammoth** (*in part*); **Manati;** **Mandrill; Marmot;** **Marsupialia; Mastodon.**
R. M'L.	Robert M'Lachlan, F.R.S. Editor of the *Entomologists' Monthly Magazine*.	**May-Fly** (*in part*).
R. M. D.	Richard Mountford Deeley, M.Inst.C.E., M.I.Mech.E., F.G.S. Late Locomotive Superintendent, Midland Railway. Joint-author of *Lubrication and Lubricants*.	**Lubricants.**
R. N. B.	Robert Nisbet Bain (d. 1909). Assistant Librarian, British Museum, 1883–1909. Author of *Scandinavia, the Political History of Denmark, Norway and Sweden, 1513–1900*; *The First Romanovs, 1613 to 1725*; *Slavonic Europe, the Political History of Poland and Russia from 1469 to 1796*; &c.	**Louis I. and II. of Hungary;** **Malachowski;** **Margaret, Queen; Martinuzzi;** **Matthias I., Hunyadi;** **Matvyeev;** **Mazepa-Koledinsky.**
R. P.	Reinhold Pauli. See the biographical article: Pauli, Reinhold.	**Lübeck** (*in part*).
R. P. S.	R. Phené Spiers, F.S.A., F.R.I.B.A. Formerly Master of the Architectural School, Royal Academy, London. Past President of Architectural Association. Associate and Fellow of King's College, London. Corresponding Member of the Institute of France. Editor of Fergusson's *History of Architecture*. Author of *Architecture: East and West*; &c.	**Manor-House.**
R. Po.	René Poupardin, D. ès L. Secretary of the École des Chartes. Honorary Librarian at the Bibliothèque Nationale, Paris. Author of *Le Royaume de Provence sous les Carolingiens*; *Recueil des chartes de Saint-Germain*; &c.	**Lorraine;** **Louis IV. and V. of France.**
R. S. C.	Robert Seymour Conway, M.A., D.Litt. (Cantab.). Professor of Latin and Indo-European Philology in the University of Manchester. Formerly Professor of Latin in University College, Cardiff; and Fellow of Gonville and Caius College, Cambridge. Author of *The Italic Dialects*.	**Mamertini;** **Marrucini;** **Marsi.**
R. T.	Sir Richard Temple. See the biographical article: Temple, Sir Richard.	**Mahrattas** (*in part*).
R. We.	Richard Webster, A.M. (Princeton). Formerly Fellow in Classics, Princeton University. Editor of *The Elegies of Maximianus*; &c.	**Mather, Increase;** **Mather, Richard.**
S. A. C.	Stanley Arthur Cook, M.A. Lecturer in Hebrew and Syriac, and formerly Fellow, Gonville and Caius College, Cambridge. Editor for Palestine Exploration Fund. Examiner in Hebrew and Aramaic, London University, 1904–1908. Author of *Glossary of Aramaic Inscriptions*; *The Laws of Moses and the Code of Hammurabi*; *Critical Notes on Old Testament History*; *Religion of Ancient Palestine*; &c.	**Lot;** **Manasseh.**

S. Bi.	SHELFORD BIDWELL, M.A., D.Sc., F.R.S. (1848–1909). Gonville and Caius College, Cambridge. Formerly President of the Physical Society and Member of Council of the Royal Society.	**Magnetism.**
S. C.	SIDNEY COLVIN, LL.D. See the biographical article: COLVIN, SIDNEY.	**Marcantonio.**
S. N.	SIMON NEWCOMB, LL.D., D.Sc. See the biographical article: NEWCOMB, SIMON.	**Mars:** *Planet.*
T. As.	THOMAS ASHBY, M.A., D.LITT., F.S.A. Director of the British School of Archaeology at Rome. Corresponding Member of the Imperial German Archaeological Institute. Formerly Scholar of Christ Church, Oxford; Craven Fellow, Oxford, 1897. Author of *The Classical Topography of the Roman Campagna*; &c.	**Lucania; Lucca;** **Lucena; Lucretilis, Mons;** **Lucus Feroniae; Luna;** **Magna Graecia; Manduria;** **Manfredonia;** **Marches, The; Marino;** **Marzabotto.**
T. Ba.	SIR THOMAS BARCLAY. Member of the Institute of International Law. Member of the Supreme Council of the Congo Free State. Officer of the Legion of Honour. Author of *Problems of International Practice and Diplomacy*; &c. M.P. for Blackburn, 1910.	**Mare Clausum.**
T. F. C.	THEODORE FREYLINGHUYSEN COLLIER, PH.D. Assistant Professor of History, Williams College, Williamstown, Mass., U.S.A.	**Marcellus.**
T. G. Br.	THOMAS GREGOR BRODIE, M.D., F.R.S. Professor of Physiology in the University of Toronto. Author of *Essentials of Experimental Physiology*.	**Lymph and Lymph Formation.**
T. H. H.*	SIR THOMAS HUNGERFORD HOLDICH, K.C.M.G., K.C.I.E., D.Sc. Superintendent, Frontier Surveys, India, 1892–1898. Gold Medallist, R.G.S., London, 1887. Author of *The Indian Borderland*; *The Countries of the King's Award*; *India*; *Tibet*.	**Makran.**
T. M. L.	THOMAS MARTIN LINDSAY, LL.D., D.D. Principal of the United Free Church College, Glasgow. Formerly Assistant to the Professor of Logic and Metaphysics in the University of Edinburgh. Author of *History of the Reformation*; *Life of Luther*; &c.	**Luther, Martin;** **Lutherans.**
T. R. R. S.	THOMAS ROSCOE REDE STEBBING, M.A., F.R.S., F.L.S., F.Z.S. Fellow of King's College, London. Hon. Fellow of Worcester College, Oxford. Zoological Secretary of Linnaean Society, 1903–1907. Author of *A History of Crustacea*; *The Naturalist of Cumbrae*; &c.	**Malacostraca.**
T. Se.	THOMAS SECCOMBE, M.A. Balliol College, Oxford. Lecturer in History, East London and Birkbeck Colleges, University of London. Stanhope Prizeman, Oxford, 1887. Assistant Editor of *Dictionary of National Biography*, 1891–1901. Author of *The Age of Johnson*; &c.	**Marlowe, Christopher** (*in part*); **Marston, Philip Bourke.**
T. W. R. D.	THOMAS WILLIAM RHYS DAVIDS, M.A., PH.D., LL.D. Professor of Comparative Religion in the University of Manchester. Professor of Pali and Buddhist Literature, University College, London, 1882–1904. President of the Pali Text Society. Fellow of the British Academy. Secretary and Librarian of Royal Asiatic Society, 1885–1902. Author of *Buddhism*; &c.	**Lumbini;** **Mahāvamsa;** **Maitreya.**
V. H. S.	REV. VINCENT HENRY STANTON, M.A., D.D. Ely Professor of Divinity in the University of Cambridge. Canon of Ely. Formerly Fellow, Dean, Tutor and Lecturer of Trinity College, Cambridge. Author of *The Jewish and the Christian Messiahs*; &c.	**Mark, Gospel of St;** **Matthew, Gospel of St;** **Luke, Gospel of St.**
W. A. B. C.	REV. WILLIAM AUGUSTUS BREVOORT COOLIDGE, M.A., F.R.G.S. Fellow of Magdalen College, Oxford. Professor of English History, St David's College, Lampeter, 1880–1881. Author of *Guide to Switzerland*; *The Alps in Nature and in History*; &c. Editor of the *Alpine Journal*, 1880–1889.	**Lötschen Pass;** **Lucerne: Canton, Town, Lake of;** **Lugano, Lake of;** **Maggiore, Lago.**
W. A. G.	WALTER ARMSTRONG GRAHAM. His Siamese Majesty's Resident Commissioner for the Siamese Malay State of Kelantan. Adviser to his Siamese Majesty's Minister for Lands and Agriculture. Author of *Kelantan, a Handbook*; &c.	**Malay States:** *Non-Federated.* **Malay States:** *Siamese.*
W. A. P.	WALTER ALISON PHILLIPS, M.A. Formerly Exhibitioner of Merton College and Senior Scholar of St John's College, Oxford. Author of *Modern Europe*; &c.	**Louis Philippe;** **Mahmud II.;** **Mass:** *Church.*
W. D. L.	WILLIAM DRAPER LEWIS, LL.B., PH.D. Dean of the Law School, University of Pennsylvania. Lecturer on Economics, Haverford College, Pennsylvania, 1890–1896. Editor of *Great American Lawyers*; &c.	**Marshall, John.**
W. E. A. A.	WILLIAM EDMUND ARMYTAGE AXON, LL.D. Formerly Deputy Chief Librarian of the Manchester Free Libraries. On Literary Staff of *Manchester Guardian*, 1874–1905. Member of the Gorsedd, with the bardic name of Manceinion. Author of *Annals of Manchester*; &c.	**Manchester.**
W. E. D.	WILLIAM ERNEST DALBY, M.A., M.INST.C.E., M.I.M.E. Professor of Civil and Mechanical Engineering at the City and Guilds of London Institute Central Technical College, South Kensington. Formerly University Demonstrator in the Engineering Department, Cambridge. Author of *The Balancing of Engines*; *Valves and Valve-Gear Mechanism*; &c.	**Mechanics:** *Applied* (*in part*).
W. E. G. F.	WILLIAM EDWARD GARRETT FISHER, M.A. Author of *The Transvaal and the Boers*.	**Marbles.**

W. F.*	Rev. William Fairweather, M.A., D.D. Minister of Dunnikier United Free Church, Kirkcaldy, N.B. Author of *Maccabees* (Cambridge Bible for Schools); *The Background of the Gospels*; &c.	**Maccabees;** **Maccabees, Books of.**
W. Ho.	Wynnard Hooper, M.A. Clare College, Cambridge. Financial Editor of *The Times*, London.	**Market.**
W. H. F.	Sir William Henry Flower, F.R.S. See the biographical article: Flower, Sir W. H.	**Mammalia (*in part*);** **Mammoth (*in part*);** **Mandrill (*in part*);** **Marten.**
W. J. M. R.	William John Macquorn Rankine, LL.D. See the biographical article: Rankine, William John Macquorn.	**Mechanics: *Applied* (*in part*).**
W. L. C.*	William Lee Corbin, A.M. Associate Professor of English, Wells College, Aurora, New York.	**Mather, Cotton.**
W. L. F.	Walter Lynwood Fleming, A.M., Ph.D. Professor of History in Louisiana State University. Author of *Documentary History of Reconstruction*; &c.	**Lynch Law;** **McGillivray, Alexander.**
W. L. G.	William Lawson Grant, M.A. Professor at Queen's University, Kingston, Canada. Formerly Beit Lecturer in Colonial History at Oxford University. Editor of *Acts of the Privy Council*, ("Colonial" series); *Canadian Constitutional Development* (in collaboration).	**Mackenzie, William Lyon;** **Manitoba (*in part*).**
W. M. R.	William Michael Rossetti. See the biographical article: Rossetti, Dante G.	**Luini; Mantegna;** **Martini; Masaccio;** **Masolino da Panicale.**
W. M. Ra.	Sir William Mitchell Ramsay, LL.D., D.C.L. See the biographical article: Ramsay, Sir William Mitchell.	**Lycaonia.**
W. P. C.	William Prideaux Courtney, D.C.L. See the article: Courtney, L. H., Baron.	**Marlborough, 1st Duke of.**
W. R. S.	William Robertson Smith, LL.D. See the biographical article: Smith, William Robertson.	**Malachi (*in part*);** **Mecca.**
W. Wn.	William Watson, D.Sc., F.R.S. Assistant Professor of Physics, Royal College of Science, London. Vice-President of the Physical Society.	**Magnetograph;** **Magnetometer.**
W. W. F.*	William Warde Fowler, M.A. Fellow of Lincoln College, Oxford. Sub-Rector, 1881–1904. Gifford Lecturer, Edinburgh University, 1908. Author of *The City-State of the Greeks and Romans*; *The Roman Festivals of the Republican Period*; &c.	**Mars: *Mythology*;** **Mauretania.**
W. Y. S.	William Young Sellar, LL.D. See the biographical article: Sellar, William Young.	**Martial;** **Lucilius (*in part*);** **Lucretius.**

PRINCIPAL UNSIGNED ARTICLES

Lord Chamberlain.
Lotteries.
Louisiana.
Lourdes.
Loyalists.
Luchu Archipelago.
Lützen.
Lyons.
Macabre.
McKinley, William.
Madeira.
Madison, James.
Madras.
Madrid.
Mafia.
Magnesium.
Magnolia.
Maine, U.S.A.
Maize.
Malplaquet.
Malta.
Mandamus.
Manganese.
Manila.
Manipur.
Manna.
Maori.
Maple.
March.
Marengo.
Marionettes.
Marriage.
Marseilles.
Marshal.
Marston Moor.
Maryland.
Massachusetts.
Match.
Mayo.
Mayor.
Measles.
Mecklenburg.

ENCYCLOPÆDIA BRITANNICA

ELEVENTH EDITION

VOLUME XVII

LORD CHAMBERLAIN, in England, an important officer of the king's household, to be distinguished from the lord great chamberlain (*q.v.*). He is the second dignitary of the court, and is always a member of the government of the day (before 1782 the office carried cabinet rank), a peer and a privy councillor. He carries a white staff, and wears a golden or jewelled key, typical of the key of the palace, which is supposed to be in his charge, as the ensigns of his office. He is responsible for the necessary arrangements connected with state ceremonies, such as coronations and royal marriages, christenings and funerals; he examines the claims of those who desire to be presented at court; all invitations are sent out in his name by command of the sovereign, and at drawing-rooms and levees he stands next to the sovereign and announces the persons who are approaching the throne. It is also part of his duty to conduct the sovereign to and from his carriage.[1] The bedchamber, privy chamber and presence chamber, the wardrobe, the housekeeper's room, the guardroom and the chapels royal are in the lord chamberlain's department. He is regarded as chief officer of the royal household, and he has charge of a large number of appointments, such as those of the royal physicians, tradesmen and private attendants of the sovereign. All theatres in the cities of London and Westminster (except patent theatres), in certain of the London boroughs and in the towns of Windsor and Brighton, are licensed by him and he is also licenser of plays (see THEATRE: *Law*; and REVELS, MASTER OF THE). His salary is £2000 a year.

The vice-chamberlain of the household is the lord chamberlain's assistant and deputy. He also is one of the ministry, a white-staff officer and the bearer of a key; and he is generally a peer or the son of a peer as well as a privy councillor. He receives £700 a year. Next to the vice-chamberlain comes the groom of the stole, an office only in use during the reign of a king. He has the charge of the vestment called the stole worn by the sovereign on state occasions. In the lord chamberlain's department also are the master, assistant master, marshal of the ceremonies and deputy-marshal of the ceremonies, officers whose special function it is to enforce the observance of the *etiquette* of the court. The reception of foreign potentates and ambassadors is under their particular care, and they assist in the ordering of all entertainments and festivities at the palace.[2] The gentleman usher of the black rod—the black rod which he carries being the ensign of his office—is the principal usher of the court and kingdom. He is one of the original functionaries of the order of the Garter, and is in constant attendance on the House of Lords, from whom, either personally or by his deputy, the yeoman usher of the black rod, it is part of his duty to carry messages and summonses to the House of Commons. There are six lords and six grooms "in waiting" who attend on the sovereign throughout the year and whose terms of attendance are of a fortnight's or three weeks' duration at a time. Usually "extra" lords and grooms in waiting are nominated by the sovereign, who, however, are unpaid and have no regular duties. Among the serjeants-at-arms there are two to whom special duties are assigned: the one attending the speaker in the House of Commons, and the other attending the lord chancellor in the House of Lords, carrying their maces and executing their orders.[3] The comptroller and examiner of accounts, the paymaster of the household, the licenser of plays, the dean and subdean of the chapels royal, the clerk and deputy clerks of the closet, the groom of the robes, the pages of the backstairs, of the chamber and of the presence, the poet laureate, the royal physicians and surgeons, chaplains, painters and sculptors, librarians and musicians, &c., are all under the superintendence of the lord chamberlain of the household.[4]

The queen consort's household is also in the department of the lord chamberlain of the household. It comprises a lord chamberlain, a vice-chamberlain and treasurer, equerry and the various ladies of the royal household, a groom and a clerk of the robes. The ladies of the household are the mistress of the robes, the ladies of the bedchamber, the bedchamber women and the maids of honour. The mistress of the robes in some measure occupies the position of the groom of the stole.[5] She is the only lady of the court who comes into office and goes out with the administration. She is always a duchess, and attends the queen consort at all state ceremonies and entertainments, but is never in permanent residence at the palace.[6] The ladies of the bedchamber share the personal attendance on the queen consort throughout the year. Of these there are eight, always peeresses, and each is in waiting for a fortnight or three weeks at a time. But the women of the bedchamber, of whom there are also eight, appear only at court ceremonies and entertainments according to a roster annually issued under the authority of the lord chamberlain of the queen consort. They are usually the daughters of peers or the wives of the sons of peers, and formerly, like the mistress of the robes and the ladies of the bedchamber, habitually assisted the queen at her daily toilette. But this has long ceased to be done by any of them. The eight maids of honour have the same terms of waiting as the ladies of the bedchamber. They are commonly if not always the daughters or granddaughters of peers, and when they have no superior title and precedence by birth are called "honourable" and placed next after the daughters of barons.

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[1] The lord chamberlain of the household at one time discharged some important political functions, which are described by Sir Harris Nicolas (*Proceedings of the Privy Council*, vol. vi., Preface, p. xxii).

[2] The office of master of the ceremonies was created by James I. The master of the ceremonies wears a medal attached to a gold chain round his neck, on one side being an emblem of peace with the motto "Beati pacifici," and on the other an emblem of war with the motto "Dieu et mon droit" (see *Finetti Philoxensis*, by Sir John Finett, master of the ceremonies to James I. and Charles I., 1656; and D'Israeli's *Curiosities of Literature*, 10th ed., p. 242 seq.).

[3] See May, *Parliamentary Practice*, pp. 236, 244.

[4] The offices of master of the great wardrobe and master of the jewel house in the lord chamberlain's department were abolished in 1782.

[5] In the reign of Queen Anne, Sarah duchess of Marlborough from 1704, and Elizabeth duchess of Somerset from 1710, held the combined offices of mistress of the robes and groom of the stole.

[6] Since the great "bedchamber question" of 1839 the settled practice has been for all the ladies of the court except the mistress of the robes to receive and continue in their appointments independently of the political connexions of their husbands, fathers and brothers (see Gladstone's *Gleanings of Past Years*, i. 40; and Torrens's *Memoirs of Lord Melbourne*, ii. 304).

LORD CHIEF JUSTICE, in England, the presiding judge of the king's bench division of the High Court of Justice, and in the absence of the lord chancellor, president of the High Court. He traces his descent from the justiciar of the Norman kings. This officer appears first as the lieutenant or deputy of the king, exercising all the functions of the regal office in the absence of the sovereign. "In this capacity William Fitz-Osbern, the steward of Normandy, and Odo of Bayeux, acted during the Conqueror's visit to the continent in 1067; they were left, according to William of Poitiers, the former to govern the north of England, the latter to hold rule in Kent, vice sua; Florence of Worcester describes them as "custodes Angliae," and Ordericus Vitalis gives to their office the name of "praefectura." It would seem most probable that William Fitz-Osbern at least was left in his character of steward, and that the Norman seneschalship was thus the origin of the English justiciarship" (Stubbs's *Constitutional History*, i. 346). The same authority observes that William of Warenne and Richard Clare (Bienfaite), who were left in charge of England in 1074, are named by a writer in the next generation "praecipui Angliae justitiarii"; but he considers the name to have not yet been definitely attached to any particular office, and that there is no evidence to show that officers appointed to this trust exercised any functions at all when the king was at home, or in his absence exercised supreme judicial authority to the exclusion of other high officers of the court. The office became permanent in the reign of William Rufus, and in the hands of Ranulf Flambard it became co-extensive with the supreme powers of government. But it was not till the reign of Henry II. that the chief officer of the crown acquired the exclusive right to the title of *capitalis* or *totius Angliae justitiarius*. Stubbs considers that the English form of the office is to be accounted for by the king's desire to prevent the administration falling into the hands of an hereditary noble. The early justiciars were clerics, in whom the possession of power could not become hereditary. The justiciar continued to be the chief officer of state, next to the king, until the fall of Hubert de Burgh (in the reign of King John), described by Stubbs as the last of the great justiciars. Henceforward, according to Stubbs, the office may be said to have survived only in the judicial functions, which were merely part of the official character of the chief justiciar. He was at the head of the curia regis, which was separating itself into the three historical courts of common law about the time when the justiciarship was falling from the supreme place. The chancellor took the place of the justiciar in council, the treasurer in the exchequer, while the two offshoots from the curia regis, the common pleas and the exchequer, received chiefs of their own. The king's bench represented the original stock of the curia regis, and its chief justice the great justiciar. The justiciar may, therefore, be said to have become from a political a purely judicial officer. A similar development awaited his successful rival the chancellor. Before the Judicature Act the king's bench and the common pleas were each presided over by a lord chief justice, and the lord chief justice of the king's bench was nominal head of all the three courts, and held the title of lord chief justice of England. The titles of lord chief justice of the common pleas and lord chief baron were abolished by the Judicature Act 1873, and all the common law divisions of the High Court united into the king's bench division, the president of which is the lord chief justice of England.

The lord chief justice is, next to the lord chancellor, the highest judicial dignitary in the kingdom. He is an *ex-officio* judge of the court of appeal. He holds office during good behaviour, and can only be removed by the crown (by whom he is appointed) after a joint address of both houses of parliament. He is now the only judicial functionary privileged to wear the collar of SS. There has been much discussion as to the origin and history of this collar;[1] it was a badge or insignia attached to certain offices entitling the holders to wear it only so long as they held those offices. The collar of SS. was worn by the chiefs of the three courts previous to their amalgamation in 1873, and that now worn by the lord chief justice of England was provided by Sir A. Cockburn in 1859 and entailed by him on all holders of the office. The salary is £8000 a year.

In the United States the supreme court consists of a chief justice and eight associate justices, any six of whom make a quorum. The salary of the chief justice is $13,000 and that of the associates $12,500. The chief justice takes rank next after the president, and he administers the oath on the inauguration of a new president and vice-president. The principal or presiding judge in most of the state judicatures also takes the title of chief justice.

LORD GREAT CHAMBERLAIN, in England, a functionary who must be carefully distinguished from the lord chamberlain; he is one of the great officers of state, whose office dates from Norman times; and the only one who still holds it under a creation of that period. As his name implies, he was specially connected by his duties with the king's chamber (*camera curie*); but this phrase was also used to denote the king's privy purse, and the chamberlain may be considered as originally the financial officer of the household. But as he was always a great baron, deputies performed his financial work, and his functions became, as they are now, mainly ceremonial, though the emblem of his office is still a key. The office had been held by Robert Malet, son of a leading companion of the Conqueror, but he was forfeited by Henry I., who, in 1133, gave the great chamberlainship to Aubrey de Vere and his heirs. Aubrey's son was created earl of Oxford, and the earls held the office, with some intermission, till 1526, when the then earl left female heirs. His heir-male succeeded to the earldom, but the crown, as is now established, denied his right to the office, which was thenceforth held under grants for life till Queen Mary and Elizabeth admitted in error the right of the earls on the strength of their own allegation. So matters continued till 1626, when an earl died and again left an heir-male and an heir-female. After an historic contest the office was adjudged to the former, Lord Willoughby d'Eresby. No further question arose till 1779, when his heirs were two sisters. In 1781 the House of Lords decided that it belonged to them jointly, and that they could appoint a deputy, which they did. Under a family arrangement the heirs of the two sisters respectively appointed deputies in alternate reigns till the death of Queen Victoria, when Lord Ancaster, the heir of the elder, who was then in possession, claimed that he, as such, had sole right to the office. Lord Cholmondeley and Lord Carrington as co-heirs of the younger sister, opposed his claim, and the crown also claimed for itself on the ground of the action taken by the king in 1526. After a long and historic contest, the House of Lords (1902) declined to re-open the question, and merely re-affirmed the decision of 1781, and the office, therefore, is now vested jointly in the three peers named and their heirs.

The lord great chamberlain has charge of the palace of Westminster, especially of the House of Lords, in which he has an office; and when the sovereign opens parliament in person he is responsible for the arrangements. At the opening or closing of the session of parliament by the sovereign in person he disposes of the sword of state to be carried by any peer he may select, and walks himself in the procession on the right of the sword of state, a little before it and next to the sovereign. He issues the tickets of admission on the same occasions. He assists at the introduction of all peers into the House of Lords on their creation, and at the homage of all bishops after their consecration. At coronations he emerges into special importance; he still asserts before the court of claims his archaic right to bring the king his "shirt, stockings and drawers" and to dress him on coronation day and to receive his ancient fees, which include the king's bed and "night robe." He also claims in error to serve the king with water before and after the banquet, which was the function of the "ewry," a distinct office held by the earls of Oxford. At the actual coronation ceremony he takes an active part in investing the king with the royal insignia.

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[1] *Notes and Queries*, series 1, vol. ii.; series 4, vols. ii. ix. x.; series 6, vols. ii. iii.; Planché, *Dictionary of Costume*, p. 126; Foss, *Lives of the Judges*, vol. vii.; Dugdale, *Orig. Jud.* fol. 102.

See J. H. Round, "The Lord Great Chamberlain" (*Monthly Review*, June 1902) and "Notes on the Lord Great Chamberlain Case" (*Ancestor*, No. IV.). (J. H. R.)

LORD HIGH CHANCELLOR, one of the great officers of state of the United Kingdom, and in England the highest judicial functionary. The history of the office and of the growth of the importance of the lord chancellor will be found under CHANCELLOR. The lord chancellor is in official rank the highest civil subject in the land outside the royal family, and takes precedence immediately after the archbishop of Canterbury. His functions have sometimes been exercised by a lord keeper of the great seal (see LORD KEEPER), the only real difference between the two offices being in the appointment of the keeper by mere delivery of the seal, while a lord chancellor receives letters patent along with it. He is by office a privy councillor, and it has long been the practice to make him a peer and also a cabinet minister. He is by prescription Speaker or prolocutor of the House of Lords, and as such he sits upon the woolsack, which is not strictly within the House. Unlike the Speaker of the House of Commons, the lord chancellor takes part in debates, speaking from his place in the House. He votes from the woolsack instead of going into the division lobby. The only function which he discharges as Speaker practically is putting the question; if two debaters rise together, he has no power to call upon one, nor can he rule upon points of order. Those taking part in debates address, not the lord chancellor, but the whole House, as "My Lords." The lord chancellor always belongs to a political party and is affected by its fluctuations. This has often been denounced as destructive of the independence and calm deliberativeness essential to the purity and efficiency of the bench. In defence, however, of the ministerial connexion of the chancellor, it has been said that, while the other judges should be permanent, the head of the law should stand or fall with the ministry, as the best means of securing his effective responsibility to parliament for the proper use of his extensive powers. The transference of the judicial business of the chancery court to the High Court of Justice removed many of the objections to the fluctuating character of the office. As a great officer of state, the lord chancellor acts for both England and Scotland, and in some respects for the United Kingdom, including Ireland (where, however, an Irish lord chancellor is at the head of the legal system). By Article XXIV. of the Act of Union (1705) one great seal was appointed to be kept for all public acts, and in this department the lord chancellor's authority extends to the whole of Britain, and thus the commissions of the peace for Scotland as well as England issue from him.[1] As an administrative officer, as a judge and as head of the law, he acts merely for England. His English ministerial functions are thus briefly described by Blackstone: "He became keeper of the king's conscience, visitor, in right of the king, of all hospitals and colleges of the king's foundation, and patron of all the king's livings under the value of twenty marks per annum in the king's books. He is the general guardian of all infants, idiots and lunatics, and has the general superintendence of all charitable uses in the kingdom." But these duties and jurisdiction by modern statutes have been distributed for the most part among other offices or committed to the judges of the High Court (see CHARITY AND CHARITIES; INFANT; INSANITY). Under the Judicature Act 1873 the lord chancellor is a member of the court of appeal, and, when he sits, its president, and he is also a judge of the High Court of Justice. He is named as president of the chancery division of the latter court. His judicial patronage is very extensive, and he is by usage the adviser of the crown in the appointment of judges[2] of the High Court. He presides over the hearing of appeals in the House of Lords. His proper title is "Lord High Chancellor of Great Britain and Ireland." His salary is £10,000 per annum, and he is entitled to a pension of £5000 per annum.

AUTHORITIES.—*Observations concerning the Office of Lord Chancellor* (1651), attributed to Lord Chancellor Ellesmere; Blackstone's *Commentaries*; Campbell's *Lives of the Chancellors*; and D. M. Kerly, *Historical Sketch of the Equitable Jurisdiction of the Court of Chancery* (1890).

LORD HIGH CONSTABLE, in England, the seventh of the great officers of state. His office is now called out of abeyance for coronations alone. The constable was originally the commander of the royal armies and the master of the horse. He was also, in conjunction with the earl marshal, president of the court of chivalry or court of honour. In feudal times martial law was administered in the court of the lord high constable. The constableship was granted as a grand serjeanty with the earldom of Hereford by the empress Maud to Milo of Gloucester, and was carried by his heiress to the Bohuns, earls of Hereford and Essex. Through a coheiress of the Bohuns it descended to the Staffords, dukes of Buckingham; and on the attainder of Edward Stafford, third duke of Buckingham, in the reign of Henry VIII. it became merged in the crown. The Lacys and Verduns were hereditary constables of Ireland from the 12th to the 14th century; and the Hays, earls of Erroll, have been hereditary constables of Scotland from early in the 14th century.

LORD HIGH STEWARD. The Lord High Steward of England, who must not be confused with the Lord Steward, ranks as the first of the great officers of state. Appointments to this office are now made only for special occasions, such as the coronation of a sovereign or the trial of a peer by his peers. The history of the office is noteworthy. The household of the Norman and Angevin kings of England included certain persons of secondary rank, styled dapifers, seneschals or stewards (the prototypes of the lord steward), who were entrusted with domestic and state duties; the former duties were those of purveyors and sewers to the king, the latter were undefined. At coronations, however, and great festivals it became the custom in England and elsewhere to appoint magnates of the first rank to discharge for the occasion the domestic functions of the ordinary officials. In accordance with this custom Henry II. appointed both Robert II., earl of Leicester, and Hugh Bigod, earl of Norfolk, to be his honorary hereditary stewards; and at the Christmas festival of 1186 the successors in title of these two earls, with William, earl of Arundel, who held the similar honorary office of hereditary butler, are described as serving the king at the royal banqueting table. Subsequently the earls of Leicester bought out the rights of the earls of Norfolk for ten knights' fees.

The last of these earls of Leicester to inherit the hereditary stewardship was Simon V. de Montfort; how he served as steward at the coronation of Eleanor, queen of Henry III., is described in the Exchequer Red Book. The office of steward in France, then recently suppressed, had for some time been the highest office of state in that kingdom, and Simon de Montfort appears to have considered that his hereditary stewardship entitled him to high official position in England; and after his victory at Lewes he repeatedly figures as steward of England in official documents under the great seal. After Simon's death at Evesham his forfeited estates were conferred on his son Edmund of Lancaster, who also obtained a grant of the stewardship, but only for life. Edmund was succeeded by Thomas, earl of Lancaster, who received a fresh grant of the stewardship to himself and the heirs of his body from Edward II.; and this earl it was who, during the weak administration of the last-mentioned king, first put forward in a celebrated tract the claim of the steward to be the second personage in the realm and supreme judge in parliament, a claim which finds some slight recognition in the preamble to the statute passed against the Despencers in the first year of Edward III.

Earl Thomas was executed for treason, and though his attainder was reversed he left no issue, and was succeeded in the earldom by his brother Henry. The subsequent earls and dukes of Lancaster were all recognized as stewards of England, the office apparently being treated as annexed to the earldom, or honor, of Leicester. John of Gaunt, indeed, at a time when it was possible that he would never obtain the Leicester moiety of the Lancastrian estates, seems to have made an ingenious but quite unfounded claim to the office as annexed to the honor of Hinckley. Strictly speaking, none of the Lancasters after Thomas had any clear title either by grant or otherwise; such title as they had merged in the crown when Henry IV. usurped the throne. Meanwhile the stewardship had increased in importance. On the accession of Edward III., Henry, earl of Lancaster, as president of the council, had superintended the coronation of the infant king; John of Gaunt did the same for the infant Richard II.; and, as part of the duties involved, sat in the White Hall of Westminster to hear and determine the claims to perform coronation services. The claims were made by petition, and included amongst others: the claim of Thomas of Woodstock to act as constable, the rival claims of John Dymock and Baldwin de Frevile to act as champion, and the claim of the barons of the Cinque Ports to carry a canopy over the king. Minutes of these proceedings, in which the duke is stated to have sat "as steward of England," were enrolled by his order. This is the origin of what is now called the Court of Claims. The precedent of Richard II. has been followed on all subsequent occasions, except that in modern times it has been the practice to appoint commissioners instead of a steward to superintend this court. In 1397 John of Gaunt created a notable precedent in support of the steward's claim to be supreme judge in parliament by presiding at the trial of the earl of Arundel and others.

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[1] The great seal, which exists in duplicate for Irish use, is the great seal of the United Kingdom.

[2] Except the lord chief justice, who is appointed on the nomination of the prime minister.

When Henry IV. came to the throne he appointed his young son Thomas, afterwards duke of Clarence, to the office of steward. Clarence held the office until his death. He himself never acted as judge in parliament; but in 1415 he was appointed to preside at the judgment of peers delivered in Southampton against Richard, earl of Cambridge, and Lord Scrope of Masham, who had been previously tried by commissioners of oyer and terminer. No permanent steward was ever again created; but a steward was always appointed for coronations to perform the various ceremonial services associated with the office, and, until the Court of Claims was entrusted to commissioners, to preside over that court. Also, in the 15th century, it gradually became the custom to appoint a steward *pro hac vice* to preside at the trial, or at the proceedings upon the attainder of a peer in parliament; and later, to preside over a court, called the court of the lord high steward, for the trial of peers when parliament was not sitting. To assist in establishing the latter court a precedent of 1400 appears to have been deliberately forged. This precedent is reported in the printed *Year-Book* of 1400, first published in 1553; it describes the trial of "the earl of H" for participation in the rebellion of that year, and gives details of procedure. John Holand, earl of Huntingdon, is undoubtedly the earl indicated, but the evidence is conclusive that he was murdered in Essex without any trial. The court of the lord high steward seems to have been first definitely instituted in 1499 for the trial of Edward Plantagenet, earl of Warwick; only two years earlier Lord Audley had been condemned by the court of chivalry, a very different and unpopular tribunal. The Warwick trial was most carefully schemed: the procedure, fundamentally dissimilar to that adopted in 1415, follows exactly the forged precedent; but the constitution of the court was plainly derived from the Southampton case. The record of the trial was consigned to a new repository (commonly but wrongly called the Baga de Secretis), which thenceforth became the regular place of custody for important state trials. Latterly, and possibly from its inception, this repository consisted of a closet with three locks, of which the keys were entrusted, one to the chief justice of England, another to the attorney-general and the third to the master of the crown office, or coroner. Notwithstanding the irregular origin of the steward's court, for which Henry VII. must be held responsible, the validity of its jurisdiction cannot be questioned. The Warwick proceedings were confirmed by act of parliament, and ever since this court has been fully recognized as part of the English constitution.

For about a century and a half prior to the reign of James I. the criminal jurisdiction of parliament remained in abeyance, and bills of attainder were the vogue. The practice of appointing a steward on these occasions to execute judgment upon a peer was kept up till 1477, when George, duke of Clarence, was attainted, and then dropped. Under the Stuarts the criminal jurisdiction of parliament was again resorted to, and when the proceedings against a peer were founded on indictment the appointment of a steward followed as a matter of settled practice. The proper procedure in cases of impeachment had, on the contrary, never been defined. On the impeachment of Strafford the lords themselves appointed Arundel to be high steward. In Danby's case a commission under the great seal issued in the common form adopted for the court of the steward; this was recalled, and the rule agreed to by a joint committee of both houses that a steward for trials of peers upon impeachments was unnecessary. But, as such an appointment was obviously convenient, the lords petitioned for a steward; and a fresh commission was accordingly issued in an amended form, which recited the petition, and omitted words implying that the appointment was necessary. This precedent has been treated as settling the practice of parliament with regard to impeachments.

Of the proceedings against peers founded upon indictment very few trials antecedent to the revolution took place in parliament. The preference given to the steward's court was largely due to the practice, founded upon the Southampton case, of summoning only a few peers selected by the steward, a practice which made it easy for the king to secure a conviction. This arrangement has been partially abrogated by the Treason Act of William III., which in cases of treason and misprision of treason requires that all peers of parliament shall be summoned twenty days at least before every such trial. The steward's court also differed in certain other particulars from the high court of parliament. For example, it was ruled by Lord Chancellor Jeffreys, as steward at the trial of Lord Delamere, that, in trials of peers which take place during the recess of parliament in the steward's court, the steward is the judge of the court, the court is held before him, his warrant convenes the prisoner to the bar, his summons convenes the peers for the trial, and he is to determine by his sole authority all questions of law that arise in the course of the trial, but that he is to give no vote upon the issue of guilty or not guilty; during a session of parliament, on the contrary, all the peers are both triers and judges, and the steward is only as chairman of the court and gives his vote together with the other lords. Lord Delamere was tried in 1685 in the steward's court; since then all trials of peers have taken place before the lords in parliament. The most recent trial was that of Earl Russell in 1901, when Lord Chancellor Halsbury was made lord high steward. The steward is addressed as "his grace," he has a rod of office, and the commission appointing him is dissolved according to custom by breaking this rod.

A court of claims sat and a steward was appointed for the coronation of Edward VII.; and during the procession in Westminster Abbey the duke of Marlborough, as steward, carried "St Edward's crown" in front of the bearer of the Bible (the bishop of London), who immediately preceded the king; this function of the steward is of modern origin. The steward's ancient and particular services at coronations are practically obsolete; the full ceremonies, procession from Westminster Hall and banquet in which he figured prominently, were abandoned on the accession of William IV.

For the early history of the steward see L. W. Vernon-Harcourt, *His Grace the Steward and Trial of Peers* (1907); for the later history of the office see Sir E. Coke, *Institutes* (1797); Cobbett and Howell, *State Trials* (1809, seq.); S. M. Phillipps, *State Trials* (1826); John Hatsell, *Precedents*, vol. 4 (1818), and Sir M. Foster, *Crown Law* (1809). See also the various works on *Coronations* for the steward's services on these occasions. (L. W. V.-H.)

LORD HIGH TREASURER, in England, once the third great officer of state. The office was of Norman origin and dated from 1216. The duty of the treasurer originally was to act as keeper of the royal treasure at Winchester, while as officer of the exchequer he sat at Westminster to receive the accounts of the sheriffs, and appoint officers to collect the revenue. The treasurer was subordinate to both the justiciar and the chancellor, but the removal of the chancery from the exchequer in the reign of Richard I., and the abolition of the office of justiciars in the reign of Henry III., increased his importance. Indeed, from the middle of the reign of Henry III. he became one of the chief officers of the crown. He took an important part in the equitable jurisdiction of the exchequer, and was now styled not merely king's treasurer or treasurer of the exchequer, but lord high treasurer and treasurer of the exchequer. The first office was conferred by delivery of a white staff, the second by patent. Near the end of the 16th century he had developed into an official so occupied with the general policy of the country as to be prevented from supervising personally the details of the department, and Lord Burleigh employed a secretary for this purpose. On the death of Lord Salisbury in 1612 the office was put in commission; it was filled from time to time until 1714, when the duke of Shrewsbury resigned it; since that time it has always been in commission (see TREASURY). The Scottish treasury was merged with the English by the Act of Union, but the office of lord high treasurer for Ireland was continued until 1816.

LORD HOWE, an island of the southern Pacific Ocean, lying about 31° 36′ S., 159° 5′ E., 520 m. E.N.E. of Sydney. Pop. 120. It was discovered in 1778 by Lieutenant Ball (whose name is commemorated in the adjacent islet of Ball's Pyramid), and is a dependency of New South Wales. It measures about 5½ m. by 1 m., and is well wooded and hilly (reaching a height of 2840 ft. at the southern end), being of volcanic formation, while there are coral reefs on the western shore. It has a pleasant climate. The name Lord Howe is given also to an islet of the Santa Cruz group, and to two islands, also known under other names—Mopiha, of the Society group, and Ongtong Java of the Solomon Islands.

LORD JUSTICE CLERK, in Scotland, a judge next in rank to the lord justice-general. He presides in the second division of the court of session, and in the absence of the lord justice-general, presides in the court of justiciary. The justice clerk was originally not a judge at all, but simply clerk and legal assessor of the justice court. In course of time he was raised from the clerk's table to the bench, and by custom presided over the court in the absence of the justice-general. Up to 1672 his position was somewhat anomalous, as it was doubtful whether he was a clerk or a judge, but an act of that year, which suppressed the office of justice-depute, confirmed his position as a judge, forming him, with the justice-general and five of the lords of session into the court of justiciary. The lord justice clerk is also one of the officers of state for Scotland, and one of the commissioners for keeping the Scottish Regalia. His salary is £4800 a year.

LORD JUSTICE-GENERAL, the highest judge in Scotland, head of the court of justiciary, called also the lord president, and as such head of the court of session and representative of the sovereign. The office of justice-general was for a considerable time a sinecure post held by one of the Scottish nobility, but by the Court of Session Act 1830, it was enacted that, at the termination of the existing interest, the office should be united with that of lord president of the court of session, who then became presiding judge of the court of justiciary. The salary is £5000 a year.

LORD KEEPER OF THE GREAT SEAL, in England, formerly a great officer of state. The Great Seal of England, which is affixed on all solemn occasions to documents expressing the pleasure of the sovereign, was first adopted by Edward the Confessor (see SEALS), and entrusted to a chancellor for keeping. The office of chancellor from the time of Becket onwards varied much in importance; the holder being an ecclesiastic, he was not only engaged in the business of his diocese, but sometimes was away from England. Consequently, it became not unusual to place the personal custody of the great seal in the hands of a vice-chancellor or keeper; this, too, was the practice followed during a temporary vacancy in the chancellorship. This office gradually developed into a permanent appointment, and the lord keeper acquired the right of discharging all the duties connected with the great seal. He was usually, though not necessarily, a peer, and held office during the king's pleasure, he was appointed merely by delivery of the seal, and not, like the chancellor, by patent. His status was definitely fixed (in the case of lord keeper Sir Nicholas Bacon) by an act of Elizabeth, which declared him entitled to "like place, pre-eminence, jurisdiction, execution of laws, and all other customs, commodities, and advantages" as the lord chancellor. In subsequent reigns the lord keeper was generally raised to the chancellorship, and retained the custody of the seal. The last lord keeper was Sir Robert Henley (afterwards Lord Northington), who was made chancellor on the accession of George III.

LORD MAYOR'S DAY, in England, the 9th of November, the date of the inauguration of the lord mayor of London (see Vol. XVI., p. 966), marked by a pageant known as the Lord Mayor's Show. The first of these pageants was held in 1215. The idea originated in the stipulation made in a charter then granted by John that the citizen chosen to be mayor should be presented to the king or his justice for approval. The crowd of citizens who accompanied the mayor on horseback to Westminster developed into a yearly pageant, which each season became more elaborate. Until the 15th century the mayor either rode or walked to Westminster, but in 1453 Sir John Norman appears to have set a fashion of going by water. From 1639 to 1655 the show disappeared owing to Puritan opposition. With the Restoration the city pageant was revived, but interregnums occurred during the years of the plague and fire, and in 1683 when a quarrel broke out between Charles and the city, ending in the temporary abrogation of the charter. In 1711 an untoward accident befell the show, the mayor Sir Gilbert Heathcote (the original of Addison's Sir Andrew Freeport) being thrown by his horse. The next year a coach was, in consequence, provided for the chief magistrate. In 1757 this was superseded by a gilded and elaborately decorated equipage costing £10,065 which was used till 1896, when a replica of it was built to replace it.

LORD PRESIDENT OF THE COUNCIL, in England, one of the great officers of state, and a member of the ministry. It was only in 1679 that the office of lord president became permanent. Previously either the lord chancellor, the lord keeper of the seal, or some particular court official took formal direction of the Privy Council. In the reign of Charles I. a special lord president of the council was appointed, but in the following reign the office was left unfilled. The office was of considerable importance when the powers of the Privy Council, exercised through various committees, were of greater extent than at the present time. For example, a committee of the lords of the council was formerly responsible for the work now dealt with by the secretary of state for foreign affairs; so also with that now discharged by the Board of Trade. The lord president up to 1855—when a new post of vice-president of the council was created—was responsible for the education department. He was also responsible for the duties of the council in regard to public health, now transferred to the Local Government Board, and for duties in regard to agriculture, now transferred to the Board of Agriculture and Fisheries. The duties of the office now consist of presiding on the not very frequent occasions when the Privy Council meets, and of the drawing up of minutes of council upon subjects which do not belong to any other department of state. The office is very frequently held in conjunction with other ministerial offices, for example, in Gladstone's fourth ministry the secretary of state for India was also lord president of the council, and in the conservative ministry of 1903 the holder of the office was also president of the Board of Education. The lord president is appointed by a declaration made in council by the sovereign. He is invariably a member of the House of Lords, and he is also included in the cabinet.

LORDS JUSTICES OF APPEAL, in England, the ordinary judges of the court of appeal, the appellate division of the High Court of Justice. Their style was provided for by the Supreme

Court of Judicature Act 1877. The number was fixed at five by the Supreme Court of Judicature Act 1881, s. 3. Their salary is £5000 a year (see APPEAL).

LORDS OF APPEAL IN ORDINARY, in England, certain persons (limited to four), who, having held high judicial office or practised at the bar for not less than fifteen years, sit as members of the House of Lords to adjudicate in cases before that House in its legal capacity, and also to aid the judicial committee of the Privy Council in hearing appeals. Of the four lords of appeal in ordinary one is usually appointed from the Irish bench or bar and one from Scotland. Their salary is £6000 a year. They hold office on the same conditions as other judges. By the Appellate Jurisdiction Act 1876, under which they are appointed, lords of appeal in ordinary are, by virtue of and according to the date of their appointment, entitled during life to rank as barons and during the time that they continue in office are entitled to a writ of summons to attend, and to sit and vote in the House of Lords. They are life peers only. The patent of a lord of appeal in ordinary differs from that of a baron in that he is not "created" but "nominated and appointed to be a Lord of Appeal in Ordinary by the style of Baron."

LORD STEWARD, in England, an important official of the king's household. He is always a member of the government, a peer and a privy councillor. Up to 1782, the office was one of considerable political importance and carried cabinet rank. The lord steward receives his appointment from the sovereign in person, and bears a white staff as the emblem and warrant of his authority. He is the first dignitary of the court. In the *Statutes of Eltham* he is called "the lord great master," but in the *Household Book* of Queen Elizabeth "the lord steward," as before and since. In an act of Henry VIII. (1539) "for placing of the lords," he is described as "the grand master or lord steward of the king's most honourable household." He presides at the Board of Green Cloth.[1] In his department are the treasurer and comptroller of the household, who rank next to him. These officials are usually peers or the sons of peers and privy councillors. They sit at the Board of Green Cloth, carry white staves, and belong to the ministry. But the duties which in theory belong to the lord steward, treasurer and comptroller of the household are in practice performed by the master of the household, who is a permanent officer and resides in the palace. He is a white-staff officer and a member of the Board of Green Cloth but not of the ministry, and among other things he presides at the daily dinners of the suite in waiting on the sovereign. In his case history repeats itself. He is not named in the *Black Book* of Edward IV. or in the *Statutes* of Henry VIII., and is entered as "master of the household and clerk of the green cloth" in the *Household Book* of Queen Elizabeth. But he has superseded the lord steward of the household, as the lord steward of the household at one time superseded the lord high steward of England.

In the lord steward's department are the officials of the Board of Green Cloth, the coroner ("coroner of the verge"), and paymaster of the household, and the officers of the almonry (see ALMONER). Other offices in the department were those of the cofferer of the household, the treasurer of the chamber, and the paymaster of pensions, but these, with six clerks of the Board of Green Cloth, were abolished in 1782. The lord steward had formerly three courts besides the Board of Green Cloth under him. First, the lord steward's court, superseded (1541) by—second—the Marshalsea court, a court of record having jurisdiction, both civil and criminal within the verge (the area within a radius of 12 m. from where the sovereign is resident), and originally held for the purpose of administering justice between the domestic servants of the sovereign, "that they might not be drawn into other courts and their service lost." Its criminal jurisdiction had long fallen into disuse and its civil jurisdiction was abolished in 1849. Third, the palace court, created by letters patent in 1612 and renewed in 1665 with jurisdiction over all personal matters arising between parties within 12 m. of Whitehall (the jurisdiction of the Marshalsea court, the City of London, and Westminster Hall being excepted). It differed from the Marshalsea court in that it had no jurisdiction over the sovereign's household nor were its suitors necessarily of the household. The privilege of practising before the palace court was limited to four counsel. It was abolished in 1849. The lord steward or his deputies formerly administered the oaths to the members of the House of Commons. In certain cases (messages from the sovereign under the sign-manual) "the lords with white staves" are the proper persons to bear communications between the sovereign and the houses of parliament.

AUTHORITIES.—*Statutes of Eltham*; *Household Book* of Queen Elizabeth; Coke, *Institutes*; Reeves, *History of the Law of England*; Stephen, *Commentaries on the Laws of England*; Hatsell, *Precedents of Proceedings in the House of Commons*; May, *Parliamentary Practice*.

LORÉ, AMBROISE DE (1396–1446), baron of Ivry in Normandy and a French commander, was born at the château of Loré (Orne, arrondissement of Domfront). His first exploit in arms was at the battle of Agincourt in 1415; he followed the party of the Armagnacs and attached himself to the dauphin Charles. He waged continual warfare against the English in Maine until the advent of Joan of Arc. He fought at Jargeau, at Meung-sur-Loire and at Patay (1429). Using his fortress of Saint Céneri as a base of operations during the next few years, he seized upon Matthew Gough near Vivoin in 1431, and made an incursion as far as the walls of Caen, whence he brought away three thousand prisoners. Taken captive himself in 1433, he was exchanged for Talbot. In 1435 he and Dunois defeated the English near Meulan, and in 1436 he helped the constable Arthur, earl of Richmond (de Richmond), to expel them from Paris. He was appointed provost of Paris in February 1437, and in 1438 he was made "judge and general reformer of the malefactors of the kingdom." He was present in 1439 at the taking of Meaux, in 1441 at that of Pontoise, and he died on the 24th of May 1446.

See the *Nouvelle Biographie Générale*, vol. xxxi., and the *Revue Historique du Maine*, vols. iii. and vi. (J. V.*)

LORE, properly instruction, teaching, knowledge. The O. Eng. *lár*, as the Dutch *leer* and Ger. *Lehre*, represents the Old Teutonic root, meaning to impart or receive knowledge, seen in "to learn," "learning." In the *Gentleman's Magazine* for June 1830 it was suggested that "lore" should be used as a termination instead of the Greek derivative *-ology* in the names of the various sciences. This was never done, but the word, both as termination and alone, is frequently applied to the many traditional beliefs, stories, &c., connected with the body of knowledge concerning some special subject; *e.g.* legendary lore, bird-lore, &c. The most familiar use is in "folk-lore" (*q.v.*).

LORELEI (from Old High Ger. *Lur*, connected with modern Ger. *lauern*, "to lurk," "be on the watch for," and equivalent to elf, and *lai*, "a rock"). The Lorelei is a rock in the Rhine near St Goar, which gives a remarkable echo, which may partly account for the legend. The tale appears in many forms, but is best known through Heinrich Heine's poem, beginning *Ich weiss nicht was soll es bedeuten.* In the commonest form of the story the Lorelei is a maiden who threw herself into the Rhine in despair over a faithless lover, and became a siren whose voice lured fishermen to destruction. The 13th-century minnesinger, known as Der Marner, says that the Nibelungen treasure was hidden beneath the rock. The tale is obviously closely connected with the myth of Holda, queen of the elves. On the Main she sits combing her locks on the Hullenstein, and the man who sees her loses sight or reason, while he who listens is condemned to wander with her for ever. The legend, which Clemens Brentano claimed as his own invention when he wrote his poem "Zu Bacharach am Rheine" in his novel of *Godwi* (1802), bears all the marks of popular mythology. In the 19th century it formed material for a great number of songs, dramatic sketches, operas and even tragedies, which are enumerated by Dr Hermann Seeliger in his *Loreleysage in Dichtung und Musik* (Leipzig-Reudnitz, 1898). The favourite poem with composers was Heine's, set to music by some twenty-five musicians, the settings by Friedrich Silcher (from an old folk-song) and by Liszt being the most famous.

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[1] A committee of the king's household, consisting of the lord steward and his subordinates, charged with the duty of examining and passing all the accounts of the household. The board had also power to punish all offenders within the verge or jurisdiction of the palace, which extended in every direction for 200 yds. from the gates of the court yard. The name is derived from the green-covered table at which the transactions of the board were originally conducted.

LORETO, an episcopal see and pilgrimage resort of the Marches, Italy, in the province of Ancona, 15 m. by rail S.S.E. of that town. Pop. (1901) 1178 (town), 8033 (commune). It lies upon the right bank of the Musone, at some distance from the railway station, on a hill-side commanding splendid views from the Apennines to the Adriatic, 341 ft. above sea-level. The town itself consists of little more than one long narrow street, lined with shops for the sale of rosaries, medals, crucifixes and similar objects, the manufacture of which is the sole industry of the place. The number of pilgrims is said to amount to 50,000 annually, the chief festival being held on the 8th of September, the Nativity of the Virgin. The principal buildings, occupying the four sides of the piazza, are the college of the Jesuits, the Palazzo Apostolico, now Reale (designed by Bramante), which contains a picture gallery with works of Lorenzo Lotto, Vouet and Caracci and a collection of majolica, and the cathedral church of the Holy House (Chiesa della Casa Santa), a Late Gothic structure continued by Giuliano da Maiano, Giuliano da Sangallo and Bramante. The handsome façade of the church was erected under Sixtus V., who fortified Loreto and gave it the privileges of a town (1586); his colossal statue stands in the middle of the flight of steps in front. Over the principal doorway is a life-size bronze statue of the Virgin and Child by Girolamo Lombardo; the three superb bronze doors executed at the latter end of the 16th century and under Paul V. (1605-1621) are also by Lombardo, his sons and his pupils, among them Tiburzio Vergelli, who also made the fine bronze font in the interior. The doors and hanging lamps of the Santa Casa are by the same artists. The richly decorated campanile, by Vanvitelli, is of great height; the principal bell, presented by Leo X. in 1516, weighs 11 tons. The interior of the church has mosaics by Domenichino and Guido Reni and other works of art. In the sacristies on each side of the right transept are frescoes, on the right by Melozzo da Forli, on the left by Luca Signorelli. In both are fine intarsias.

But the chief object of interest is the Holy House itself. It is a plain stone building, 28 ft. by 12½ and 13½ ft. in height; it has a door on the north side and a window on the west; and a niche contains a small black image of the Virgin and Child, in Lebanon cedar, and richly adorned with jewels. St Luke is alleged to have been the sculptor; its workmanship suggests the latter half of the 15th century. Around the Santa Casa is a lofty marble screen, designed by Bramante, and executed under Popes Leo X., Clement VII. and Paul III., by Andrea Sansovino, Girolamo Lombardo, Bandinelli, Guglielmo della Porta and others. The four sides represent the Annunciation, the Nativity, the Arrival of the Santa Casa at Loreto and the Nativity of the Virgin respectively. The treasury contains a large variety of rich and curious votive offerings. The architectural design is finer than the details of the sculpture. The choir apse is decorated with modern German frescoes, which are somewhat out of place.

The legend of the Holy House seems to have sprung up (how is not exactly known) at the close of the crusading period.

It is briefly referred to in the *Italia Illustrata* of Flavius Blondus, secretary to Popes Eugenius IV., Nicholas V., Calixtus III. and Pius II. (*ob.* 1464); it is to be read in all its fullness in the "Redemptoris mundi Matris Ecclesiae Lauretana historia," by a certain Teremannus, contained in the *Opera Omnia* (1576) of Baptista Mantuanus. According to this narrative the house at Nazareth in which Mary had been born and brought up, had received the annunciation, and had lived during the childhood of Jesus and after His ascension, was converted into a church by the apostles. In 336 the empress Helena made a pilgrimage to Nazareth and caused a basilica to be erected over it, in which worship continued until the fall of the kingdom of Jerusalem. Threatened with destruction by the Turks, it was carried by angels through the air and deposited (1291) in the first instance on a hill at Tersatto in Dalmatia, where an appearance of the Virgin and numerous miraculous cures attested its sanctity, which was confirmed by investigations made at Nazareth by messengers from the governor of Dalmatia. In 1294 the angels carried it across the Adriatic to a wood near Recanati; from this wood (lauretum), or from the name of its proprietrix (Laureta), the chapel derived the name which it still retains ("sacellum gloriosae Virginis in Laureto"). From this spot it was afterwards (1295) removed to the present hill, one other slight adjustment being required to fix it in its actual site. Bulls in favour of the shrine at Loreto were issued by Pope Sixtus IV. in 1491 and by Julius II. in 1507, the last alluding to the translation of the house with some caution ("ut pie creditur et fama est"). The recognition of the sanctuary by subsequent pontiffs has already been alluded to. In the end of the 17th century Innocent XII. appointed a "missa cum officio proprio" for the feast of the Translation of the Holy House, and the feast is still enjoined in the Spanish Breviary as a "greater double" (December 10).

See also U. Chevalier, *Notre-Dame de Lorette* (Paris, 1906).

LORETO, an inland department of Peru, lying E. of the Andean Cordilleras and forming the N.E. part of the republic. Extensive territories, nominally parts of this department, are in dispute between Peru and the neighbouring republics of Brazil, Colombia and Ecuador (see PERU), and the northern and eastern boundaries of the territory are therefore not definitely determined. Loreto is bounded W. by the departments of Amazonas and San Martin (the latter a new department, with an area of 30,744 sq. m., taken from Loreto, lying between the central and eastern Cordilleras and extending from the 6th to the 9th parallels, approximately), and S. by Huánuco and Cuzco. The area of the department, including the territories claimed by Peru, is estimated at 257,798 sq. m. The population is estimated (1906) at 120,000. The aboriginal population is not numerous, as the thick, humid forests are inhabited only where lakes and streams make open spaces for sunlight and ventilation. With the exception of the eastern Andean slopes and a little-known range of low mountains on the Brazilian frontier, called the Andes Conomamas, the surface is that of a thickly wooded plain sloping gently towards the Marañon, or Upper Amazon, which crosses it from W. to E. There are open plains between the Ucayali and Huallaga, known as the Pampas del Sacramento, but otherwise there are no extensive breaks in the forest. The elevation of the plain near the base of the Andes is 526 ft. on the Ucayali, 558 on the Huallaga, and 453 at Barranca, on the Marañon, a few miles below the Pongo de Manseriche. The eastward slope of the plain is about 250 ft. in the 620 m. (direct) between this point and Tabatinga, on the Brazilian frontier; this not only shows the remarkably level character of the Amazon valley of which it forms a part, but also the sluggish character of its drainage. From the S. the principal rivers traversing Loreto are the Ucayali and Huallaga, the former entering from Cuzco across its southern boundary and skirting the eastern base of the Andes for about four degrees of latitude before it turns away to the N.E. to join the Marañon, and the latter breaking through the Eastern Cordillera between the 6th and 7th parallels and entering the Marañon 143 m. below Yurimaguas, where navigation begins. The lower Ucayali, which has a very tortuous course, is said to have 868 m. of navigable channel at high water and 620 m. at low water. North of the Marañon several large rivers pass through Peruvian territory between the Santiago and Napo (see ECUADOR), nearly all having navigable channels. On the level plains are a number of lakes, some are formed by the annual floods and are temporary in character. Among the permanent lakes are the Gran Cocama, of the Pampas del Sacramento, the Caballococha—a widening of the Amazon itself about 60 m. N.W. of Tabatinga—and Rimachuma, on the north side of the Marañon, near the lower Pastaza.

The natural resources of this extensive region are incalculable, but their development has been well nigh impossible through lack of transport facilities. They include the characteristic woods of the Amazon valley, rubber, nuts, cinchona or Peruvian bark, medicinal products, fish, fruits and fibres. The cultivated products include cocoa, coffee, tobacco and fruits. Straw hats and hammocks are manufactured to some extent. The natural outlet of this region is the Amazon river, but this involves 2500 m. of river navigation from Iquitos before the ocean is reached. Communication with the Pacific coast cities and ports of Peru implies the crossing of three high, snow-covered ranges of the Andes by extremely difficult trails and passes. A rough mountain road has been constructed from Oroya to Puerto Bermudez, at the head of navigation on the Pachitea, and is maintained by the government pending the construction of a railway, but the distance is 210 m. and it takes nine days for a mule train to make the journey. At Puerto Bermudez a river steamer connects with Iquitos, making the distance of 930 m. in seven days. From Lima to Iquitos by this route, therefore, involves 17 days travel over a distance of 1268 m. The most feasible route from the department to the Pacific coast is that which connects Puerto Limon, on the Marañon, with the Pacific port of Payta, a distance of 410 m., it being possible to cross the Andes on this route at the low elevation of 6600 ft. The climate of Loreto is hot and humid, except on the higher slopes of the Andes. The year is divided into a wet and a dry season, the first from May to October, and the average annual rainfall is estimated at 70 in. though it varies widely between distant points. The capital and only town of importance in the department is Iquitos.

LORIENT, a maritime town of western France, capital of an arrondissement in the department of Morbihan, on the right bank of the Scorff at its confluence with the Blavet, 34 m. W. by N. of Vannes by rail. Pop. (1906) 40,848. The town is modern and regularly built. Its chief objects of interest are the church of St Louis (1709) and a statue by A. Mercié of Victor Massé, the composer, born at Lorient in 1822. It is one of the five maritime prefectures in France and the first port for naval construction in the country. The naval port to the east of the town is formed by the channel of the Scorff, on the right bank of which the chief naval establishments are situated. These include magazines, foundries, forges, fitting-shops, rope-works and other workshops on the most extensive scale, as well as a graving dock, a covered slip and other slips. A floating bridge connects the right bank with the peninsula of Caudan formed by the union of the Scorff and Blavet. Here are the shipbuilding yards covering some 38 acres, and comprising nine slips for large vessels and two others for smaller vessels, besides forges and workshops for iron shipbuilding. The commercial port to the south of the town consists of an outer tidal port protected by a jetty and of an inner dock, both lined by fine quays planted with trees. It separates the older part of the town, which is hemmed in by fortifications from a newer quarter. In 1905, 121 vessels of 28,785 tons entered with cargo and 145 vessels of 38,207 tons cleared. The chief export is pit-timber, the chief import is coal. Fishing is actively carried on. Lorient is the seat of a sub-prefect, of commercial and maritime tribunals and of a tribunal of first instance, and has a chamber of commerce, a board of trade-arbitrators, a lycée, schools of navigation, and naval artillery. Private industry is also engaged in iron-working and engine making. The trade in fresh fish, sardines, oysters (which are reared near Lorient) and tinned vegetables is important and the manufacture of basket-work, tin-boxes and passementerie, and the preparation of preserved sardines and vegetables are carried on. The roadstead, formed by the estuary of the Blavet, is accessible to vessels of the largest size; the entrance, 3 or 4 m. south from Lorient, which is defended by numerous forts, is marked on the east by the peninsula of Gâvres (an artillery practising ground) and the fortified town of Port Louis; on the west are the fort of Loqueltas and, higher up, the battery of Kernevel. In the middle of the channel is the granite rock of St Michel, occupied by a powder magazine. Opposite it, on the right bank of the Blavet, is the mouth of the river Ter, with fish and oyster breeding establishments from which 10 millions of oysters are annually obtained. The roadstead is provided with six lighthouses. Above Lorient on the Scorff, here spanned by a suspension bridge, is Kérentrech, a pretty village surrounded by numerous country houses.

Lorient took the place of Port Louis as the port of the Blavet. The latter stands on the site of an ancient hamlet which was fortified during the wars of the League and handed over by Philip Emmanuel, duke of Morcœur, to the Spaniards. After the treaty of Vervins it was restored to France, and it received its name of Port Louis under Richelieu. Some Breton merchants trading with the Indies had established themselves first at Port Louis, but in 1628 they built their warehouses on the other bank. The Compagnie des Indes Orientales, created in 1664, took possession of these, giving them the name of l'Orient. In 1745 the Compagnie des Indes, then at the acme of its prosperity, owned thirty-five ships of the largest class and many others of considerable size. Its decadence dates from the English conquest of India, and in 1770 its property was ceded to the state. In 1782 the town was purchased by Louis XVI. from its owners, the Rohan-Guéméné family. In 1746 the English under Admiral Richard Lestock made an unsuccessful attack on Lorient.

LORINER, or LORIMER (from O. Fr. *loremier* or *lorenier*, a maker of *lorains*, bridles, from Lat. *lorum*, thong, bridle; the proper form is with the *n*; a similar change is found in Latimer for Latiner, the title of an old official of the royal household, the king's interpreter), one who makes bits and spurs and the metal mountings for saddles and bridles; the term is also applied to a worker in wrought iron and to a maker of small iron ware. The word is now rarely used except as the name of one of the London livery companies (see LIVERY COMPANY).

LORIS, a name of uncertain origin applied to the Indo-Malay representatives of the lemurs, which, together with the African pottos, constitute the section *Nycticebinae* of the family *Nycticebidae* (see PRIMATES). From their extremely slow movements and lethargic habits in the daytime these weird little creatures are commonly called sloths by Anglo-Indians. Their soft fur, huge staring eyes, rudimentary tails and imperfectly developed index-fingers render lorises easy of recognition. The smallest is the slender loris (*Loris gracilis*) of the forests of Madras and Ceylon, a creature smaller than a squirrel. It is of such exceeding strangeness and beauty that it might have been thought it would be protected by the natives; but they hold it alive before a fire till its beautiful eyes burst in order to afford a supposed remedy for ophthalmia! The mainland and Cingalese animals form distinct races. Both in this species and the slow loris there is a pair of rudimentary abdominal teats in addition to the normal pectoral pair. The slow loris (*Nycticebus tardigradus*) is a heavier built and larger animal, ranging from eastern Bengal to Cochin China, Siam, the Malay Peninsula, Java and Sumatra. There are several races, mostly grey in colour, but the Sumatran *N. t. hilleri* is reddish. (R. L.*)

LORIS-MELIKOV, MICHAEL TARIELOVICH, COUNT (1825?–1888), Russian statesman, son of an Armenian merchant, was born at Tiflis in 1825 or 1826, and educated in St Petersburg, first in the Lazarev School of Oriental Languages, and afterwards in the Guards' Cadet Institute. He joined a hussar regiment, and four years afterwards (1847) he was sent to the Caucasus, where he remained for more than twenty years, and made for himself during troublous times the reputation of a distinguished cavalry officer and an able administrator. In the latter capacity, though a keen soldier, he aimed always at preparing the warlike and turbulent population committed to his charge for the transition from military to normal civil administration, and in this work his favourite instrument was the schoolmaster. In the Russo-Turkish War of 1877–78 he commanded a separate corps d'armée on the Turkish frontier in Asia Minor. After taking the fortress of Ardahan, he was repulsed by Mukhtar Pasha at Zevin, but subsequently defeated his opponent at Aladja Dagh, took Kars by storm, and laid siege to Erzerum. For these services he received the title of Count. In the following year he was appointed temporary governor-general of the region of the Lower Volga, to combat an outbreak of the plague. The measures he adopted proved so effectual that he was transferred to the provinces of Central Russia to combat the Nihilists and Anarchists, who had adopted a policy of terrorism, and had succeeded in assassinating the governor of Kharkov. His success in this struggle led to his being appointed chief of the Supreme Executive Commission which had been created in St Petersburg to deal with the revolutionary agitation in general. Here, as in the Caucasus, he showed a decided preference for the employment of ordinary legal methods rather than exceptional extra-legal measures, and an attempt on his own life soon after he assumed office did not shake his convictions. In his opinion the best policy was to strike at the root of the evil by removing the causes of popular discontent, and for this purpose he recommended to the emperor a large scheme of administrative and economic reforms. Alexander II., who was beginning to lose faith in the efficacy of the simple method of police repression hitherto employed, lent a willing ear to the suggestion; and when the Supreme Commission was dissolved in August 1880, he appointed Count Loris-Melikov Minister of the Interior with exceptional powers. The proposed scheme of reforms was at once taken in hand, but it was never carried out. On the very day in March 1881 that the emperor signed a ukaz creating several commissions, composed of officials and eminent private individuals, who should prepare reforms in various branches of the administration, he was assassinated by Nihilist conspirators; and his successor, Alexander III., at once adopted a strongly reactionary policy. Count Loris-Melikov immediately resigned, and lived in retirement until his death, which took place at Nice on the 22nd of December 1888. (D. M. W.)

LORIUM, an ancient village of Etruria, Italy, on the Via Aurelia, 12 m. W. of Rome. Antoninus Pius, who was educated here, afterwards built a palace, in which he died. It was also a favourite haunt of Marcus Aurelius. Remains of ancient buildings exist in the neighbourhood of the road on each side (near the modern Castel di Guido) and remains of tombs, inscriptions, &c., were excavated in 1823–1824. Two or three miles farther west was probably the post-station of Bebiana, where inscriptions show that some sailors of the fleet were stationed—no doubt a detachment of those at Centumcellae, which was reached by this road.

LÖRRACH, a town in the grand-duchy of Baden, in the valley of the Wiese, 6 m. by rail N.E. of Basel. Pop. (1905) 10,794. It is the seat of considerable industry, its manufactures including calico, shawls, cloth, silk, chocolate, cotton, ribbons, hardware and furniture, and has a trade in wine, fruit and timber. There is a fine view from the neighbouring Schützenhaus, 1085 ft. high. In the neighbourhood also is the castle of Rötteln, formerly the residence of the counts of Hachberg and of the margraves of Baden; this was destroyed by the French in 1678, but was rebuilt in 1867. Lörrach received market rights in 1403, but did not obtain municipal privileges until 1682.

See Höchstetter, *Die Stadt Lörrach* (Lörrach, 1882).

LORRAINE, one of the former provinces of France. The name has designated different districts in different periods. Lotharingia, or Lothringen, *i.e. regnum Lotharii*, is derived from the *Lotharingi* or *Lotharienses* (O.G. *Lotheringen*, Fr. *Loherains*, *Lorrains*), a term applied originally to the Frankish subjects of Lothair, but restricted at the end of the 9th century to those who dwelt north of the southern Vosges.

Lorraine in Medieval Times.—The original kingdom of Lorraine was the northern part of the territories allotted by the treaty of Verdun (August 843) to the emperor Lothair I., and in 855 formed the inheritance of his second son, King Lothair. This kingdom of Lorraine was situated between the realms of the East and the West Franks, and originally extended along the North Sea between the mouths of the Rhine and the Ems, including the whole or part of Frisia and the cities on the right bank of the Rhine. From Bonn the frontier followed the Rhine as far as its confluence with the Aar, which then became the boundary, receding from the left bank in the neighbourhood of Bingen so as to leave the cities of Worms and Spires to Germany, and embracing the duchy of Alsace. After crossing the Jura, the frontier joined the Saône a little south of its confluence with the Doubs, and followed the Saône for some distance, and finally the valleys of the Meuse and the Scheldt. Thus the kingdom roughly comprised the region watered by the Moselle and the Meuse, together with the dioceses of Cologne, Trier, Metz, Toul, Verdun, Liége and Cambrai, Basel, Strassburg and Besançon, and corresponded to what is now Holland and Belgium, parts of Rhenish Prussia, of Switzerland, and of the old province of Franche-Comté, and to the district known later as Upper Lorraine, or simply Lorraine. Though apparently of an absolutely artificial character, this kingdom corresponded essentially to the ancient Francia, the cradle of the Carolingian house, and long retained a certain unity. It was to the inhabitants of this region that the name of *Lotharienses* or *Lotharingi* was primitively applied, although the word *Lotharingia*, as the designation of the country, only appears in the middle of the 10th century.

The reign of King Lothair (*q.v.*), which was continually disturbed by quarrels with his uncles, Charles the Bald and Louis the German, and by the difficulties caused by the divorce of his queen Teutberga, whom he had forsaken for a concubine called Waldrada, ended on the 8th of August 869. His inheritance was disputed by his uncles, and was divided by the treaty of Meersen (8th of August 870), by which Charles the Bald received part of the province of Besançon and some land between the Moselle and the Meuse. Then for a time the emperor Charles the Fat united under his authority the whole of the kingdom of Lorraine with the rest of the Carolingian empire. After the deposition of Charles in 888 Rudolph, king of Burgundy, got himself recognized in Lorraine. He was unable to maintain himself there, and succeeded in detaching definitively no more than the province of Besançon. Lorraine remained in the power of the emperor Arnulf, who in 895 constituted it a distinct kingdom in favour of his son Zwentibold. Zwentibold quickly became embroiled with the nobles and the bishops, and especially with Bishop Radbod of Trier. Among the lay lords the most important was Regnier (incorrectly called Long-neck), count of Hesbaye and Hainault, who is styled duke by the Lotharingian chronicler Reginon, though he does not appear ever to have borne the title. In 898 Zwentibold stripped Regnier of his fiefs, whereupon the latter appealed to the king of France, Charles the Simple, whose intervention, however, had no enduring effect. After the death of Arnulf in 899, the Lotharingians appealed to his successor, Louis the Child, to replace Zwentibold, who, on the 13th of August 900, was killed in battle. In spite of the dissensions which immediately arose between him and the Lotharingian lords, Louis retained the kingdom till his death. The Lotharingians, however, refused to recognize the new German king, Conrad I., and testified their attachment to the Carolingian house by electing as sovereign the king of the West Franks, Charles the Simple. Charles was at first supported by Giselbert, son and successor of Regnier, but was abandoned by his ally, who in 919 appealed to the German king, Henry I. The struggle ended in the treaty of Bonn (921), by which apparently the rights of Charles over Lorraine were recognized. The revolt of the Frankish lords in 922 and the captivity of Charles finally settled the question. After an unsuccessful attack by Rudolph or Raoul, king of France, Henry became master of Lorraine in 925, thanks to the support of Giselbert, whom he rewarded with the hand of his daughter Gerberga and the title of duke of Lorraine. Giselbert at first remained faithful to Henry's son, Otto the Great, but in 938 he appears to have joined the revolt directed against Otto by Eberhard, duke of Franconia. In 939, in concert with Eberhard and Otto's brother, Henry of Saxony, he declared open war against Otto and appealed to Louis d'Outremer, who penetrated into Lorraine and Alsace, but was soon called back to France by the revolt of the count of Vermandois. In the same year Giselbert and Eberhard were defeated and killed near Andernach, and Otto at once made himself recognized in the whole of Lorraine, securing it by a treaty with Louis d'Outremer, who married Giselbert's widow Gerberga, and entrusting the government of it to Count Otto, son of Ricuin, until Giselbert's son Henry should have attained his majority.

After the deaths of the young Henry and Count Otto in 944, Otto the Great gave Lorraine to Conrad the Red, duke of

Franconia, the husband of his daughter Liutgard, a choice which was not completely satisfactory to the Lotharingians. In 953 Conrad, in concert with Liudulf, the son of the German king, revolted against Otto, but was abandoned by his supporters. Otto stripped Conrad of his duchy, and in 954 gave the government of it to his own brother Bruno, archbishop of Cologne. Bruno had to contend against the efforts of the last Carolingians of France to make good their claims on Lorraine, as well as against the spirit of independence exhibited by the Lotharingian nobles; and his attempts to raze certain castles built by brigand lords and to compel them to respect their oath of fidelity resulted in serious sedition. To obviate these difficulties Bruno divided the ducal authority, assigning Lower Lorraine to a certain Duke Godfrey, who was styled *dux Ripuariorum*, and Upper Lorraine to Frederick (d. 959), count of Bar, a member of the house of Ardenne and son-in-law of Hugh the Great, with the title of *dux Mosellanorum*; and it is probable that the partition of the ancient kingdom of Lorraine into two new duchies was confirmed by Otto after Bruno's death in 965. In 977 the emperor Otto II. gave the government of Lower Lorraine to Charles I., a younger son of Louis d'Outremer, on condition that that prince should acknowledge himself his vassal and should oppose any attempt of his brother Lothair on Lorraine. The consequent expedition of the king of France in 978 against Aix-la-Chapelle had no enduring result, and Charles retained his duchy till his death about 992. He left two sons, Otto, who succeeded him and died without issue, and Henry, who is sometimes regarded as the ancestor of the landgraves of Thuringia. The duchy of Lower Lorraine, sometimes called *Lothier* (*Lotharium*), was then given to Godfrey (d. 1023), son of Count Godfrey of Verdun, and for some time the history of Lorraine is the history of the attempts made by the dukes of Lothier to seize Upper Lorraine. Gothelon (d. 1043), son of Duke Godfrey, obtained Lorraine at the death of Frederick II., duke of Upper Lorraine, in 1027, and victoriously repulsed the incursions of Odo (Eudes) of Blois, count of Champagne, who was defeated and killed in a battle near Bar (1037). At Gothelon's death in 1043, his son Godfrey the Bearded received from the emperor only Lower Lorraine, his brother Gothelon II. obtaining Upper Lorraine. Godfrey attempted to seize the upper duchy, but was defeated and imprisoned in 1045. On the death of Gothelon in 1046, Godfrey endeavoured to take Upper Lorraine from Albert of Alsace, to whom it had been granted by the emperor Henry III. The attempt, however, also failed; and Godfrey was for some time deprived of his own duchy of Lower Lorraine in favour of Frederick of Luxemburg. Godfrey took part in the struggles of Pope Leo IX. against the Normans in Italy, and in 1053 married Beatrice, daughter of Duke Frederick of Upper Lorraine and widow of Boniface, margrave of Tuscany. On the death of Frederick of Luxemburg in 1065 the emperor Henry IV. restored the duchy of Lower Lorraine to Godfrey, who retained it till his death in 1069, when he was succeeded by his son Godfrey the Hunchback (d. 1076), after whose death Henry IV. gave the duchy to Godfrey of Bouillon, the hero of the first crusade, son of Eustace, count of Boulogne, and Ida, sister of Godfrey the Hunchback. On the death of Godfrey of Bouillon in 1100 Lower Lorraine was given to Henry, count of Limburg. The new duke supported the emperor Henry IV. in his struggles with his sons, and in consequence was deposed by the emperor Henry V., who gave the duchy in 1106 to Godfrey, count of Louvain, a descendant of the Lotharingian dukes of the beginning of the 10th century. This Godfrey was the first hereditary duke of Brabant, as the dukes of Lower Lorraine came to be called.

Upper Lorraine.—The duchy of Upper Lorraine, or Lorraine *Mosellana*, to which the name of Lorraine was restricted from the 11th century, consisted of a tract of undulating country watered by the upper course of the Meuse and Moselle, and bounded N. by the Ardennes, S. by the table-land of Langres, E. by the Vosges and W. by Champagne. Its principal fiefs were the countship of Bar which Otto the Great gave in 951 to Count Frederick of Ardenne, and which passed in 1093 to the lords of Montbéliard; the countship of Chiny, formed at the end of the 10th century, of which, since the 13th, Montmédy was the capital; the lordship of Commercy, whose rulers bore the special title of *damoiseau*, and which passed in the 13th century to the house of Saarebrücken; and, finally the three important ecclesiastical lordships of the bishops of Metz, Toul and Verdun. Theodoric, or Thierri (d. 1026), son of Frederick, count of Bar and first duke of Upper Lorraine, was involved in a war with the emperor Henry II., a war principally remarkable for the siege of Metz (1007). After having been the object of numerous attempts on the part of the dukes of Lower Lorraine, Upper Lorraine was given by the emperor Henry III. to Albert of Alsace, and passed in 1048 to Albert's brother Gerard, who died by poison in 1069, and who was the ancestor of the hereditary house of Lorraine. Until the 15th century the representatives of the hereditary house were Theodoric II., called the Valiant (1069–1115), Simon (1115–1139), Matthew (1139–1176), Simon II. (1176–1205), Ferri I. (1205–1206), Ferri II. (1206–1213), Theobald (Thibaut) I. (1213–1220), Matthew II. (1220–1251), Ferri III. (1251–1304), Theobald II. (1304–1312), Ferri IV., called the Struggler (1312–1328), Rudolph, or Raoul (1328–1346), John (1346–1391) and Charles II. or I., called the Bold (1391–1431). The 12th century and the first part of the 13th were occupied with wars against the counts of Bar and Champagne. Theobald I. intervened in Champagne to support Erard of Brienne against the young count Theobald IV. The regent of Champagne, Blanche of Navarre, succeeded in forming against the duke of Lorraine a coalition consisting of the count of Bar and the emperor Frederick II., who had become embroiled with Theobald over the question of Rosheim in Alsace. Attacked by the emperor, the duke of Lorraine was forced at the treaty of Amance (1218) to acknowledge himself the vassal of the count of Champagne, and to support the count in his struggles against his ancient ally the count of Bar. The long government of Ferri III. was mainly occupied with wars against the feudal lords and the bishop of Metz, which resulted in giving an impulse to the municipal movement through Ferri's attempt to use the movement as a weapon against the nobles. The majority of the municipal charters of Lorraine were derived from the charter of Beaumont in Argonne, which was at first extended to the Barrois and was granted by Ferri, in spite of the hostility of his barons, to La Neuveville in 1257, to Frouard in 1263 and to Lunéville in 1265. In the church lands the bishops of Toul and Metz granted liberties from the end of the 12th century to the communes in their lordship, but not the Beaumont charter, which, however, obtained in the diocese of Verdun in the 14th and 15th centuries.

By the will of Duke Charles the Bold, Lorraine was to pass to his daughter Isabella, who married René of Anjou, duke of Bar, in 1420. But Anthony of Vaudemont, Charles's nephew and heir male, disputed this succession with René, who obtained from the king of France an army commanded by Arnault Guilhem de Barbazan. René, however, was defeated and taken prisoner at the battle of Bulgnéville, where Barbazan was killed (2nd of July 1431). The negotiations between René's wife and Anthony had no result, in spite of the intervention of the council of Basel and the emperor Sigismund, and it was not until 1436 that René obtained his liberty by paying a ransom of 200,000 crowns, and was enabled to dispute with Alfonso of Aragon the kingdom of Naples, which he had inherited in the previous year. In 1444 Charles VII. of France and the dauphin Louis went to Lorraine, accompanied by envoys from Henry VI. of England, and procured a treaty (confirmed at Chalons in 1445), by which Yolande, René's eldest daughter, married Anthony's son, Ferri of Vaudemont, and René's second daughter Margaret became the wife of Henry VI. of England. After his return to Lorraine in 1442, René was seldom in the duchy. Like his successor John, duke of Calabria, who died in 1470, he was continually occupied with expeditions in Italy or in Spain. John's son and successor, Nicholas (d. 1473), who supported the duke of Burgundy, Charles the Bold, against the king of France, died without children, and his heir was René, son of Frederick of Vaudemont. The duke of Burgundy, however, disputed this inheritance, and carried off the young René and his mother, but on the intervention of Louis XI. had to set them at liberty. René helped the Swiss during their wars with Charles the Bold, who invaded Lorraine and was killed under the walls of Nancy (1477). René's last years were mainly spent in expeditions in Provence and Italy. He died in 1508, leaving by his second wife three sons—Anthony, called the Good, who succeeded him; Claude, count (and afterwards duke) of Guise, the ancestor of the house of Guise; and John (d. 1550), known as the cardinal of Lorraine. Anthony, who was declared of age at his father's death by the estates of Lorraine, although his mother had tried to seize the power as regent, had been brought up from the age of twelve at the French court, where he became the friend of Louis XII., whom he accompanied on his Italian expeditions. In 1525 he had to defend Lorraine against the revolted Alsatian peasants known as *rustauds* (boors), whom he defeated at Lupstein and Scherweiler; and he succeeded in maintaining a neutral position in the struggle between Francis I. of France and the emperor Charles V. He died on the 14th of June 1544, and was succeeded by his son Francis I., who died of apoplexy (August 1545) at the very moment when he was negotiating peace between the king of France and the emperor.

Lorraine in Modern Times.—Francis's son Charles III. or II., called the Great, succeeded under the tutelage of his mother and Nicholas of Vaudemont, bishop of Metz. Henry II. of France took this opportunity to invade Lorraine, and in 1552 seized the three bishoprics of Metz, Toul and Verdun. In the same year the emperor laid siege to Metz, but was forced to retreat with heavy loss before the energetic resistance of Duke Francis of Guise. On leaving Lorraine, Henry II. took Charles to France, brought him up at the court and married him to his daughter Claude. After the accession of Francis II., the young duke returned to Lorraine, and, while his cousins the Guises endeavoured to make good the claims of the house of Lorraine to the crown of France by virtue of its descent from the Carolingians through Charles, the son of Louis d'Outremer, he devoted himself mainly to improving the administration of his duchy. He reconstituted his domain by revoking the alienations irregularly granted by his predecessors, instructed his *chambre des comptes* to institute inquiries on this subject, and endeavoured to ameliorate the condition of industry and commerce by reorganizing the working of the mines and saltworks, unifying weights and measures and promulgating edicts against vagabonds. His duchy suffered considerably from the passage of German bands on their way to help the Protestants in France, and also from disturbances caused by the progress of Calvinism, especially in the neighbourhood of the three bishoprics. To combat Calvinism Charles had recourse to the Jesuits, whom he established at Pont-à Mousson, and to whom he gave over the university he had founded in that town in 1572. To this foundation he soon added chairs of medicine and law, the first professor of civil law being the *maître des requêtes*, the Scotsman William Barclay, and the next Gregory of Toulouse, a pupil of the jurist Cujas. Charles died on the 14th of May 1608, and was succeeded by his eldest son Henry II., called the Good, who rid Lorraine of the German bands and died in 1624 without issue.

Henry was succeeded by his brother Francis II., who abdicated on the 26th of November 1624 in favour of his son Charles IV. or III. At the beginning of the reign of Louis XIII. Charles embroiled himself with France by harbouring French malcontents. Louis entered Lorraine, and by the treaty of Vic (31st of December 1631) bound over Charles to desist from supporting the enemies of France, and compelled him to cede the fortress of Marsal. Charles's breach of this treaty led to a renewal of hostilities, and the French troops occupied St Mihiel, Bar-le-duc, Pont-à-Mousson and Nancy, which the duke was forced to cede for four years (1633). In 1632, by the treaty of Liverdun, he had already had to abandon the fortresses of Stenay and Clermont in Argonne. On the 19th of January 1634 he abdicated in favour of his younger brother Francis Nicholas, cardinal of Lorraine, and withdrew to Germany, the parlement of Paris declaring him guilty of rebellion and confiscating his estates. After vain attempts to regain his estates with the help of the emperor, he decided to negotiate with France; and the treaty of St Germain (29th of March 1641) re-established him in his duchy on condition that he should cede Nancy, Stenay and other fortresses until the general peace. This treaty he soon broke, joining the Imperialists in the Low Countries and defeating the French at Tuttlingen (December 1643). He was restored, however, to his estates in 1644, and took part in the wars of the Fronde. He was arrested at Brussels in 1654, imprisoned at Toledo and did not recover his liberty until the peace of the Pyrenees in 1659. On the 28th of February 1661 the duchies of Lorraine and Bar were restored to him by the treaty of Vincennes, on condition that he should demolish the fortifications of Nancy and cede Clermont, Saarburg and Pfalzburg. In 1662 Hugues de Lionne negotiated with him the treaty of Montmartre, by which Charles sold the succession to the duchy to Louis XIV. for a life-rent; but the Lorrainers, perhaps with the secret assent of their prince, refused to ratify the treaty. Charles, too, was accused of intriguing with the Dutch, and was expelled from his estates, Marshal de Créqui occupying Lorraine. He withdrew to Germany, and in 1673 took an active part in the coalition of Spain, the Empire and Holland against France. After an unsuccessful invasion of Franche-Comté he took his revenge by defeating Créqui at Conzer Brücke (11th of August 1675) and forcing him to capitulate at Trier. On the 18th of September 1675 died this adventurous prince, who, as Voltaire said, passed his life in losing his estates. His brother Francis, in favour of whom he had abdicated, was a cardinal at the age of nineteen and subsequently bishop of Toul, although he had never taken orders. He obtained a dispensation to marry his cousin, Claude of Lorraine, and died in 1670. He had one son, Charles, who in 1675 took the title of duke of Lorraine and was recognized by all the powers except France. After an unsuccessful attempt to seize Lorraine in 1676, Charles vainly solicited the throne of Poland, took an active part in the wars in Hungary, and married Eleanor of Austria, sister of the emperor Leopold I., in 1678. At the treaty of Nijmwegen France proposed to restore his estates on condition that he should abandon a part of them; but Charles refused, and passed the rest of his life in Austria, where he took part in the wars against the Turks, whom he defeated at Mohacz (1687). He died in 1690.

Leopold, Charles's son and successor, was restored to his estates by the treaty of Ryswick (1697), but had to dismantle all the fortresses in Lorraine and to disband his army with the exception of his guard. Under his rule Lorraine flourished. While diminishing the taxes, he succeeded in augmenting his revenues by wise economy. The population increased enormously during his reign—that of Nancy, for instance, almost trebling itself between the years 1699 and 1735. Leopold welcomed French immigrants, and devoted himself to the development of commerce and industry, particularly to the manufacture of stuffs and lace, glass and paper. He was responsible, too, for the compilation of a body of law which was known as the "Code Léopold." Some time after his death, which occurred on the 27th of March 1729, his heir Francis III. was betrothed to Maria Theresa of Austria, the daughter and heiress of the emperor Charles VI. France, however, could not admit the possibility of a union of Lorraine with the Empire; and in 1735, at the preliminaries of Vienna, Louis XV. negotiated an arrangement by which Francis received the duchy of Tuscany, which was vacant by the death of the last Medici, in exchange for Lorraine, and Stanislaus Leszczynski, the dethroned king of Poland and father-in-law of Louis XV., obtained Lorraine, which after his death would pass to his daughter—in other words, to France. These arrangements were confirmed by the treaty of Vienna (18th of November 1738). In 1736, by a secret agreement, Stanislaus had abandoned the financial administration of his estates to Louis XV. for a yearly subsidy. The intendant, Chaumont de la Galaizière, was instructed to apply the French system of taxation in Lorraine; and in spite of the severity of the administration Lorraine preserved a grateful memory of the good king Stanislaus, who held his brilliant little court at Lunéville, and founded an academy and several libraries and hospitals. At his death in February 1766 the two duchies of Lorraine and Bar became definitively incorporated in the kingdom of France. The treaties of 1735 and 1736, however, guaranteed their legislation, the privileges enjoyed by the three orders, and their common law and customs tariffs, which they retained until the French Revolution. Lorraine and Barrois formed a large government corresponding, together with the little government of the three bishoprics, to the *intendance* of Lorraine and the *généralité* of Metz. For legal purposes, Metz had been the seat of a parlement since 1633, and the parlement of Nancy was created in 1776. There was, too, a *chambre des comptes* at Metz, and another at Bar-le-duc. (For the later history see ALSACE-LORRAINE.)

See Dom. A. Calmet, *Histoire ecclésiastique et civile de Lorraine* (2nd ed., Nancy, 1747–1757); A. Digot, *Histoire de Lorraine* (1879–1880); E. Huhn, *Geschichte Lothringens* (Berlin, 1877); R. Parisot, *Le Royaume de Lorraine sous les Carolingiens* (Paris, 1899), Comte D'Haussonville, *Histoire de la réunion de la Lorraine à la France* (2nd ed., Paris, 1860); E. Bonvalot, *Histoire du droit et des institutions de la Lorraine et des Trois-Évêchés* (Paris, 1895); and E. Duvernoy, *Les États Généraux des duchés de Lorraine et de Bar jusqu'à la majorité de Charles III*. (Paris, 1904). (R. Po.)

LORTZING, GUSTAV ALBERT (1801–1851), German composer, was born at Berlin on the 23rd of October 1801. Both his parents were actors, and when he was nineteen the son began to play youthful lover at the theatres of Düsseldorf and Aachen, sometimes also singing in small tenor or baritone parts. His first opera *Ali Pascha von Jannina* appeared in 1824, but his fame as a musician rests chiefly upon the two operas *Der Wildschütz* (1842) and *Czar und Zimmermann* (1837). The latter, although now regarded as one of the masterpieces of German comic opera, was received with little enthusiasm by the public of Leipzig. Subsequent performance in Berlin, however, provoked such a tempest of applause that the opera was soon placed on all the stages of Germany. It was translated into English, French, Swedish, Danish, Dutch, Bohemian, Hungarian and Russian. *Der Wildschütz* was based on a comedy of Kotzebue, and was a satire on the unintelligent and exaggerated admiration for the highest beauty in art expressed by the *bourgeois gentilhomme*. Of his other operas it is only necessary to note *Der Pole und sein Kind*, produced shortly after the Polish insurrection of 1831, and *Undine* (1845). Lortzing died at Berlin on the 21st of January 1851.

LORY, CHARLES (1823–1889), French geologist, was born at Nantes on the 30th of July 1823. He graduated *D. ès Sc.* in 1847; in 1852 he was appointed to the chair of geology at the University of Grenoble, and in 1881 to that of the *École Normale Supérieure* in Paris. He was distinguished for his researches on the geology of the French Alps, being engaged on the geological survey of the departments of Isère, Drôme and the Hautes Alpes, of which he prepared the maps and explanatory memoirs. He dealt with some of the disturbances in the Savoy Alps, describing the fan-like structures, and confirming the views of J. A. Favre with regard to the overthrows, reversals and duplication of the strata. His contributions to geological literature include also descriptions of the fossils and stratigraphical divisions of the Lower Cretaceous and Jurassic rocks of the Jura. He died at Grenoble on the 3rd of May 1889.

LORY (a word of Malayan origin signifying parrot, in general use with but slight variation of form in many European languages), the name of certain birds of the order *Psittaci*, mostly from the Moluccas and New Guinea, remarkable for their bright scarlet or crimson colouring, though also, and perhaps subsequently, applied to some others in which the plumage is chiefly green. The lories have been referred to a considerable number of genera, of which *Lorius* (the *Domicella* of some authors), *Eos* and *Chalcopsittacus* may be here particularized, while under the name of "lorikeets" may be comprehended such genera as *Trichoglossus*, *Charmosyna*, *Loriculus* and *Coriphilus*. By most systematists some of these forms have been placed far apart, even in different families of *Psittaci*, but A. H. Garrod has shown (*Proc. Zool. Society*, 1874, pp. 586–598, and 1876, p. 692) the many common characters they possess, which thus goes some way to justify the relationship implied by their popular designation. A full account of these birds is given in the first part of Count T. Salvadori's *Ornitologia della Papuasia e delle Molucche* (Turin 1880), whilst a later classification appeared in Salvadori's section of the British Museum *Catalogue of Birds*, xx., 1891.

Though the name lory has often been used for the species of *Eclectus*, and some other genera related thereto, modern writers would restrict its application to the birds of the genera *Lorius*, *Eos*, *Chalcopsittacus* and their near allies, which are often placed in a subfamily, *Loriinae*, belonging to the so-called family of *Trichoglossidae* or "brush-tongued" parrots. Garrod in his investigations on the anatomy of *Psittaci* was led not to attach much importance to the structure indicated by the epithet "brush-tongued" stating (*Proc. Zool. Society*, 1874, p. 597) that it "is only an excessive development of the papillae which are always found on the lingual surface." The birds of this group are very characteristic of the New Guinea subregion,[1] in which occur, according to Count Salvadori, ten species of *Lorius*, eight of *Eos* and four of *Chalcopsittacus*; but none seem here to require any further notice,[2] though among them, and particularly in the genus *Eos*, are included some of the most richly-coloured birds in the whole world; nor does it appear that more need be said of the lorikeets.

The family is the subject of an excellent monograph by St George Mivart (London, 1896). (A. N.)

LOS ANDES, a former state of Venezuela under the redivision of 1881, which covered the extreme western part of the republic N. of Zamora and S. of Zulia. In the redivision of 1904 Los Andes was cut up into three states—Mérida Táchira and Trujillo.

LOS ANGELES, a city and the county-seat of Los Angeles county, in southern California, U.S.A., along the small Los Angeles river, in the foothills of the San Gabriel Mountains; a narrow strip, 18 m. long, joins the main part of the city to its water front on the ocean, San Pedro Bay. Pop. (1880) 11,183, (1890) 50,395, (1900) 102,479, of whom 19,964 were foreign-born;[3] the growth in population since 1900 has been very rapid and in 1910 it was 319,198. The city had in 1910 an area of 85·1 sq. m., of which more than one-half has been added since 1890. Los Angeles is served by the Southern Pacific, the Atchison, Topeka & Santa Fé, and the San Pedro, Los Angeles & Salt Lake railways; by steamers to San Francisco; and by five systems of urban and suburban electric railways, which have 300 m. of track within the city and 700 m. within a radius of 30 m. beyond its limits. Inclined railways ascend Third Street Hill and Court Street Hill, in the heart of the city; and a system of subways extends from the centre of the city to its western limits. The harbour, San Pedro Bay, originally open and naturally poor, has been greatly improved by the Federal government; a breakwater 9250 ft. long was begun in 1898 and the bar has been deepened, and further improvements of the inner harbour at Wilmington (which is nearly landlocked by a long narrow island lying nearly east and west across its mouth) were begun in 1907. Important municipal docks have been built by the city.

The situation of the city between the mountains and the sea is attractive. The site of the business district is level, and its plan regular; the suburbs are laid out on hills. Although not specifically a health resort, Los Angeles enjoys a high reputation for its climate. From July 1877 to 1908 (inclusive) the mean of the minima for January, the coldest month of the year, was 44·16° F.; the mean of the minima for August, the warmest month, was 60·1° F.; and the difference of the mean temperature of the coldest and the warmest month was about 18° F.; while on five days only in this period (and on no day in the years 1904–1908) did the official thermometer fall below 32° F. There are various pleasure resorts in the mountains, and among seaside resorts are Santa Monica, Ocean Park, Venice, Playa del Rey, Hermosa, Redondo, Terminal Island, Long Beach, Alamitos Bay, Huntington Beach, Newport, Balboa and Corona del Mar. There are excellent roads throughout the country. Los Angeles has beautiful shade trees and a wealth of semi-tropic vegetation. Its residential portions are characterized by detached homes set in ample and beautiful grounds. Towering eucalyptus, graceful pepper trees, tropic palms, rubber trees, giant bananas, yuccas and a wonderful growth of roses, heliotrope, calla lilies in hedges, orange trees, jasmine, giant geraniums and other flowers beautify the city throughout the year. There are 22 parks, with about 3800 acres within or on the borders of the city limits; among the parks are Griffith (3015 acres), Elysian (532 acres), Eastlake (57 acres), Westlake (35 acres) and Echo (38 acres). The old Spanish-Moorish mission architecture has considerably influenced building styles. Among the important buildings are the Federal Building, the County Court House, the City Hall, a County Hall of Records, the Public Library with about 110,000 volumes in 1908, the large Auditorium and office buildings and the Woman's Club. The exhibit in the Chamber of Commerce Building illustrates the resources of southern California. Here also are the Coronel Collection, given in 1901 by Dona Mariana, the widow of Don Antonio Coronel, and containing relics of the Spanish and Mexican régime in California; and the Palmer Collection of Indian antiquities. In Los Angeles also are the collections of the Southwest Society (1904; for southern California, Arizona and New Mexico) of the Archaeological Institute of America. On the outskirts of the city, near Eastlake Park, is the Indian Crafts Exhibition, which contains rare collections of aboriginal handiwork, and where Indians may be seen making baskets, pottery and blankets. Of interest to visitors is that part of the city called Sonora Town, with its adobe houses, Mexican quarters, old Plaza and the Church of Our Lady, Queen of the Angels (first erected in 1822; rebuilt in 1861), which contains interesting paintings by early Indian converts. Near Sonora Town is the district known as Chinatown. The principal educational institutions are the University of Southern California (Methodist Episcopal, 1880), the Maclay College of Theology and a preparatory school; Occidental College (Presbyterian, 1887), St Vincent's College (Roman Catholic, founded 1865; chartered 1869) and the Los Angeles State Normal School (1882).

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[1] They extend, however, to Fiji, Tahiti and Fanning Island.

[2] Unless it be *Oreopsittacus arfaki*, of New Guinea, remarkable as the only parrot known as yet to have fourteen instead of twelve rectrices.

[3] In addition to the large foreign-born population (4023 Germans, 3017 English, 2683 English Canadians, 1885 Chinese, 1720 Irish and smaller numbers of French, Mexicans, Swedes, Italians, Scots, Swiss, Austrians, Danes, French Canadians, Russians, Norwegians, Welsh and Japanese) 26,105 of the native white inhabitants were of foreign parentage (*i.e.* had one or both parents not native born), so that only 54,121 white persons were of native parentage. German, French and Italian weekly papers are published in Los Angeles.

The economic interests of Los Angeles centre in the culture of fruits. The surrounding country is very fertile when irrigated, producing oranges, lemons, figs and other semi-tropical fruits. Thousands of artesian wells have been bored, the region between Los Angeles, Santa Clara and San Bernardino being one of the most important artesian well regions of the world. The city, which then got its water supply from the Los Angeles river bed, in 1907 authorized the issue of $23,000,000 worth of 4% bonds for the construction of an aqueduct 209 m. long, bringing water to the city from the Owens river, in the Sierra Nevada Mountains. It was estimated that the project would furnish water for one million people, beside supplying power for lighting, manufacturing and transportation purposes. All the water in excess of the city's actual needs may be employed for irrigation. Work on the aqueduct was begun in 1908, and it was to be completed in five years. From 1900 to 1905 the value of the factory products increased from $15,133,696 to $34,814,475 or 130%, and the capital employed in manufactures from $10,045,095 to $28,181,418 or 180·5%. The leading manufacturing industries in 1905, with the product-value of each in this year, were slaughtering and meat-packing ($4,040,162), foundry and machine shop work ($3,146,914), flour and grist milling ($2,798,740), lumber manufacturing and planing ($2,519,081), printing and publishing (newspapers and periodicals, $2,097,339; and book and job printing, $1,278,841), car construction and repairing ($1,549,836)—in 1910 there were railway shops here of the Southern Pacific, Pacific Electric, Los Angeles Street, Salt Lake and Santa Fé railways—and the manufacture of confectionery ($953,915), furniture ($879,910) and malt liquors ($789,393). The canning and preserving of fruits and vegetables are important industries. There is a large wholesale trade with southern California, with Arizona and with the gold-fields of Nevada, with which Los Angeles is connected by railway. Los Angeles is a port of entry, but its foreign commerce is relatively unimportant. The value of its imports increased from $721,705 in 1905 to $1,654,549 in 1907; in 1908 the value was $1,193,552. The city's exports were valued at $45,000 in 1907 and at $306,439 in 1908. The coastwise trade is in lumber (about 700,000,000 ft. annually), shipped from northern California, Oregon and Washington, and in crude oil and general merchandise. There are rich oil-fields N. and W. of the city and wells throughout the city; petroleum is largely employed as fuel in factories. The central field, the Second Street Park field in the city, was developed between 1892 and 1895 and wells were drilled farther E. until in 1896 the eastern field was tapped with wells at Adobe and College streets; the wells within the city are gradually being abandoned. The western field and the western part of the central field were first worked in 1899–1900. The Salt Lake field, controlled by the Salt Lake Oil Company, near Rancho de Brea, W.S.W. of the city, first became important in 1902 and in 1907 it was the most valuable field in California, S. of Santa Barbara county, and the value of its product was $1,749,980. In 1905 the value of petroleum refined in Los Angeles was $461,281.

Land has not for many years been cheap (*i.e.* absolutely) in the southern Californian fruit country, and immigration has been, generally, of the comparatively well-to-do. This fact has greatly affected the character and development of the city. The assessed valuation of property increased more than threefold from 1900 to 1910, being $276,801,517 in the latter year, when the bonded city debt was $17,259,312·50. Since 1896 there has been a strong independent movement in politics, marked by the organization of a League for Better City Government (1896) and a Municipal League (1900), and by the organization of postal primaries to secure the co-operation of electors pledged to independent voting. Since 1904 the public school system has been administered by a non-partisan Board of Education chosen from the city at large, and not by wards as theretofore.

Los Angeles, like all other Californian cities, has the privilege of making and amending its own charter, subject to the approval of the state legislature. In 1902 thirteen amendments were adopted, including provisions for the initiative, the referendum and the recall. The last of these provides that 25% of the voters choosing a municipal officer may, by signing a petition for his recall, force a new election during his term of office and thereby remove him if another candidate receives a greater number of votes. This provision, introducing an entirely new principle into the American governmental system, came into effect in January 1903, and was employed in the following year when a previously elected councilman who was "recalled" by petition and was unsuccessful in the 1904 election brought suit to hold his office, and on a mere technicality the Supreme Court of the state declared the recall election invalid. In 1909 there was a recall election at which a mayor was removed and another chosen in his place.

The Pueblo de Nuestra Señora la Reina de los Angeles was founded in 1781. The Franciscan mission of San Gabriel—still a famous landmark—had been established ten years earlier a few miles eastward. Beginning about 1827, Los Angeles, being the largest pueblo of the territory, became a rival of Monterey for the honour of being the capital of California, was the seat of conspiracies to overthrow the Mexican authority, and the stronghold of the South California party in the bickerings and struggles that lasted down to the American occupation. In 1835 it was made a city by the Mexican Congress, and declared the capital, but the last provision was not enforced and was soon recalled. In 1836–1838 it was the headquarters of C. A. Carrillo, a legally-named but never *de facto* governor of California, whose jurisdiction was never recognized in the north; and in 1845–1847 it was the actual capital. The city was rent by factional quarrels when war broke out between Mexico and the United States, but the appearance of United States troops under Commodore Robert F. Stockton and General John C. Frémont before Los Angeles caused both factions to unite against a common foe. The defenders of Los Angeles fled at the approach of the troops, and on the 13th of August 1846 the American flag was raised over the city. A garrison of fifty men, left in control, was compelled in October to withdraw on account of a revolt of the inhabitants, and Los Angeles was not retaken until

General Philip Kearny and Commodore Stockton entered the city on the 18th of January 1847. This was the only important overt resistance to the establishment of the new régime in California. The city was chartered in 1850. It continued to grow steadily thereafter until it attained railway connexion with the Central Pacific and San Francisco in 1876, and with the East by the Santa Fé system in 1885. The completion of the latter line precipitated one of the most extraordinary of American railway wars and land booms, which resulted in giving southern California a great stimulus. The growth of the city since 1890 has been even more remarkable. In 1909 the township of Wilmington (pop. in 1900, 2983), including the city of San Pedro (pop. in 1900, 1787), Colegrove, a suburb W.N.W. of the city, Cahuenga (pop. in 1900, 1586), a township N.W. of the former city limits, and a part of Los Feliz were annexed to the city.

LOS ISLANDS (Islas de los Idolos), a group of islands off the coast of French Guinea, West Africa, lying south of Sangarea Bay, between 9° 25′ and 9° 31′ N. and 13° 46′ and 13° 51′ W., and about 80 m. N.N.W. of Freetown, Sierra Leone. There are five principal islands: Tamara, Factory, Crawford, White (or Ruma) and Coral. The two largest islands are Tamara and Factory, Tamara, some 8 m. long by 1 to 2 m. broad, being the largest. These two islands lie parallel to each other, Tamara to the west; they form a sort of basin, in the centre of which is the islet of Crawford. The two other islands are to the south. The archipelago is of volcanic formation, Tamara and Factory islands forming part of a ruined crater, with Crawford Island as the cone. The highest point is a knoll, some 450 ft. above sea-level, in Tamara. All the islands are richly clothed with palm trees and flowering underwood. Tamara has a good harbour, and contains the principal settlement. The inhabitants, about 1500, are immigrants of the Baga tribe of Senegambian negroes, whose home is the coast land between the Pongo and Nunez rivers. These are chiefly farmers. The Church of England has a flourishing mission, with a native pastorate. At one time the islands were a great seat of slave-traders and pirates. The latter are supposed to have buried large amounts of treasure in them. In an endeavour to stop the slave trade and piracy, the islands were garrisoned (1812–1813) by British troops, but the unhealthiness of the climate led to their withdrawal. In 1818 Sir Charles McCarthy, governor of Sierra Leone, obtained the cession of the islands to Great Britain from the chiefs of the Baga country, and in 1882 France recognized them to be a British possession. They were then the headquarters of several Sierra Leone traders. By article 6 of the Anglo-French convention of the 8th of April 1904, the islands were ceded to France. They were desired by France because of their geographical position, Konakry, the capital of French Guinea, being built on an islet but 3 m. from Factory Island, and at the mercy of long range artillery planted thereon. The islands derive their name from the sacred images found on them by the early European navigators.

See A. B. Ellis, *West African Islands* (London, 1885), and the works cited under French Guinea.

LOSSIEMOUTH, a police burgh of Elginshire, Scotland. Pop. (1901) 3904. It embraces the villages of Lossiemouth, Branderburgh and Stotfield, at the mouth of the Lossie, 5½ m. N.N.E. of Elgin, of which it is the port, by a branch line of the Great North of Scotland railway. The industries are boat-building and fishing. Lossiemouth, or the Old Town, dates from 1700; Branderburgh, farther north, grew with the harbour and began about 1830; Stotfield is purely modern and contiguous to the splendid golf-course. The cliffs at Covesea, 2 m. W., contain caves of curious shape. Sir Robert Gordon of Gordonstown used one as a stable in the rebellion of 1745; weapons of prehistoric man were found in another, and the roof of a third is carved with ornaments and emblems of early Celtic art.

Kinneddar Castle in the parish of Drainie—in which Lossiemouth is situated—was a seat of the bishops of Moray, and Old Duffus Castle, 2½ m. S.W., was built in the reign of David II. The estate of Gordonstown, close by, was founded by Sir Robert Gordon (1580–1656), historian of the Sutherland family, and grandfather of the baronet who, because of his inventions and scientific attainments, was known locally as "Sir Robert the Warlock" (1647–1704). Nearly midway between Lossiemouth and Elgin stand the massive ruins of the palace of Spynie, formerly a fortified residence of the bishops of Moray. "Davie's Tower," 60 ft. high with walls 9 ft. thick, was built by Bishop David Stewart about 1470. The adjacent loch is a favourite breeding-place for the sea-birds, which resort to the coast of Elginshire in enormous numbers. A mile S.E. of the lake lies Pitgaveny, one of the reputed scenes of the murder of King Duncan by Macbeth.

LOSSING, BENSON JOHN (1813–1891), American historical writer, was born in Beekman, New York, on the 12th of February 1813. After editing newspapers in Poughkeepsie he became an engraver on wood, and removed to New York in 1839 for the practice of his profession, to which he added that of drawing illustrations for books and periodicals. He likewise wrote or edited the text of numerous publications. His *Pictorial Field-Book of the Revolution* (first issued in 30 parts, 1850–1852, and then in 2 volumes) was a pioneer work of value in American historical literature. In its preparation he travelled some 9000 m. during a period of nearly two years; made more than a thousand sketches of extant buildings, battlefields, &c.; and presented his material in a form serviceable to the topographer and interesting to the general reader. Similar but less characteristic and less valuable undertakings were a *Pictorial Field-Book of the War of 1812* (1868), and a *Pictorial History of the Civil War in the United States of America* (3 vols. 1866–1869). His other books were numerous: an *Outline History of the Fine Arts*; many illustrated histories, large and small, of the United States; popular descriptions of Mount Vernon and other localities associated with famous names; and biographical sketches of celebrated Americans, of which *The Life and Times of Major-General Philip Schuyler* (2 vols. 1860–1873) was the most considerable. He died at Dover Plains, New York, on the 3rd of June 1891.

LÖSSNITZ, a district in the kingdom of Saxony, extending for about 5 m. along the right bank of the Elbe, immediately N.W. of Dresden. Pop. (1905) 6929. A line of vine-clad hills shelters it from the north winds, and so warm and healthy is the climate that it has gained for the district the appellation of the "Saxon Nice." Asparagus, peaches, apricots, strawberries, grapes and roses are largely cultivated and find a ready market in Dresden.

LOST PROPERTY. The man who loses an article does not lose his right thereto, and he may recover it from the holder whoever he be, unless his claim be barred by some Statute of Limitations or special custom, as sale in market overt. The rights and duties of the finder are more complex. If he know or can find out the true owner, and yet convert the article to his own use, he is guilty of theft. But if the true owner cannot be discovered, the finder keeps the property, his title being superior to that of every one except the true owner. But this is only if the find be in public or some public place. Thus if you pick up bank notes in a shop where they have been lost by a stranger, and hand them to the shopkeeper that he may discover and repossess the true owner, and he fail to do so, then you can recover them from him. The owner of private land, however, is entitled to what is found on it. Thus a man sets you to clear out his pond, and you discover a diamond in the mud at the bottom. The law will compel you to hand it over to the owner of the pond. This applies even against the tenant. A gas company were lessees of certain premises; whilst making excavations therein they came upon a prehistoric boat; and they were forced to surrender it to their lessor. An aerolite becomes the property of the owner of the land on which it falls, and not of the person finding or digging it out. The principle of these three last cases is that whatever becomes part of the soil belongs to the proprietor of that soil.

Property lost at sea is regulated by different rules. Those who recover abandoned vessels are entitled to salvage. Property absolutely lost upon the high seas would seem to belong to the finder. It has been claimed for the crown, and the American courts have held, that apart from a decree the finder is only entitled to salvage rights, the court retaining the rest, and thus practically taking it for the state on the original owner not being found. The modern English law on the subject of wreck (including everything found on the shore of the sea or tidal river) is contained in the Merchant Shipping Act 1894. The finder must forthwith make known his discovery to the receiver of wreck under a penalty. He is entitled to a salvage reward, but the property belongs to the crown or its grantee unless the true owner claims within a year. In the United States unclaimed wreck after a year generally becomes the property of the state. In Scotland the right to lost property is theoretically in the crown, but the finder would not in practice be interfered with except under the provisions of the Burgh Police (Scotland) Act 1892. Section 412 requires all persons finding goods to deliver them forthwith to the police under a penalty. If the true owner is not discovered within six months the magistrates may hand them over to the finder. If the owner appears he must pay a reasonable reward. Domestic animals, including swans, found straying without an owner may be seized by the crown or lord of the manor, and if not claimed within a year and a day they become the property of the crown or the lord, on the observance of certain formalities. In Scotland they were held to belong to the crown or its donatory, usually the sheriff of a county. By the Burgh Police Act above quoted provision is made for the sale of lost animals and the disposal of the free proceeds for the purposes of the act unless such be claimed. In the United States there is diversity of law and custom. Apart from special rule, lost animals become the property of the finder, but in many cases the proceeds of their sale are applied to public purposes. When property is lost by carriers, innkeepers or railway companies, special provisions as to their respective responsibilities apply. As to finds of money or the precious metals, see Treasure Trove.

LOSTWITHIEL, a market town and municipal borough in the Bodmin parliamentary division of Cornwall, England, 30½ m. W. of Plymouth by the Great Western railway. Pop. (1901) 1379. It is pleasantly situated on the banks of the river Fowey. The church of St Bartholomew is remarkable for a fine Early English tower surmounted by a Decorated spire; there are also beautiful Decorated windows and details in the body of the church, and a richly carved octagonal font. A bridge of the 14th century crosses the river. The shire hall includes remains of a building, called the Stannary prison, dating from the 13th century. The Great Western railway has workshops at Lostwithiel.

Lostwithiel owed its ancient liberties—probably its existence—to the neighbouring castle of Restormel. The Pipe Rolls (1194–1203) show that Robert de Cardinan, lord of Restormel, paid ten marks yearly for having a market at Lostwithiel. By an undated charter still preserved with the corporation's muniments he surrendered to the burgesses all the liberties given them by his predecessors (*antecessores*) when they founded the town. These included hereditary succession to tenements, exemption from sullage, the right to elect a reeve (*praepositus*) if the grantor thought one necessary and the right to marry without the lord's interference. By Isolda, granddaughter of Robert de Cardinan, the town was given to Richard, king of the Romans, who in the third year of his reign granted to the burgesses a gild merchant sac and soc, toll, team and infangenethef, freedom from pontage, lastage, &c., throughout Cornwall, and exemption from the jurisdiction of the hundred and county courts, also a yearly fair and a weekly market. Richard transferred the assizes from Launceston to Lostwithiel. His son Edmund, earl of Cornwall, built a great hall at Lostwithiel and decreed that the coinage of tin should be at Lostwithiel only. In 1325 Richard's charter was confirmed and the market ordered to be held on Thursdays. In 1386 the assizes were transferred back to Launceston. In 1609 a charter of incorporation provided for a mayor, recorder, six capital burgesses and seventeen assistants and courts of record and pie powder. The boundaries of the borough were extended in 1733. Under the reformed charter granted in 1885 the corporation consists of a mayor, four aldermen and twelve councillors. From 1305 to 1832 two members represented Lostwithiel in parliament. The electors after 1609 were the twenty-five members of the corporation. Under the Reform Act (1832) the borough became merged in the county. For the Thursday market granted in 1326 a Friday market was substituted in 1733, and this continues to be held. The fair granted in 1326 and the three fairs granted in 1733 have all given place to others. The archdeacon's court, the sessions and the county elections were long held at Lostwithiel, but all have now been removed. For the victory gained by Charles I. over the earl of Essex in 1644, see Great Rebellion.

LOT, in the Bible, the legendary ancestor of the two Palestinian peoples, Moab and Ammon (Gen. xix. 30-38; cp. Ps. lxxxiii. 8); he appears to have been represented as a Horite or Edomite (cp. the name Lotan, Gen. xxxvi. 20, 22). As the son of Haran and grandson of Terah, he was Abraham's nephew (Gen. xi. 31), and he accompanied his uncle in his migration from Haran to Canaan. Near Bethel[1] Lot separated from Abraham, owing to disputes between their shepherds, and being offered the first choice, chose the rich fields of the Jordan valley which were as fertile and well irrigated as the "garden of Yahweh" (*i.e.* Eden, Gen. xiii. 7 sqq.). It was in this district that the cities of Sodom and Gomorrah were situated. He was saved from their fate by two divine messengers who spent the night in his house, and next morning led Lot, his wife, and his two unmarried daughters out of the city. His wife looked back and was changed to a pillar of salt,[2] but Lot with his two daughters escaped first to Zoar and then to the mountains east of the Dead Sea, where the daughters planned and executed an incest by which they became the mothers of Moab and Ben-Ammi (*i.e.* Ammon; Gen. xix.). The account of Chedorlaomer's invasion and of Lot's rescue by Abraham belongs to an independent source (Gen. xiv.), the age and historical value of which has been much disputed. (See further Abraham; Melchizedek.) Lot's character is made to stand in strong contrast with that of Abraham, notably in the representation of his selfishness (xiii. 5 sqq.), and reluctance to leave the sinful city (xix. 16 sqq.); relatively, however, he was superior to the rest (with the crude story of his insistence upon the inviolable rights of guests, xix. 5 sqq., cf. Judges xix. 22 sqq.), and is regarded in 2 Pet. ii. 7 seq. as a type of righteousness.

Lot and his daughters passed into Arabic tradition from the Jews. The daughters are named Zahy and Ra'wa by Mas'ūdi ii. 139; but other Arabian writers give other forms. Paton (*Syria and Palestine*, pp. 43, 123) identifies Lot-Lotan with *Ruten*, one of the Egyptian names for Palestine; its true meaning is obscure. For traces of mythical elements in the story see Winckler, *Altorient. Forsch.* ii. 87 seq. See further, J. Skinner, *Genesis*, pp. 310 sqq. (S. A. C.)

LOT (Lat. *Oltis*), a river of southern France flowing westward across the central plateau, through the departments of Lozère, Aveyron, Lot and Lot-et-Garonne. Its length is about 300 m., the area of its basin 4444 sq. m. The river rises in the Cévennes on the Mont du Goulet at a height of 4918 ft. about 15 m. E. of Mende, past which it flows. Its upper course lies through gorges between the Causse of Mende and Aubrac Mountains on the north and the tablelands (*causses*) of Sauveterre, Severac and Comtal on the south. Thence its sinuous course crosses the plateau of Quercy and entering a wider fertile plain flows into the Garonne at Aiguillon between Agen and Marmande. Its largest tributary, the Truyère, rises in the Margeride mountains and after a circuitous course joins it on the right at Entraygues (department of Aveyron), its affluence more than doubling the volume of the river. Lower down it receives the Dourdou de Bozouls (or du Nord) on the left and on the right the Célé above Cahors (department of Lot), which is situated on a peninsula skirted by one of the river's many windings. Villeneuve-sur-Lot (department of Lot-et-Garonne) is the only town of any importance between this point and its mouth. The Lot is canalized between Bouquiès, above which there is no navigation, and the Garonne (160 m.).

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[1] The district is thus regarded as the place where the Hebrews, on the one side, and the Moabites and Ammonites, on the other, commence their independent history. Whilst the latter settle across the Jordan, Abraham moves down south to Hebron.

[2] Tradition points to the *Jebel Usdum* (cp. the name Sodom) at the S.W. end of the Dead Sea. It consists almost entirely of pure crystallized salt with pillars and pinnacles such as might have given rise to the story (see Driver, *Genesis*, p. 201; and cf. also *Palestine Explor. Fund, Quart. Statements*, 1871, p. 16, 1885, p. 20; Conder, *Syrian Stone-lore*, p. 279 seq.). Jesus cites the story of Lot and his wife to illustrate the sudden coming of the Kingdom of God (Luke xvii. 28-32). The history of the interpretation of the legend by the early and medieval church down to the era of rational and scientific investigation will be found in A. D. White, *Warfare of Science with Theology*, ii. ch. xviii.

LOT, a department of south-western France, formed in 1790 from the district of Quercy, part of the old province of Guyenne. It is bounded N. by Corrèze, W. by Dordogne and Lot-et-Garonne, S. by Tarn-et-Garonne, and E. by Aveyron and Cantal. Area 2017 sq. m. Pop. (1906) 216,611. The department extends over the western portion of the Massif Central of France; it slopes towards the south-west, and has a maximum altitude of 2560 ft. on the borders of Cantal with a minimum of 213 ft. at the point where the river Lot quits the department. The Lot, which traverses it from east to west, is navigable for the whole distance (106 m.) with the help of locks; its principal tributary within the department is the Célé (on the right). In the north of the department the Dordogne has a course of 37 m., among its tributaries are the Cère, which has its rise in Cantal, and the Ouysse, a river of no great length, but remarkable for the abundance of its waters. The streams in the south of Lot all flow into the Tarn. The eastern and western portions of the department are covered by ranges of hills; the north, the centre, and part of the south are occupied by a belt of limestone plateaus or *causses*, that to the north of the Dordogne is called the Causse de Martel; between the Dordogne and the Lot is the Causse de Gramat or de Rocamadour; south of the Lot is the Causse de Cahors. The *causses* are for the most part bare and arid owing to the rapid disappearance of the rain in clefts and chasms in the limestone, which are known as *igues*. These are most numerous in the Causse de Gramat and are sometimes of great beauty; the best known is the Gouffre de Padirac, 7 m. N.E. of Rocamadour. The altitude of the *causses* (from 700 to 1300 ft., much lower than that of the similar plateaus in Lozère, Hérault and Aveyron) permits the cultivation of the vine; they also yield a small quantity of cereals and potatoes and some wood. The deep intervening valleys are full of verdure, being well watered by abundant springs. The climate is on the whole that of the Girondine region; the valleys are warm, and the rainfall is somewhat above the average for France. The difference of temperature between the higher parts of the department belonging to the central plateau and the sheltered valleys of the south-west is considerable. Wheat, maize, oats and rye are the chief cereals. Wine is the principal product, the most valued being that of Cahors grown in the valley of the Lot, which is, in general, the most productive portion of the department. It is used partly for blending with other wines and partly for local consumption. The north-east cantons produce large quantities of chestnuts; walnuts, apples and plums are common, and the department also grows potatoes and tobacco and supplies truffles. Sheep are the most abundant kind of live stock; but pigs, horned cattle, horses, asses, mules and goats are also reared, as well as poultry and bees. Iron and coal are mined, and there are important zinc deposits (Planioles). Limestone is quarried. There are oil-works and numerous mills, and wool spinning and carding as well as cloth making, tanning, currying, brewing and the making of agricultural implements are carried on to some extent. The three arrondissements are those of Cahors, the capital, Figeac and Gourdon; there are 29 cantons and 329 communes.

Lot belongs to the 17th military district, and to the *académie* of Toulouse, and falls within the circumscription of the court of appeal at Agen, and the province of the archbishop of Albi. It is served by the Orleans railway. Cahors, Figeac and Rocamadour are the principal places. Of the interesting churches and châteaux of the department, may be mentioned the fine feudal fortress at Castelnau occupying a commanding natural position, with an audience hall of the 12th century, and the Romanesque abbey-church at Souillac with fine sculpturing on the principal entrance. The plateau of Puy d'Issolu, near Vayrac, is believed by most authorities to be the site of the ancient Uxellodunum, the scene of the last stand of the Gauls against Julius Caesar in 51 B.C. Lot has many dolmens, the finest being that of Pierre Martine, near Livernon (arr. of Figeac).

LOT-ET-GARONNE, a department of south-western France, formed in 1790 of Agenais and Bazadais, two districts of the old province of Guienne, and of Condomois, Lomagne, Brullois and pays d'Albret, formerly portions of Gascony. It is bounded W. by Gironde, N. by Dordogne, E. by Lot and Tarn-et-Garonne, S. by Gers and S.W. by Landes. Area 2079 sq. m. Pop. (1906) 274,610. The Garonne, which traverses the department from S.E. to N.W., divides it into two unequal parts. That to the north is a country of hills and deep ravines, and the slope is from east to west, while in the region to the south, which is a continuation of the plateau of Lannemezan and Armagnac, the slope is directly from south to north. A small portion in the south-west belongs to the sterile region of the Landes (*q.v.*); the broad valleys of the Garonne and of its affluent the Lot are proverbial for their fertility. The wildest part is towards the north-east on the borders of Dordogne, where a region of *causses* (limestone plateaus) and forests begins; the highest point (896 ft.) is also found here. The Garonne, where it quits the department, is only some 20 ft. above the sea-level; it is navigable throughout, with the help of its lateral canal, as also are the Lot and Baise with the help of locks. The Drot, a right affluent of the Garonne in the north of the department, is also navigable in the lower part of its course. The climate is that of the Girondine region—mild and fine—the mean temperature of Agen being 56·6° Fahr., or 5° above that of Paris; the annual rainfall, which, in the plain of Agen, varies from 20 to 24 in., is nearly the least in France. Agriculturally the department is one of the richest. Of cereals wheat is the chief, maize and oats coming next. Potatoes, vines and tobacco are important sources of wealth. The best wines are those of Clairac and Buzet. Vegetable and fruit-growing are prosperous. Plum-trees (*pruniers d'ente*) are much cultivated in the valleys of the Garonne and Lot, and the apricots of Nicole and Tonneins are well known. The chief trees are the pine and the oak; the cork-oak flourishes in the Landes, and poplars and willows are abundant on the borders of the Garonne. Horned cattle, chiefly of the Garonne breed, are the principal live stock. Poultry and pigs are also reared profitably. There are deposits of iron in the department. The forges, blast furnaces and foundries of Fumel are important; and agricultural implements and other machines are manufactured. The making of lime and cement, of tiles, bricks and pottery, of confectionery and dried plums (pruneaux d'Agen) and other delicacies, and brewing and distilling, occupy many of the inhabitants. At Tonneins (pop. 4691 in 1906) there is a national tobacco manufactory. Cork cutting, of which the centre is Mézin, hat and candle making, wool spinning, weaving of woollen and cotton stuffs, tanning, paper-making, oil-making, dyeing and flour and saw-milling are other prominent industries. The peasants still speak the Gascon patois. The arrondissements are 4—Agen, Marmande, Nérac and Villeneuve-sur-Lot—and there are 35 cantons and 326 communes.

Agen, the capital, is the seat of a bishopric and of the court of appeal for the department of Lot-et-Garonne. The department belongs to the region of the XVII. army corps, the *académie* of Bordeaux, and the province of the archbishop of Bordeaux. Lot-et-Garonne is served by the lines of the Southern and the Orleans railways, its rivers afford about 160 m. of navigable waterway, and the lateral canal of the Garonne traverses it for 54 m. Agen, Marmande, Nérac and Villeneuve-sur-Lot, the principal places, are treated under separate headings. The department possesses Roman remains at Mas d'Agenais and at Aiguillon. The churches of Layrac, Monsempron, Mas d'Agenais, Moirax, Mézin and Vianne are of interest, as also are the fortifications of Vianne of the 13th century, and the châteaux of Xaintrailles, Bonaguil, Gavaudun and of the industrial town of Casteljaloux.

LOTHAIR I. (795–855), Roman emperor, was the eldest son of the emperor Louis I., and his wife Irmengarde. Little is known of his early life, which was probably passed at the court of his grandfather Charlemagne, until 815 when he became ruler of Bavaria. When Louis in 817 divided the Empire between his sons, Lothair was crowned joint emperor at Aix-la-Chapelle and given a certain superiority over his brothers. In 821 he married Irmengarde (d. 851), daughter of Hugo, count of Tours; in 822 undertook the government of Italy; and, on the 5th of April 823, was crowned emperor by Pope Paschal I. at Rome. In November 824 he promulgated a statute concerning the relations of pope and emperor which reserved the supreme power to the secular potentate, and he afterwards issued various ordinances for the good government of Italy. On his return to his father's court his step-mother Judith won his consent to her plan for securing a kingdom for her son Charles, a scheme which was carried out in 829. Lothair, however, soon changed his attitude, and spent the succeeding decade in constant strife over the division of the Empire with his father. He was alternetely master of the Empire, and banished and confined to Italy; at one time taking up arms in alliance with his brothers and at another fighting against them; whilst the bounds of his appointed kingdom were in turn extended and reduced. When Louis was dying in 840, he sent the imperial *insignia* to Lothair, who, disregarding the various partitions, claimed the whole of the Empire. Negotiations with his brother Louis and his half-brother Charles, both of whom armed to resist this claim, were followed by an alliance of the younger brothers against Lothair. A decisive battle was fought at Fontenoy on the 25th of June 841, when, in spite of his personal gallantry, Lothair was defeated and fled to Aix. With fresh troops he entered upon a war of plunder, but the forces of his brothers were too strong for him, and taking with him such treasure as he could collect, he abandoned to them his capital. Efforts to make peace were begun, and in June 842 the brothers met on an island in the Saône, and agreed to an arrangement which developed, after much difficulty and delay, into the treaty of Verdun signed in August 843. By this Lothair received Italy and the imperial title, together with a stretch of land between the North and Mediterranean Seas lying along the valleys of the Rhine and the Rhone. He soon abandoned Italy to his eldest son, Louis, and remained in his new kingdom, engaged in alternate quarrels and reconciliations with his brothers, and in futile efforts to defend his lands from the attacks of the Normans and the Saracens. In 855 he became seriously ill, and despairing of recovery renounced the throne, divided his lands between his three sons, and on the 23rd of September entered the monastery of Prüm, where he died six days later. He was buried at Prüm, where his remains were found in 1860. Lothair was entirely untrustworthy and quite unable to maintain either the unity or the dignity of the empire of Charlemagne.

See "Annales Fuldenses"; Nithard, "Historiarum Libri," both in the *Monumenta Germaniae historica. Scriptores*, Bände i. and ii. (Hanover and Berlin, 1826 fol.); E. Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881); E. Dümmler, *Geschichte des ostfränkischen Reichs* (Leipzig, 1887–1888); B. Simson, *Jahrbücher des deutschen Reiches unter Ludwig dem Frommen* (Leipzig, 1874–1876).

LOTHAIR II. or III. (*c.* 1070–1137), surnamed the "Saxon," Roman emperor, son of Gebhard, count of Supplinburg, belonged to a family possessing extensive lands around Helmstadt in Saxony, to which he succeeded on his father's death in 1075. Gebhard had been a leading opponent of the emperor Henry IV. in Saxony, and his son, taking the same attitude, assisted Egbert II., margrave of Meissen, in the rising of 1088. The position and influence of Lothair in Saxony, already considerable, was increased when in 1100 he married Richenza, daughter of Henry, count of Nordheim, who became an heiress on her father's death in 1101, and inherited other estates when her brother Otto died childless in 1116. Having assisted the German king, Henry V., against his father in 1104, Lothair was appointed duke of Saxony by Henry, when Duke Magnus, the last of the Billungs, died in 1106. His first care was to establish his authority over some districts east of the Elbe; and quickly making himself independent of the king, he stood forth as the representative of the Saxon race. This attitude brought him into collision with Henry V., to whom, however, he was forced to submit after an unsuccessful rising in 1112. A second rising was caused when, on the death of Ulrich II., count of Weimar and Orlamünde, without issue in 1112, Henry seized these counties as vacant fiefs of the empire, while Lothair supported the claim of Siegfried, count of Ballenstädt, whose mother was a relative of Ulrich. The rebels were defeated, and Siegfried was killed at Warnstädt in 1113, but his son secured possession of the disputed counties. After the defeat by Lothair of Henry's forces at Welfesholz on the 11th of February 1115, events called Henry to Italy; and Lothair appears to have been undisturbed in Saxony until 1123, when the death of Henry II., margrave of Meissen and Lusatia raised a dispute as to the right of appointment to the vacant margraviates. A struggle ensued, in which victory remained with the duke. The Saxony policy of Lothair during these years had been to make himself independent, and to extend his authority; to this end he allied himself with the papal party, and easily revived the traditional hostility of the Saxons to the Franconian emperors.

When Henry V. died in 1125, Lothair, after a protracted election, was chosen German king at Mainz on the 30th of August 1125. His election was largely owing to the efforts of Adalbert, archbishop of Mainz, and the papal party, who disliked the candidature of Henry's nephew and heir, Frederick II. of Hohenstaufen, duke of Swabia. The new king was crowned at Aix-la-Chapelle on the 13th of September 1125. Before suffering a severe reverse, brought about by his interference in the internal affairs of Bohemia, Lothair requested Frederick of Hohenstaufen to restore to the crown the estates bequeathed to him by the emperor Henry V. Frederick refused, and was placed under the ban. Lothair, unable to capture Nüremberg, gained the support of Henry the Proud, the new duke of Bavaria, by giving him his daughter, Gertrude, in marriage, and that of Conrad, count of Zähringen, by granting him the administration of the kingdom of Burgundy, or Arles. As a counterstroke, however, Conrad of Hohenstaufen, the brother of Frederick, was chosen German king in December 1127, and was quickly recognized in northern Italy. But Lothair gained the upper hand in Germany, and by the end of 1129 the Hohenstaufen strongholds, Nüremberg and Spires, were in his possession. This struggle was accompanied by disturbances in Lorraine, Saxony and Thuringia, but order was soon restored after the resistance of the Hohenstaufen had been beaten down. In 1131 the king led an expedition into Denmark, where one of his vassals had been murdered by Magnus, son of the Danish king, Niels, and where general confusion reigned; but no resistance was offered, and Niels promised to pay tribute to Lothair.

The king's attention at the time was called to Italy where two popes, Innocent II. and Anacletus II., were clamouring for his support. At first Lothair, fully occupied with the affairs of Germany, remained heedless and neutral; but in March 1131 he was visited at Liége by Innocent, to whom he promised his assistance. Crossing the Alps with a small army in September 1132, he reached Rome in March 1133, accompanied by Innocent. As St Peter's was held by Anacletus, Lothair's coronation as emperor took place on the 4th of June 1133 in the church of the Lateran. He then received as papal fiefs the vast estates of Matilda, marchioness of Tuscany, thus securing for his daughter and her Welf husband lands which might otherwise have passed to the Hohenstaufen. His efforts to continue the investiture controversy were not very serious. He returned to Germany, where he restored order in Bavaria, and made an expedition against some rebels in the regions of the lower Rhine. Resuming the struggle against the Hohenstaufen, Lothair soon obtained the submission of the brothers, who retained their lands, and a general peace was sworn at Bamberg. The emperor's authority was now generally recognized, and the annalists speak highly of the peace and order of his later years. In 1135, Eric II., king of Denmark, acknowledged himself a vassal of Lothair;

Boleslaus III., prince of the Poles, promised tribute and received Pomerania and Rügen as German fiefs; while the eastern emperor, John Comnenus, implored Lothair's aid against Roger II. of Sicily.

The emperor seconded the efforts of his vassals, Albert the Bear, margrave of the Saxon north mark, and Conrad I., margrave of Meissen and Lusatia, to extend the authority of the Germans in the districts east of the Elbe, and assisted Norbert, archbishop of Magdeburg, and Albert I., archbishop of Bremen, to spread Christianity. In August 1136, attended by a large army, Lothair set out upon his second Italian journey. The Lombard cities were either terrified into submission or taken by storm; Roger II. was driven from Apulia; and the imperial power enforced over the whole of southern Italy. A mutiny among the German soldiers and a breach with Innocent concerning the overlordship of Apulia compelled the emperor to retrace his steps. An arrangement was made with regard to Apulia, after which Lothair, returning to Germany, died at Breitenwang, a village in the Tirol, on the 3rd or 4th of December 1137. His body was carried to Saxony and buried in the monastery which he had founded at Königslutter. Lothair was a strong and capable ruler, who has been described as the "imitator and heir of the first Otto." Contemporaries praise his justice and his virtue, and his reign was regarded, especially by Saxons and churchmen, as a golden age for Germany.

The main authorities for the life and reign of Lothair are: "Vita Norberti archiepiscopi Magdeburgensis"; Otto von Freising; "Chronicon Annalista Saxo" and "Narratio de electione Lotharii" all in the *Monumenta Germaniae historica. Scriptores*, Bände vi., xii. and xx. (Hanover and Berlin, 1826–1892). The best modern works are: L von Ranke, *Weltgeschichte*, pt. viii. (Leipzig, 1887–1888); W. von Giesebrecht, *Geschichte der Deutschen Kaiserzeit*, Band iv. (Brunswick, 1877), Band v. (Leipzig, 1888); Ph. Jaffe, *Geschichte des Deutschen Reiches unter Lothar* (Berlin, 1843); W. Bernhardi, *Lothar von Supplinburg* (Leipzig, 1879); O. von Heinemann, *Lothar der Sachse und Konrad III.* (Halle, 1869); and Ch. Volkmar, "Das Verhältniss Lothars III. zur Investiturfrage," in the *Forschungen zur Deutschen Geschichte*, Band xxvi. (Göttingen, 1862–1886).

LOTHAIR (941–986), king of France, son of Louis IV., succeeded his father in 954, and was at first under the guardianship of Hugh the Great, duke of the Franks, and then under that of his maternal uncle Bruno, archbishop of Cologne. The beginning of his reign was occupied with wars against the vassals, particularly against the duke of Normandy. Lothair then seems to have conceived the design of recovering Lorraine. He attempted to precipitate matters by a sudden attack, and in the spring of 978 nearly captured the emperor Otto II. at Aix-la-Chapelle. Otto took his revenge in the autumn by invading France. He penetrated as far as Paris, devastating the country through which he passed, but failed to take the town, and was forced to retreat with heavy loss. Peace was concluded in 980 at Margut-sur-Chiers, and in 983 Lothair was even chosen guardian to the young Otto III. Towards 980, however, Lothair quarrelled with Hugh the Great's son, Hugh Capet, who, at the instigation of Adalberon, archbishop of Reims, became reconciled with Otto III. Lothair died on the 2nd of March 986. By his wife Emma, daughter of Lothair, king of Italy, he left a son who succeeded him as Louis V.

See F. Lot, *Les Derniers Carolingiens* (Paris, 1891); and the *Recueil des actes de Lothaire et de Louis V.*, edited by L. Halphen and F. Lot (1908).

LOTHAIR (825–869), king of the district called after him Lotharingia, or Lorraine, was the second son of the emperor Lothair I. On his father's death in 855, he received for his kingdom a district lying west of the Rhine, between the North Sea and the Jura mountains, which was called *Regnum Lotharii* and early in the 10th century became known as Lotharingia or Lorraine. On the death of his brother Charles in 863 he added some lands south of the Jura to this inheritance, but, except for a few feeble expeditions against the Danish pirates, he seems to have done little for its government or its defence. The reign was chiefly occupied by efforts on the part of Lothair to obtain a divorce from his wife Teutberga, a sister of Hucbert, abbot of St Maurice (d. 864); and his relations with his uncles, Charles the Bald and Louis the German, were influenced by his desire to obtain their support to this plan. Although quarrels and reconciliations between the three kings followed each other in quick succession, in general it may be said that Louis favoured the divorce, and Charles opposed it, while neither lost sight of the fact that Lothair was without male issue. Lothair, whose desire for the divorce was prompted by his affection for a certain Waldrada, put away Teutberga; but Hucbert took up arms on her behalf, and after she had submitted successfully to the ordeal of water, Lothair was compelled to restore her in 858. Still pursuing his purpose, he won the support of his brother, the emperor Louis II., by a cession of lands, and obtained the consent of the local clergy to the divorce and to his marriage with Waldrada, which was celebrated in 862. A synod of Frankish bishops met at Metz in 863 and confirmed this decision, but Teutberga fled to the court of Charles the Bald, and Pope Nicholas I. declared against the decision of the synod. An attack on Rome by the emperor was without result, and in 865 Lothair, convinced that Louis and Charles at their recent meeting had discussed the partition of his kingdom, and threatened with excommunication, again took back his wife. Teutberga, however, either from inclination or compulsion, now expressed her desire for a divorce, and Lothair went to Italy to obtain the assent of the new pope Adrian II. Placing a favourable interpretation upon the words of the pope, he had set out on the return journey, when he was seized with fever and died at Piacenza on the 8th of August 869. He left, by Waldrada, a son Hugo who was declared illegitimate, and his kingdom was divided between Charles the Bald and Louis the German.

See Hincmar, "Opusculum de divortio Lotharii regis et Tetbergae reginae," in *Cursus completus patrologiae*, tome cxxv., edited by J. P. Migne (Paris, 1857–1879); M. Sdralek, *Hinkmars von Rheims Kanonistisches Gutachten über die Ehescheidung des Königs Lothar II.* (Freiburg, 1881); E. Dümmler, *Geschichte des ostfrankischen Reiches* (Leipzig, 1887–1888); and E. Mühlbacher, *Die Regenten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881).

LOTHIAN, EARLS AND MARQUESSES OF. Mark Kerr, 1st earl of Lothian (d. 1609), was the eldest son of Mark Kerr (d. 1584), abbot, and then commendator, of Newbattle, or Newbottle, and was a member of the famous border family of Ker of Cessford. The earls and dukes of Roxburghe, who are also descended from the Kers of Cessford, have adopted the spelling Ker, while the earls and marquesses of Lothian have taken the form Kerr. Like his father, the abbot of Newbattle, Mark Kerr was an extraordinary lord of session under the Scottish king James VI.; he became Lord Newbattle in 1587 and was created earl of Lothian in 1606. He was master of inquests from 1577 to 1606, and he died on the 8th of April 1609, having had, as report says, thirty-one children by his wife, Margaret (d. 1617), daughter of John Maxwell, 4th Lord Herries. His son Robert, the 2nd earl, died without sons in July 1624. He had, in 1621, obtained a charter from the king enabling his daughter Anne to succeed to his estates provided that she married a member of the family of Ker. Consequently in 1631 she married William Ker, son of Robert, 1st earl of Ancrum (1578–1654), a member of the family of Ker of Fernichurst, whose father, William Ker, had been killed in 1590 by Robert Ker, afterwards 1st earl of Roxburghe. Robert was in attendance upon Charles I. both before and after he came to the throne, and was created earl of Ancrum in 1633. He was a writer and a man of culture, and among his friends were the poet Donne and Drummond of Hawthornden. His elder son William was created earl of Lothian in 1631, the year of his marriage with Anne Kerr, and Sir William Kerr of Blackhope, a brother of the 2nd earl, who had taken the title of earl of Lothian in 1624, was forbidden to use it (see *Correspondence of Sir Robert Ker, earl of Ancrum, and his son William, third earl of Lothian*, 1875).

William Ker (*c.* 1605–1675), who thus became 3rd earl of Lothian, signed the Scottish national covenant in 1638 and marched with the Scots into England in 1640, being present when the English were routed at Newburn, after which he became governor of Newcastle-on-Tyne. During the Civil War he was prominent rather as a politician than as a soldier; he became a Scottish secretary of state in 1649, and was one of the commissioners who visited Charles II. at Breda in 1650. He died at Newbattle Abbey, near Edinburgh, in October 1675. William's eldest son Robert, the 4th earl (1636–1703), supported the Revolution of 1688 and served William III. in several capacities; he became 3rd earl of Ancrum on the death of his uncle Charles in 1690, and was created marquess of Lothian in 1701. His eldest son William, the 2nd marquess (*c.* 1662–1722), who had been a Scottish peer as Lord Jedburgh since 1692, was a supporter of the union with England. His son William, the 3rd marquess (*c.* 1690–1767), was the father of William Henry, the 4th marquess, who was wounded at Fontenoy and was present at Culloden. He was a member of parliament for some years and had reached the rank of general in the army when he died at Bath on the 12th of April 1775. His grandson William, the 6th marquess (1763–1824), married Henrietta (1762–1805), daughter and heiress of John Hobart, 2nd earl of Buckinghamshire, thus bringing Blickling Hall and the Norfolk estates of the Hobarts into the Kerr family. In 1821 he was created a peer of the United Kingdom as Baron Ker and he died on the 27th of April 1824. In 1900 Robert Schomberg Kerr (b. 1874) succeeded his father, Schomberg Henry, the 9th marquess (1833–1900), as 10th marquess of Lothian.

LOTHIAN. This name was formerly applied to a considerably larger extent of country than the three counties of Linlithgow, Edinburgh and Haddington. Roxburghshire and Berwickshire at all events were included in it, probably also the upper part of Tweeddale (at least Selkirk). It would thus embrace the eastern part of the Lowlands from the Forth to the Cheviots, *i.e.* all the English part of Scotland in the 11th century. This region formed from the 7th century onward part of the kingdoms of Bernicia and Northumbria, though we have no definite information as to the date or events by which it came into English hands. In Roman times, according to Ptolemy, it was occupied by a people called Otadini, whose name is thought to have been preserved in Manaw Gododin, the home of the British king Cunedda before he migrated to North Wales. There is no reason to doubt that the district remained in Welsh hands until towards the close of the 6th century; for in the *Historia Brittonum* the Bernician king Theodoric, whose traditional date is 572–579, is said to have been engaged in war with four Welsh kings. One of these was Rhydderch Hen who, as we know from Adamnan, reigned at Dumbarton, while another named Urien is said to have besieged Theodoric in Lindisfarne. If this statement is to be believed it is hardly likely that the English had by this time obtained a firm footing beyond the Tweed. At all events there can be little doubt that the whole region was conquered within the next fifty years. Most probably the greater part of it was conquered by the Northumbrian king Æthelfrith, who, according to Bede, ravaged the territory of the Britons more often than any other English king, in some places reducing the natives to dependence, in others exterminating them and replacing them by English settlers.

In the time of Oswic the English element became predominant in northern Britain. His supremacy was acknowledged both by the Welsh in the western Lowlands and by the Scots in Argyllshire. On the death of the Pictish king Talorgan, the son of his brother Eanfrith, he seems to have obtained the sovereignty over a considerable part of that nation also. Early in Ecgfrith's reign an attempt at revolt on the part of the Picts proved unsuccessful. We hear at this time also of the establishment of an English bishopric at Abercorn, which, however, only lasted for a few years. By the disastrous overthrow of Ecgfrith in 685 the Picts, Scots and some of the Britons also recovered their independence. Yet we find a succession of English bishops at Whithorn from 730 to the 9th century, from which it may be inferred that the south-west coast had already by this time become English. The Northumbrian dominions were again enlarged by Eadberht, who in 750 is said to have annexed Kyle, the central part of Ayrshire, with other districts. In conjunction with Œngus mac Fergus, king of the Picts, he also reduced the whole of the Britons to submission in 756. But this subjugation was not lasting, and the British kingdom, though now reduced to the basin of the Clyde, whence its inhabitants are known as Strathclyde Britons, continued to exist for nearly three centuries. After Eadberht's time we hear little of events in the northern part of Northumbria, and there is some reason for suspecting that English influence in the south-west began to decline before long, as our list of bishops of Whithorn ceases early in the 9th century; the evidence on this point, however, is not so decisive as is commonly stated. About 844 an important revolution took place among the Picts. The throne was acquired by Kenneth mac Alpin, a prince of Scottish family, who soon became formidable to the Northumbrians. He is said to have invaded "Saxonia" six times, and to have burnt Dunbar and Melrose. After the disastrous battle at York in 867 the Northumbrians were weakened by the loss of the southern part of their territories, and between 883 and 889 the whole country as far as Lindisfarne was ravaged by the Scots. In 919, however, we find their leader Aldred calling in Constantine II., king of the Scots, to help them. A few years later together with Constantine and the Britons they acknowledged the supremacy of Edward the Elder. After his death, however, both the Scots and the Britons were for a time in alliance with the Norwegians from Ireland, and consequently Æthelstan is said to have ravaged a large portion of the Scottish king's territories in 934. Brunanburh, where Æthelstan defeated the confederates in 937, is believed by many to have been in Dumfriesshire, but we have no information as to the effects of the battle on the northern populations. By this time, however, the influence of the Scottish kingdom certainly seems to have increased in the south, and in 945 the English king Edmund gave Cumberland, *i.e.* apparently the British kingdom of Strathclyde, to Malcolm I., king of the Scots, in consideration of his alliance with him. Malcolm's successor Indulph (954–962) succeeded in capturing Edinburgh, which thenceforth remained in possession of the Scots. His successors made repeated attempts to extend their territory southwards, and certain late chroniclers state that Kenneth II. in 971–975 obtained a grant of the whole of Lothian from Edgar. Whatever truth this story may contain, the cession of the province was finally effected by Malcolm II. by force of arms. At his first attempt in 1006 he seems to have suffered a great defeat from Uhtred, the son of earl Waltheof. Twelve years later, however, he succeeded in conjunction with Eugenius, king of Strathclyde, in annihilating the Northumbrian army at Carham on the Tweed, and Eadulf Cudel, the brother and successor of Uhtred, ceded all his territory to the north of that river as the price of peace. Henceforth in spite of an invasion by Aldred, the son of Uhtred, during the reign of Duncan, Lothian remained permanently in possession of the Scottish kings. In the reign of Malcolm III. and his son, the English element appears to have acquired considerable influence in the kingdom. Some three years before he obtained his father's throne Malcolm had by the help of earl Siward secured the government of Cumbria (Strathclyde) with which Lothian was probably united. Then in 1068 he received a large number of exiles from England, amongst them the Ætheling Eadgar, whose sister Margaret he married. Four other sons in succession occupied the throne, and in the time of the youngest, David, who held most of the south of Scotland as an earldom from 1107–1124 and the whole kingdom from 1124–1153, the court seems already to have been composed chiefly of English and Normans.

Authorities.—Bede, *Historia Ecclesiastica* (ed. C. Plummer, Oxford, 1896); *Anglo-Saxon Chronicle* (ed. Earle and Plummer, Oxford, 1899); Simeon of Durham (Rolls Series, ed. T. Arnold, 1882); W. F. Skene, *Chronicle of Picts and Scots* (Edinburgh, 1867), and *Celtic Scotland* (Edinburgh, 1876–1880); and J. Rhys, *Celtic Britain* (London). (F. G. M. B.)

LOTI, PIERRE [the pen-name of Louis Marie Julien Viaud] (1850–), French author, was born at Rochefort on the 14th of January 1850. The Viauds are an old Protestant family, and Pierre Loti consistently adhered, at least nominally, to the faith of his fathers. Of the picturesque and touching incidents of his childhood he has given a very vivid account in *Le Roman d'un enfant* (1890). His education began in Rochefort, but at the age of seventeen, being destined for the navy, he entered the naval school, Le Borda, and gradually rose in his profession, attaining the rank of captain in 1906. In January 1910 he was placed on the reserve list. His pseudonym is said to be due to his extreme shyness and reserve in early life, which made his comrades call him after *le Loti*, an Indian flower which loves to blush unseen. He was never given to books or study (when he was received at the French Academy, he had the courage to say, "Loti ne sait pas lire"), and it was not until 1876 that he was persuaded to write down and publish some curious experiences at Constantinople, in *Aziyadé*, a book which, like so many of Loti's, seems half a romance, half an autobiography. He proceeded to the South Seas, and on leaving Tahiti published the Polynesian idyl, originally called *Rarahu* (1880), which was reprinted as *Le Mariage de Loti*, and which first introduced to the wider public an author of remarkable originality and charm. *Le Roman d'un spahi*, a record of the melancholy adventures of a soldier in Senegambia, belongs to 1881. In 1882 Loti issued a collection of short studies under the general title of *Fleurs d'ennui*. In 1883 he achieved the widest celebrity, for not only did he publish *Mon frère Yves*, a novel describing the life of a French bluejacket in all parts of the world—perhaps his most characteristic production—but he was involved in a public discussion in a manner which did him great credit. While taking part as a naval officer in the Tongking War, Loti had exposed in the *Figaro* a series of scandals which followed on the capture of Hué (1883), and was suspended from the service for more than a year. He continued for some time nearly silent, but in 1886 he published a novel of life among the Breton fisherfolk, called *Pêcheur d'islande*, the most popular of all his writings. In 1887 he brought out a volume of extraordinary merit, which has not received the attention it deserves; this is *Propos d'exil*, a series of short studies of exotic places, in his peculiar semi-autobiographic style. The fantastic novel of Japanese manners, *Madame Chrysanthème*, belongs to the same year. Passing over one or two slighter productions, we come in 1890 to *Au Maroc*, the record of a journey to Fez in company with a French embassy. A collection of strangely confidential and sentimental reminiscences, called *Le Livre de la pitié et de la mort*, belongs to 1891. Loti was on board his ship at the port of Algiers when news was brought to him of his election, on the 21st of May 1891, to the French Academy. In 1892 he published *Fantôme d'orient*, another dreamy study of life in Constantinople, a sort of continuation of *Aziyadé*. He described a visit to the Holy Land, somewhat too copiously, in three volumes (1895–1896), and wrote a novel, *Ramuntcho* (1897), a story of manners in the Basque province, which is equal to his best writings. In 1900 he visited British India, with the view of describing what he saw; the result appeared in 1903—*L'Inde (sans les Anglais)*. At his best Pierre Loti was unquestionably the finest descriptive writer of the day. In the delicate exactitude with which he reproduced the impression given to his own alert nerves by unfamiliar forms, colours, sounds and perfumes, he was without a rival. But he was not satisfied with this exterior charm; he desired to blend with it a moral sensibility of the extremest refinement, at once sensual and ethereal. Many of his best books are long sobs of remorseful memory, so personal, so intimate, that an English reader is amazed to find such depth of feeling compatible with the power of minutely and publicly recording what is felt. In spite of the beauty and melody and fragrance of Loti's books his mannerisms are apt to pall upon the reader, and his later books of pure description were rather empty. His greatest successes were gained in the species of confession, half-way between fact and fiction, which he essayed in his earlier books. When all his limitations, however, have been rehearsed, Pierre Loti remains, in the mechanism of style and cadence, one of the most original and most perfect French writers of the second half of the 19th century. Among his later works were: *La Troisième jeunesse de Mme Prune* (1905); *Les Désenchantées* (1906, Eng. trans. by C. Bell); *La Mort de Philae* (1908); *Judith Renaudin* (Théâtre Antoine, 1904), a five-act historical play based on an earlier book; and, in collaboration with Emile Vedel, a translation of *King Lear*, also produced at the Théâtre Antoine in 1904. (E.G.)

LÖTSCHEN PASS, or LÖTSCHBERG, an easy glacier pass (8842 ft.) leading from Kandersteg in the Bernese Oberland to the Lötschen valley in the Valais. It is a very old pass, first mentioned distinctly in 1352, but probably crossed previously by the Valaisans who colonized various parts of the Bernese Oberland. In 1384 and again in 1419 battles were fought on it between the Bernese and the Valaisans, while in 1698 a mule path (of which traces still exist) was constructed on the Bernese slope, though not continued beyond owing to the fear of the Valaisans that the Bernese would come over and alter their religion. In 1906 the piercing of a tunnel (8½ m. long) beneath this pass was begun, starting a little above Kandersteg and ending at Goppenstein near the mouth of the Lötschen valley. Subsidies were granted by both the confederation and the canton of Bern. This pass is to be carefully distinguished from the Lötschenlücke (10,512 ft.), another easy glacier pass which leads from the head of the Lötschen valley to the Great Aletsch glacier. (W. A. B. C.)

LOTTERIES. The word lottery[1] has no very definite signification. It may be applied to any process of determining prizes by lot, whether the object be amusement or gambling or public profit. In the Roman Saturnalia and in the banquets of aristocratic Romans the object was amusement; the guests received *apophoreta*. The same plan was followed on a magnificent scale by some of the emperors. Nero gave such prizes as a house or a slave. Heliogabalus introduced an element of absurdity—one ticket for a golden vase, another for six flies. This custom descended to the festivals given by the feudal and merchant princes of Europe, especially of Italy; and it formed a prominent feature of the splendid court hospitality of Louis XIV. In the Italian republics of the 16th century the lottery principle was applied to encourage the sale of merchandise. The lotto of Florence and the seminario of Genoa are well known, and Venice established a monopoly and drew a considerable revenue for the state. The first letters patent for a lottery in France were granted in 1539 by Francis I., and in 1656 the Italian, Lorenzo Tonti (the originator of "Tontines") opened another for the building of a stone bridge between the Louvre and the Faubourg St Germain. The institution became very popular in France, and gradually assumed an important place in the government finance. The parlements frequently protested against it, but it had the support of Mazarin, and L. Phelypeaux, comte de Pontchartrain, by this means raised the expenses of the Spanish Succession War. Necker, in his *Administration des finances*, estimates the public charge for lotteries at 4,000,000 livres per annum. There were also lotteries for the benefit of religious communities and charitable purposes. Two of the largest were the *Loteries de Piété* and *Des Enfans Trouvés*. These and also the great *Loterie de l'École militaire* were practically merged in the *Loterie Royale* by the decree of 1776, suppressing all private lotteries in France. The financial basis of these larger lotteries was to take $\frac{5}{24}$ths for expenses and benefit, and return $\frac{19}{24}$ths to the public who subscribed. The calculation of chances had become a familiar science. It is explained in detail by Caminade de Castres in *Enc. méth. finances*, ii. *s.v.* "Loterie." The names of the winning numbers in the first drawing were (1) *extrait*, (2) *ambe*, (3) *terne*, (4) *quaterne*, (5) *quine*. After this there were four drawings called *primes gratuites*. The *extrait* gave fifteen times the price of the ticket; the *quine* gave one million times the price. These are said to be much more favourable terms than were given in Vienna, Frankfort and other leading European cities at the end of the 18th century. The *Loterie Royale* was ultimately suppressed in 1836. Under the law of the 29th of May 1844 lotteries may be held for the assistance of charity and the fine arts. In 1878 twelve million lottery tickets of one franc each were sold in Paris to pay for prizes to exhibitors in the great Exhibition and expenses of working-men visitors. The first prize was worth £5000; the second, £4000, and the third and fourth £2000 each. The Société du Crédit Foncier, and many of the large towns, are permitted to contract loans, the periodical repayments of which are determined by lot. This practice, which is prohibited in Germany and England, resembles the older system of giving higher and lower rates of interest for money according to lot. Lotteries were suppressed in Belgium in 1830, Sweden in 1841 and Switzerland in 1865, but they still figure in the state budgets of Austria-Hungary, Prussia and other German States, Holland, Spain, Italy and Denmark. In addition to lottery loans, ordinary lotteries (*occasion lotteries*) are numerous in various countries of the continent of Europe. They are of various magnitude and are organized for a variety of purposes, such as charity, art, agriculture, church-building, &c. It is becoming the tendency, however, to discourage private and indiscriminate lotteries, and even state lotteries which contribute to the revenue. In Austria-Hungary and Germany, for instance, every year sees fewer places where tickets can be taken for them receive licenses. In 1904 a proposal for combining a working-class savings bank with a national lottery was seriously considered by the Prussian ministry. The scheme, which owes its conception to August Scherl, editor of the Berlin *Lokalanzeiger*, is an endeavour to utilize the love of gambling for the purpose of promoting thrift among the working-classes. It was proposed to make weekly collections from subscribers, in fixed amounts, ranging from sixpence to four shillings. The interest on the money deposited would not go to the depositors but would be set aside to form the prizes. Three hundred thousand tickets, divisible into halves, quarters and eighths, according to the sum deposited weekly, would form a series of 12,500 prizes, of a total value of £27,000. At the same time, the subscriber, while having his ordinary lottery chances of these prizes, still has to his credit intact the amount which he has subscribed week by week.

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[1] The word "lottery" is directly derived from Ital. *lotteria*, cf. Fr. *loterie*, formed from *lotto*, lot, game of chance. "Lot" is in origin a Teutonic word, adopted into Romanic languages. In O. Eng. it appears as *hlot*, cf. Dutch *lot*, Ger. *Loos*, Dan. *lod*, &c. The meaning of the Teutonic root *hleut* from which these words have derived is unknown. Primarily "lot" meant the object, such as a disk or counter of wood, a pebble, bean or the like, which was drawn or cast to decide by chance, under divine guidance, various matters, such as disputes, divisions of property, selection of officers and frequently as a method of divination in ancient times. From this original sense the meaning develops into that which falls to a person by lot, chance or fate, then to any portion of land, &c., allotted to a person, and hence, quite generally, of a quantity of anything.

In England the earliest lotteries sanctioned by government were for such purposes as the repair of harbours in 1569, and the Virginia Company in 1612. In the lottery of 1569, 40,000 chances were sold at ten shillings each, the prizes being "plate, and certain sorts of merchandises." In 1698 lotteries, with the exception of the Royal Oak lottery for the benefit of the Royal Fishing Company, were prohibited as common nuisances, by which children, servants and other unwary persons had been ruined. This prohibition was in the 18th century gradually extended to illegal insurances on marriages and other events, and to a great many games with dice, such as faro, basset, hazard, except backgammon and games played in the royal palace. In spite of these prohibitions, the government from 1709 down to 1824 annually raised considerable sums in lotteries authorized by act of parliament. The prizes were in the form of terminable or perpetual annuities. The £10 tickets were sold at a premium of say 40% to contractors who resold them in retail (sometimes in one-sixteenth parts) by "morocco men," or men with red leather books who travelled through the country. As the drawing extended over forty days, a very pernicious system arose of insuring the fate of tickets during the drawing for a small premium of 4d. or 6d. This was partly cured by the Little Go Act of 1802, directed against the itinerant wheels which plied between the state lotteries, and partly by Perceval's Act in 1806, which confined the drawing of each lottery to one day. From 1793 to 1824 the government made an average yearly profit of £346,765. Cope, one of the largest contractors, is said to have spent £36,000 in advertisements in a single year. The English lotteries were used to raise loans for general purposes, but latterly they were confined to particular objects, such as the improvement of London, the disposal of a museum, the purchase of a picture gallery, &c. Through the efforts of Lord Lyttleton and others a strong public opinion was formed against them, and in 1826 they were finally prohibited. An energetic proposal to revive the system was made before the select committee on metropolitan improvements in 1830, but it was not listened to. By a unique blunder in legislation, authority was given to hold a lottery under an act of 1831 which provided a scheme for the improvement of the city of Glasgow. These "Glasgow lotteries" were suppressed by an act of 1834. Art Unions were legalized by the Art Unions Act 1846. The last lottery prominently before the public in England was that of Dethier's twelfth-cake lottery, which was suppressed on the 27th of December 1860. As defined at the beginning of this article, the word lottery has a meaning wide enough to include missing-word competitions, distributions by tradesmen of prize coupons, sweepstakes, &c. See *Report of Joint Select Committee on Lotteries, &c.* (1908). The statute law in Scotland is the same as in England. At common law in Scotland it is probable that all lotteries and raffles, for whatever purpose held, may be indicted as nuisances. The art unions are supposed to be protected by a special statute.

United States.—The American Congress of 1776 instituted a national lottery. Most states at that time legalized lotteries for public objects, and before 1820 the Virginia legislature passed seventy acts authorizing lotteries for various public purposes, such as schools, roads, &c.—about 85% of the subscriptions being returned in prizes. At an early period (1795) the city of Washington was empowered to set up lotteries as a mode of raising money for public purposes; and this authorization from the Maryland legislature was approved by an act of the Federal Congress in 1812. In 1833 they were prohibited in New York and Massachusetts and gradually in the other states, until they survived only in Louisiana. In that state, the Louisiana State Lottery, a company chartered in 1868, had a monopoly for which it paid $40,000 to the state treasury. Its last charter was granted in 1879 for a period of twenty-five years, and a renewal was refused in 1890. In 1890 Congress forbade the use of the mails for promoting any lottery enterprise by a statute so stringent that it was held to make it a penal offence to employ them to further the sale of Austrian government bonds, issued under a scheme for drawing some by lot for payment at a premium (see *Horner* v. *United States*, 147 United States Reports, 449). This had the effect of compelling the Louisiana State Lottery to move its quarters to Honduras, in which place it still exists, selling its bonds to a considerable extent in the Southern States.

Since lotteries have become illegal there have been a great number of judicial decisions defining a lottery. In general, where skill or judgment is to be exercised there is no lottery, the essential element of which is chance or lot. There are numerous statutes against lotteries, the reason being given that they "tend to promote a gambling spirit," and that it is the duty of the state to "protect the morals and advance the welfare of the people." In New York the Constitution of 1846 forbade lotteries, and by § 324 of the Penal Code a lottery is declared "unlawful and a public nuisance." "Contriving" and advertising lotteries is also penal. The following have been held illegal lotteries: In New York, a concert, the tickets for which entitled the holder to a prize to be drawn by lot; in Indiana, offering a gold watch to the purchaser of goods who guesses the number of beans in a bottle; in Texas, selling "prize candy" boxes; and operating a nickel-in-the-slot machine—so also in Louisiana; in Massachusetts, the "policy" or "envelope game," or a "raffle"; in Kentucky (1905), prize coupon packages, the coupons having to spell a certain word (*U.S.* v. *Jefferson*, 134 Fed. R. 299); in Kansas (1907) it was held by the Supreme Court that the gift of a hat-pin to each purchaser was not illegal as a "gift enterprise," there being no chance or lot. In Oklahoma (1907) it was held that the making of contracts for the payment of money, the certainty in value of return being dependent on chance, was a lottery (*Fidelity Fund Co.* v. *Vaughan*, 90 Pac. Rep. 34). The chief features of a lottery are "procuring through lot or chance, by the investment of a sum of money or something of value, some greater amount of money or thing of greater value. When such are the chief features of any scheme whatever it may be christened, or however it may be guarded or concealed by cunningly devised conditions or screens, it is under the law a lottery" (*U.S.* v. *Wallace*, 58. Fed. Rep. 942). In 1894 and 1897 Congress forbade the importation of lottery tickets or advertisements into the United States. In 1899, setting up or promoting lotteries in Alaska was prohibited by Congress, and in 1900 it forbade any lottery or sale of lottery tickets in Hawaii. In Porto Rico lotteries, raffles and gift-enterprises are forbidden (Penal Code, 1902, § 291).

Authorities.—*Critique hist. pol. mor. econ. et comm. sur les loteries anc. et mod. spirituelles et temporelles des états et des églises* (3 vols., Amsterdam, 1697), by the Bolognese historian Gregorio Leti; J. Dessaulx, *De la passion du jeu depuis les anciens temps jusqu'à nos jours* (Paris, 1779); Endemann, *Beiträge zur Geschichte der Lottrie und zur heutigen Lotterie* (Bonn, 1882); Larson, *Lottrie und Volkswirthschaft* (Berlin, 1894); J. Ashton, *History of English Lotteries* (1893); *Annual Report of the American Historical Association* (1892); *Journal of the American Social Science Association*, xxxvi. 17.

LOTTI, ANTONIO (1667?–1740), Italian musical composer, was the son of Matteo Lotti, Kapellmeister to the court of Hanover. He was born, however, at Venice and as a pupil of Legrenzi. He entered the Doge's chapel as a boy, and in 1689 was engaged as an alto singer, succeeding later to the posts of deputy organist (1690), second organist (1692), first organist (1704), and, finally, in 1736 Maestro di Cappella at St Mark's church. He was also a composer of operas, and having attracted the interest of the crown prince of Saxony during his visit to Venice in 1712, he was invited to Dresden, where he went in 1717. After producing three operas there he was obliged to return to his duties at Venice in 1719. He died on the 5th of January 1740. Like many other Venetian composers he wrote operas for Vienna, and enjoyed a considerable reputation outside Italy. A volume of madrigals published in 1705 contains the famous *In una siepe ombrosa*, passed off by Bononcini as his own in London. Another is quoted by Martini in his *Saggio di Contrappunto*. Among his pupils were Alberti, Bassani, Galuppi, Gasparini and Marcello. Burney justly praises his church music, which is severe in style, but none the less modern in its grace and pathos. A fine setting of the *Dies Irae* is in the Imperial Library at Vienna, and some of his masses have been printed in the collections of Proske and Lück.

LOTTO, LORENZO (*c.* 1480–1556), Italian painter, is variously stated to have been born at Bergamo, Venice and Treviso, between 1475 and 1480, but a document published by Dr Bampo proves that he was born in Venice, and it is to be gathered from his will that 1480 was probably the year of his birth. Overshadowed by the genius of his three great contemporaries, Titian, Giorgione and Palma, he had been comparatively neglected by art historians until Mr Bernhard Berenson devoted to him an "essay in constructive art criticism," which not only restores to him his rightful position among the great masters of the Renaissance, but also throws clear light upon the vexed question of his artistic descent. Earlier authorities have made Lotto a pupil of Giovanni Bellini (Morelli), of Previtali (Crowe and Cavalcaselle), of Leonardo da Vinci (Lomazzo), whilst others discovered in his work the influences of Cima, Carpaccio, Dürer, Palma and Francia. Mr Berenson has, however, proved that he was the pupil of Alvise Vivarini, whose religious severity and asceticism remained paramount in his work, even late in his life when he was attracted by the rich glow of Giorgione's and Titian's colour. What distinguishes Lotto from his more famous contemporaries is his psychological insight into character and his personal vision—his unconventionality, which is sufficient to account for the comparative neglect suffered by him when his art is placed beside the more typical art of Titian and Giorgione, the supreme expression of the character of the period.

That Lotto, who was one of the most productive painters of his time, could work for thirty years without succumbing to the mighty influence of Titian's sumptuous colour, is explained by the fact that during these years he was away from Venice, as is abundantly proved by documents and by the evidence of signed and dated works. The first of these documents, dated 1503, proves him to have lived at Treviso at this period. His earliest authentic pictures, Sir Martin Conway's "Danaë" (about 1498) and the "St Jerome" of the Louvre (a similar subject is at the Madrid Gallery ascribed to Titian), as indeed all the works executed before 1509, have unmistakable Vivarinesque traits in the treatment of the drapery and landscape, and cool grey tonality. To this group belong the Madonnas at Bridgewater House, Villa Borghese, Naples, and Sta Cristina near Treviso, the Recanati altarpiece, the "Assumption of the Virgin" at Asolo, and the portrait of a young man at Hampton Court. We find him at Rome between 1508 and 1512, at the time Raphael was painting in the Stanza della Signatura. A document in the Corsini library mentions that Lotto received 100 ducats as an advance payment for fresco-work in the upper floor of the Vatican, but there is no evidence that this work was ever executed. In the next dated works, the "Entombment" at Jesi (1512), and the "Transfiguration," "St James," and "St Vincent" at Recanati, Lotto has abandoned the dryness and cool colour of his earlier style, and adopted a fluid method and a blonde, joyful colouring. In 1513 we find him at Bergamo, where he had entered into a contract to paint for 500 gold ducats an altarpiece for S. Stefano. The picture was only completed in 1516, and is now at S. Bartolommeo. From the next years, spent mostly at Bergamo, with intervals in Venice and Jesi in the Marches, date the Dresden "Madonna," "Christ taking leave of his Mother" at the Berlin Gallery, the "Bride and Bridegroom" at Madrid, the National Gallery "Family Group" and portrait of the Protonothary Giuliano, several portraits in Berlin, Milan and Vienna, numerous altarpieces in and near Bergamo, the strangely misnamed "Triumph of Chastity" at the Rospigliosi Palace in Rome, and the portrait of Andrea Odoni at Hampton Court. In 1526 or 1527 Lotto returned to Venice, where Titian ruled supreme in the world of art; and it was only natural that the example of the great master should have fired him to emulation, though his experiments in this direction were confined to an attempt at rivalling the master's rich and ruddy colour-schemes. Even in the Carmine altarpiece, the "St Nicholas of Bari," which is his nearest approach to Titian, he retained his individualized, as opposed to Titian's generalized, expression of emotion. But it was only a passing phase, and he soon returned to the cooler schemes of his earlier work. Among his chief pictures executed in Venice between 1529 and 1540 are the "Christ and the Adulteress," now at the Louvre, the "Visitation" at the Jesi Library, the "Crucifixion" at Monte S. Giusto, the Madonna at the Uffizi, the "Madonna and Saints" at Cingoli, and some portraits at the Berlin and Vienna museums, the Villa Borghese and Doria Palace in Rome, and at Dorchester House. He is again to be found at Treviso from 1542–1545, at Ancona in 1550, the year in which he entirely lost his voice; and in 1552 he "devoted his person and all his property to the Holy Virgin of Loreto" and took up his abode with the monks of that shrine. He died in 1556. A codex in his own handwriting, discovered in the archives of Loreto, not only includes a complete statement of his accounts from about 1539 to his death, but has a most interesting entry from which we gather that in 1540 Lotto completed the portraits of Martin Luther and his wife. These portraits could not have been painted from life; they were presumably executed from some contemporary engraving.

See *Lorenzo Lotto*, by Bernard Berenson (London, 1901).

LOTTO (Ital. for "lot"), a gambling game usually called *Keno* in America, played by any number of persons upon large boards or cards, each of which is divided into three horizontal rows of nine spaces, four spaces in each row being left blank and the other five marked with numbers up to 90. Each card is designated by a general number. The cards usually lie on the gambling-table, and a player may buy from the bank as many as he cares to use, each card being registered or *pegged* on an exposed table as soon as bought. Ninety small ivory markers, generally balls flattened on one side, numbered from 1 to 90, are placed in a bag and shaken out one by one, or, more usually, in a so-called *keno-goose*, a kind of urn with a spout through which the balls are allowed to roll by means of a spring. When a number falls out, the banker, or *keno-roller*, calls it out distinctly, and each player upon whose card that number occurs places a mark over it. This is repeated until one player has all the numbers in one row of his card covered, upon which he calls out "Keno!" and wins all the money staked excepting a percentage to the bank.

LOTUS, a popular name applied to several plants. The lotus fruits of the Greeks belonged to *Zizyphus Lotus*, a bush native in south Europe with fruits as large as sloes, containing a mealy substance which can be used for making bread and also a fermented drink. In ancient times the fruits were an important article of food among the poor; whence "lotophagi" or lotus-eaters. *Zizyphus* is a member of the natural order Rhamnaceae to which belongs the British buckthorn. The Egyptian lotus was a water-lily, *Nymphaea Lotus*; as also is the sacred lotus of the Hindus, *Nelumbium speciosum*. The lotus tree, known to the Romans as the Libyan lotus, and planted by them for shade, was probably *Celtis australis*, the nettle-tree (*q.v.*), a southern European tree, a native of the elm family, with fruits like small cherries, which are first red and then black. *Lotus* of botanists is a genus of the pea-family (*Leguminosae*), containing a large number of species of herbs and undershrubs widely distributed in the temperate regions of the old world. It is represented in Britain by *L. corniculatus*, bird's foot trefoil, a low-growing herb, common in pastures and waste places, with clusters of small bright yellow pea-like flowers, which are often streaked with crimson; the popular name is derived from the pods which when ripe spread like the toes of a bird's foot.

LOTUS-EATERS (Gr. *Λωτοφάγοι*), a Libyan tribe known to the Greeks as early as the time of Homer. Herodotus (iv. 177) describes their country as in the Libyan district bordering on the Syrtes, and says that a caravan route led from it to Egypt. Victor Bérard identifies it with the modern Jerba. When Odysseus reached the country of the Lotophagi, many of his sailors after eating the lotus lost all wish to return home. Both Greeks and Romans used the expression "to eat the lotus" to denote forgetfulness (cf. Tennyson's poem "The Lotus-Eaters").

There has been considerable discussion as to the identification of the Homeric lotus. Some have held that it is a prickly shrub, Zizyphus Lotus, which bears a sweet-tasting fruit, and still grows in the old home of the Lotophagi. It is eaten by the natives, who also make a kind of wine from the juice. P. Champault (*Phéniciens et Grecs en Italie d'après l'Odyssée*, p. 400, note 2), however, maintains that the lotus was a date; Victor Bérard (*Les Phéniciens et l'Odyssée*, 1902–1903, ii. 102) is doubtful, but contends that it was certainly a tree-fruit. If either of these be correct, then the lotus of *Od.* iv. 603–604 is quite a different plant, a kind of clover. Now Strabo (xvii. 829*a*) calls the lotus *πόαν τινὰ καὶ ῥίζαν*. Putting these two references together with Sulpicius Severus, *Dialogi* i. 4. 4, R. M. Henry suggests that the Homeric lotus was really the *πόα* of Strabo, *i.e.* a kind of clover (*Classical Review*, December 1906, p. 435).

LOTZE, RUDOLF HERMANN (1817–1881), German philosopher, was born in Bautzen on the 21st of May 1817, the son of a physician. He received his education in the gymnasium of Zittau under teachers who inspired him with an enduring love of the classical authors, as we see from his translation of the *Antigone* of Sophocles into Latin verse, published when he had reached middle life. He went to the university of Leipzig as a student of philosophy and natural sciences, but entered officially as a student of medicine. He was then only seventeen. It appears that thus early Lotze's studies were governed by two distinct interests. The first was scientific, based upon mathematical and physical studies under the guidance of E. H. Weber, W. Volckmann and G. T. Fechner. The other was his aesthetical and artistic interest, which was developed under the care of C. H. Weisse. To the former he owes his appreciation of exact investigation and a complete knowledge of the aims of science, to the latter an equal admiration for the great circle of ideas which had been diffused by the teaching of Fichte, Schelling and Hegel. Each of these influences, which early in life must have been familiar to him, tempered and modified the other. The true method of science which he possessed forced him to condemn as useless the entire form which Schelling's and Hegel's expositions had adopted, especially the dialectic method of the latter, whilst his love of art and beauty, and his appreciation of moral purposes, revealed to him the existence of a trans-phenomenal world of values into which no exact science could penetrate. It is evident how this initial position at once defined to him the tasks which philosophy had to perform. First there were the natural sciences, themselves only just emerging from a confused conception of their true method; especially those which studied the borderland of physical and mental phenomena, the medical sciences; and pre-eminently that science which has since become so popular, the science of biology.

Lotze's first essay was his dissertation *De futurae biologiae principibus philosophicis*, with which he gained (1838) the degree of doctor of medicine, after having only four months previously got the degree of doctor of philosophy. Then, secondly, there arose the question whether the methods of exact science sufficed to explain the connexion of phenomena, or whether for the explanation of this the thinking mind was forced to resort to some hypothesis not immediately verifiable by observation, but dictated by higher aspirations and interests. And, if to satisfy these we were forced to maintain the existence of a world of moral standards, it was, thirdly, necessary to form some opinion as to the relation of these moral standards of value to the forms and facts of phenomenal existence. These different tasks, which philosophy had to fulfil, mark pretty accurately the aims of Lotze's writings, and the order in which they were published. He laid the foundation of his philosophical system very early in his *Metaphysik* (Leipzig, 1841) and his *Logik* (1843), short books published while he was still a junior lecturer at Leipzig, from which university he migrated to Göttingen, succeeding Herbart in the chair of philosophy. But it was only during the last decade of his life that he ventured, with much hesitation, to present his ideas in a systematic and final form. The two books mentioned remained unnoticed by the reading public, and Lotze first became known to a larger circle through a series of works which aimed at establishing in the study of the physical and mental phenomena of the human organism in its normal and diseased states the same general principles which had been adopted in the investigation of inorganic phenomena. These works were his *Allgemeine Pathologie und Therapie als mechanische Naturwissenschaften* (Leipzig, 1842, 2nd ed., 1848), the articles "Lebenskraft" (1843) and "Seele und Seelenleben" (1846) in Rud. Wagner's *Handwörterbuch der Physiologie*, his *Allgemeine Physiologie des Körperlichen Lebens* (Leipzig, 1851), and his *Medizinische Psychologie oder Physiologie der Seele* (Leipzig, 1852).

When Lotze published these works, medical science was still much under the influence of Schelling's philosophy of nature. The mechanical laws, to which external things were subject, were conceived as being valid only in the inorganic world; in the organic and mental worlds these mechanical laws were conceived as being disturbed or overridden by other powers, such as the influence of final causes, the existence of types, the work of vital and mental forces. This confusion Lotze, who had been trained in the school of mathematical reasoning, tried to dispel. The laws which govern particles of matter in the inorganic world govern them likewise if they are joined into an organism. A phenomenon *a*, if followed by *b* in the one case, is followed by the same *b* also in the other case. Final causes, vital and mental forces, the soul itself can, if they act at all, only act through the inexorable mechanism of natural laws. As we therefore have only to do with the study of existing complexes of material and spiritual phenomena, the changes in these must be explained in science by the rule of mechanical laws, such as obtain everywhere in the world, and only by such. One of the results of these investigations was to extend the meaning of the word mechanism, and comprise under it all laws which obtain in the phenomenal world, not excepting the phenomena of life and mind. Mechanism was the unalterable connexion of every phenomenon *a* with other phenomena *b*, *c*, *d*, either as following or preceding it; mechanism was the inexorable form into which the events of this world are cast, and by which they are connected. The object of those writings was to establish the all-pervading rule of mechanism. But the mechanical view of nature is not identical with the materialistic. In the last of the above-mentioned works the question is discussed at great length how we have to consider mind, and the relation between mind and body; the answer is—we have to consider mind as an immaterial principle, its action, however, on the body and vice versa as purely mechanical, indicated by the fixed laws of a psycho-physical mechanism. These doctrines of Lotze—though pronounced with the distinct and reiterated reserve that they did not contain a solution of the philosophical question regarding the nature, origin, or deeper meaning of this all-pervading mechanism, neither an explanation how the action of external things on each other takes place nor yet of the relation of mind and body, that they were merely a preliminary formula of practical scientific value, itself requiring a deeper interpretation—these doctrines were nevertheless by many considered to be the last word of the philosopher who, denouncing the reveries of Schelling or the idealistic theories of Hegel, established the science of life and mind on the same basis as that of material things. Published as they were during the years when the modern school of German materialism was at its height,[1] these works of Lotze were counted among the opposition literature which destroyed the phantom of Hegelian wisdom and vindicated the independent and self-sufficing position of empirical philosophy. Even philosophers of the eminence of I. H. Fichte (the younger) did not escape this misinterpretation of Lotze's true meaning, though they had his *Metaphysik* and *Logik* to refer to, though he promised in his *Allgemeine Physiologie* (1851) to enter in a subsequent work upon the "bounding province between aesthetics and physiology," and though in his *Medizinische Psychologie* he had distinctly stated that his position was neither the idealism of Hegel nor the realism of Herbart, nor materialism, but that it was the conviction that the essence of everything is the part it plays in the realization of some idea which is in itself valuable, that the sense of an all-pervading mechanism is to be sought in this, that it denotes the ways and means by which the highest idea, which we may call the idea of the good, has voluntarily chosen to realize itself.

The misinterpretations which he had suffered induced Lotze to publish a small pamphlet of a polemical character (*Streitschriften*, Leipzig, 1857), in which he corrected two mistakes. The opposition which he had made to Hegel's formalism had induced some to associate him with the materialistic school, others to count him among the followers of Herbart. Lotze publicly and formally denied that he belonged to the school of Herbart, though he admitted that historically the same doctrine which might be considered the forerunner of Herbart's teachings might lead to his own views, viz. the monadology of Leibnitz.

When Lotze wrote these explanations, he had already given to the world the first volume of his great work, *Mikrokosmus* (vol. i. 1856, vol. ii. 1858, vol. iii. 1864; 3rd ed., 1876–1880). In many passages of his works on pathology, physiology, and psychology Lotze had distinctly stated that the method of research which he advocated there did not give an explanation of the phenomena of life and mind, but only the means of observing and connecting them together; that the meaning of all phenomena, and the reason of their peculiar connexions, was a philosophical problem which required to be attacked from a different point of view; and that the significance especially which lay in the phenomena of life and mind would only unfold itself if by an exhaustive survey of the entire life of man, individually, socially, and historically, we gain the necessary data for deciding what meaning attaches to the existence of this microcosm, or small world of human life, in the macrocosm of the universe. This review, which extends, in three volumes, over the wide field of anthropology, beginning with the human frame, the soul, and their union in life, advancing to man, his mind, and the course of the world, and concluding with history, progress, and the connexion of things, ends with the same idea which was expressed in Lotze's earliest work, his *Metaphysik*. The view peculiar to him is reached in the end as the crowning conception towards which all separate channels of thought have tended, and in the light of which the life of man in nature and mind, in the individual and in society, had been surveyed. This view can be briefly stated as follows: Everywhere in the wide realm of observation we find three distinct regions,—the region of facts, the region of laws and the region of standards of value. These three regions are separate only in our thoughts, not in reality. To comprehend the real position we are forced to the conviction that the world of facts is the field in which, and that laws are the means by which, those higher standards of moral and aesthetical value are being realized; and such a union can again only become intelligible through the idea of a personal Deity, who in the creation and preservation of a world has voluntarily chosen certain forms and laws, through the natural operation of which the ends of His work are gained.

Whilst Lotze had thus in his published works closed the circle of his thought, beginning with a conception metaphysically gained, proceeding to an exhaustive contemplation of things in the light it afforded, and ending with the stronger conviction of its truth which observation, experience, and life could afford, he had all the time been lecturing on the various branches of philosophy according to the scheme of academical instruction transmitted from his predecessors. Nor can it be considered anything but a gain that he was thus induced to expound his views with regard to those topics, and in connexion with those problems, which were the traditional forms of philosophical utterance. His lectures ranged over a wide field: he delivered annually lectures on psychology and on logic (the latter including a survey of the entirety of philosophical research under the title *Encyclopädie der Philosophie*), then at longer intervals lectures on metaphysics, philosophy of nature, philosophy of art, philosophy of religion, rarely on history of philosophy and ethics. In these lectures he expounded his peculiar views in a stricter form, and during the last decade of his life he embodied the substance of those courses in his *System der Philosophie*, of which only two volumes have appeared (vol. i. *Logik*, 1st ed., Leipzig, 1874, 2nd ed., 1880; vol. ii. *Metaphysik*, 1879). The third and concluding volume, which was to treat in a more condensed form the principal problems of practical philosophy, of philosophy of art and religion, never appeared. A small pamphlet on psychology, containing the last form in which he had begun to treat the subject in his lectures (abruptly terminated through his death on the 1st of July 1881) during the summer session of 1881, has been published by his son. Appended to this volume is a complete list of Lotze's writings, compiled by Professor Rehnisch of Göttingen.

To understand this series of Lotze's writings, it is necessary to begin with his definition of philosophy. This is given after his exposition of logic has established two points, viz. the existence in our mind of certain laws and forms according to which we connect the material supplied to us by our senses, and, secondly, the fact that logical thought cannot be usefully employed without the assumption of a further set of connexions, not logically necessary, but assumed to exist between the data of experience and observation. These connexions of a real not formal character are handed to us by the separate sciences and by the usage and culture of everyday life. Language has crystallized them into certain definite notions and expressions, without which we cannot proceed a single step, but which we have accepted without knowing their exact meaning, much less their origin. In consequence the special sciences and the wisdom of common life entangle themselves easily and frequently in contradictions. A problem of a purely formal character thus presents itself, viz. this—to try to bring unity and harmony into the scattered thoughts of our general culture, to trace them to their primary assumptions and follow them into their ultimate consequences, to connect them all together, to remodel, curtail or amplify them, so as to remove their apparent contradictions, and to combine them in the unity of an harmonious view of things, and especially to investigate those conceptions which form the initial assumptions of the several sciences, and to fix the limits of their applicability. This is the formal definition of philosophy. Whether an harmonious conception thus gained will represent more than an agreement among our thoughts, whether it will represent the real connexion of things and thus possess objective not merely subjective value, cannot be decided at the outset. It is also unwarranted to start with the expectation that everything in the world should be explained by one principle, and it is a needless restriction of our means to expect unity of method. Nor are we able to start our philosophical investigations by an inquiry into the nature of human thought and its capacity to attain an objective knowledge, as in this case we would be actually using that instrument the usefulness of which we were trying to determine. The main proof of the objective value of the view we may gain will rather lie in the degree in which it succeeds in assigning to every element of culture its due position, or in which it is able to appreciate and combine different and apparently opposite tendencies and interests, in the sort of justice with which it weighs our manifold desires and aspirations, balancing them in due proportions, refusing to sacrifice to a one-sided principle any truth or conviction which experience has proven to be useful and necessary. The investigations will then naturally divide themselves into three parts, the first of which deals with those to our mind inevitable forms in which we are obliged to think about things, if we think at all (metaphysics), the second being devoted to the great region of facts, trying to apply the results of metaphysics to these, specially the two great regions of external and mental phenomena (cosmology and psychology), the third dealing with those standards of value from which we pronounce our aesthetical or ethical approval or disapproval. In each department we shall have to aim first of all at views clear and consistent within themselves, but, secondly, we shall in the end wish to form some general idea or to risk an opinion how laws, facts and standards of value may be combined in one comprehensive view. Considerations of this latter kind will naturally present themselves in the two great departments of cosmology and psychology, or they may be delegated to an independent research under the name of religious philosophy. We have already mentioned the final conception in which Lotze's speculation culminates, that of a personal Deity, Himself the essence of all that merits existence for its own sake, who in the creation and government of a world has voluntarily chosen certain laws and forms through which His ends are to be realized. We may add that according to this view nothing is real but the living spirit of God and the world of living spirits which He has created; the things of this world have only reality in so far as they are the appearance of spiritual substance, which underlies everything. It is natural that Lotze, having this great and final conception always before him, works under its influence from the very beginning of his speculations, permitting us, as we progress, to gain every now and then a glimpse of that interpretation of things which to him contains the solution of our difficulties.

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[1] See Vogt, *Physiologische Briefe* (1845–1847); Moleschott, *Der Kreislauf des Lebens* (1852); Büchner, *Kraft und Stoff* (1855).

The key to Lotze's theoretical philosophy lies in his metaphysics, to the exposition of which important subject the first and last of his larger publications have been devoted. To understand Lotze's philosophy, a careful and repeated perusal of these works is absolutely necessary. The object of his metaphysics is so to remodel the current notions regarding the existence of things and their connexions with which the usage of language supplies us as to make them consistent and thinkable. The further assumption, that the modified notions thus gained have an objective meaning, and that they somehow correspond to the real order of the existing world which of course they can never actually describe, depends upon a general confidence which we must have in our reasoning powers, and in the significance of a world in which we ourselves with all the necessary courses of our thoughts have a due place assigned. The principle therefore of these investigations is opposed to two attempts frequently repeated in the history of philosophy, viz.: (1) the attempt to establish general laws or forms, which the development of things must have obeyed, or which a Creator must have followed in the creation of a world (Hegel); and (2) the attempt to trace the genesis of our notions and decide as to their meaning and value (modern theories of knowledge). Neither of these attempts is practicable. The world of many things surrounds us; our notions, by which we manage correctly or incorrectly to describe it, are also ready made. What remains to be done is, not to explain how such a world manages to be what it is, nor how we came to form these notions, but merely this—to expel from the circle and totality of our conceptions those abstract notions which are inconsistent and jarring, or to remodel and define them so that they may constitute a consistent and harmonious view. In this endeavour Lotze discards as useless and untenable many favourite conceptions of the school, many crude notions of everyday life. The course of things and their connexion is only thinkable by the assumption of a plurality of existences, the reality of which (as distinguished from our knowledge of them) can be conceived only as a multitude of relations. This quality of standing in relation to other things is that which gives to a thing its reality. And the nature of this reality again can neither be consistently represented as a fixed and hard substance nor as an unalterable something, but only as a fixed order of recurrence of continually changing events or impressions. But, further, every attempt to think clearly what those relations are, what we really mean, if we talk of a fixed order of events, forces upon us the necessity of thinking also that the different things which stand in relations or the different phases which follow each other cannot be merely externally strung together or moved about by some indefinable external power, in the form of some predestination or inexorable fate. The things themselves which exist and their changing phases must stand in some internal connexion; they themselves must be active or passive, capable of doing or suffering. This would lead to the view of Leibnitz, that the world consists of monads, self-sufficient beings, leading an inner life. But this idea involves the further conception of Leibnitz, that of a pre-established harmony, by which the Creator has taken care to arrange the life of each monad, so that it agrees with that of all others. This conception, according to Lotze, is neither necessary nor thoroughly intelligible. Why not interpret at once and render intelligible the common conception originating in natural science, viz. that of a system of laws which governs the many things? But, in attempting to make this conception quite clear and thinkable, we are forced to represent the connexion of things as a universal substance, the essence of which we conceive as a system of laws which underlies everything and in its own self connects everything, but imperceptible, and known to us merely through the impressions it produces on us, which we call things. A final reflection then teaches us that the nature of this universal and all-pervading substance can only be imagined by us as something analogous to our own mental life, where alone we experience the unity of a substance (which we call self) preserved in the multitude of its (mental) states. It also becomes clear that only where such mental life really appears need we assign an independent existence, but that the purposes of everyday life as well as those of science are equally served if we deprive the material things outside of us of an independence, and assign to them merely a connected existence through the universal substance by the action of which alone they can appear to us.

The universal substance, which we may call the absolute, is at this stage of our investigations not endowed with the attributes of a personal Deity, and it will remain to be seen by further analysis in how far we are able—without contradiction—to identify it with the object of religious veneration, in how far that which to metaphysics is merely a postulate can be gradually brought nearer to us and become a living power. Much in this direction is said by Lotze in various passages of his writings; anything complete, however, on the subject is wanting. Nor would it seem as if it could be the intention of the author to do much more than point out the lines on which the further treatment of the subject should advance. The actual result of his personal inquiries, the great idea which lies at the foundation of his philosophy, we know. It may be safely stated that Lotze would allow much latitude to individual convictions, as indeed it is evident that the empty notion of an absolute can only become living and significant to us in the same degree as experience and thought have taught us to realize the seriousness of life, the significance of creation, the value of the beautiful and the good, and the supreme worth of personal holiness. To endow the universal substance with moral attributes, to maintain that it is more than the metaphysical ground of everything, to say it is the perfect realization of the holy, the beautiful and the good, can only have a meaning for him who feels within himself what real not imaginary values are clothed in those expressions.

We have still to mention that aesthetics formed a principal and favourite study of Lotze's, and that he has treated this subject also in the light of the leading ideas of his philosophy. See his essays *Ueber den Begriff der Schönheit* (Gottingen, 1845) and *Ueber Bedingungen der Kunstschönheit*, ibid. (1847); and especially his *Geschichte der Aesthetik in Deutschland* (Munich, 1868).

Lotze's historical position is of much interest. Though he disclaims being a follower of Herbart, his formal definition of philosophy and his conception of the object of metaphysics are similar to those of Herbart, who defines philosophy as an attempt to remodel the notions given by experience. In this endeavour he forms with Herbart an opposition to the philosophies of Fichte, Schelling and Hegel, which aimed at objective and absolute knowledge, and also to the criticism of Kant, which aimed at determining the validity of all human knowledge. But this formal agreement includes material differences, and the spirit which breathes in Lotze's writings is more akin to the objects and aspirations of the idealistic school than to the cold formalism of Herbart. What, however, with the idealists was an object of thought alone, the absolute, is to Lotze only inadequately definable in rigorous philosophical language; the aspirations of the human heart, the contents of our feelings and desires, the aims of art and the tenets of religious faith must be grasped in order to fill the empty idea of the absolute with meaning. These manifestations of the divine spirit again cannot be traced and understood by reducing (as Hegel did) the growth of the human mind in the individual, in society and in history to the monotonous rhythm of a speculative schematism; the essence and worth which is in them reveals itself only to the student of detail, for reality is larger and wider than philosophy; the problem, "how the one can be many," is only solved for us in the numberless examples in life and experience which surround us, for which we must retain a lifelong interest and which constitute the true field of all useful human work. This conviction of the emptiness of terms and abstract notions, and of the fulness of individual life, has enabled Lotze to combine in his writings the two courses into which German philosophical thought had been moving since the death of its great founder, Leibnitz. We may define these courses by the terms esoteric and exoteric—the former the philosophy of the school, cultivated principally at the universities, trying to systematize everything and reduce all our knowledge to an intelligible principle, losing in this attempt the deeper meaning of Leibnitz's philosophy; the latter the unsystematized philosophy of general culture which we find in the work of the great writers of the classical period, Lessing, Winkelmann, Goethe, Schiller and Herder, all of whom expressed in some degree their indebtedness to Leibnitz. Lotze can be said to have brought philosophy out of the lecture-room into the market-place of life. By understanding and combining what was great and valuable in those divided and scattered endeavours, he became the true successor of Leibnitz.

The age in which Lotze lived and wrote in Germany was not one peculiarly fitted to appreciate the position he took up. Frequently misunderstood, yet rarely criticized, he was nevertheless greatly admired, listened to by devoted hearers and read by an increasing circle. But this circle never attained to the unity of a philosophical school. The real meaning of Lotze's teaching is reached only by patient study, and those who in a larger or narrower sense call themselves his followers will probably feel themselves indebted to him more for the general direction he has given to their thoughts, for the tone he has imparted to their inner life, for the seriousness with which he has taught them to consider even small affairs and practical duties, and for the indestructible confidence with which his philosophy permits them to disregard the materialism of science, the scepticism of shallow culture, the disquieting results of philosophical and historical criticism.

See E. Pfleiderer, *Lotze's philosophische Weltanschauung nach ihren Grundzügen* (Berlin, 1882; 2nd ed., 1884); E. von Hartmann, *Lotze's Philosophie* (Leipzig, 1888); O. Caspari, *H. Lotze in seiner Stellung zu der durch Kant begründeten neuesten Geschichte der Philosophie* (Breslau, 1883; 2nd ed., 1894); R. Falckenberg, *Hermann Lotze* (Stuttgart, 1901); Henry Jones, *A Critical Account of the Philosophy of Lotze* (Glasgow, 1895); Paul Lange, *Die Lehre vom Instincte bei Lotze und Darwin* (Berlin, 1896); A. Lichtenstein, *Lotze und Wundt* (Bern, 1900). (J. T. M.; H. St.)

LOUBET, ÉMILE FRANÇOIS (1838–), 7th president of the French republic, was born on the 30th of December 1838, the son of a peasant proprietor at Marsanne (Drôme), who was more than once mayor of Marsanne. He was admitted to the Parisian bar in 1862, and took his doctorate-in-law next year. He was still a student when he witnessed the sweeping triumph of the Republican party in Paris at the general election in 1863. He settled down to the exercise of his profession in Montélimar, where he married in 1869 Marie Louis Picard. He also inherited a small estate at Grignan. At the crisis of 1870 he became mayor of Montélimar, and thenceforward was a steady supporter of Gambetta's policy. Elected to the Chamber of Deputies in 1876 by Montélimar he was one of the famous 363 who in June 1877 passed the vote of want of confidence in the ministry of the duc de Broglie. In the general election of October he was re-elected, local enthusiasm for him being increased by the fact that the government had driven him from the mayoralty. In the Chamber he occupied himself especially with education, fighting the clerical system established by the Loi Falloux, and working for the establishment of free, obligatory and secular primary instruction. In 1880 he became president of the departmental council in Drôme. His support of the second Jules Ferry ministry and his zeal for the colonial expansion of France gave him considerable weight in the moderate Republican party. He had entered the Senate in 1885, and he became minister of public works in the Tirard ministry (December 1887 to March 1888). In 1892 President Sadi Carnot, who was his personal friend, asked him to form a cabinet. Loubet held the portfolio of the interior with the premiership, and had to deal with the anarchist crimes of that year and with the great strike of Carmaux, in which he acted as arbitrator, giving a decision regarded in many quarters as too favourable to the strikers. He was defeated in November on the question of the Panama scandals, but he retained the ministry of the interior in the next cabinet under Alexandre Ribot, though he resigned on its reconstruction in January. His reputation as an orator of great force and lucidity of exposition and as a safe and honest statesman procured for him in 1896 the presidency of the Senate, and in February 1899 he was chosen president of the republic in succession to Félix Faure by 483 votes as against 279 recorded by Jules Méline, his only serious competitor. He was marked out for fierce opposition and bitter insult as the representative of that section of the Republican party which sought the revision of the Dreyfus case. On the day of President Faure's funeral Paul Déroulède met the troops under General Roget on their return to barracks, and demanded that the general should march on the Élysée. Roget sensibly took his troops back to barracks. At the Auteuil steeplechase in June the president was struck on the head with a cane by an anti-Dreyfusard. In that month President Loubet summoned Waldeck-Rousseau to form a cabinet, and at the same time entreated Republicans of all shades of opinion to rally to the defence of the state. By the efforts of Loubet and Waldeck-Rousseau the Dreyfus affair was settled, when Loubet, acting on the advice of General Galliffet, minister of war, remitted the ten years' imprisonment to which Dreyfus was condemned at Rennes. Loubet's presidency saw an acute stage of the clerical question, which was attacked by Waldeck-Rousseau and in still more drastic fashion by the Combes ministry. The French ambassador was recalled from the Vatican in April 1905, and in July the separation of church and state was voted in the Chamber of Deputies. Feeling had run high between France and England over the mutual criticisms passed on the conduct of the South African War and the Dreyfus case respectively. These differences were composed by the Anglo-French *entente*, and in 1904 a convention between the two countries secured the recognition of French claims in Morocco in exchange for non-interference with the English occupation of Egypt. President Loubet was a typical example of the peasant-proprietor class, and had none of the aristocratic, not to say monarchical, proclivities of President Faure. He inaugurated the Paris Exhibition of 1900, received the tsar Nicholas II. in September 1901 and paid a visit to Russia in 1902. He also exchanged visits with King Edward VII., with the king of Italy and the king of Spain. The king of Spain's visit in 1905 was the occasion of an attempt on his life, a bomb being thrown under his carriage as he was proceeding with his guest to the opera. His presidency came to an end in January 1906, when he retired into private life.

LOUDON, ERNST GIDEON, Freiherr von (1717–1790), Austrian soldier, was born at Tootzen in Livonia, on the 2nd of February 1717. His family, of Scottish origin,[1] had been settled in that country since before 1400. His father was a lieutenant-colonel, retired on a meagre pension from the Swedish service, and the boy was sent in 1732 into the Russian army as a cadet. He took part in Field Marshal Münnich's siege of Danzig in 1734, in the march of a Russian corps to the Rhine in 1735 and in the Turkish war 1738–1739. Dissatisfied with his prospects he resigned in 1741 and sought military employment elsewhere. He applied first to Frederick the Great, who declined his services. At Vienna he had better fortune, being made a captain in Trenck's free corps. He took part in its forays and marches, though not in its atrocities, until wounded and taken prisoner in Alsace. He was shortly released by the advance of the main Austrian army. His next active service, still under Trenck, was in the Silesian mountains in 1745, in which campaign he greatly distinguished himself as a leader of light troops. He was present also at Soor. He retired shortly afterwards, owing to his distaste for the lawless habits of his comrades in the irregulars, and after long waiting in poverty for a regular commission he was at last made a captain in one of the frontier regiments, spending the next ten years in half-military, half-administrative work in the Carlstadt district. At Bunich, where he was stationed, he built a church and planted an oak forest now called by his name. He had reached the rank of lieutenant-colonel when the outbreak of the Seven Years' War called him again into the field. From this point began his fame as a soldier. Soon promoted colonel, he distinguished himself repeatedly and was in 1757 made a General-feldwacht-meister (major-general of cavalry) and a knight of the newly founded order of Maria Theresa. In the campaign of 1758 came his first opportunity for fighting an action as a commander-in-chief, and he used it so well that Frederick the Great was obliged to give up the siege of Olmütz and retire into Bohemia (action of Dom-stadtl, 30th of June). He was rewarded with the grade of lieutenant-field-marshal and having again shown himself an active and daring commander in the campaign of Hochkirch, he was created a Freiherr in the Austrian nobility by Maria Theresa and in the peerage of the Holy Roman Empire by her husband the emperor Francis. Maria Theresa gave him, further, the grand cross of the order she had founded and an estate near Kuttenberg in Bohemia. He was placed in command of the Austrian contingent sent to join the Russians on the Oder. At Kunersdorf he turned defeat into a brilliant victory, and was promoted Feldzeugmeister and made commander-in-chief in Bohemia, Moravia and Silesia. In 1760 he destroyed a whole corps of Frederick's army under Fouqué at Landshut and stormed the important fortress of Glatz. In 1760 he sustained a reverse at Frederick's hands in the battle of Liegnitz (Aug. 15th, 1760), which action led to bitter controversy with Daun and Lacy, the commanders of the main army, who, Loudon claimed, had left his corps unsupported. In 1761 he operated, as usual, in Silesia, but he found his Russian allies as timid as they had been after Kunersdorf, and all attempts against Frederick's entrenched camp of Bunzelwitz (see Seven Years' War) failed. He brilliantly seized his one fleeting opportunity, however, and stormed Schweidnitz on the night of Sept. 30/October 1st, 1761. His tireless activity continued to the end of the war, in conspicuous contrast with the temporizing strategy of Daun and Lacy. The student of the later campaigns of the Seven Years' War will probably admit that there was need of more aggressiveness than Daun displayed, and of more caution than suited Loudon's genius. But neither recognized this, and the last three years of the war are marked by an ever-increasing friction between the "Fabius" and the "Marcellus," as they were called, of the Austrian army.

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[1] His name is phonetically spelt Laudon or Laudohn by Germans, and the latter form was that adopted by himself and his family. In 1759, however, he reverted to the original Scottish form.

After the peace, therefore, when Daun became the virtual commander-in-chief of the army, Loudon fell into the background. Offers were made, by Frederick the Great amongst others, to induce Loudon to transfer his services elsewhere. Loudon did not entertain these proposals, although negotiations went on for some years, and on Lacy succeeding Daun as president of the council of war Loudon was made inspector-general of infantry. Dissensions, however, continued between Loudon and Lacy, and on the accession of Joseph II., who was intimate with his rival, Loudon retired to his estate near Kuttenberg. Maria Theresa and Kaunitz caused him, however, to be made commander-in-chief in Bohemia and Moravia in 1769. This post he held for three years, and at the end of this time, contemplating retirement from the service, he settled again on his estate. Maria Theresa once more persuaded him to remain in the army, and, as his estate had diminished in value owing to agrarian troubles in Bohemia, she repurchased it from him (1776) on generous terms. Loudon then settled at Hadersdorf near Vienna, and shortly afterwards was made a field-marshal. Of this Carlyle (*Frederick the Great*) records that when Frederick the Great met Loudon in 1776 he deliberately addressed him in the emperor's presence as "Herr Feldmarschall." But the hint was not taken until February 1778.

In 1778 came the War of the Bavarian Succession. Joseph and Lacy were now reconciled to Loudon, and Loudon and Lacy commanded the two armies in the field. On this occasion, however, Loudon seems to have in a measure fallen below his reputation, while Lacy, who was opposed to Frederick's own army, earned new laurels. For two years after this Loudon lived quietly at Hadersdorf, and then the reverses of other generals in the Turkish War called him for the last time into the field. Though old and broken in health, he was commander-in-chief in fact as well as in name, and he won a last brilliant success by capturing Belgrade in three weeks, 1789. He died within the year, on the 14th of July at Neu-Titschein in Moravia, still on duty. His last appointment was that of commander-in-chief of the armed forces of Austria, which had been created for him by the new emperor Leopold. Loudon was buried in the grounds of Hadersdorf. Eight years before his death the emperor Joseph had caused a marble bust of this great soldier to be placed in the chamber of the council of war.

His son Johann Ludwig Alexius, Freiherr von Loudon (1762–1822) fought in the Revolutionary and Napoleonic Wars with credit, and rose to the rank of lieutenant-field-marshal.

See memoir by v. Arneth in *Allgemeine deutsche Biographie*, s.v. "Laudon," and life by G. B. Malleson.

LOUDOUN, JOHN CAMPBELL, 1st Earl of (1598–1663), Scottish politician, eldest son of Sir James Campbell of Lawers, became Baron Loudoun in right of his wife Margaret, granddaughter of Hugh Campbell, 1st Baron Loudoun (d. 1622). He was created earl on the 12th of May 1633, but in consequence of his opposition to Charles I.'s church policy in Scotland the patent was stopped in Chancery. In 1637 he was one of the supplicants against the introduction of the English liturgy; and with John Leslie, 6th earl of Rothes, he took a leading part in the promulgation of the Covenant and in the General Assembly which met at Glasgow in the autumn of 1638. He served under General Leslie, and was one of the Scottish commissioners at the Pacification of Berwick in June 1639. In November of that year and again in 1640 the Scottish estates sent Loudoun with Charles Seton, 2nd earl of Dunfermline, to London on an embassy to Charles I. Loudoun intrigued with the French ambassador and with Thomas Savile, afterwards earl of Sussex, but without much success. He was in London when John Stewart, earl of Traquair, placed in Charles's hands a letter signed by Loudoun and six others and addressed to Louis XIII. In spite of his protest that the letter was never sent, and that it would in any case be covered by the amnesty granted at Berwick, he was sent to the Tower. He was released in June, and two months later he re-entered England with the Scottish invading army, and was one of the commissioners at Ripon in October. In the following August (1641) Charles opened parliament at Edinburgh in person, and in pursuance of a policy of conciliation towards the leaders of the Covenant Loudoun was made lord chancellor of Scotland, and his title of earl of Loudoun was allowed. He also became first commissioner of the treasury. In 1642 he was sent by the Scottish council to York to offer to mediate in the dispute between Charles and the parliament, and later on to Oxford, but in the second of these instances Charles refused to accept his authority. He was constantly employed in subsequent negotiations, and in 1647 was sent to Charles at Carisbrooke Castle, but the "Engagement" to assist the king there made displeased the extreme Covenanters, and Loudoun was obliged to retract his support of it. He was now entirely on the side of the duke of Argyll and the preachers. He assisted in the capacity of lord chancellor at Charles II.'s coronation at Scone, and was present at Dunbar. He joined in the royalist rising of 1653, but eventually surrendered to General Monk. His estates were forfeited by Cromwell, and a sum of money settled on the countess and her heirs. At the Restoration he was removed from the chancellorship, but a pension of £1000 granted him by Charles I. in 1643 was still allowed him. In 1662 he was heavily fined. He died in Edinburgh on the 15th of March 1663.

The earl's elder son, James (d. 1684), 2nd earl of Loudoun, passed his life out of Great Britain, and when he died at Leiden was succeeded by his son Hugh (d. 1731). The 3rd earl held various high positions in England and Scotland, being chosen one of the representative peers for Scotland at the union of the parliaments in 1707. He rendered good service to the government during the rising of 1715, especially at the battle of Sheriffmuir, and was succeeded as 4th earl by his son John (1705–1782), who fought against the Jacobites in 1745, was commander-in-chief of the British force in America in 1756 and died unmarried. The title then passed to James Mure Campbell (d. 1786), a grandson of the 2nd earl, and was afterwards borne by the marquesses of Hastings, descendants of the 5th earl's daughter and heiress, Flora (1780–1840). Again reverting to a female on the death of Henry, 4th marquess of Hastings, in 1868, it came afterwards to Charles (b. 1855), a nephew of this marquess, who became 11th earl of Loudoun.

LOUDUN, a town of western France, capital of an arrondissement in the department of Vienne, on an eminence overlooking a fertile plain, 45 m. by rail S.W. of Tours. Pop. (1906) 3931. It was formerly surrounded by walls, of which a single gateway and two towers remain. Of the old castle of the counts of Anjou which was destroyed under Richelieu, the site now forming a public promenade, a fine rectangular donjon of the 12th century is preserved; at its base traces of Roman constructions have been found, with fragments of porphyry pavement, mosaics and mural paintings. The Carmelite convent was the scene of the trial of Urban Grandier, who was burnt alive for witchcraft in 1634; the old Romanesque church of Sainte Croix, of which he was curé, is now used as a market. The church of St Pierre-du-Marché, Gothic in style with a Renaissance portal, has a lofty stone spire. There are several curious old houses in the town.

Théophraste Renaudot (d. 1653), founder of the *Gazette de France*, was born at Loudun, where there is a statue of him. The manufacture of lace and upholstery trimming and of farm implements is carried on, and there is a considerable trade in agricultural products, wine, &c. Loudun (*Loudunum* in ancient times) was a town of importance during the religious wars and gave its name in 1616 to a treaty favourable to the Protestants.

LOUGHBOROUGH, a market town and municipal borough in the Loughborough (Mid) parliamentary division of Leicestershire, England, near the river Soar and on the Loughborough canal. Pop. (1901) 21,508. It is 110 m. N.N.W. of London by the Midland railway, and is served by the Great Central and a branch of the London and North-Western railways. The neighbourhood is a rich agricultural district, and to the S.W. lies the hilly tract known as Charnwood Forest. The church of All Saints stands on rising ground, and is a conspicuous object for many miles round; it is of Decorated work, and the tower is Perpendicular. The other churches are modern. Public buildings include the town hall and exchange, town offices, county hall and free library. The grammar school, founded in 1495 under the charity of Thomas Burton, occupies modern buildings in pleasant grounds. There is also a girls' grammar school partly dependent on the same foundation. The principal industry is hosiery making; there are also engineering, iron and dye works and bell foundries. The great bell for St Paul's cathedral, London, was cast here in 1881. Loughborough was incorporated in 1888. Area, 3045 acres.

The manor of Loughborough (*Lucteburne, Lucteburg, Lughteburgh*) was granted by William the Conqueror to Hugh Lupus, from whom it passed to the Despensers. In 1226–1227 when it belonged to Hugh Despenser he obtained various privileges for himself and his men and tenants there, among which were quittance from suits at the county and hundred courts, of sheriffs' aids and of view of frankpledge, and also a market every Thursday and a fair on the vigil, day and morrow of St Peter ad vincula. The market rights were purchased by the town in 1880 from the trustees of Thomas Cradock, late lord of the manor. Edward II. visited the manor several times when it belonged to his favourite, Hugh Despenser the elder. Among the subsequent lords were Henry de Beaumont and Alice his wife, Sir Edward Hastings, created Baron Hastings of Loughborough in 1558, Colonel Henry Hastings, created baron in 1645, and the earls of Huntingdon. Alexander Wedderburn was created Baron Loughborough in 1780 when he became chief justice of the common pleas. During the 19th century most of the manorial rights were purchased by the local board. Loughborough was at first governed by a bailiff, afterwards by a local board, and was finally incorporated in 1888 under a mayor, 6 aldermen and 18 councillors. It has never been represented in parliament. Lace-making was formerly the chief industry, but machines for making lace set up in the town by John Heathcote were destroyed by the Luddites in 1816, and the manufacture lost its importance. Bell-founding was introduced in 1840. John Cleveland, the Royalist poet, was born at Loughborough in 1613, John Howe the painter in 1630 and Richard Pulteney the botanist in 1730.

See *Victoria County History, Leicestershire*; W. G. D. Fletcher, *Chapters in the History of Loughborough* (1883); Sir Thomas Pochin, "Historical Description of Loughborough" (1770) (vol. viii. of *Bibliotheca topographica Britannica*).

LOUGHREA, a market town of Co. Galway, Ireland, pleasantly situated on the N. shore of Lough Rea, 116 m. W. from Dublin by a branch from Attymon Junction on the Midland Great Western railway. Pop. (1901), 2815. There are slight remains of an Early English Carmelite friary dating *c.* 1300, which escaped the Dissolution. Loughrea is the seat of the Roman Catholic bishop of Clonfert, and has a cathedral built in 1900–1905. A part of the castle of Richard de Burgh, the founder of the friary, still survives, and there are traces of the town fortifications. In the neighbourhood are a cromlech and two ruined towers, and crannogs, or ancient stockaded islands, have been discovered in the lough. Apart from the surroundings of the lough, the neighbouring country is peculiarly desolate.

LOUGHTON, an urban district in the Epping parliamentary division of Essex, England, 11½ m. N.N.E. of Liverpool Street station, London, by the Great Eastern railway. Pop. (1901), 4730. This is one of the villages which has become the centre of a residential district, and is frequented by holiday-makers from London, owing to its proximity to the pleasant woodland scenery of Epping Forest. It lies on the eastern outskirts of the Forest, near the river Roding. There are several modern churches. The lordship of the manor was granted to Waltham Abbey. In the vicinity are large earthworks, probably of British origin, known as Loughton Camp.

LOUHANS, a town of east-central France in the old province of Franche-Comté, now capital of an arrondissement in the department of Saône-et-Loire, 34 m. N.N.E. of Mâcon by road. Pop. (1906), 3216. Its church has a fine tower of the 15th century, of which the balustrade is carved so as to form the first words of the Ave Maria. There are also a hospital of the 17th century with a collection of ancient earthenware, a town-hall of the 18th century and remains of ramparts of the 16th and 17th century. The town is the central market of the agricultural plain of Bresse; chickens form the chief article of commerce. There is also a large felt-hat manufactory.

LOUIS, or LEWIS (from the Frankish *Chlodowich*, *Chlodwig*, Latinized as *Chlodowius*, *Lodhuwicus*, *Lodhuvicus*, whence—in the Strassburg oath of 842—O. Fr. *Lodhuwigs*, then *Chlovis*, *Loys* and later *Louis*, whence Span. *Luis* and—through the Angevin kings—Hungarian *Lájos*; cf. Ger. *Ludwig* or *Ludewig*, from O. H. Ger. *Hluduwic*, *Hludwig*, *Ludhuwig*, M. H. Ger. *Ludewic*; Ital. *Lodovico*), a masculine proper name, meaning "Fame-fight" or "Famous in fight," from old Frankish *chlud*, *chlod* (O. H. Ger. *hlud*, *hlod*), "fame," and *wich* (O. H. Ger. *wic.*, *wig*, A.S. *wig*) "war," "battle" (cf. Gr. Κλυτόμαχος). The name has been borne by numerous European sovereigns and others, of whom some are noticed below in the following order: (1) Roman emperors and Frankish and German kings, (2) kings of Bavaria, (3) kings of France, (4) kings of Hungary, (5) kings of Naples, (6) Louis of Nassau. (Louis Philippe, king of the French, is dealt with separately.)

LOUIS I. (778–840), surnamed the "Pious," Roman emperor, third son of the emperor Charlemagne and his wife Hildegarde, was born at Chasseneuil in central France, and crowned king of Aquitaine in 781. He received a good education; but as his tastes were ecclesiastical rather than military, the government of his kingdom was mainly conducted by his counsellors. Louis, however, gained sound experience in warfare in the defence of Aquitaine, shared in campaigns against the Saxons and the Avars, and led an army to Italy in 792. In 794 or 795 he married Irmengarde, daughter of Ingram, count of Haspen. After the deaths of his two elder brothers, Louis, at his father's command, crowned himself co-emperor at Aix-la-Chapelle on the 11th of September 813, and was formally associated in the government of the Empire, of which he became sole ruler, in the following January. He earned the surname of "Pious" by banishing his sisters and others of immoral life from court; by attempting to reform and purify monastic life; and by showing great liberality to the church. In October 816 he was crowned emperor at Reims by Pope Stephen IV.; and at Aix in July 817, he arranged for a division of his Empire among his sons. This was followed by a revolt of his nephew, Bernard, king of Italy; but the rising was easily suppressed, and Bernard was mutilated and killed. The emperor soon began to repent of this cruelty, and when his remorse had been accentuated by the death of his wife in 818, he pardoned the followers of Bernard and restored their estates, and in 822 did public penance at Attigny. In 819 he married Judith, daughter of Welf I., count of Bavaria, who in 823 bore him a son Charles, afterwards called the Bald. Judith made unceasing efforts to secure a kingdom for her child; and with the support of her eldest step-son Lothair, a district was carved out for Charles in 829. Discontent at this arrangement increased to the point of rebellion, which broke out the following year, provoked by Judith's intrigues with Bernard, count of Barcelona, whom she had installed as her favourite at court. Lothair and his brother Pippin joined the rebels, and after Judith had been sent into a convent and Bernard had fled to Spain, an assembly was held at Compiègne, when Louis was practically deposed and Lothair became the real ruler of the Empire. Sympathy was, however, soon aroused for the emperor, who was treated as a prisoner, and a second assembly was held at Nimwegen in October 830 when, with the concurrence of his sons Pippin and Louis, he was restored to power and Judith returned to court.

Further trouble between Pippin and his father led to the nominal transfer of Aquitaine from Pippin to his brother Charles in 831 The emperor's plans for a division of his dominions then led to a revolt of his three sons Louis met them in June 833 near Kolmar, but owing possibly to the influence of Pope Gregory IV , who took part in the negotiations, he found himself deserted by his supporters, and the treachery and falsehood which marked the proceedings gave to the place the name of *Lügenfeld*, or the "field of lies." Judith, charged with infidelity, was again banished, Louis was sent into the monastery of St Medard at Soissons, and the government of the Empire was assumed by his sons. The emperor was forced to confess his sins, and declare himself unworthy of the throne, but Lothair did not succeed in his efforts to make his father a monk. Sympathy was again felt for Louis, and when the younger Louis had failed to induce Lothair to treat the emperor in a more becoming fashion, he and Pippin took up arms on behalf of their father The result was that in March 834 Louis was restored to power at St Denis; Judith once more returned to his side and the kingdoms of Louis and Pippin were increased The struggle with Lothair continued until the autumn, when he submitted to the emperor and was confined to Italy To make the restoration more complete, a great assembly at Diedenhofen declared the deposition of Louis to have been contrary to law, and a few days later he was publicly restored in the cathedral of Metz. In December 838 Pippin died, and a new arrangement was made by which the Empire, except Bavaria, the kingdom of Louis, was divided between Lothair, now reconciled to his father, and Charles. The emperor was returning from suppressing a revolt on the part of his son Louis, provoked by this disposition, when he died on the 20th of June 840 on an island in the Rhine near Ingelheim. He was buried in the church of St Arnulf at Metz. Louis was a man of strong frame, who loved the chase, and did not shrink from the hardships of war He was, however, easily influenced and was unequal to the government of the Empire bequeathed to him by his father No sustained effort was made to ward off the inroads of the Danes and others, who were constantly attacking the borders of the Empire. Louis, who is also called *Le Débonnaire*, counts as Louis I., king of France.

See *Annales Fuldenses*; *Annales Bertiniani*, Thegan, *Vita Hludowici*; the *Vita Hludowici* attributed to Astronomus, Ermoldus Nigellus, *In honorem Hludowici imperatoris*, Nithard, *Historiarum libri*, all in the *Monumenta Germaniae historica Scriptores*, Bände i. and ii. (Hanover and Berlin, 1826 fol), E Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881); and *Deutsche Geschichte unter den Karolingern* (Stuttgart, 1886); B. Simson, *Jahrbücher des fränkischen Reichs unter Ludwig dem Frommen* (Leipzig, 1874–1876), and E Dümmler, *Geschichte des ostfränkischen Reiches* (Leipzig, 1887–1888). (A. W H.*)

LOUIS II. (825–875), Roman emperor, eldest son of the emperor Lothair I., was designated king of Italy in 839, and taking up his residence in that country was crowned king at Rome by Pope Sergius II. on the 15th of June 844. He at once preferred a claim to the rights of an emperor in the city, which was decisively rejected; but in 850 he was crowned joint emperor at Rome by Pope Leo IV., and soon afterwards married his cousin, Engelberga, a daughter of King Louis the German, and undertook the independent government of Italy. He took the field against the Saracens; quashed some accusations against Pope Leo, held a diet at Pavia; and on the death of his father in September 855 became sole emperor. The division of Lothair's dominions, by which he obtained no territory outside Italy, aroused his discontent, and in 857 he allied himself with Louis the German against his brother Lothair, king of Lorraine, and King Charles the Bald. But after Louis had secured the election of Nicholas I as pope in 858, he became reconciled with his brother, and received some lands south of the Jura in return for assistance given to Lothair in his efforts to obtain a divorce from his wife, Teutberga. In 863, on the death of his brother Charles, Louis received the kingdom of Provence, and in 864 came into collision with Pope Nicholas I over his brother's divorce. The archbishops, who had been deposed by Nicholas for proclaiming this marriage invalid, obtained the support of the emperor, who reached Rome with an army in February 864; but, having been seized with fever, he made peace with the pope and left the city In his efforts to restore order in Italy, Louis met with considerable success both against the turbulent princes of the peninsula and against the Saracens who were ravaging southern Italy. In 866 he routed these invaders, but could not follow up his successes owing to the want of a fleet. So in 869 he made an alliance with the eastern emperor, Basil I., who sent him some ships to assist in the capture of Bari, the headquarters of the Saracens, which succumbed in 871. Meanwhile his brother Lothair had died in 869, and owing to his detention in southern Italy he was unable to prevent the partition of Lorraine between Louis the German and Charles the Bald. Some jealousy between Louis and Basil followed the victory at Bari, and in reply to an insult from the eastern emperor Louis attempted to justify his right to the title "emperor of the Romans." He had withdrawn into Benevento to prepare for a further campaign, when he was treacherously attacked in his palace, robbed and imprisoned by Adelchis, prince of Benevento, in August 871. The landing of fresh bands of Saracens compelled Adelchis to release his prisoner a month later, and Louis was forced to swear he would take no revenge for this injury, nor ever enter Benevento with an army. Returning to Rome, he was released from his oath, and was crowned a second time as emperor by Pope Adrian II. on the 18th of May 872 He won further successes against the Saracens, who were driven from Capua, but the attempts of the emperor to punish Adelchis were not very successful. Returning to northern Italy, he died, somewhere in the province of Brescia, on the 12th of August 875, and was buried in the church of St Ambrose at Milan, having named as his successor in Italy his cousin Carloman, son of Louis the German. Louis was an excellent ruler, of whom it was said "in his time there was great peace, because every one could enjoy his own possessions."

See *Annales Bertiniani*, *Chronica S. Benedicti Casinensis*, both in the *Monumenta Germaniae historica. Scriptores*, Bände i. and iii. (Hanover and Berlin, 1826 fol.); E. Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881); Th. Sickel, *Acta regum et imperatorum Karolinorum, digesta et enarrata* (Vienna, 1867–1868), and E Dümmler, *Geschichte des ostfränkischen Reiches* (Leipzig, 1887–1888). (A. W. H.*)

LOUIS III. (*c* 880–928), surnamed the "Blind," Roman emperor, was a son of Boso, king of Provence or Lower Burgundy, and Irmengarde, daughter of the emperor Louis II. The emperor Charles the Fat took Louis under his protection on the death of Boso in 887, but Provence was in a state of wild disorder, and it was not until 890, when Irmengarde had secured the support of the Bavarian king Arnulf and of Pope Stephen V., that Louis was recognized as king. In 900, after the death of the emperor Arnulf, he went to Italy to obtain the imperial crown. He was chosen king of the Lombards at Pavia, and crowned emperor at Rome in February 901 by Pope Benedict IV. He gained a temporary authority in northern Italy, but was soon compelled by his rival Berengar, margrave of Friuli, to leave the country and to swear he would never return. In spite of his oath he went again to Italy in 904, where he secured the submission of Lombardy; but on the 21st of July 905 he was surprised at Verona by Berengar, who deprived him of his sight and sent him back to Provence, where he passed his days in enforced inactivity until his death in September 928. He married Adelaide, possibly a daughter of Rudolph I., king of Upper Burgundy. His eldest son, Charles Constantine, succeeded to no more than the county of Vienne.

See *Forschungen zur deutschen Geschichte*, Bände ix. and x. (Göttingen, 1862–1886); E. Dümmler, *Geschichte des ostfränkischen Reichs* (Leipzig, 1887–1888); and *Gesta Berengarii imperatoris* (Halle, 1871); and F. de Gingins-la-Sarra, *Mémoires pour servir à l'histoire de Provence et de Bourgogne Jurane* (Zürich, 1851).

(A. W H.*)

LOUIS IV., or **V.** (*c.* 1287–1347), surnamed the Bavarian, Roman emperor and duke of Upper Bavaria, was the second son of Louis II., duke of Upper Bavaria and count palatine of the Rhine, and Matilda, daughter of the German king Rudolph I. Having lost his father in 1294 he inherited, jointly with his elder brother Rudolph, Upper Bavaria and the Palatinate, but passed his time mainly at the court of the Habsburgs in Vienna, while his early experiences of warfare were gained in the campaigns of his uncle, the German king Albert I. He was soon at variance with his brother over their joint possessions. Albert taking the part of Louis in this quarrel, Rudolph promised in 1301 to admit his brother to a share in the government of Bavaria and the Palatinate. When Albert was murdered in May 1308, Louis became a candidate for the German throne; but his claim was not strongly supported. The new king, Henry VII., was very friendly with Rudolph, and as the promise of 1301 had not been carried out, Louis demanded a partition of their lands. Upper Bavaria was accordingly divided in 1310, and Louis received the north-western part of the duchy, but Rudolph refused to surrender any part of the Palatinate. In 1310, on the death of Stephen I., duke of Lower Bavaria, Louis undertook the guardianship of his two young sons. This led to a war between the brothers, which lasted till June 1313, when peace was made at Munich. Many of the nobles in Lower Bavaria, however, angered at Louis, called in the aid of Frederick I. (the Fair), duke of Austria; but he was defeated at Gammelsdorf on the 9th of November 1313, a victory which not only led to peace, but conferred considerable renown on Louis.

In August 1313 the German throne had again become vacant, and Louis was chosen at Frankfort on the 20th of October 1314 by a majority of the electors, and his coronation followed at Aix-la-Chapelle on the 25th of November. A minority of princes had, however, supported Frederick of Austria; and a war followed between the rivals, during which Louis was supported by the cities and the districts of the middle and lower Rhine. His embarrassments were complicated by a renewal of the dispute with his brother; but when this had been disposed of in 1317 by Rudolph's renunciation of his claims on upper Bavaria and the Palatinate in consideration of a yearly subsidy, Louis was able to give undivided attention to the war with Frederick, and obtained several fresh allies. On the 28th of September 1322 a battle was fought at Mühldorf, which ended in a complete victory for Louis, owing mainly to the timely aid of Frederick IV. of Hohenzollern, burgrave of Nüremburg. Frederick of Austria was taken prisoner, but the struggle was continued by his brother Leopold until the latter's death in 1326. Attempts to enable the two kings to rule Germany jointly failed, and about 1326 Frederick returned to Austria, leaving Louis in undisputed possession of the country. Before this conclusion, however, a new enemy had taken the field. Supported by Philip V. of France in his desire to free Italy entirely from German influence, Pope John XXII. refused to recognize either Frederick or Louis, and asserted his own right to administer the empire during a vacancy. After the battle of Mühldorf Louis sent Berthold of Neifen, count of Marstetten, into Italy with an army, which soon compelled the papal troops to raise the siege at Milan. The pope threatened Louis with excommunication unless he resigned his kingdom within three months. The king thereupon appealed to a general council, and was placed under the papal ban on the 23rd of March 1324, a sentence which he answered by publishing his charges against the pope. In the contest Louis was helped by the Minorites, who were upholding against John the principal of clerical poverty, and by the writings of Marsilius of Padua (who dedicated to Louis his *Defensor pacis*), William of Occam, John of Jandun and others. Taking the offensive, Louis met his Ghibelline supporters at Trent and reached Italy in March 1327; and in May he received the Lombard crown at Milan. Although the pope renewed his fulminations Louis compelled Pisa to surrender, and was hailed with great rejoicing in Rome. On the 17th of January 1328 he was crowned emperor in St Peter's by Sciarra Colonna, a Roman noble; and he answered the continued attacks of Pope John by pronouncing his deposition, and proclaiming Peter of Corvara pope as Nicholas V. He then undertook an expedition against John's ally, Robert, king of Naples, but, disunion among his troops and scarcity of money and provisions, drove him again to Rome, where, finding that his exactions had diminished his popularity, he left the city, and after passing six months at Pisa, returned to Germany in January 1330. The struggle with the pope was renewed in Germany, and when a formidable league had been formed against Louis, his thoughts turned to a reconciliation. He was prepared to assent to very humiliating terms, and even agreed to abdicate; but the negotiations, which were prolonged by further demands on the part of the pope, were interrupted by his death in December 1334. John's successor, Benedict XII., seemed more anxious to come to an arrangement, but was prevented from doing so by the influence of Philip VI. of France. Overtures for peace were made to Philip, but without success; and in July 1337 Louis concluded an alliance with Edward III., king of England, and made active preparations for war. During these years his attention was also occupied by a quarrel with John, king of Bohemia, over the possession of Tirol, by a campaign in Lower Bavaria, and a futile expedition against Nicholas I., bishop of Constance. But although his position was shaken by the indifferent success which attended these campaigns, it was improved when the electors meeting at Rense in July 1338 banded themselves together to defend their elective rights, and when the diet at Frankfort confirmed a decree which declared that the German king did not need the papal approbation to make his election valid.

Louis devoted considerable thought and time to extending the possessions of the Wittelsbach family, to which he belonged. Tirol had for some time been a subject of contention between the emperor and other princes. The heiress of this county, Margaret Maultasch, had married John Henry, margrave of Moravia, son of King John of Bohemia. Having quarrelled with her husband, Margaret fled to the protection of Louis, who seized the opportunity to declare her marriage void and to unite her in 1342 with his son Louis. The emperor also increased his possessions by his own marriage. In 1322 his first wife, Beatrice, daughter of Henry III., count of Glogau, had died after thirteen years of married life, and Louis then married Margaret, daughter of William III., count of Holland. When her brother, count William IV., died childless in 1345, the emperor obtained possession of Holland, Zealand and Friesland. In 1341 he recovered a portion of the Palatinate, and soon deserted Edward of England and came to terms with Philip of France. The acquisition of the territories, and especially of Tirol, had provided Louis with many enemies, prominent among whom were John of Bohemia and his family, that of Luxemburg. John, therefore, entered into an alliance with Pope Clement VI. The course of the war which ensued in Germany was such as to compel the emperor to submit to humiliating terms, though he stopped short of accepting the election of Charles, margrave of Moravia (afterwards the emperor Charles IV.) as German king in July 1346. Charles consequently attacked Tirol; but Louis, who appeared to have considerable chances of success, died suddenly at a bear-hunt near Munich on the 11th of October 1347. He was buried in the Frauenkirche at Munich, where a statue was erected to his memory in 1622 by Maximilian I., elector of Bavaria, and where a second was unveiled in 1905. He had seven sons, three of whom were subsequently electors of Brandenburg, and ten daughters.

Various estimates have been formed of the character of Louis. As a soldier he possessed skill as well as bravery, but he lacked perseverance and decision in his political relations. At one time haughtily defying the pope, at another abjectly craving his pardon, he seems a very inglorious figure; and the fact that he remained almost undisturbed in the possession of Germany in spite of the utmost efforts of the popes, is due rather to the political and intellectual tendencies of the time than to his own good qualities. Nevertheless he ruled Bavaria with considerable success. He befriended the towns, encouraged trade and commerce and gave a new system of laws to the duchy German took the place of Latin in the imperial charters, and although not a scholar, the emperor was a patron of learning. Louis was a man of graceful appearance, with ruddy countenance and prominent nose.

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LOUIS (804–876) surnamed the "German," king of the East Franks, was the third son of the emperor Louis I and his wife Irmengarde. His early years were partly spent at the court of his grandfather Charlemagne, whose special affection he is said to have won. When the emperor Louis divided his dominions between his sons in 817, Louis received Bavaria and the neighbouring lands, but did not undertake the government until 825, when he became involved in war with the Slavonic tribes on his eastern frontier. In 827 he married Emma, daughter of Welf I., count of Bavaria, and sister of his stepmother Judith; and he soon began to interfere in the quarrels arising from Judith's efforts to secure a kingdom for her own son Charles, and the consequent struggles of Louis and his brothers with the emperor Louis I. (*q.v.*). When the elder Louis died in 840 and his eldest son Lothair claimed the whole Empire, Louis in alliance with his half-brother, king Charles the Bald, defeated Lothair at Fontenoy on the 25th of June 841. In June 842 the three brothers met on an island in the Saône to negotiate a peace, and each appointed forty representatives to arrange the boundaries of their respective kingdoms This developed into the treaty of Verdun concluded in August 843, by which Louis received the bulk of the lands of the Carolingian empire lying east of the Rhine, together with a district around Spires, Worms and Mainz, on the left bank of the river His territories included Bavaria, where he made Regensburg the centre of his government, Thuringia, Franconia and Saxony He may truly be called the founder of the German kingdom, though his attempts to maintain the unity of the Empire proved futile. Having in 842 crushed a rising in Saxony, he compelled the Abotrites to own his authority, and undertook campaigns against the Bohemians, the Moravians and other tribes, but was not very successful in freeing his shores from the ravages of Danish pirates At his instance synods and assemblies were held where laws were decreed for the better government of church and state. In 853 and the following years Louis made more than one attempt to secure the throne of Aquitaine, which the people of that country offered him in their disgust with the cruel misrule of Charles the Bald. But though he met with sufficient success to encourage him to issue a charter in 858, dated "the first year of the reign in West Francia," treachery and desertion in his army, and the loyalty to Charles of the Aquitanian bishops brought about the failure of the enterprise, which Louis renounced by a treaty signed at Coblenz on the 7th of June 860.

In 855 the emperor Lothair died, and was succeeded in Italy by his eldest son Louis II., and in the northern part of his kingdom by his second son, Lothair. The comparative weakness of these kingdoms, together with the disorder caused by the matrimonial troubles of Lothair, afforded a suitable opening for the intrigues of Louis and Charles the Bald, whose interest was increased by the fact that both their nephews were without male issue. Louis supported Lothair in his efforts to divorce his wife Teutberga, for which he received a promise of Alsace, while Charles opposed the divorce. But in 865 Louis and Charles meeting near Toul, renewed the peace of Coblenz, and doubtless discussed the possibility of dividing Lothair's kingdom. In 868 at Metz they agreed definitely to a partition; but when Lothair died in 869, Louis was lying seriously ill, and his armies were engaged with the Moravians. Charles the Bald accordingly seized the whole kingdom; but Louis, having recovered, compelled him by a threat of war to agree to the treaty of Mersen, which divided it between the claimants. The later years of Louis were troubled by risings on the part of his sons, the eldest of whom, Carloman, revolted in 861 and again two years later; an example that was followed by the second son Louis, who in a further rising was joined by his brother Charles. A report that the emperor Louis II was dead led to peace between father and sons. The emperor, however, was not dead, but a prisoner; and as he was not only the nephew, but also the son-in-law of Louis, that monarch hoped to secure both the imperial dignity and the Italian kingdom for his son Carloman. Meeting his daughter Engelberga, the wife of Louis II., at Trent in 872, Louis made an alliance with her against Charles the Bald, and in 874 visited Italy doubtless on the same errand. The emperor, having named Carloman as his successor, died in August 875, but Charles the Bald reached Italy before his rival, and by persuading Carloman, when he did cross the Alps, to return, secured the imperial crown. Louis was preparing for war when he died on the 28th of September 876 at Frankfort, and was buried at Lorsch, leaving three sons and three daughters. Louis was in war and peace alike, the most competent of the descendants of Charlemagne He obtained for his kingdom a certain degree of security in face of the attacks of Normans, Hungarians, Moravians and others. He lived in close alliance with the Church, to which he was very generous, and entered eagerly into schemes for the conversion of his heathen neighbours.

See *Annales Fuldenses*; *Annales Bertiniani*; Nithard, *Historiarum Libri*, all in the *Monumenta Germaniae historica. Scriptores*, Bände i. and ii. (Hanover and Berlin, 1826 seq.); E. Dümmler, *Geschichte des ostfränkischen Reiches* (Leipzig, 1887–1888); Th. Sickel, *Die Urkunden Ludwigs des Deutschen* (Vienna, 1861–1862); E. Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881); and A. Krohn, *Ludwig der Deutsche* (Saarbrücken, 1872). (A. W. H.*)

LOUIS I., king of Bavaria (1786–1868), son of the then prince, afterwards duke and elector, Max Joseph of Zweibrücken and his wife Princess Augusta of Hesse-Darmstadt (–1796), was born at Strassburg on the 25th of August 1786. He received a careful education at home, afterwards (in 1803) going to the Bavarian national university of Landshut and to Göttingen. As a young man he was drawn into the Romantic movement then at its height, but both the classics and contemporary classical poetry took hold upon his receptive mind (he visited Goethe in 1827). He had himself strong artistic tendencies, though his numerous poems show but little proof of this, and as a patron of the arts he proved himself as great as any who had ever occupied a

German throne, and more than a mere dilettante. His first visit to Italy, in 1804, had an important influence upon this side of his development.

But even in Italy the crown prince (his father had become elector in 1799 and king of Bavaria in 1805) did not forget his nationality. He soon made himself leader of the small anti-French party in Bavaria. Napoleon sought in vain to win him over, and Louis fell more and more out of favour with him Napoleon was even reported to have said. "Qui m'empêche de laisser fusiller ce prince?" Their relations continued to be strained, although in the campaigns of 1807 and 1809, in which Bavaria was among the allies of France, Louis won his laurels in the field.

The crown prince was also averse from a Napoleonic marriage, and preferred to marry (October 12, 1810) the Princess Therese of Saxe-Hildburghausen (1792–1854). Three daughters and four sons were born of this marriage, one of whom succeeded him as Maximilian II., while another, Luitpold, became prince regent of Bavaria on the death of Louis II.

During the time that he was crown prince Louis resided chiefly at Innsbruck or Salzburg as governor of the circle of the Inn and Salzach. In 1815 he attended the Congress of Vienna, where he was especially occupied in endeavouring to obtain the restoration of Alsace and Lorraine to Germany; and later in the year he was with the allies in Paris, using his influence to secure the return of the art treasures carried off by the French.

After 1815 also the crown prince maintained his anti-French attitude, and it was mainly his influence that in 1817 secured the fall of Montgelas, the minister with French sympathies. Opposed to absolutism, Louis took great interest in the work of organizing the Bavarian constitution (1818) and defended it against Metternich and the Carlsbad Decrees (1819); he was also one of the most zealous of the ardent Philhellenes in Germany at the time. He succeeded to the crown of Bavaria on the 12th of October 1825, and at once embarked upon a moderate constitutional policy, in which he found himself in general agreement with the parliament. Although he displayed a loyal attachment to the Catholic Church, especially owing to his artistic sympathies, he none the less opposed all its more exaggerated pretensions, especially as represented by the Jesuits, whom he condemned as un-German. In the year of his accession he abolished an old edict concerning the censorship. He also furthered in many ways the internal administration of the state, and especially that of the finances. His personal tastes, apart from his activities as a Maecenas, being economical, he endeavoured also to limit public expenditure, in a way which was not always a benefit to the country. Bavaria's power of self-defence especially was weakened by his economies and by his lack of interest in the military aspect of things.

He was a warm friend of learning, and in 1826 transferred the university of Landshut to Munich, where he placed it under his special protection. Prominent scholars were summoned to it, mostly belonging to the Romantic School, such as Goerres, Schubert and Schelling, though others were not discouraged. In the course of his visits to Italy he formed friendships with famous artists such as Thorwaldsen and Cornelius. He was especially anxious to obtain works of art, mainly sculpture, for the famous Munich collections which he started, and in this he had the advantage of the assistance of the painter Martin Wagner. He also set on foot movements for excavation and the collection of works of art in Greece, with excellent results.

Under the influence of the July revolution of 1830, however, he also began to be drawn into the current of reaction; and though he still declared himself openly against absolutism, and never took up such a hostile attitude towards constitutional ideas as his brother-in-law King Frederick William IV., he allowed the reactionary system of surveillance which commended itself to the German Confederation after 1830 to be introduced into Bavaria (see BAVARIA: *History*). He continued, on the other hand, to do much for the economic development of the country. As a follower of the ideas of Friedrich List, he furthered the foundation of the Zollverein in the year 1833 and the making of canals. Railways he looked upon as a "necessary evil."

In external politics peace was maintained on the whole after 1825 Temporary diplomatic complications arose between Bavaria and Baden in connexion with Louis's favourite project of winning back the part then belonging to Baden of the old Palatinate, the land of his birth, which was always very dear to him.

Of European importance was his enthusiasm for the liberation of Greece from the rule of Turkey. Not only did he erect the *Propyläen* at Munich in her honour, but he also helped her in the most generous way both with money and diplomatic resources. And after his second son Otto had become king of Greece in 1832, Greek affairs became from time to time the central point of his foreign policy. In 1835 he made a visit to Greece, partly political, partly inspired by his old interest in art. But his son proved unequal to his task, and in 1862 was forced to abdicate (see OTHO, king of Greece). For this unfortunate issue Louis was not without blame, for from the very first, owing to an exaggerated idealism and love of antiquity, he had totally misunderstood the national character of the Greeks and the problems involved in the attempts to govern them by bureaucratic methods.

In Bavaria, too, his government became more and more conservative, especially after Karl Abel became the head of the ministry in 1837 The king had not yet, it is true, altogether committed himself to the clerical ultras, and on the occasion of the dispute about the bishops in Prussia in the same year had taken up a wise attitude of compromise. But in Bavaria itself the strict Catholic party influenced affairs more and more decisively. For a while, indeed, this opposition did not impair the king's popularity, due to his amiable character, his extraordinary services in beautifying his capital of Munich, and to his benevolence (it has been reckoned that he personally received about 10,000 letters asking for help every year, and that the money he devoted to charity amounted to about a fifth of his income) The year 1846, however, brought a change which had sad consequences. This was due to the king's relations with the Spanish dancer Lola Montez, who appeared in Munich in October 1846, and soon succeeded by her beauty and wit in fascinating the king, who was always susceptible to feminine charms. The political importance of this lay in the fact that the royal mistress began to use her great influence against the clerical policy of the Abel ministry. So when the king was preparing the way for ennobling her, in order to introduce her into court circles, which were unwilling to receive her, the ministry protested in the famous memorandum of the 11th of February 1847 against the king's demand for her naturalization as a Bavarian, the necessary preliminary to her ennoblement. The position was still further embittered by the fact that, owing to an indiscretion, the memorandum became known to the public. Thereupon the king, irritated and outraged, replaced Abel's Clerical ministry by a more accommodating Liberal one under Zu Rhein under which Lola Montez without more difficulty became Countess Landsberg. Meanwhile, the criticism and opposition of the people, and especially of the students, was turned against the new leader of the court of Munich On top of this came the revolutionary movement of 1848. The king's position became more and more difficult, and under the pressure of popular opposition he was forced to banish the countess. But neither this nor the king's liberal proclamation of the 6th of March succeeded in establishing peace, and in the capital especially the situation became increasingly threatening. All this made such a deep impression on the king. that on the 20th of March 1848 he abdicated in favour of his son Maximilian.

He now retired entirely into private life, and continued to play the Maecenas magnificently, frequently staying at his villa in Rome, the Villa Malta, and enjoying extraordinary vigour of mind and body up to the end of his days. His popularity, which had been shaken by the Montez affair, he soon recovered, especially among artists. To him Munich owes her finest art collections and most remarkable buildings. The monarch's artistic sense led him not only to adorn his house with a number of works of antique art, but also to study German medieval art, which he did to good effect. To him Munich owes the acquisition of the famous Rhenish collection of the Boisserée brothers. The king also worked with great zeal for the care of monuments, and the cathedrals of Spires and Cologne enjoyed his special care. He was also an unfailing supporter of contemporary painting, in so far as it responded to his romantic tendencies, and he gave a fresh impulse to the arts of working in metal and glass. As visible signs of his permanent services to art Munich possesses the Walhalla, the Glyptothek, the two Pinakotheken, the Odeon, the University, and many other magnificent buildings both sacred and profane. The rôle which the Bavarian capital now plays as the leading art centre of Germany would have been an impossibility without the splendid munificence of Louis I.

He died on the 28th of February 1868 at Nice, and on the 9th of March was buried in Munich, amid demonstrations of great popular feeling.

The chief part of Louis's records is contained in seven sealed chests in the archives of his family, and by the provisions of his will these were not to be opened till the year 1918. These records contain an extraordinarily large and valuable mass of historical material, including, as one item, 246 volumes of the king's diary.

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(J. Hn.)

LOUIS II., king of Bavaria (1845–1886), son of his predecessor Maximilian II. and his wife Maria, daughter of Prince William of Prussia, was born at Nymphenburg on the 25th of August 1845. Together with his brother Otto, three years younger than himself, Louis received, in accordance with the wishes of his learned father, a simple and serious education modelled on that of the German *Gymnasien*, of which the classical languages are the chief feature. Of modern languages the crown prince learnt only French, of which he remained fond all his life. The practical value of the prince's training was small. It was not till he was eighteen years old that he received his first pocket-money, and at that age he had no ideas about money and its value. Military instruction, physical exercises and sport, in spite of the crown prince's strong physique, received little attention. Thus Louis did not come enough into contact with young men of his own age, and consequently soon developed a taste for solitude, which was found at an early age to be combined with the romantic tendencies and musical and theatrical tastes traditional in his family.

Louis succeeded to the throne on the 10th of March 1864, at the age of eighteen. The early years of his reign were marked by a series of most serious political defeats for Bavaria. In the Schleswig-Holstein question, though he was opposed to Prussia and a friend of Duke Frederick VIII. of Augustenburg, he did not command the material forces necessary effectively to resist the powerful policy of Bismarck. Again, in the war of 1866, Louis and his minister von der Pfordten took the side of Austria, and at the conclusion of peace (August 22) Bavaria had, in addition to the surrender of certain small portions of her territory, to agree to the foundation of the North German Confederation under the leadership of Prussia. The king's Bavarian patriotism, one of the few steadfast ideas underlying his policy, was deeply wounded by these occurrences, but he was face to face with the inevitable, and on the 10th of August wrote a letter of reconciliation to King William of Prussia. The defeat of Bavaria in 1866 showed clearly the necessity for a reform of the army. Under the new Liberal ministry of Hohenlohe (December 29, 1866–February 13, 1870) and under Pranckh as minister of war, a series of reforms were carried through which prepared for the victories of 1870. As regards his ecclesiastical policy, though Louis remained personally true to the Catholic Church, he strove for a greater independence of the Vatican. He maintained friendly relations with Ignaz von Döllinger, the leader of the more liberal Catholics who opposed the definition of papal infallibility, but without extending his protection to the anti-Roman movement of the Old Catholics. In spite of this the Old Bavarian opposition was so aroused by the Liberalism of the Hohenlohe ministry that at the beginning of 1870 Louis had to form a more Conservative cabinet under Count Bray-Steinburg. On the outbreak of the Franco-Prussian War he at once took the side of Prussia, and gave orders for mobilization. In 1871 it was he who offered the imperial crown to the king of Prussia; but this was not done on his own initiative. Bismarck not only determined the king of Bavaria to take the decisive step which put an end to a serious diplomatic crisis, but actually drafted the letter to King William which Louis copied and despatched without changing a word. Louis placed very few difficulties in the way of the new German Empire under the leadership of Prussia, though his Bavarian particularism remained unchanged.

Though up till the beginning of the year 1880 he did not cease to give some attention to state affairs, the king's interests lay in quite other spheres. His personal idiosyncrasies had, in fact, developed meanwhile in a most unhappy direction. His enthusiasm for all that is beautiful soon led him into dangerous bypaths. It found its most innocent expression in the earliest years of his reign when he formed an intimate friendship with Richard Wagner, whom from May 1864 to December 1865 he had constantly in his company. Louis was entirely possessed by the soaring ideas of the master, and was energetic in their realization. He not only established Wagner's material position at the moment by paying 18,000 gulden of debts for him and granting him a yearly income of 4000 gulden (afterwards increased to 8000), but he also proceeded to realize the ambitious artistic plans of the master. A series of brilliant model performances of the Wagnerian music-dramas was instituted in Munich under the personal patronage of the king, and when the further plan of erecting a great festival theatre in Munich for the performance of Wagner's "music of the future" broke down in the face of the passive resistance of the local circles interested, the royal enthusiast conceived the idea of building at Bayreuth, according to Wagner's new principles, a theatre worthy of the music-dramas. For a time Louis was entirely under Wagner's influence, the fantastic tendencies of whose art cast a spell over him, and there is extant a series of emotional letters of the king to Wagner. Wagner, on the whole, used his influence in artistic and not in political affairs.[1] In spite of this the opposition to him became permanent. Public opinion in Bavaria for the most part turned against him. He was attacked for his foreign origin, his extravagance, his intrigues, his artistic utopias, and last but by no means least, for his unwholesome influence over the king. Louis in the end was compelled to give him up. But the relations between king and artist were by no means at an end. In face of the war which was imminent in 1866, and in the midst of the preparation for war, the king hastened in May to Triebschen, near Lucerne, in order to see Wagner again.[1] In 1868 they were seen together in public for the last time at the festival performances in Munich. In 1876 Wagner's *Ring des Nibelungen* was performed for the first time at Bayreuth in the presence of the king. Later, in 1881, the king formed a similar friendship with Joseph Kainz the actor, but it soon came to an end. In January 1867 the young king became betrothed to Duchess Sophie of Bavaria (afterwards Duchesse d'Alençon), daughter of Duke Max and sister of the empress of Austria; but the betrothal was dissolved in October of the same year.

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[1] It was on Wagner's advice that the king appointed Hohenlohe prime minister in 1866. See Hohenlohe-Schillingfurst, Prince Chlodwig zu, under HOHENLOHE. [Ed.]

Though even in his later years he remained interested in lofty and intellectual pursuits, as may be gathered, apart from his enthusiasm for art and nature, from his wide reading in history, serious poetry and philosophy, yet in his private life there became increasingly marked the signs of moral and mental weakness which gradually gained the mastery over his once pure and noble nature. A prominent feature was his blind craving for solitude. He cut himself off from society, and avoided all intercourse with his family, even with his devotedly affectionate mother. With his ministers he came to communicate in writing only. At the end he was surrounded only by inferior favourites and servants. His life was now spent almost entirely in his castles far from the capital, which irked him more and more, or in short and hasty journeys, in which he always travelled incognito. Even the theatre he could now only enjoy alone. He arranged private performances in his castles or in Munich at fabulous cost, and appointed an official poet to his household. Later his avoidance of society developed into a dread of it, accompanied by a fear of assassination and delusions that he was being followed.

Side by side with this pathological development his inborn self-consciousness increased apace, turning more and more to megalomania, and impelling the weak-willed monarch to those extraordinary displays of magnificence which can still be admired to-day in the castles built or altered by him, such as Berg on the Starnberger See, Linderhof, Herrenchiemsee, Hohenschwangau, Neuschwanstein, &c., which are among the most splendid buildings in Germany. It is characteristic of the extravagance of the king's ideas that he adopted as his model the style of Louis XIV. and fell into the habit of imitating the *Roi Soleil*. He no longer stayed for any length of time in one castle. Often he scoured the country in wild nocturnal rides, and madness gained upon him apace. His mania for buying things and making presents was comparatively harmless, but more serious matters were the wild extravagance which in 1880 involved him in financial ruin, his fits of destructive rage, and the tendency to the most cruel forms of abnormal vice. None the less, at the time when the king's mental weakness was increasing, his character still retained lovable traits—his simple sense of beauty, his kindliness, and his highly developed understanding of art and artistic crafts. Louis's love of beauty also brought material profit to Bavaria.

But the financial and political dangers which arose from the king's way of life were so great that interference became necessary. On the 8th of June 1886 medical opinion declared him to be affected with chronic and incurable madness and he was pronounced incapable of governing. On the 10th of June his uncle, Prince Luitpold, assumed the regency, and after violent resistance the late king was placed under the charge of a mental specialist. On the 13th of June 1886 he met with his death by drowning in the Starnberger See, together with his doctor von Gudden, who had unwisely gone for a walk alone with his patient, whose physical strength was enormous. The details of his death will never be fully known, as the only possible eye-witness died with him. An examination of the brain revealed a condition of incurable insanity, and the faculty submitted a report giving the terrible details of his malady. Louis's brother Otto, who succeeded him as king of Bavaria, was also incurably insane.

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LOUIS II.[2] (846–879), king of France, called "le Bègue" or "the Stammerer," was a son of Charles II. the Bald, Roman emperor and king of the West Franks, and was born on the 1st of November 846. After the death of his elder brother Charles in 866 he became king of Aquitaine, and in October 877 he succeeded his father as king of the West Franks, but not as emperor. Having made extensive concessions to the nobles both clerical and lay, he was crowned king by Hincmar, archbishop of Reims, on the 8th of December following, and in September 878 he took advantage of the presence of Pope John VIII. at the council of Troyes to be consecrated afresh. After a feeble and ineffectual reign of eighteen months Louis died at Compiègne on the 10th or 11th of April 879. The king is described as "un homme simple et doux, aimant la paix, la justice et la religion." By his first wife, Ansgarde, a Burgundian princess, he had two sons, his successors, Louis III. and Carloman; by his second wife, Adelaide, he had a posthumous son, Charles the Simple, who also became king of France. (A. W. H.*)

LOUIS III. (*c.* 863–882), king of France, was a son of Louis II. and with his brother Carloman succeeded his father as king in April 879. A strong party, however, cast some doubts upon the legitimacy of the young princes, as the marriage of their parents had not been recognized by the emperor Charles the Bald; consequently it was proposed to offer the crown to the East Frankish ruler Louis, a son of Louis the German. But this plan came to nothing, and in September 879 the brothers were crowned at Ferrières by Ansègisus, archbishop of Sens. A few months later they divided their kingdom, Louis receiving the part of France north of the Loire. They acted together against the Northmen, over whom in August 881 they gained a memorable victory. They also turned against Boso who had been set up as king in Burgundy and Provence. On the 5th of August 882 Louis died at St Denis. He left no sons and Carloman became sole king. (A. W. H.*)

LOUIS IV. (921–954), king of France, surnamed "d'Outremer" (*Transmarinus*), was the son of Charles III. the Simple. In consequence of the imprisonment of his father in 922, his mother Odgiva (Eadgyfu), sister of the English king Æthelstan, fled to England with the young Louis—a circumstance to which he owes his surname. On the death of the usurper Rudolph (Raoul), Ralph of Burgundy, Hugh the Great, count of Paris, and the other nobles between whom France was divided, chose Louis for their king, and the lad was brought over from England and consecrated at Laon on the 19th of June 936. Although his *de facto* sovereignty was confined to the town of Laon and to some places in the north of France, Louis displayed a zeal beyond his years in procuring the recognition of his authority by his turbulent vassals. The beginning of his reign was marked by a disastrous irruption of the Hungarians into Burgundy and Aquitaine (937). In 939 Louis became involved in a struggle with the emperor Otto the Great on the question of Lorraine, the nobles of which district had sworn an oath of fidelity to the king of France. When Louis married Gerberga, sister of Otto, and widow of Giselbert, duke of Lorraine, there seemed to be a fair prospect of peace; but the war was resumed, Otto supporting the rebel lords of the kingdom of France, and peace was not declared until 942, at the treaty of Visé-sur-Meuse. On the death of William Longsword, duke of Normandy, who had been assassinated by Arnulf, count of Flanders, in December 942, Louis endeavoured to obtain possession of the person of Richard, the young son and heir of the late duke. After an unsuccessful expedition into Normandy, Louis fell into the hands of his adversaries, and was for some time kept prisoner at Rouen (945), and subsequently handed over to Hugh the Great, who only consented to release him on condition that he should surrender Laon. Menaced, however, by Louis' brother-in-law, Otto the Great, and excommunicated by the council of Ingelheim (948), the powerful vassal was forced to make submission and to restore Laon to his sovereign. The last years of the reign were troubled by fresh difficulties with Hugh the Great and also by an irruption of the Hungarians into the south of France. Louis died on the 10th of September 954, and was succeeded by his son Lothair.

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[1] Hohenlohe (*Denkwürdigkeiten*) comments on the fact that the king did not even take the trouble to review the troops proceeding to the war. [ED.]

[2] The emperor Louis I. is counted as Louis I., king of France.

The chief authority for the reign is the chronicler Flodoard. See also Ph. Lauer, *La Règne de Louis IV d'Outre-Mer* (Paris, 1900); and A. Heil, *Die politischen Beziehungen zwischen Otto dem Grossen und Ludwig IV. von Frankreich* (Berlin, 1904). (R. Po.)

LOUIS V. (967–987), king of France, succeeded his father Lothair in March 986 at the age of nineteen, and finally embroiled the Carolingian dynasty with Hugh Capet and Adalberon, archbishop of Reims. From the absence of any important event in his one year's reign the medieval chroniclers designated him by the words "qui nihil fecit," *i.e.* "le Fainéant" or "do-nothing." Louis died in May 987, his mother Emma being accused of having poisoned him. He had married Adelaide, sister of Geoffrey Grisegonelle, count of Anjou, but had no issue. His heir by blood was Charles, duke of Lower Lorraine, son of Louis IV., but the defection of the bishops and the treason of Adalberon (Ascelinus), bishop of Laon, assured the success of Hugh Capet.

See F. Lot, *Les Derniers Carolingiens* (Paris, 1891); and the *Recueil des actes de Lothaire et de Louis V*, edited by L. Halphen and F. Lot (1908). (R. Po.)

LOUIS VI. (1081–1137), king of France, surnamed "the Fat," was the son of Philip I. of France and Bertha of Holland. He was also surnamed the "Wide-awake" and "the Bruiser," and lost none of his energy when he earned the nickname by which he is known in history. In 1098 Louis was made a knight, and about the same time was associated with his father in the government, which the growing infirmities of Philip left more and more to his son, in spite of the opposition of Bertrada, the queen, whose criminal union with Philip had brought the anathema of the church. From 1100 to 1108 Louis by his victorious wars on the English and brigands had secured the army on his side, while the court supported Bertrada. Unable to make headway against him in war she attempted to poison him, and contemporary chroniclers attributed to this poison the pallor of his face, which seems to have been in remarkable contrast to his stalwart, and later his corpulent figure. Louis' reign is one of the most important in the history of France. He is little less than the second founder of the Capetian dynasty. When the feeble and incompetent Philip I. died (29th of July 1108) Louis was faced by feudal barons as powerful as himself, and ready to rise against him. He was forced to have himself hurriedly crowned at Orleans, supported by a handful of vassals and some ecclesiastics. As king he continued the policy he had followed during the previous eight years, of securing the roads leading to Paris by putting down feudal brigands and destroying their strongholds in the Île-de-France. The castle of the most notorious of these, Hugues du Puiset, was three times taken and burned by the king's men, but Hugues was spared to go back each time to his robber life, until he died on a crusade. In the north, Thomas de Marle, son of Enguerrand de Coucy, carried on a career of rapine and murder for almost thirty years before the king succeeded in taking him prisoner (1130). Twenty-four years of continuous war finally rooted out the robber barons who lived on the plunder of the roads leading to Paris: the lords of Montlhéri, who commanded the roads to Orleans, Melun and the south, those of Montmorency near St Denis on the north (who had to restore what they had robbed the abbey of St Denis), those of Le Puiset toward the west, on the way to Chartres, and many others. Parallel with this consolidation of his power in the ancestral domains Louis met energetically the Anglo-Norman danger, warring with Henry I. of England for twenty-five years. After the victory of Tinchebray (1106) Louis supported the claims of William Clito, son of Robert, duke of Normandy, against Henry I. A ruthless war followed, in which Louis was at times reduced to the sorest straits. In 1119, at a council held at Reims under the presidency of Pope Calixtus II., the enemies were reconciled; but William Clito's claims were not satisfied, and in 1123 war began again on a larger scale. Henry I. induced the emperor Henry V. to join in the attack upon France; and, his heir having been drowned in the loss of the "White Ship," won the count of Anjou by marrying his only daughter Matilda to Geoffrey, the Angevin heir (1127). The invasion of Henry V. was met by something like a national army, which gathered under Louis at Reims. "For a few days at least, the lord of the Île-de-France was truly a king of France" (Luchaire). Suger proudly gives the list of barons who appeared. Henry V. came no farther than Metz. Royalty had won great prestige. Even Theobald, count of Chartres, the king's greatest enemy, the soul of feudal coalitions, came with his contingent. Shortly afterwards (1126), Louis was able to overawe the great count of Aquitaine, William IX., and force his vassal, the count of Auvergne, to treat justly the bishop of Clermont. In Flanders Louis interfered upon the assassination of Charles the Good. He caused the barons to elect as their count in Arras the same William Clito who claimed Normandy, and who was closely bound to the king. For a while Louis had Flanders absolutely at his disposal, but he had hardly left William alone (1127) when his brutal oppression roused both towns and nobles, who declared that Louis had no right to interfere in Flanders. The death of William Clito, and a savage war with his own seneschal, prevented Louis from effectually resenting this attitude; but Thierry of Alsace, the new count, consented in 1128 to receive from Louis the investiture of all his French fiefs, and henceforth lived on good terms with him. In all his wars—those mentioned are but a part of them—Louis fought in person. Proud of his strength, reckless in the charge as on the march, plunging into swollen rivers, entering blazing castles, he gained the reputation of a national hero, the protector of the poor, the church, the peasants and the towns. The communal movement grew during his reign, and he encouraged it on the fiefs of his vassals in order to weaken them; but the title "Father of the Communes" by which he was known in history is not deserved, though he did grant some privileges to towns on his domains. Neither was Louis the author of the movement for the emancipation of the serfs, as was formerly claimed. His attitude toward the movement was like that of his predecessors and contemporaries, to favour emancipation when it promised greater chance of profit, greater scope for exploitation of the peasants; otherwise to oppose it. He was a great benefactor to the church, aided the new, reformed monastic congregations of Cîteau, Prémontré and Fontevrault, and chose his two chief ministers from the clergy. Étienne de Garlande, whom Louis raised from obscurity to be archdeacon of Notre Dame at Paris, chancellor and seneschal of France, was all-powerful with the king from 1108 to 1127. His relatives monopolized the highest offices of the state. But the queen Adelaide became his enemy; both Ivo of Chartres and St Bernard bitterly attacked him; and the king suddenly stripped him of all his offices and honours. Joining the rebellious barons, Étienne then led a bitter war against the king for three years. When Louis had reduced him to terms he pardoned him and restored him to the chancellorship (1132), but not to his old power. Suger (*q.v.*), administrator of St Denis, enters the scene toward the close of this reign, but his great work belongs to the next. Louis VI. died on the 1st of August 1137, just a few days after his son, Louis the Young, had set out for the far south-west, the Aquitaine which had been won by the marriage with Eleanor. His wife was Adelaide, or Alice, daughter of Humbert II., count of Savoy, by whom he had seven sons and a daughter.

See A. Luchaire, *Louis le Gros, annales de sa vie et son règne* (1890), and the same writer's volume, *Les Premiers Capétiens*, in E. Lavisse's *Histoire de France*. (J. T. S.*)

LOUIS VII. (*c.* 1121–1180), king of France, son of Louis VI. the Fat, was associated with his father and anointed by Innocent II. in 1131. In 1137 he succeeded his father, and in the same year married at Bordeaux Eleanor, heiress of William II., duke of Aquitaine. In the first part of his reign he was vigorous and jealous of his prerogatives, but after his crusade his religiosity developed to such an extent as to make him utterly inefficient. His accession was marked by no disturbances, save the risings of the burgesses of Orleans and of Poitiers, who wished to organize communes. But soon he came into violent conflict with Pope Innocent II. The archbishopric of Bourges became vacant, and the king supported as candidate the chancellor Cadurc, against the pope's nominee Pierre de la Châtre, swearing upon relics that so long as he lived Pierre should never enter Bourges. This brought the interdict upon the king's lands. At the same time he became involved in a war with Theobald, count of Champagne, by permitting Rodolphe (Raoul), count of Vermandois and seneschal of France, to repudiate his wife, Theobald's niece, and to marry Petronille of Aquitaine, sister of the queen of France. The war, which lasted two years (1142–44), was marked by the occupation of Champagne by the royal army and the capture of Vitry, where many persons perished in the burning of the church. Geoffrey the Handsome, count of Anjou, by his conquest of Normandy threatened the royal domains, and Louis VII. by a clever manœuvre threw his army on the Norman frontier and gained Gisors, one of the keys of Normandy. At his court which met in Bourges Louis declared on Christmas Day 1145 his intention of going on a crusade. St Bernard assured its popularity by his preaching at Vézelay (Easter 1146), and Louis set out from Metz in June 1147, on the overland route to Syria. The expedition was disastrous, and he regained France in 1149, overcome by the humiliation of the crusade. In the rest of his reign he showed much feebleness and poor judgment. He committed a grave political blunder in causing a council at Beaugency (on the 21st of March 1152) to annul his marriage with Eleanor of Aquitaine, under pretext of kinship, but really owing to violent quarrels during the crusade. Eleanor married Henry II. of England in the following May, and brought him the duchy of Aquitaine. Louis VII. led a half-hearted war against Henry for having married without the authorization of his suzerain; but in August 1154 gave up his rights over Aquitaine, and contented himself with an indemnity. In 1154 Louis married Constance, daughter of the king of Castile, and their daughter Marguerite he affianced imprudently by the treaty of Gisors (1158) to Henry, eldest son of the king of England, promising as dowry the Vexin and Gisors. Five weeks after the death of Constance, on the 4th of October 1160, Louis VII. married Adèle of Champagne, and Henry II. to counterbalance the aid this would give the king of France, had the marriage of their infant children celebrated at once. Louis VII. gave little sign of understanding the danger of the growing Angevin power, though in 1159 he made an expedition in the south to aid Raymond V., count of Toulouse, who had been attacked by Henry II. At the same time the emperor Frederick I. in the east was making good the imperial claims on Arles. When the schism broke out, Louis took the part of the pope Alexander III., the enemy of Frederick, and after two comedy-like failures of Frederick to meet Louis VII. at Saint Jean de Losne (on the 29th of August and the 22nd of September 1162), Louis definitely gave himself up to the cause of Alexander, who lived at Sens from 1163 to 1165. Alexander gave the king, in return for his loyal support, the golden rose. Louis VII. received Thomas Becket and tried to reconcile him with King Henry II. He supported Henry's rebellious sons, but acted slowly and feebly, and so contributed largely to the break up of the coalition (1173–1174). Finally in 1177 the pope intervened to bring the two kings to terms at Vitry. By his third wife, Adèle, Louis had an heir, the future Philip Augustus, born on the 21st of August 1165. He had him crowned at Reims in 1179, but, already stricken with paralysis, he himself was not able to be present at the ceremony, and died on the 18th of September 1180. His reign from the point of view of royal territory and military power, was a period of retrogression. Yet the royal authority had made progress in the parts of France distant from the royal domains. More direct and more frequent connexion was made with distant feudatories, a result largely due to the alliance of the clergy with the crown. Louis thus reaped the reward for services rendered the church during the least successful portion of his reign.

See R. Hirsch, *Studien zur Geschichte König Ludwigs VII. von Frankreich* (1892); A. Cartellieri, *Philipp II. August von Frankreich bis zum Tode seines Vaters, 1165–1180* (1891); and A. Luchaire in E. Lavisse's *Histoire de France*, tome iii. 1st part, pp. 1-81. (J. T. S.*)

LOUIS VIII. (1187–1226), king of France, eldest son of Philip Augustus and of Isabella of Hainaut, was born in Paris on the 5th of September 1187. Louis was short, thin, pale-faced, with studious tastes, cold and placid temper, sober and chaste in his life. He left the reputation of a saint, but was also a warrior prince. In 1213 he led the campaign against Ferrand, count of Flanders; in 1214, while Philip Augustus was winning the victory of Bouvines, he held John of England in check, and was victorious at La Roche-aux-Moines. In the autumn of 1215 Louis received from a group of English barons, headed by Geoffrey de Mandeville, a request to "pluck them out of the hand of this tyrant" (John). Some 7000 French knights were sent over to England during the winter and two more contingents followed, but it was only after twenty-four English hostages had arrived in Paris that Louis himself prepared to invade England. The expedition was forbidden by the papal legate, but Louis set out from Calais on the 20th and landed at Stonor on the 22nd of May 1216. In three months he had obtained a strong foothold in eastern England, and in the end of July he laid siege to Dover, while part of his army besieged Windsor with a view to securing the safety of London. The pretexts on which he claimed the English crown were set down in a memorandum drawn up by French lawyers in 1215. These claims—that John had forfeited the crown by the murder of his nephew, Arthur of Brittany, and that the English barons had the right to dispose of the vacant throne—lost their plausibility on the death of King John and the accession of his infant son as Henry III. in October 1216. The papal legate, Gualo, who had forbidden the enterprise, had arrived in England at the same time as Louis. He excommunicated the French troops and the English rebels, and Henry III. found a valiant defender in William Marshal, earl of Pembroke. After the "Fair of Lincoln," in which his army was defeated, Louis was compelled to resign his pretensions, though by a secret article of the treaty of Lambeth (September 1217) he secured a small war indemnity. Louis had assisted Simon de Montfort in his war against the Albigenses in 1215, and after his return to France he again joined the crusade. With Simon's son and successor, Amauri de Montfort, he directed the brutal massacre which followed the capture of Marmande. Philip II., suspicious of his son until the close of his life, took precautions to assure his obedience, narrowly watched his administration in Artois, which Louis held from his mother Isabella, and, contrary to the custom of the kings of France, did not associate his son with him by having him crowned. Philip Augustus dying on the 14th of July 1223, Louis VIII. was anointed at Reims on the 6th of August following. He surrounded himself with councillors whom his father had chosen and formed, and continued his father's policy. His reign was taken up with two great designs: to destroy the power of the Plantagenets, and to conquer the heretical south of France. An expedition conquered Poitou and Saintonge (1224); in 1226 he led the crusade against the Albigenses in the south, forced Avignon to capitulate and received the submission of Languedoc. While passing the Auvergne on his return to Paris, he was stricken with dysentery, and died at Montpensier on the 8th of

November 1226. His reign, short as it was, brought gains both to the royal domains and to the power of the crown over the feudal lords. He had married in 1200 Blanche of Castile, daughter of Alphonso IX. of Castile and granddaughter of Henry II. of England, who bore him twelve children; his eldest surviving son was his successor, Louis IX.

See C. Petit-Dutaillis, *Étude sur la vie et le règne de Louis VIII.* (Paris, 1894); and E. Lavisse, *Histoire de France*, tome iii. (1901). (M. Br.)

LOUIS IX. (1214–1270), king of France, known as Saint Louis, was born on the 25th of April 1214, and was baptized at Poissy. His father, Louis VIII., died in 1226, leaving the first minority since the accession of the Capetians, but his mother, Queen Blanche of Castile, proved more than a match for the feudal nobility. She secured her son's coronation at Reims on the 29th of November 1226; and, mainly by the aid of the papal legate, Romano Bonaventura, bishop of Porto (d. 1243), and of Thibaut IV., count of Champagne, was able to thwart the rebellious plans of Pierre Mauclerc, duke of Brittany, and Philippe Hurepel, a natural son of Philip Augustus. Mauclerc's opposition was not finally overcome, however, until 1234. Then in 1236 Thibaut, who had become king of Navarre, turned against the queen, formed an alliance with Brittany, marrying his daughter without royal consent to Jean le Roux, Mauclerc's son, and attempted to make a new feudal league. The final triumph of the regent was shown when the king's army assembled at Vincennes. His summons met with such general and prompt obedience as to awe Thibaut into submission without striking a blow. Thus the reign of Louis IX. began with royal prerogatives fully maintained; the kingdom was well under control, and Mauclerc and Thibaut were both obliged to go on crusade. But the influence of the strong-willed queen-mother continued to make itself felt to the close of her life. Louis IX. did not lack independence of character, but his confidence in his mother had been amply justified and he always acted in her presence like a child. This confidence he withheld from his wife, Margaret, daughter of Raymond Berenger, count of Provence, whom he married at Sens in May 1234. The reign was comparatively uneventful. A rising of the nobles of the south-west, stirred up by Isabella, widow of King John of England, and her husband, Hugh de Lusignan, count of the Marche, upon the occasion of the investment of Alphonse of Poitiers with the fiefs left him by Louis VIII. as a result of the Albigensian crusade, reached threatening dimensions in 1242, but the king's armies easily overran Count Hugh's territories, and defeated Henry III. of England, who had come to his aid, at Saintes. Isabella and her husband were forced to submit, and Raymond VII., count of Toulouse, yielded without resistance upon the advent of two royal armies, and accepted the peace of Lorris in January 1243. This was the last rising of the nobles in Louis's reign.

At the end of 1244, during an illness, Louis took the cross. He had already been much distressed by the plight of John of Brienne, emperor at Constantinople, and bought from him the crown of thorns, parts of the true cross, the holy lance, and the holy sponge. The Sainte Chapelle in Paris still stands as a monument to the value of these relics to the saintly king. But the quarrel between the papacy and the emperor Frederick II., in which Louis maintained a watchful neutrality—only interfering to prevent the capture of Innocent IV. at Lyons—and the difficulties of preparation, delayed the embarkation until August 1248. His defeat and capture at Mansura, in February 1250, the next four years spent in Syria in captivity, in diplomatic intrigues, and finally in raising the fortifications of Caesarea and Joppa,—these events belong to the history of the crusades (*q.v.*). His return to France was urgently needed, as Blanche of Castile, whom he had left as regent, had died in November 1252, and upon the removal of her strong hand feudal turbulence had begun to show itself.

This period between his first and second crusades (1254–1269) is the real age of Saint Louis in the history of France. He imposed peace between warring factions of his nobility by mere moral force, backed up by something like an awakened public opinion. His nobles often chafed under his unrelenting justice but never dared rebel. The most famous of his settlements was the treaty of Paris, drawn up in May 1258 and ratified in December 1259, by which the claims of Henry III. of England were adjusted. Henry renounced absolutely Normandy, Anjou, Touraine, Maine and Poitou, and received, on condition of recognizing Louis as liege suzerain, all the fiefs and domains of the king of France in the dioceses of Limoges, Cahors and Perigueux, and the expectation of Saintonge south of the Charente, and Agenais, if they should fall to the crown of France by the death of Alphonse of Poitiers. In addition, Louis promised to provide Henry with sufficient money to maintain 500 knights for two years. This treaty was very unpopular in France, since the king surrendered a large part of France that Henry had not won; but Louis was satisfied that the absolute sovereignty over the northern provinces more than equalled the loss in the south. Historians still disagree as to its wisdom. Louis made a similar compromise with the king of Aragon in the treaty of Corbeil, 1258, whereby he gave up the claims of kings of France to Roussillon and Barcelona, which went back to the conquest of Charlemagne. The king of Aragon in his turn gave up his claims to part of Provence and Languedoc, with the exception of Narbonne. Louis's position was strikingly shown in 1264 when the English barons submitted their attempt to bind Henry III. by the Provisions of Oxford to his arbitration. His reply in the "Dit" or Mise of Amiens was a flat denial of all the claims of the barons and failed to avert the civil war. Louis was more successful in preventing feuds between his own nobles: between the counts of Brittany and Champagne over the succession to Navarre; the dauphin of Vienne (Guigues VII.) and Charles of Anjou; the count of Burgundy and the count of Châlons; Henry of Luxemburg and the duke of Lorraine with the count of Bar. Upon the whole he maintained peace with his neighbours, although both Germany and England were torn with civil wars. He reluctantly consented to sanction the conquest of Naples by his brother, Charles, duke of Anjou, and it is possible that he yielded here in the belief that it was a step toward another crusade.

On the 24th of March 1267, Louis called to Paris such of his knights as were not with Charles of Anjou in Naples. No one knew why he had called them; but when the king in full assembly proclaimed his purpose of going on a second crusade, few ventured to refuse the cross. Three years of preparation followed; then on the 1st of July 1270 they sailed from Aigues Mortes for Tunis, whither the expedition seems to have been directed by the machinations of Charles of Anjou, who, it is claimed, persuaded his brother that the key to Egypt and to Jerusalem was that part of Africa which was his own most dangerous neighbour. After seventeen days' voyage to Carthage, one month of the summer's heat and plague decimated the army, and when Charles of Anjou arrived he found that Louis himself had died of the plague on the 25th of August 1270.

Saint Louis stands in history as the ideal king of the middle ages. An accomplished knight, physically strong in spite of his ascetic practices, fearless in battle, heroic in adversity, of imperious temperament, unyielding when sure of the justness of his cause, energetic and firm, he was indeed "every inch a king." Joinville says that he was taller by a head than any of his knights. His devotions would have worn out a less robust saint. He fasted much, loved sermons, regularly heard two masses a day and all the offices, dressing at midnight for matins in his chapel, and surrounded even when he travelled by priests on horseback chanting the hours. After his return from the first crusade, he wore only grey woollens in winter, dark silks in summer. He built hospitals, visited and tended the sick himself, gave charity to over a hundred beggars daily. Yet he safeguarded the royal dignity by bringing them in at the back door of the palace, and by a courtly display greater than ever before in France. His naturally cold temperament was somewhat relieved by a sense of humour, which however did not prevent his making presents of haircloth shirts to his friends. He had no favourite, nor prime minister. Louis was canonized in 1297.

As a statesman Louis IX. has left no distinct monument. The famous "*Établissements* of St Louis" has been shown in our own day to have been private compilation. It was a *coutumier* drawn up before 1273, including, as well as some royal decrees, the civil and feudal law of Anjou, Maine and the Orléanais. Recent researches have also denied Louis the credit of having aided the communes. He exploited them to the full. His standpoint in this respect was distinctly feudal. He treated his clergy as he did his barons, enforcing the supremacy of royal justice, and strongly opposing the exactions of the pope until the latter part of his reign, when he joined forces with him to extort as much as possible from the clergy. At the end of the reign most of the sees and monasteries of France were in debt to the Lombard bankers. Finally, the reign of Saint Louis saw the introduction of the pontifical inquisition into France.

There are numerous portraits of St Louis, but they are unauthentic and contradictory. In 1903 M. Salomon Reinach claimed to have found in the heads sculptured in the angles of the arches of the chapel at St Germain portraits of St Louis, his brothers and sisters, and Queen Marguerite, or Blanche, made between 1235 and 1240. This conjectured portrait somewhat resembles the modern type, which is based upon a statue of Charles V. once in the church of the Celestins in Paris, and which Lenoir mistakenly identified as that of Louis IX. The king had eleven children, six sons and five daughters, among them being his successor, Philip III., and Robert, count of Clermont, the ancestor of Henry IV.

The best contemporary accounts of Louis IX. are the famous Memoirs of the Sire Jean de Joinville (*q.v.*), published by N. de Wailly for the *Soc. de l'Hist. de France*, under the title *Histoire de Saint Louis* (Paris, 1868), and again with translation (1874); English translation by J. Hutton (1868). See also William of Nangis, *Gesta Ludovici IX.*, edited by M. Bouquet in vol. xx. of the *Recueil des historiens des Gaules et de la France*. Of modern works may be mentioned C. V. Langlois in E. Lavisse's *Histoire de France*, tome iii., with references to literature; Frederick Perry, *Saint Louis, the Most Christian King* (New York, 1901); E. J. Davis, *The Invasion of Egypt by Louis IX. of France* (1898); H. A. Wallon, *Saint Louis et son temps* (1875); A. Lecoy de la Marche, *Saint Louis* (Tours, 1891); and E. Berger, *Saint Louis et Innocent IV* (Paris, 1893), and *Histoire de Blanche de Castille* (1895). See also *The Court of a Saint*, by Winifred F. Knox (1909). (J. T. S.*)

LOUIS X. (1289–1316), king of France and Navarre, called *le Hutin* or "the Quarreller," was the son of Philip IV. and of Jeanne of Navarre. He was born at Paris on the 4th of October 1289, took the title king of Navarre on the death of his mother, on the 2nd of April 1305, and succeeded Philip IV. in France on the 29th of November 1314, being crowned at Reims in August 1315. The origin of his surname is uncertain. Louis X. is a somewhat indistinct figure among the kings of France, the preponderating influence at court during his short reign being that of his uncle, Charles of Valois. The reign began with reaction against the policy of Philip IV. Private vengeance was wreaked on Enguerrand de Marigny, who was hanged, Pierre de Latilli, bishop of Châlons and chancellor, and Raoul de Presle, advocate of the parlement, who were imprisoned. The leagues of the lesser country gentry, formed in 1314 before the accession of Louis, continued to demand the ancient privileges of the nobility,—tourneys, private wars and judgment of nobles not by king's officers but by their peers—and to protest against the direct call by the king of their vassals to the royal army. Louis X. granted them charters in which he made apparent concessions, but used evasive formulas which in reality ceded nothing. There was a charter to the Normans, one to the Burgundians, one to the Languedocians (1315). Robert de Béthune, count of Flanders, refused to do homage, and his French fiefs were declared confiscate by a court of his peers. In August 1315 Louis X. led an army toward Lille, but the flooded Lys barred his passage, the ground was so soaked with rains that the army could not advance, and it was thrown back, without a battle, on Tournai. Need of money inspired one famous ordinance of this reign; in 1315 the serfs of the royal domains were invited to buy their civil liberty,—an invitation which did not meet with great enthusiasm, as the freedman was merely freed for further exploitation, and Philip V. was obliged to renew it in 1318. Louis X. died suddenly on the 5th of June 1316. His first wife was Margaret, daughter of Robert II., duke of Burgundy; she was accused of adultery and died a prisoner in the château Gaillard. By her he had one daughter, Jeanne, wife of Philip, count of Evreux and king of Navarre. By his second wife Clémence, daughter of Charles Martel, titular king of Hungary, he left a posthumous son, King John I.

See Ch. Dufayard, "La réaction feodale sous les fils de Philippe le Bel," in *Revue historique* (1894); Paul Lehugeur, *Histoire de Philippe le Long, roi de France* (Paris, 1897); and Joseph Petit, *Charles de Valois* (Paris, 1900). (J. T. S.*)

LOUIS XI. (1423–1483), king of France, the son of Charles VII. and his queen, Marie of Anjou, was born on the 3rd of July 1423, at Bourges, where his father, then nicknamed the "King of Bourges," had taken refuge from the English. At the birth of Louis XI. part of France was in English hands; when he was five years old, Joan of Arc appeared; he was just six when his father was crowned at Reims. But his boyhood was spent apart from these stirring events, in the castle of Loches, where his father visited him rarely. John Gerson, the foremost theologian of France, wrote a manual of instructions (still extant) for the first of his tutors, Jean Majoris, a canon of Reims. His second tutor, Bernard of Armagnac, was noted for his piety and humility. If, as has been claimed, Louis owed to them any of his tendency to prefer the society of the poor, or rather of the *bourgeois*, to that of the nobility, their example was his best lesson in the craft of kingship. In June 1436, when scarcely thirteen, he was married to Margaret (*c.* 1425–1445), daughter of James I. of Scotland, a princess of about his own age, but sickly and romantic, and in every way his opposite. Three years after this unhappy marriage Louis entered upon his stormy political career. Sent by his father in 1439 to direct the defence of Languedoc against the English, and to put down the brigandage in Poitou, he was induced by the rebellious nobles to betray his trust and place himself at the head of the Praguerie (*q.v.*). Charles VII. pardoned him this rebellion, due to his ambition and the seductive proposal of the nobles to make him regent. The following year he was fighting the English, and in 1443 aided his father to suppress the revolt of the count of Armagnac. His first important command, however, was in the next year, when he led an army of from 15,000 to 20,000 mercenaries and brigands,—the product of the Hundred Years' War,—against the Swiss of the canton of Basel. The heroism of some two hundred Swiss, who for a while held thousands of the French army at bay, made a great impression on the young prince. After an ineffective siege of Basel, he made peace with the Swiss confederation, and led his robber soldiers into Alsace to ravage the country of the Habsburgs, who refused him the promised winter quarters. Meanwhile his father, making a parallel campaign in Lorraine, had assembled his first brilliant court at Nancy, and when Louis returned it was to find the king completely under the spell of Agnes Sorel. He at first made overtures to members of her party, and upon their rejection through fear of his ambition, his deadly hatred of her and of them involved the king. The death in 1445 of his wife Margaret, who was a great favourite of Charles VII., made the rupture complete. From that year until the death of the king father and son were enemies. Louis began his rebellious career by a futile attempt to seduce the cities of Agenais into treason, and then he prepared a plot to seize the king and his minister Pierre de Brézé. Antoine de Chabannes, who was to be the instrument of the plot, revealed it to Charles, and Louis was mildly punished by being sent off to Dauphiné (1447). He never saw his father again.

Louis set out to govern his principality as though it were an independent state. He dismissed the governor; he determined advantageously to himself the boundaries between his state and the territories of the duke of Savoy and of the papacy; and he enforced his authority over perhaps the most unruly nobility in western Europe, both lay and ecclesiastical. The right of private warfare was abolished; the bishops were obliged to give up most of their temporal jurisdiction, the scope of their courts was limited, and appeals to Rome were curtailed. On the other hand, Louis granted privileges to the towns and consistently used their alliance to overthrow the nobility. He watched the roads, built new ones, opened markets, protected the only bankers of the country, the Jews, and reorganized the administration so as to draw the utmost revenue possible from the prosperity thus secured. His ambition led him into foreign entanglements; he made a secret treaty with the duke of Savoy which was to give him right of way to Genoa, and made arrangements for a partition of the duchy of Milan. The alliance with Savoy was sealed by the marriage of Louis with Charlotte, daughter of Duke Lodovico, in 1452, in spite of the formal prohibition of Charles VII. The king marched south, but withdrew again leaving his son unsubdued. Four years later, as Charles came to the Bourbonnais, Louis, fearing for his life, fled to Flanders to the court of Philip the Good, duke of Burgundy, leaving Dauphiné to be definitely annexed to the crown of France. The policy of the dauphin was reversed, his ten years' work was undone. Meanwhile he was installed in the castle of Genappe, in Brabant, where he remained until the death of his father. For this he waited impatiently five years, keeping himself posted by spies of every stage of the king's last illness, and thus laying himself open to the accusation, believed in by Charles himself, that he had hastened the end by poison, a charge which modern historians deny.

On the 15th of August 1461, Louis was anointed at Reims, and Philip of Burgundy, as *doyen* of the peers of France, placed the crown on his head. For two months Philip acted as though the king were still his protégé. But in the midst of the festivities with which he was entertaining Paris, the duke found that Louis ventured to refuse his candidates for office, and on the 24th of September the new king left abruptly for Touraine. His first act was to strike at the faithful ministers of Charles VII. Pierre de Brézé and Antoine de Chabannes were captured and imprisoned, as well as men of sterling worth like Étienne Chevalier. But the king's shrewdness triumphed before long over his vengeance, and the more serviceable of the officers of Charles VII. were for the most part soon reinstated, Louis' advisers were mostly men of the middle class. He had a ready purse for men of talent, drawing them from England, Scotland, Italy, Spain and Portugal. Such a motley throng of competent men had never before been seen at the court of France. Their origin, their previous crimes or virtues, their avarice or brutality, were indifferent to him so long as they served him loyally. Torture and imprisonment awaited them, whether of high or low degree, if he fancied that they were betraying him. Among the most prominent of these men in addition to Brézé, Chevalier and Chabannes, were Tristan Lermite, Jean de Daillon, Olivier le Dain (the barber), and after 1472, Philippe de Commines, drawn from the service of Charles the Bold of Burgundy, who became his most intimate adviser and biographer. Surrounded by men like these Louis fought the last great battle of French royalty with feudalism.

Louis XI. began his reign with the same high-handed treatment of the nobles which had marked his rule in Dauphiné, going so far as to forbid them to hunt without his permission. He forced the clergy to pay long-neglected feudal dues, and intrigued against the great houses of Anjou and Orleans in Italy. The malcontent nobles soon began to plan revolt. Discharged officers of Charles VII. like Jean Dunois and John II. duke of Bourbon, stirred up hostility to the new men of the king, and Francis II. duke of Brittany was soon embroiled with Louis over an attempt to assert royal control over that practically independent duchy. The dissatisfied nobility found their greatest ally in Charles the Bold, afterwards duke of Burgundy, and in 1465 formed a "league of public welfare" and declared war on their king. The nominal head was the king's brother Charles, duke of Berry, then eighteen years old, a weak character, the tool of the rebels as he was later the dupe of the king. Every great noble in France was in the league, except Gaston de Foix—who kept the south of France for the king,—and the counts of Vendôme and Eu. The whole country seemed on the verge of anarchy. It was saved by the refusal of the lesser gentry to rise, and by the alliance of the king with the citizen class, which was not led astray by the pretences of regard for the public weal which cloaked the designs of the leaguers. After a successful campaign in the Bourbonnais, Louis fought an indecisive battle with the Burgundians who had marched on Paris at Montlhéry, on the 16th of July 1465, and then stood a short siege in Paris. On the 28th of September he made a truce with Charles the Bold, and in October the treaties of Conflans and Saint Maur-les-Fossés, ended the war. The king yielded at all points; gave up the "Somme towns" in Picardy, for which he had paid 200,000 gold crowns, to Philip the Good, thus bringing the Burgundians close to Paris and to Normandy. Charles, the king's brother, was given Normandy as an apanage, thus joining the territories of the rebellious duke of Brittany with those of Charles the Bold. The public weal was no longer talked about, while the kingdom was plundered both by royal tax gatherers and by unsubdued feudal lords to pay the cost of the war.

After this failure Louis set to work to repair his mistakes. The duke of Bourbon was won over by the gift of the government of the centre of France, and Dunois and Chabannes by restoring them their estates. Two months after he had granted Normandy to Charles, he took advantage of a quarrel between the duke of Brittany and his brother to take it again, sending the duke of Bourbon "to aid" Charles, while Dunois and Chabannes prepared for the struggle with Burgundy. The death of Duke Philip, on the 15th of June 1467, gave Charles the Bold a free hand. He gained over Edward IV. of England, whose sister Margaret he married; but while he was celebrating the wedding Louis invaded Brittany and detached Duke Francis from alliance with him. Normandy was completely reduced. The king had won a great triumph. It was followed by his greatest mistake. Eager as he always was to try diplomacy instead of war, Louis sent a gift of 60,000 golden crowns to Charles and secured a safe conduct from him for an interview. The interview took place on the 9th of October 1468 at Péronne. News came on the 11th that, instigated by the king of France, the people of Liége had massacred their bishop and the ducal governor. The news was false, but Charles, furious at such apparent duplicity, took Louis prisoner, only releasing him, three days later, on the king signing a treaty which granted Flanders freedom from interference from the parlement of Paris, and agreeing to accompany Charles to the siege of his own ally, Liége. Louis made light of the whole incident in his letters, but it marked the greatest humiliation of his life, and he was only too glad to find a scapegoat in Cardinal Jean Balue, who was accused of having plotted the treason of Péronne. Balue thereupon joined Guillaume de Harancourt, bishop of Verdun, in an intrigue to induce Charles of France to demand Champagne and Brie in accordance with the king's promise to Charles the Bold, instead of distant Guienne where the king was determined to place him. The discovery of this conspiracy placed these two high dignitaries in prison (April 1469). Balue (*q.v.*) spent eleven years in prison quarters, comfortable enough, in spite of the legend to the contrary, while Harancourt was shut up in an iron cage until 1482. Then Louis, inducing his brother to accept Guienne,—where, surrounded by faithful royal officers, he was harmless for the time being,—undertook to play off the Lancastrians against Edward IV. who, as the ally of Charles the Bold, was menacing the coast of Normandy. Warwick, the king-maker, and Queen Margaret were aided in the expedition which in 1470 again placed Henry VI. upon the English throne. In the autumn Louis himself took the offensive, and royal troops overran Picardy and the Maconnais to Burgundy itself. But the tide turned against Louis in 1471. While Edward IV. won back England by the battles of Barnet and Tewkesbury, Charles the Bold besieged Amiens, and Louis was glad to make a truce, availing himself of the double dealing of the constable, the count of Saint Pol, who, trying to win an independent position for himself in Picardy, refused his aid to Charles unless he would definitely join the French nobility in another rising against the king. This rising was to be aided by the invasion of France by John II. of Aragon, Yolande, duchess of Savoy, and Edward IV.

of England, who was to be given the old Plantagenet inheritance. The country was saved a desperate civil war by the death of the king's brother, Charles, the nominal head of the coalition, on the 24th of May 1472. Louis' joy on receiving news of this death knew no bounds. Charles the Bold, who had again invaded France, failed to take Beauvais, and was obliged to make a lasting truce. His projects were henceforth to be directed towards Germany. Louis then forced the duke of Brittany to make peace, and turned against John V. count of Armagnac, whose death at the opening of March 1473 ended the power of one of the most dangerous houses of the south. The first period of Louis' reign was closed, and with it closed for ever the danger of dismemberment of France. John of Aragon continued the war in Roussillon and Cerdagne, which Louis had seized ten years before, and a most desperate rising of the inhabitants protracted the struggle for two years. After the capture of Perpignan on the 10th of March 1475, the wise and temperate government of Imbert de Batarnay and Boffile de Juge slowly pacified the new provinces. The death of Gaston IV. count of Foix in 1472 opened up the long diplomatic struggle for Navarre, which was destined to pass to the loyal family of Albret shortly after the death of Louis. His policy had won the line of the Pyrenees for France.

The overthrow of Charles the Bold was the second great task of Louis XI. This he accomplished by a policy much like that of Pitt against Napoleon. Louis was the soul of all hostile coalitions, especially urging on the Swiss and Sigismund of Austria, who ruled Tirol and Alsace. Charles's ally, Edward IV., invaded France in June 1475, but Louis bought him off on the 29th of August at Picquigny—where the two sovereigns met on a bridge over the Somme, with a strong grille between them, Edward receiving 75,000 crowns, and a promise of a pension of 50,000 crowns annually. The dauphin Charles was to marry Edward's daughter. Bribery of the English ministers was not spared, and in September the invaders recrossed to England. The count of Saint Pol, who had continued to play his double part, was surrendered by Charles to Louis, and executed, as was also Jacques d'Armagnac, duke of Nemours. With his vassals terrorized and subdued, Louis continued to subsidize the Swiss and René II. of Lorraine in their war upon Charles. The defeat and death of the duke of Burgundy at Nancy on the 5th of January 1477 was the crowning triumph of Louis' diplomacy. But in his eagerness to seize the whole inheritance of his rival, Louis drove his daughter and heiress, Mary of Burgundy, into marriage with Maximilian of Austria (afterwards the emperor Maximilian I.), who successfully defended Flanders after a savage raid by Antoine de Chabannes. The battle of Guinegate on the 7th of August 1479 was indecisive, and definite peace was not established until after the death of Mary, when by the treaty of Arras (1482) Louis received Picardy, Artois and the Boulonnais, as well as the duchy of Burgundy and Franche Comté. The Austrians were left in Flanders, a menace and a danger. Louis failed here and in Spain; this failure being an indirect cause of that vast family compact which surrounded France later with the empire of Charles V. His interference in Spain had made both John II. of Aragon and Henry IV. of Castile his enemies, and so he was unable to prevent the marriage of their heirs, Ferdinand and Isabella. But the results of these marriages could not be foreseen, and the unification of France proved of more value than the possession of so wide-spread an empire. This unification was completed (except for Brittany) and the frontiers enlarged by the acquisition, upon the death of René of Anjou in 1480, of the duchies of Anjou and Bar, and in 1481 of Maine and Provence upon the death of Charles II., count of Maine. Of the inheritance of the house of Anjou only Lorraine escaped the king.

Failure in Spain was compensated for in Italy. Without waging war Louis made himself virtual arbiter of the fate of the principalities in the north, and his court was always besieged by ambassadors from them. After the death of Charles the Bold, Yolande, duchess of Savoy, was obliged to accept the control of Louis, who was her brother. In Milan he helped to place Lodovico il Moro in power in 1479, but he reaped less from this supple tyrant than he had expected. Pope Sixtus IV. the enemy of the Medici, was also the enemy of the king of France. Louis, who at the opening of his reign had denounced the Pragmatic Sanction of 1438, had played fast and loose with the papacy. When Sixtus threatened Florence after the Pazzi conspiracy, 1478, Louis aided Lorenzo dei Medici to form an alliance with Naples, which forced the papacy to come to terms.

More than any other king of France, Louis XI. was a "bourgeois king." The upper bourgeois, the aristocracy of his "good cities," were his allies both against the nobles and against the artisan class, whenever they revolted, driven to desperation by the oppressive royal taxes which furnished the money for his wars or diplomacy. He ruled like a modern capitalist; placed his bribes like investments in the courts of his enemies; and, while draining the land of enormous sums, was pitiless toward the two productive portions of his realm, the country population and the artisans. His heartlessness toward the former provoked even an accomplice like Commines to protest. The latter were kept down by numerous edicts, tending to restrict to certain privileged families the rank of master workman in the gilds. There was the paternalism of a Frederick the Great in his encouragement of the silk industry,—"which all idle people ought to be made to work at,"—in his encouragement of commerce through the newly acquired port of Marseilles and the opening up of market placed. He even dreamed of a great trading company "of two hundred thousand livres or more," to monopolize the trade of the Mediterranean, and planned to unify the various systems of weights and measures. In 1479 he called a meeting of two burgesses from each "good city" of his realm to consider means for preventing the influx of foreign coin. Impatient of all restraint upon his personal rule, he was continually in violent dispute with the parlement of Paris, and made "justice" another name for arbitrary government; yet he dreamed of a unification of the local customary laws (*coûtumes*) of France. He was the perfect model of a tyrant. The states-general met but once in his reign, in 1468, and then no talk of grievances was allowed; his object was only to get them to declare Normandy inalienable from the crown. They were informed that the king could raise his revenue without consulting them. Yet his budgets were enormously greater than ever before. In 1481 the *taille* alone brought in 4,600,000 livres, and even at the peaceful close of his reign his whole budget was 4,655,000 livres—as against 1,800,000 livres at the close of his father's reign.

The king who did most for French royalty would have made a sorry figure at the court of a Louis XIV. He was ungainly, with rickety legs. His eyes were keen and piercing, but a long hooked nose lent grotesqueness to a face marked with cunning rather than with dignity. Its ugliness was emphasized by the old felt hat which he wore,—its sole ornament the leaden figure of a saint. Until the close of his life, when he tried to mislead ambassadors as to the state of his health by gorgeous robes, he wore the meanest clothes. Dressed in grey like a pilgrim, and accompanied by five or six trustworthy servants, he would set out on his interminable travels, "ambling along on a good mule." Thus he traversed France, avoiding all ceremony, entering towns by back streets, receiving ambassadors in wayside huts, dining in public houses, enjoying the loose manners and language of his associates, and incidentally learning at first hand the condition of his people and the possibilities of using or taxing them—his needs of them rather than theirs of him. He loved to win men, especially those of the middle class, by affability and familiarity, employing all his arts to cajole and seduce those whom he needed. Yet his honied words easily turned to gall. He talked rapidly and much, sometimes for hours at a time, and most indiscreetly. He was not an agreeable companion, violent in his passions, nervous, restless, and in old age extremely irascible. Utterly unscrupulous, and without a trace of pity, he treated men like pawns, and was content only with absolute obedience.

But this Machiavellian prince was the genuine son of St Louis.

His religiosity was genuine if degenerate. He lavished presents on influential saints, built shrines, sent gifts to churches, went on frequent pilgrimages and spent much time in prayer—employing his consummate diplomacy to win celestial allies, and rewarding them richly when their aid secured him any advantage. St Martin of Tours received 1200 crowns after the capture of Perpignan. He tried to bribe the saints of his enemies, as he did their ministers. An unfaltering faith taught him the value of religion—as a branch of politics. Finally, more in the spirit of orthodoxy, he used the same arts to make sure of heaven. When the ring of St Zanobius and the blood of Cape Verde turtles gave him no relief from his last illness, he showered gifts upon his patron saints, secured for his own benefit the masses of his clergy, and the most potent prayers in Christendom, those of the two most effective saints of his day, Bernardin of Doulins and Francis of Paola.

During the last two or three years of his life Louis lived in great isolation, "seeing no one, speaking with no one, except such as he commanded," in the château of Plessis-les-Tours, that "spider's nest" bristling with watch towers, and guarded only by the most trusty servitors. A swarm of astrologers and physicians preyed upon his fears—and his purse. But, however foolish in his credulity, he still made his strong hand felt both in France and in Italy, remaining to the last "the terrible king." His fervent prayers were interrupted by instructions for the regency which was to follow. He died on the 30th of August 1483, and was buried, according to his own wish, without royal state, in the church at Cléry, instead of at St Denis. He left a son, his successor, Charles VIII., and two daughters.

See the admirable résumé by Charles Petit-Dutaillis in Lavisse's *Histoire de France*, tome iv. pt. ii. (1902), and bibliographical indications given there. Michelet's wonderful depiction in his *Histoire de France* (livres 13 to 17) has never been surpassed for graphic word-painting, but it is inaccurate in details, and superseded in scholarship. Of the original sources for the reign the *Lettres de Louis XI.* (edited by Charavay and Vaesen, 8 vols., 1883–1902), the celebrated *Mémoires* of Philippe de Commines and the *Journal* of Jean de Royl naturally come first. The great mass of literature on the period is analysed in masterly fashion by A. Molinier, *Sources de l'histoire de France* (tome v. pp. 1-146), and to this exhaustive bibliography the reader is referred for further research. See also C. Hare, *The Life of Louis XI.* (London, 1907). (J. T. S.*)

LOUIS XII. (1462–1515), king of France, was grandson of Louis of Orleans, the brother of Charles VI., and son of the poet prince, Charles of Orleans, who, after the battle of Agincourt, spent twenty-five years of captivity in England. Louis was duke of Orleans until his accession to the throne, and he was fourteen years old when Louis XI. gave him the hand of his second daughter, Joan the Lame. In the first years of the reign of Charles VIII., Louis made a determined stand against the government of the Beaujeus, stirred up coalitions of the feudal nobles against them, and was finally defeated and taken prisoner at St Aubin du Cormier in 1488. Charles VIII. set him at liberty in 1491. These successive checks tamed him a little. In the Italian expedition of 1494 he commanded the vanguard of the royal army, occupied Genoa, and remained in the north of Italy, menacing Milan, on which he was already dreaming of asserting his rights. The children of Charles VIII. having died in infancy, he became heir-presumptive to the throne, and succeeded Charles in 1499. Louis was then thirty-six years old, but he seems to have grown old prematurely. He was fragile, narrow-shouldered and of a sickly constitution. His intelligence was mediocre, his character weak, and he allowed himself to be dominated by his wife, Anne of Brittany, and his favourite the Cardinal d'Amboise. He was a good king, full of moderation and humanity, and bent upon maintaining order and improving the administration of justice. He enjoyed a genuine popularity, and in 1506 the estates of Tours conferred on him the surname of *Père du Peuple*. His foreign policy, which was directed wholly towards Italy, was for the most part unskilful; to his claims on Naples he added those on Milan, which he based on the marriage of his grandfather, Louis of Orleans, with Valentina Visconti. He led in person several armies into Italy, and proved as severe and pitiless towards his enemies as he was gentle and clement towards his subjects. Louis had no children. After his accession he had divorced his virtuous and ill-favoured queen, Joan, and had married, in 1499, Anne of Brittany, the widow of Charles VIII. On her death in January 1514, in order to detach England from the alliance against him, he married on the 9th of October 1514, Mary Tudor, sister of Henry VIII. of England (see MARY, queen of France). He died on the 1st of January 1515.

For a bibliography of the printed sources see Henri Hauser, *Les Sources de l'histoire de France, XVI^{e} siècle*, vol. 1. (Paris, 1906). The principal secondary authorities are De Maulde, *Histoire de Louis XII.* (Paris, 1889–1893); Le Roux de Lincy, *Vie de la reine Anne de Bretagne* (Paris, 1860); H. Lemonnier, *Les Guerres d'Italie* (Paris, 1903) in the *Histoire de France* by E. Lavisse. (J. I.)

LOUIS XIII. (1601–1643), king of France, was the son of Henry IV. and of Marie de' Medici. He became king on his father's assassination in 1610; but his mother at once seized the full powers of regent. She determined to reverse the policy of her husband and to bring France into alliance with Spain and the Austrian house, upon which power Henry had been meditating an attack at the time of his death. Two marriages were designed to cement this alliance. Louis was to marry Anne of Austria, daughter of the Spanish king, Philip III., and the Spanish prince, afterwards Philip IV., himself was to marry the Princess Elizabeth, the king's sister. Notwithstanding the opposition of the Protestants and nobles of France, the queen carried through her purpose and the marriages were concluded in 1615. The next years were full of civil war and political intrigue, during which the queen relied upon the Marshal d'Ancre. Louis XIII. was a backward boy, and his education had been much neglected. We have the fullest details of his private life, and yet his character remains something of a mystery. He was fond of field sports and seemed to acquiesce in his mother's occupation of power and in the rule of her favourites. But throughout his life he concealed his purposes even from his closest friends; sometimes it seems as if he were hardly conscious of them himself. In 1617 he was much attached to Charles d'Albert, sieur de Luynes; and with his help he arrested Marshal d'Ancre, and on his resistance had him assassinated. From this time to her death the relation between the king and his mother was one of concealed or open hostility. The article on FRANCE must be consulted for the intricate events of the following years.

The decisive incident for his private life as well as for his reign was the entrance of Cardinal Richelieu, hitherto the queen's chief adviser, into the king's council in 1624. Henceforth the policy of France was directed by Richelieu, who took up in its main features the system of Protestant alliances and opposition to the power of Austria and Spain, which had been begun by Henry IV. and had been interrupted by the queen-mother during the regency; while he asserted the power of the crown against all rivals at home. This policy had remarkable results for the king's private life. It not only brought him into unremitting conflict with the Protestants and the nobles of France, but also made him the enemy of his mother, of his brother Gaston of Orleans, who made himself the champion of the cause of the nobles, and sometimes even of his wife. It is not easy to define his relations to Richelieu. He was convinced of his loyalty and of his genius, and in the end always supported his policy. But he disliked the friction with his family circle which this policy produced. In the difficulty with which he expressed himself and in a certain indecision of character the king was curiously unlike his father, the frank and impetuous Henry of Navarre, and his absolute son Louis XIV. He took a great interest in all the externals of war. He was present, and is said to have played an important part at the passage of Susa in 1629, and also eagerly participated in the siege of Rochelle, which surrendered in the same year. But for the most part his share in the great events of the reign was a passive one. The one all-important fact was that he supported his great minister. There were certain occasions when it seemed as if that support would be denied. The chief of these was what is known as the "Day of Dupes" (1630). Then the queen-mother and the king's brother passionately attacked the minister, and for a moment it was believed that Richelieu was dismissed and that the queen-mother and a Spanish policy had triumphed. But the sequel only strengthened the power of the minister. He regained his ascendancy over the king, punished his enemies and forced Marie de' Medici and Gaston of Orleans to sue for pardon. In 1631 Gaston fled to Lorraine and the queen-mother to Brussels. Gaston soon returned, to plot, to fail and to sue for pardon again and again; but Marie de'Medici ended her life in exile.

Richelieu's position was much strengthened by these incidents, but to the end of life he had to struggle against conspiracies which were designed to deprive him of the king's support, and usually Gaston of Orleans had some share in these movements. In 1632 the duke of Montmorency's conspiracy brought its leader to the scaffold. But the last great effort to overthrow Richelieu was closely connected with the king. Louis XIII. had from the beginning of his reign had favourites—young men for the most part with whom he lived freely and intimately and spoke of public affairs lightly and unreservedly; and who in consequence often exaggerated their influence over him. Henri d'Effiat, marquis de Cinq-Mars, was the last of these favourites. The king is said to have allowed him to speak hostilely of Richelieu and even to recall the assassination of Marshal d'Ancre. Cinq-Mars believed himself secure of the king's favour. He entered into negotiations with Spain and was secretly supported by Gaston of Orleans. But Richelieu discovered his treasonous relations with Spain and by this means defeated his plot. Louis was reconciled to his minister. "We have lived too long together to be separated" he is reported to have said (September 1642). Yet when Richelieu died in December of the same year he allowed himself to speak of him in a jealous and satirical tone. He died himself a few months later (May 1643).

His nature was timid, lethargic and melancholy, and his court was not marked by the scandals which had been seen under Henry IV. Yet Mademoiselle de la Fayette and Madame d'Hautefort and others are said to have been his mistresses. His brother Gaston survived him, but gave unexpectedly little trouble during the wars of the Fronde which ensued on the death of Louis XIII.

The chief source of information on Louis XIII.'s life is to be found in the contemporary memoirs, of which the chief are: Bassompierre, Fontenay-Mareuil, Gaston d'Orléans, Montrésor, Omer Talon. Richelieu's own Memoirs are chiefly concerned with politics and diplomacy. Of modern works those most directly bearing on the king's personal life are R. de Beauchamp, *Louis XIII. d'après sa correspondance avec le cardinal de Richelieu*; G. Hanotaux, *Histoire du cardinal de Richelieu* (1893–1896); Rossignol, *Louis XIII. avant Richelieu*; M. Topin, *Louis XIII. et Richelieu* (1876). See too Professor R. Lodge, *Richelieu*; J. B. H. R. Capefigue, *Richelieu, Mazarin et la Fronde* (1835–1836); and Dr J. H. Bridges, *Richelieu, Mazarin and Colbert* (1866).

For full bibliography see G. Monod, *Bibliographie de l'histoire de France*; *Cambridge Modern History*, vol. iv. ("The Thirty Years' War"); Lavisse et Rambaud, *Histoire générale*, vol. v. ("Guerres de religion"). (A. J. G.*)

LOUIS XIV. (1638–1715), king of France, was born at Saint-Germain-en-Laye on the 5th of September 1638. His father, Louis XIII., had married Anne of Austria, daughter of Philip III., king of Spain, in 1615, but for twenty years the marriage had remained without issue. The childlessness of the king was a constant threat to the policy of his great minister Richelieu; for the king's brother and heir, Gaston of Orleans, was a determined opponent of that policy. The birth of the prince who was destined to reign as Louis XIV. was therefore hailed as a triumph, not less important than any of those won by diplomacy or arms. The death of his father made Louis XIV. king on the 14th of May 1643, but he had to wait sixteen years before he began to rule. Power lay for some time in the hands of the queen-mother and in those of her minister, Cardinal Mazarin, who found it difficult to maintain the power of the throne and the integrity of French territory during the domestic troubles of the Fronde and the last stages of the Thirty Year's War. The minister was hated as a foreigner, and the childhood of the king weakened the royal authority. Twice the court had to flee from Paris; once when there was a rumour of intended flight the populace was admitted to see the king in his bed. The memory of these humiliations played their part in developing later the autocratic ideas of Louis. Mazarin, in spite of all disadvantages, triumphed alike over his domestic and his foreign opponents. The Fronde was at an end by 1653; the peace of Westphalia (1648) and the peace of the Pyrenees (1659) marked the success of the arms and of the diplomacy of France. Louis XIV. was now twenty-one years of age and was anxious to rule as well as to reign. The peace of the Pyrenees was a decisive event in his personal history as well as in that of France, for one of its most important stipulations referred to his marriage. He had already been strongly attracted to one of the nieces of Mazarin, but reasons of state triumphed over personal impulse; and it was agreed that the new friendship with Spain should be cemented by the marriage of Louis to his cousin, the Infanta Maria Theresa. A large dowry was stipulated for; and in consideration of this the king promised to forgo all claims that his wife might otherwise possess to the Spanish crown or any part of its territories. The dowry was never paid, and the king held himself free of his promise.

The marriage took place at once, and the king entered Paris in triumph in 1660. Mazarin died in the next year; but so strong was the feeling that the kings of France could only rule through a first minister that it was generally expected that Mazarin would soon have a successor. The king, however, at once announced his intention of being his own first minister; and from this resolution he never swerved. Whatever great qualities he may have lacked he certainly possessed industry and patience in the highest degree. He built up a thoroughly personal system of government, and presided constantly over the council and many of its committees. He was fond of gaiety and of sport; but neither ever turned him away from the punctual and laborious discharge of his royal duties. Even the greatest of his ministers found themselves controlled by the king. Fouquet, the finance minister, had accumulated enormous wealth during the late disturbances, and seemed to possess power and ambition too great for a subject. Louis XIV. found it necessary almost to conspire against him; he was overthrown and condemned to perpetual imprisonment. Those who had most of the king's confidence afterwards were Colbert for home affairs; Lionne for diplomacy; Louvois for war; but as his reign proceeded he became more self-confident and more intolerant of independence of judgment in his ministers.

His court was from the first one of great brilliance. In art and in literature, the great period, which is usually called by the king's name, had in some respects passed its zenith when he began to reign. But France was unquestionably the first state in Europe both in arms and arts, and within France the authority of the king was practically undisputed. The nation, proud of its pre-eminence and weary of civil war, saw in the king its true representative and the guarantee of its unity and success. Louis was singularly well fitted by his physical and intellectual gifts for the rôle of *Grand Monarque* and he played it to perfection. His wife Maria Theresa bore him children but there was no community of tastes between them, and the chief influence at court is to be found not in the queen but in the succession of avowed mistresses. Mademoiselle de la Vallière held the position from 1662 to 1670; she was then ousted by Madame de Montespan, who had fiercely intrigued for it, and whose proud and ambitious temper offered a great contrast to her rival. She held her position from 1670 to 1679 and then gave place to the still more famous Madame de Maintenon, who ruled, however, not as mistress but as wife. The events that brought about this incident form the strangest episode in the king's private life. Madame de Maintenon was the widow of the dramatist Scarron, and first came into relationship with the king as governess to his illegitimate children. She was a woman of unstained life and strongly religious temperament; and it was by this that she gained so great an influence over the king. Through her influence the king was reconciled to his wife, and, when Maria Theresa died in 1683, Madame de Maintenon shortly afterwards (in 1684) became the king's wife, though this was never officially declared. Under her influence the court lost most of its gaiety, and religion came to exercise much control over the life and the policy of the king.

The first years of the king's rule were marked by the great schemes of Colbert for the financial, commercial, industrial and naval reorganization of France, and in these schemes Louis took a deep interest. But in 1667 began the long series of wars, which lasted with little real intermission to the end of the reign (see FRANCE). In the steps that led to these wars and in their conduct the egotistic ambition and the vanity of the king played an important part; though he never showed real military skill and took no share in any military operations except in certain sieges. The War of Devolution (or the Queen's War) in 1667–68 to enforce the queen's claim to certain districts in the Spanish Netherlands, led to the Dutch War (1672–78), and in both these wars the supremacy of the French armies was clearly apparent. The next decade (1678–1688) was the real turning-point in the history of the reign, and the strength of France was seriously diminished. The chief cause of this is to be found in the revocation of the Edict of Nantes. The church had always opposed this settlement and had succeeded in altering it in many points. Now the new religious zeal and the autocratic temper of Louis XIV. came to the support of the church. The French Huguenots found their privileges decreased, and then, in 1685, the edict was altogether withdrawn. The results were ruinous to France. It was not only that she lost many thousands of her best citizens, but this blow against Protestantism deprived her of those Protestant alliances in Europe which had been in the past her great diplomatic support. Then the English Revolution came in 1688 and changed England from a wavering ally into the most determined of the enemies of France.

The war with the Grand Alliance, of which King William III. was the heart and soul, lasted from 1688 to 1697; and the treaty of Ryswick, which brought it to an end, deprived France of certain territories on her frontier. But Louis saw in the Spanish question a chance of more than making up for this loss. The Spanish king Charles II. was dying, and the future of the possessions of Spain was doubtful. The astute diplomacy of Louis succeeded in winning the inheritance for his grandson Philip. But this involved France and Europe in an immense war (1700) and by the peace of Utrecht (1713), though the French prince retained the Spanish crown, France had again to make concessions of territory.

Louis XIV. had shown wonderful tenacity of purpose during this disastrous war, and sometimes a nobler and more national spirit than during the years of his triumphs. But the condition of France was terrible. She was burdened with debt; the reforms of Colbert were ruined; and opposition to the king's régime began to make itself felt. Peace brought some relief to France, but the last years of the king's life were gloomy in the extreme. His numerous descendants seemed at one time to place the succession beyond all difficulty. But his eldest son, the dauphin, died in April 1711; his eldest grandson the duke of Burgundy in February 1712; and his great-grandson the duke of Brittany in March 1712. The heir to the throne was now the duke of Burgundy's son, the duke of Anjou, afterwards Louis XV. The king died on the 1st of September 1715, after the longest recorded reign in European history. The judgment of posterity has not repeated the flattering verdict of his contemporaries; but he remains the model of a great king in all that concerns the externals of kingship.

The reign of Louis XIV. is particularly rich in memoirs describing the life of the court. The chief are Madame de Motteville's memoirs for the period of the Fronde, and the letters of Madame de Sévigné and the memoirs of Saint-Simon for the later period. The king's ideas are best seen in the *Mémoires de Louis XIV. pour l'instruction du dauphin* (edited by Dreyss, 2 vols.). His private life is revealed in the letters of Madame de Maintenon and in those of Madame, Duchesse d'Orléans. Of the ordinary historians of France Michelet is fullest on the private life of the king. Mention may also be made of Voltaire, *Siècle de Louis XIV.*; P. Clément, *Histoire de la vie et de l'administration de Colbert*; Sainte-Beuve, *Causeries de lundi*. Full bibliographies of the reign will be found in G. Monod's *Bibliographie de l'histoire de France*; vol. v. ("The Age of Louis XIV.") of the *Cambridge Modern History*; and vol. vi. ("Louis XIV.") of the *Histoire générale* of Lavisse and Rambaud. (A. J. G.*)

LOUIS XV. (1710–1774), king of France, was the great-grandson of Louis XIV. and the third son of Louis, duke of Burgundy, and Marie Adelaide, princess of Savoy. The first son had died in 1705, and in 1712 the second son, the duke of Brittany, as well as his father and mother, was carried off by a mysterious disease. Louis was thus unexpectedly brought into the line of the succession, and was only five years old when Louis XIV. died. The dead king had endeavoured by his will to control the administration even after his death by a carefully selected council of regency, in which the duke of Orleans should have only the nominal presidency; but with the help of the parlement of Paris the arrangement was at once set aside, and the duke was declared regent with full traditional powers. The duke had capacity, but his life was so licentious that what influence he had upon the king was for evil. Fleury, bishop of Fréjus, was appointed his tutor, and the little king was sincerely attached to him. The king attained his legal majority at the age of thirteen, shortly before the death of the duke of Orleans. His first minister was the incapable duke of Bourbon, who in 1725 procured the repudiation of the Spanish princess, to whom the king had been betrothed, and his marriage to Maria Leszczynska, daughter of the exiled king of Poland, then resident in Alsace. In 1726 the duke of Bourbon was displaced by the king's tutor, Bishop (afterwards Cardinal) Fleury, who exercised almost absolute power, for the king took little interest in affairs of state. His administration was successful and peaceful until the year 1734, when a disputed succession in Poland brought about the interference of France on behalf of the queen's father. France was unsuccessful in her immediate object, but at the peace of Vienna (1735) secured the possession of Lorraine. Up to this point the reign had been prosperous; but from this time on it is a record of declining national strength, which was not compensated by some days of military glory. Fleury's great age (he died still in office at the age of ninety) prevented him from really controlling the policy of France and of Europe. In 1740 the war of the Austrian Succession broke out and France drifted into it as an ally of Frederick of Prussia and the enemy of England, and of Maria Theresa of Austria.

On Fleury's death in 1743 no one took his place, and the king professed to adopt the example of Louis XIV. and to establish a personal autocracy. But he was not strong enough in will or intellect to give unity to the administration. The marquis d'Argenson writes that at the council table Louis "opened his mouth, said little and thought not at all," and again that "under the appearance of personal monarchy it was really anarchy that reigned." He had followed too in his domestic life the example of his predecessors. The queen for some time seems to have secured his affections, and she bore him seven children. But soon we hear of the royal mistresses. The first to acquire notoriety was the duchess of Châteauroux, the third sister of one family who held this position. She was at least in part the cause of the only moment of popularity which the king enjoyed. She urged him to take part personally in the war. France had just received a humiliating check at Dettingen, and the invasion of the north-eastern frontier was feared. The king went to Metz in 1744, and his presence there did something to ward off the danger. While the nation felt genuine gratitude for his energy and its success, he was reported to have fallen dangerously ill. The king, of whom it was said that the fear of hell was the only part of religion which had any reality for him, now dismissed the duchess of Châteauroux and promised amendment. Prayers were offered everywhere for his recovery, and the country was swept by a delirium of loyal enthusiasm, which conferred on him the title of *Louis le bien aimé*. But his future life disappointed all these hopes. The duchess of Châteauroux died in the same year, but her place was taken in 1745 by Madame de Pompadour. This woman had philanthropic impulses and some real interest in art and letters; but her influence on public affairs was a fatal one. She had many rivals during her lifetime and on her death in 1764 she was succeeded by Madame du Barry (*q.v.*). But the mention of these three women gives no idea of the degradation of the king's life. There has doubtless been exaggeration as to certain details, and the story of his seraglio at the *Parc aux cerfs* is largely apocryphal. But it would be difficult to mention the name of any European king whose private life shows such a record of vulgar vice unredeemed by higher aims of any kind. He was not without ambition, but without sufficient tenacity of purpose to come near to realizing it. To the last he maintained the pretence of personal rule, but the machinery of government fell out of gear, and the disorder of the finances was never remedied before the revolution of 1789.

The peace of Aix-la-Chapelle (1748), which ended the war of the Austrian Succession, brought no gains to France in spite of her victories at Fontenoy and Raucoux; and the king was blamed for the diplomatic failure. The interval between this war and the Seven Years' War (1756) saw that great reversal of alliances which is sometimes called the "Diplomatic Revolution"; whereby France repudiated the alliance of Frederick the Great and joined hands with her old enemy Austria. The intrigues of Madame de Pompadour played in this change an important though not a decisive part. It was the cause of immense disasters to France; for after a promising beginning, both by land and sea, France suffered reverses which lost her both India and Canada and deprived her of the leading position which she had so long held in Europe. Her humiliation was declared by the peace of Paris (1763).

The article on the history of France (*q.v.*) shows how there arose during the last years of Louis XV.'s reign a strong reaction against the monarchy and its methods. Military success had given it its strength; and its prestige was ruined by military failure. In the parlements, provincial and Parisian; in religion and in literature, a note of opposition is struck which was never to die until the monarchy was overthrown. France annexed Corsica in 1768, but this was felt to be the work of the minister Chauvelin, and reflected no credit on the king. He died in 1774 of smallpox. If the reign of his predecessor shows us almost the ideal of personal monarchy we may see in that of Louis XV. all the vices and errors exemplified which lie in wait for absolute hereditary rule which has survived the period of its usefulness.

For the king's life generally see the memoirs of Saint-Simon, d'Argenson, Villars and Barbier, and for the details of his private life E. Boutaric, *Correspondance secrète de Louis XV.*; Madame de Pompadour's *Correspondance* published by P. Malassi; Dietric, *Les Maîtresses de Louis XV.*; and Fleury, *Louis XV. intimes et les petites maîtresses* (1909).

For the system of secret diplomacy and organized espionage, known as the *Secret du roi*, carried on under the auspices of Louis XV., see Albert duc de Broglie, *Le Secret du roi*. *Correspondance secrète de Louis XV. avec ses agents diplomatiques 1752–1774* (Paris, 1878); and for a general account of the reign, H. Carré, *La France sous Louis XV.* (Paris, 1891). For other works, general and special, see G. Monod, *Bibliographie de la France*, and the bibliography in the *Histoire générale* of Lavisse and Rambaud, vol. vii., and the *Cambridge Modern History*, vol. vi. (A. J. G.*)

LOUIS XVI. (1754–1793), king of France, was the son of Louis, dauphin of France, the son of Louis XV., and of Marie Joseph of Saxony, and was born at Versailles on the 23rd of August 1754, being baptized as Louis Augustus. His father's death in 1765 made him heir to the throne, and in 1770 he was married to Marie Antoinette, daughter of the empress Maria Theresa. He was just twenty years old when the death of Louis XV. on the 10th of May 1774 placed him on the throne. He began his reign under good auspices, with Turgot, the greatest living French statesman, in charge of the disorganized finances; but in less than two years he had yielded to the demand of the vested interests attacked by Turgot's reforms, and dismissed him. Turgot's successor, Necker, however, continued the régime of reform until 1781, and it was only with Necker's dismissal that the period of reaction began. Marie Antoinette then obtained that ascendancy over her husband which was partly responsible for the extravagance of the ministry of Calonne, and brought on the Revolution by the resulting financial embarrassment.[1] The third part of his reign began with the meeting of the states-general on the 4th of May 1789, which marked the opening of the Revolution. The revolt of Paris and the taking of the Bastille on the 14th of July were its results. The suspicion, not without justification, of a second attempt at a *coup d'état* led on the 6th of October to the "capture" of the king and royal family at Versailles by a mob from Paris, and their transference to the Tuileries. In spite of the growing radicalism of the clubs, however, loyalty to the king remained surprisingly strong. When he swore to maintain the constitution, then in progress of construction, at the festival of the federation on the 14th of July 1790, he was at the height of his popularity. Even his attempted flight on the 20th of June 1791 did not entirely turn the nation against him, although he left documents which proved his opposition to the whole Revolution. Arrested at Varennes, and brought back to Paris, he was maintained as a constitutional king, and took his oath on the 13th of September 1791. But already a party was forming in Paris which demanded his deposition. This first became noticeable in connexion with the affair of the Champ de Mars on the 17th of July 1791. Crushed for a time the party gained strength through the winter of 1791–1792. The declaration of war against the emperor Francis II., nephew of Marie Antoinette, was forced upon the king by those who wished to discredit him by failure, or to compel him to declare himself openly an enemy to the Revolution. Their policy proved effective. The failure of the war, which intensified popular hatred of the Austrian queen, involved the king; and the invasion of the Tuileries on the 20th of June 1792 was but the prelude to the conspiracy which resulted, on the 10th of August, in the capture of the palace and the "suspension" of royalty by the Legislative Assembly until the convocation of a national convention in September. On the 21st of September 1792 the Convention declared royalty abolished, and in January it tried the king for his treason against the nation, and condemned him to death. He was executed on the 21st of January 1793.

Louis XVI. was weak in character and mentally dull. His courage and dignity during his trial and on the scaffold has left him a better reputation than he deserves. His diary shows how little he understood, or cared for, the business of a king. Days on which he had not shot anything at the hunt were blank days for him. The entry on the 14th of July 1789 was "nothing"! The greater part of his time was spent hunting. He also amused himself making locks, and a little at masonry. Awkward and uncourtly, at heart shy, he was but a poor figure-head for the stately court of France. At first he did not care for Marie Antoinette, but after he came under her influence, her thoughtless conduct compromised him, and it was largely she who encouraged him in underhand opposition to the Revolution while he pretended to accept it. The only point on which he had of his own initiative shown a strong objection to revolutionary measures was in the matter of the civil constitution of the clergy. A devoted and sincere Roman Catholic, he refused at first to sanction a constitution for the church in France without the pope's approval, and after he had been compelled to allow the constitution to become law he resolved to oppose the Revolution definitely by intrigues. His policy was both feeble and false. He was singularly unfortunate even when he gave in, delaying his acquiescence until it had the air of a surrender. It is often said that Louis XVI. was the victim of the faults of his predecessors. He was also the victim of his own.

Having lost his elder son in 1789 Louis left two children, Louis Charles, usually known as Louis XVII., and Marie Thérèse Charlotte (1778–1851), who married her cousin, Louis, duke of Angoulême, son of Charles X., in 1799. The "orphan of the Temple," as the princess was called, was in prison for three years, during which time she remained ignorant of the fate which had befallen her parents. She died on the 19th of October 1851. Her life by G. Lenotre has been translated into English by J. L. May (1908).

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[1] The responsibility of Marie Antoinette for the policy of the king before and during the Revolution has been the subject of much controversy. In general it may be said that her influence on politics has been much exaggerated. (See Marie Antoinette.) [Ed.]

See the articles FRENCH REVOLUTION and MARIE ANTOINETTE. F. X. J. Droz, *Histoire du règne de Louis XVI.* (3 vols., Paris, 1860), a sane and good history of the period; and Arsène Houssaye, *Louis XVI.* (Paris, 1891). See also the numerous memoirs of the time, and the marquis de Ségur's *Au couchant de la monarchie, Louis XVI. et Turgot* (1910).

For bibliographies see G. Monod, *Bibl. de la France*; Lavisse et Rambaud, *Hist. Univ.*, vols. vii. and viii.; and the *Cambridge Modern History*, vol. viii. (R. A.*)

LOUIS XVII. (1785–1795?), titular king of France, second son of Louis XVI. and Marie Antoinette, was born at Versailles on the 27th of March 1785, was christened the same day Louis Charles, and given the title of duke of Normandy. Louis Charles became dauphin on the death of his elder brother on the 4th of June 1789. It is only with his incarceration in the Temple on the 13th of August 1792, that his history, apart from that of his parents, becomes of interest. The royal party included, beside the king and queen, their daughter Marie Thérèse Charlotte (Madame Royale), the king's sister Madame Élisabeth, the valet Cléry and others. The prisoners were lodged at first in the smaller Tower, but were removed to the larger Tower on the 27th of October. Louis Charles was then separated from his mother and aunt to be put in his father's charge, except for a few hours daily, but was restored to the women when Louis was isolated from his family at the beginning of his trial in December.

On the 21st of January 1793 Louis became, for the royalists, king of France, and a week later the comte de Provence arrogated to himself the title of regent. From that moment began new plots for the escape of the prisoners from the Temple, the chief of which were engineered by the Chevalier de Jarjayes,[1] the baron de Batz,[2] and the faithful Lady Atkyns.[3] On the 3rd of July the little dauphin was again separated from his mother, this time to be given into the keeping of the cobbler Antoine Simon[4] who had been named his guardian by the Committee of General Security. The tales told by the royalist writers of the barbarous cruelty inflicted by Simon and his wife on the child are not proven. Marie Jeanne, in fact, took great care of the child's person, and there is documentary evidence to prove that he had air and food. But the Simons were obviously grotesquely unfit guardians for a prince, and they doubtless caused much suffering to the impressionable child, who was made on occasion to eat and drink to excess, and learnt the language of the gutter. But the scenes related by A. de Beauchesne of the physical martyrdom of the child are not supported by any other testimony, though he was at this time seen by a great number of people. On the 6th of October Pache, Chaumette, Hébert and others visited him and secured from him admissions of infamous accusations against his mother, with his signature to a list of her alleged crimes since her entry in the Temple, and next day he was confronted with his sister Marie Thérèse for the last time.

Simon's wife now fell ill, and on the 19th of January 1794 the Simons left the Temple, after securing a receipt for the safe transfer of their prisoner, who was declared to be in good health. A large part of the Temple records from that time onwards were destroyed under the Restoration, so that exact knowledge of the facts is practically impossible. Two days after the departure of the Simons the prisoner is said by the Restoration historians to have been put in a dark room which was barricaded like the cage of a wild animal. The story runs that food was passed through the bars to the child, who survived in spite of the accumulated filth of his surroundings. Robespierre[5] visited Marie Thérèse on the 11th of May, but no one, according to the legend, entered the dauphin's room for six months until Barras visited the prison after the 9th Thermidor (July 27, 1794). Barras's account of the visit describes the child as suffering from extreme neglect, but conveys no idea of the alleged walling in. It is nevertheless certain that during the first half of 1794 he was very strictly secluded; he had no special guardian, but was under the charge of guards changed from day to day. The child made no complaint to Barras of his treatment, probably because he feared to do so. He was then cleansed and re-clothed, his room cleaned, and during the day he was visited by his new attendant, a creole and a compatriot of Joséphine de Beauharnais, named Jean Jacques Christophe Laurent (1770–1807), who had from the 8th of November onwards assistance for his charge from a man named Gomin. The child was now taken out to walk on the roof of the Tower. From about the time of Gomin's entrance the prisoner was inspected, not by delegates of the Commune, but by representatives of the civil committee of the 48 sections of Paris. The rare recurrence of the same inspectors would obviously facilitate fraud, if any such were intended. From the end of October onwards the child maintained an obstinate silence, explained by Laurent as a determination taken on the day he made his deposition against his mother. On the 19th of December 1794 he was visited by three commissioners from the Committee of General Security—J. B. Harmand de la Meuse, J. B. C. Mathieu and J. Reverchon—who extracted no word from him. On Laurent's retirement Étienne Lasne was appointed on the 31st of March 1795 to be the child's guardian. In May 1795 the prisoner was seriously ill, and a doctor, P. J. Desault, well acquainted with the dauphin, having visited him seven months earlier, was summoned. Desault died suddenly, not without suspicion of poison, on the 1st of June, and it was some days before doctors Pelletan and Dumangin were called. Then it was announced that on the 8th Louis Charles died. Next day an autopsy was held at which it was stated that a child apparently about ten years of age, "which the commissioners told us was the late Louis Capet's son," had died of a scrofulous affection of long standing. He was buried on the 10th in the cemetery of Ste Marguerite, but no stone was erected to mark the spot.

The weak parts of this story are the sudden and unexplained departure of the Simons; the subsequent useless cruelty of treating the child like a wild beast and keeping him in a dark room practically out of sight (unless any doubt of his identity was possible), while his sister was in comparative comfort; the cause of death, declared to be of long standing, but in fact developed with such rapidity; the insufficient excuse provided for the child's muteness under Gomin's régime (he had answered Barras) and the irregularities in the formalities in attending the death and the funeral, when a simple identification of the body by Marie Thérèse would have prevented any question of resuscitated dauphins. Both Barras and Harmand de la Meuse are said to have given leave for the brother and sister to see each other, but the meeting was never permitted. The argument from the sudden disappearance of persons in a position to know something of the truth is of a less convincing character. It may be noted that the more famous of the persons alleged by partisans of subsequent pretenders to have been hustled out of the world for their connexion with the secret are the empress Josephine, the duc d'Enghien and the duc de Berri.

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[1] F. A. Regnier de Jarjayes (1745–1822). See P. Gaulot, *Un Complot sous la Terreur.*

[2] Jean, baron de Batz (1761–1822), attempted to carry off the dauphin in 1794. See G. Lenôtre, *Un Conspirateur royaliste pendant la Terreur, le baron de Batz* (1896).

[3] Charlotte Walpole (*c.* 1785–1836), an English actress who married in 1779 Sir Edward Atkyns, and spent most of her life in France. She expended large sums in trying to secure the escape of the prisoners of the Temple. See F. Barbey, *A Friend of Marie Antoinette* (Eng. ed. 1906).

[4] Antoine Simon (1736–1794) married Marie Jeanne Aladame, and belonged to the section of the Cordeliers. They owed their position to Anaxagoras Chaumette, procureur of the Commune, and to the fact that Simon had prevented one of the attempts of the baron de Batz. Simon was sent to the guillotine with Robespierre in 1794, and two years later Marie Jeanne entered a hospital for incurables in the rue de Sèvres, where she constantly affirmed the dauphin's escape. She was secretly visited after the Restoration by the duchess of Angoulême. On the 16th of November 1816, she was interrogated by the police, who frightened her into silence about the supposed substitution of another child for the dauphin. She died in 1819. See G. Lenôtre, *Vieilles maisons, vieux papiers* (2nd series, 1903).

[5] In a bulletin dated May 17-24, Paris, and enclosed by Francis Drake (June 17, 1794) at Milan to Lord Grenville, it is stated (Hist. MSS. Comm. Fortescue Papers at Dropmore, vol. ii. 576-577) that Robespierre in the night of 23-24 May fetched the king (the dauphin) from the Temple and took him to Meudon. "The fact is certain, although only known to the Committee of Public Safety. It is said to be ascertained that he was brought back to the Temple the night of 24-25th, and that this was a test to assure the ease of seizing him." This police report at least serves to show the kind of rumours then current.

Immediately on the announcement of the dauphin's death there arose a rumour that he had escaped. Simien-Despréaux, one of Louis XVIII.'s own authors, stated at a later period (1814) that Louis XVII. was living and that among the signatories of the treaty of April 13th were some who possessed proofs of his existence; and Eckard, one of the mainstays of the official account, left among his unpublished papers a statement that many members of "an assembly of our wise men" obstinately named Louis XVII. as the prince whom their wishes demanded. Unfortunately the removal of the child suited the plans of the comte de Provence (now Louis XVIII. for the *émigrés*) as well as it suited the revolutionary government, and no serious attempt was made by the royal family to ascertain the truth, though they paid none of the tributes to the memory of the dead king which might reasonably have been expected, had they been convinced of his death. Even his sister wore no mourning for him until she arrived at Vienna and saw that this was expected of her. In spite of the mass of literature which has accumulated on the subject, neither his death in the Temple nor his escape therefrom has been definitely established, though a very strong presumption is established in favour of the latter.

Some forty candidates for his honours were forthcoming under the Restoration. The most important of these pretenders were Karl Wilhelm Naundorff and the comte de Richemont. Naundorff's story rested on a series of complicated intrigues. According to him Barras determined to save the dauphin in order to please Joséphine Beauharnais, the future empress, having conceived the idea of using the dauphin's existence as a means of dominating the comte de Provence in the event of a restoration. The dauphin was concealed in the fourth storey of the Tower, a wooden figure being substituted for him. Laurent, to protect himself from the consequences of the substitution, replaced the wooden figure by a deaf mute, who was presently exchanged for the scrofulous child of the death certificate. The deaf mute was also concealed in the Temple. It was not the dead child, but the dauphin who left the prison in the coffin, whence he was extracted by his friends on the way to the cemetery. Richemont's tale that the woman Simon, who was genuinely attached to him, smuggled him out in a basket, is simple and more credible, and does not necessarily invalidate the story of the subsequent operations with the deaf mute and the scrofulous patient, Laurent in that case being deceived from the beginning, but it renders them extremely unlikely. A third pretender, Eleazar Williams, did not affect to know anything of his escape. He possessed, he said, no consciousness of his early years, only emerging from idiocy at the age of thirteen, when he was living with an Indian family in New York State. He was a missionary to the Indians when the prince de Joinville, son of Louis Philippe, met him, and after some conversation asked him to sign a document abdicating his rights in favour of Louis Philippe, in return for which he, the dauphin (alias Eleazar Williams), was to receive the private inheritance which was his. This Eleazar refused to do. The wildness of this tale refutes itself.

Richemont (Henri Ethelbert Louis Victor Hébert) was in prison in Milan for seven years and began to put forward his claims in Paris in 1828. In 1833 he was again arrested, was brought to trial in the following year and was condemned to twelve years' imprisonment. He escaped after a few months and left the country, to return in 1840. He died at Gleize on the 10th of August 1853, the name of Louis Charles de France being inscribed on his tomb until the government ordered its removal.

Naundorff, or Naündorff, who had arrived from nowhere in Berlin in 1810, with papers giving the name Karl Wilhelm Naundorff, in order to escape the persecutions of which he declared himself the object, settled at Spandau in 1812 as a clockmaker, and married in 1818 Johanna Einert. In 1822 he removed to Brandenburg, and in 1828 to Crossen, near Frankfort. He was imprisoned from 1825 to 1828 for coining, though apparently on insufficient evidence, and in 1833 came to push his claims in Paris, where he was recognized as the dauphin by many persons formerly connected with the court of Louis XVI. Expelled from France in 1836, the day after bringing a suit against the duchess of Angoulême for the restitution of the dauphin's private property, he lived in exile till his death at Delft on the 10th of August 1845, and his tomb was inscribed "Louis XVII., roi de France et de Navarre (Charles Louis, duc de Normandie)." The Dutch authorities who had inscribed on his death certificate the name of Charles Louis de Bourbon, duc de Normandie (Louis XVII.) permitted his son to bear the name de Bourbon, and when the family appealed in 1850–1851, and again in 1874, for the restitution of their civil rights as heirs of Louis XVI. no less an advocate than Jules Favre pleaded their cause. Of all the pretenders Naundorff has the best case. He was certainly not the Jew of Prussian Poland which his enemies declared him to be, and he has to this day a circle of devoted adherents. Since he was sincerely convinced of his own rights, it is surprising that he put forward no claim in 1814.

If the dauphin did escape, it seems probable that he perished shortly afterwards or lived in a safe obscurity. The account of the substitution in the Temple is well substantiated, even to the names of the substitutes. The curious imbroglio deceived royalists and republicans alike. Lady Atkyns was trying by every possible means to get the dauphin out of his prison when he was apparently already in safe hands, if not outside the Temple walls. A child was in fact delivered to her agents, but he was a deaf mute. That there was fraud, and complicated fraud, in the guardians of the dauphin may be taken as proved by a succession of writers from 1850 onwards, and more recently by Frédéric Barbey, who wisely attempts no ultimate solution. When the partisans of Richemont or Naundorff come to the post-Temple careers of their heroes, they become in most cases so uncritical as to be unconvincing.

The official version of the dauphin's history as accepted under the Restoration was drawn up by Simien Despréaux in his uncritical *Louis XVII.* (1817), and is found, fortified by documents, in M. Eckard's *Mémoires historiques sur Louis XVII.* (1817) and in A. de Beauchesne's *Louis XVII., sa vie, son agonie, sa mort. Captivité de la famille royale au Temple* (2 vols., 1852, and many subsequent editions), containing copies of original documents, and essential to the study of the question, although its sentimental pictures of the boy martyr can no longer be accepted. L. de la Sicotière, "Les faux Louis XVII.," in *Revue des questions historiques* (vol. xxxii., 1882), deals with the pretenders Jean Marie Hervagault, Mathurin Bruneau and the rest; see also Dr Cabanes, *Les Morts mystérieuses de l'histoire* (1901), and revised catalogue of the J. Sanford Saltus collection of Louis XVII. books (New York, 1908). Catherine Welch, in *The Little Dauphin* (1908) gives a résumé of the various sides of the question.

Madame Royale's own account of the captivity of the Temple was first printed with additions and suppressions in 1817, and often subsequently, the best edition being that from her autograph text by G. Lenôtre, *La Fille de Louis XVI., Marie Thérèse Charlotte de France, duchesse d'Angoulême, le Temple, l'échange, l'exil* (1907). There are two collections of writings on the subject: *Marie Thérèse de France*, compiled (1852) by the marquis de Pastoret, and comprising beside the memoir written by Marie Thérèse herself, articles by M. de Montbel, Sainte-Beuve, J. Lemoine, La Guéronnière and extracts from Joseph Weber's memoirs; and *Mémoires de Marie Thérèse duchesse d'Angoulême*, comprising extracts from the narratives of Charles Goret (*Mon Témoignage*, 1852), of C. F. Beaulieu (*Mémoire adressée à la nation*, 1795), of L. G. Michaud (*Opinion d'un Français, 1795*) and of Mme de Tourzel (*Mémoires* 1883). Cf. A. Lanne, *La Sœur de Louis XVII.*, and the articles on "Madame Royale," on the "Captivité de la famille royale au Temple" and on the "Mise en liberté de Madame" in M. Tourneux's *Bibliographie de l'histoire de Paris pendant la révolution française* (vol. iv., 1906, and vol. i., 1890).

Naündorff.—For the case of Naündorff see his own narrative. *Abrégé de l'histoire des infortunes du Dauphin* (London, 1836; Eng. trans., 1838); also Modeste Gruau de la Barre, *Intrigues* *dévoilées ou Louis XVII.* . . . (3 vols., Rotterdam, 1846–1848); O. Friedrichs, *Correspondance intime et inédite de Louis XVII.* (Naundorff) 1834–1838 (2 vols., 1904); *Plaidoirie de Jules Favre devant la cour d'appel de Paris pour les héritiers de feu Charles-Guillaume Naundorff* (1874); H. Provins, *Le Dernier roi légitime de France* (2 vols., the first of which consists of destructive criticism of Beauchesne and his followers, 1889); A. Lanne, "Louis XVII. et le secret de la Révolution," *Bulletin mensuel* (1893 et seq.) of the Société des études sur la question Louis XVII., also *La Légitimité* (Bordeaux, Toulouse, 1883–1898). See further the article "Naundorff" in M. Tourneux, *Bibl. de la ville de Paris pendant la Révolution*, vol. iv. (1906).

Williams.—J. H. Hanson, *The Lost Prince: Facts tending to prove the Identity of Louis XVII. of France and the Rev. Eleazer Williams* (London and New York, 1854).

De Richemont.—*Mémoires du duc de Normandie, fils de Louis XVI., écrits et publiés par lui-même* (Paris, 1831), compiled, according to Quérard, by E. T. Bourg, called Saint Edme; Morin de Guérivière, *Quelques souvenirs* . . . (Paris, 1832); and J. Suvigny, *La Restauration convaincue . . . ou preuves de l'existence du fils de Louis XVI.* (Paris, 1851).

The widespread interest taken in Louis XVII. is shown by the fact that since 1905 a monthly periodical has appeared in Paris on this subject, entitled *Revue historique de la question Louis XVII.*, also by the promised examination of the subject by the Société d'Histoire contemporaine. (M. Br.)

LOUIS XVIII. (Louis le Désiré) (1755–1824). Louis-Stanislas-Xavier, comte de Provence, third son of the dauphin Louis, son of Louis XV., and of Maria Josepha of Saxony, was born at Versailles on the 17th of November 1755. His education was supervised by the devout duc de la Vauguyon, but his own taste was for the writings of Voltaire and the encyclopaedists. On the 14th of May 1771 took place his marriage with Louise-Marie-Joséphine of Savoy, by whom he had no children. His position at court was uncomfortable, for though ambitious and conscious of possessing greater abilities than his brother (Louis XVI.), his scope for action was restricted; he consequently devoted his energies largely to intrigue, especially against Marie Antoinette, whom he hated.[1] During the long absence of heirs to Louis XVI., "Monsieur," as heir to the throne, courted popularity and took an active part in politics, but the birth of a dauphin (1781) was a blow to his ambitions.[2] He opposed the revival of the *parlements*, wrote a number of political pamphlets,[3] and at the Assembly of Notables presided, like the other princes of the blood, over a bureau, to which was given the name of the *Comité des sages*; he also advocated the double representation of the *tiers*. At the same time he cultivated literature, entertaining poets and writers both at the Luxembourg and at his château of Brunoy (see Dubois-Corneau, *Le Comte de Provence à Brunoy*, 1909), and gaining a reputation for wit by his verses and *mots* in the salon of the charming and witty comtesse de Balbi, one of Madame's ladies, who had become his mistress,[4] and till 1793 exerted considerable influence over him. He did not emigrate after the taking of the Bastille, but, possibly from motives of ambition, remained in Paris. Mirabeau thought at one time of making him chief minister in his projected constitutional government (see *Corr. de Mirabeau et La Marck*, ed. Bacourt, i. 434, 436, 442), but was disappointed by his caution and timidity. The *affaire Favras* (Dec. 1789) aroused great feeling against Monsieur, who was believed by many to have conspired with Favras, only to abandon him (see Lafayette's *Mems.* and *Corr. of Mirabeau*). In June 1791, at the time of the flight to Varennes, Monsieur also fled by a different route, and, in company with the comte d'Avaray[5]—who subsequently replaced Mme de Balbi as his confidant, and largely influenced his policy during the emigration—succeeded in reaching Brussels, where he joined the comte d'Artois and proceeded to Coblenz, which now became the headquarters of the emigration.

Here, living in royal state, he put himself at the head of the counter-revolutionary movement, appointing ambassadors, soliciting the aid of the European sovereigns, and especially of Catherine II. of Russia. Out of touch with affairs in France and surrounded by violent anti-revolutionists, headed by Calonne and the comte d'Artois, he followed an entirely selfish policy, flouting the National Assembly (see his reply to the summons of the National Assembly, in Daudet, *op. cit.* i. 96), issuing uncompromising manifestoes (Sept. 1791, Aug. 1792, &c.), and obstructing in every way the representatives of the king and queen.[6] After Valmy he had to retire to Hamm in Westphalia, where, on the death of Louis XVI., he proclaimed himself regent; from here he went south, with the idea of encouraging the royalist feeling in the south of France, and settled at Verona, where on the death of Louis XVII. (8th of June 1795) he took the title of Louis XVIII. At this time ended his *liaison* with Mme de Balbi, and the influence of d'Avaray reached its height. From this time onward his life is a record of constant wanderings, negotiations and conspiracies. In April 1796 he joined Condé's army on the German frontier, but was shortly requested to leave the country, and accepted the hospitality of the duke of Brunswick at Blanckenberg till 1797, when, this refuge being no longer open to him, the emperor Paul I. permitted him to settle at Mittau in Courland, where he stayed till 1801. All this time he was in close communication with the royalists in France, but was much embarrassed by the conflicting policy pursued by the comte d'Artois from England, and was largely at the mercy of corrupt and dishonest agents.[7] At Mittau was realized his cherished plan of marrying Madame Royale, daughter of Louis XVI., to the duc d'Angoulême, elder son of the comte d'Artois. From Mittau, too, was sent his well-known letter to Bonaparte (1799) calling upon him to play the part of Monk, a proposal contemptuously refused (E. Daudet, *Hist. de l'émigration*, ii. 371, 436), though Louis in turn declined to accept a pension from Bonaparte, and later, in 1803, though his fortunes were at their lowest ebb, refused to abdicate at his suggestion and accept an indemnity.

Suddenly expelled from Mittau in 1801 by the capricious Paul I., Louis made his way, in the depth of winter, to Warsaw, where he stayed for three years. All this time he was trying to convert France to the royalist cause, and had a "*conseil royal*" in Paris, founded at the end of 1799 by Royer-Collard, Montesquiou and Clermont-Gallerande, the actions of which were much impeded by the activity of the rival committee of the comte d'Artois (see E. Daudet, *op. cit.* ii., and Remâcle, *Bonaparte et les Bourbons*, Paris, 1899), but after 1800, and still more after the failure of the royalist conspiracy of Cadoudal, Pichegru and Moreau, followed by the execution of the duc d'Enghien (March 1804), and the assumption by Napoleon of the title of emperor (May 1804), the royalist cause appeared quite hopeless. In September 1804 Louis met the comte d'Artois at Calmar in Sweden, and they issued a protest against Napoleon's action, but being warned that he must not return to Poland, he gained permission from Alexander I. again to retire to Mittau. After Tilsit, however (1807), he was again forced to depart, and took refuge in England, where he stayed first at Gosfield in Essex, and afterwards (1809 onwards) at Hartwell in Buckinghamshire.

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[1] See Arneth and Geffroy, *Corr. de Marie-Thérèse avec le comte de Mercy-Argenteau*, vol. i., "Mercy to Maria Theresa, June 22nd, 1771," also i. 261, ii. 186, 352, 393. Marie Antoinette says (ii. 393): ". . . à un caractère très faible, il joint une marche souterraine, et quelquefois très basse."

[2] See his letters to Gustavus III. of Sweden in A. Geffroy, *Gustave III et la cour de France*, vol. ii. appendix.

[3] Two pamphlets at least are ascribed to him: "Les Mannequins, conte ou histoire, comme l'on voudra" (against Turgot; anon., Paris, 1776) and "Description historique d'un monstre symbolique pris vivant sur les bords du lac Fagua, près de Santa-Fé, par les soins de Francisco Xaveiro de Neunris" (against Calonne; Paris, 1784) (A. Debidour in *La Grande Encyclopédie*).

[4] It has frequently been alleged that his relations with Mme de Balbi, and indeed with women generally, were of a platonic nature. De Reiset (*La Comtesse de Balbi*, pp. 152-161) produces evidence to disprove this assertion.

[5] Antoine-Louis-François de Bésiade, comte, afterwards duc, d'Avaray. In spite of his loyalty and devotion, the effect of his influence on Louis XVIII. may be gathered from a letter of J. de Maistre to Blacas, quoted by E. Daudet, *Hist. de l'émigration*, ii. 11: "celui qui n'a pu dans aucun pays aborder aucun homme politique sans l'aliéner n'est pas fait pour les affaires."

[6] See Klinckowström, *Le Comte de Fersen et la cour de France*. Fersen says (i. 7), "Monsieur ferait mieux seul, mais il est entièrement subjugué par l'autre" (*i.e.* the comte d'Artois, who was in turn under the influence of Calonne). See Daudet, *op. cit.* vol. i.

[7] See E. Daudet, *La Conjuration de Pichegru* (Paris, 1901).

In 1810 his wife died, and in 1811 d'Avaray died, his place as favourite being taken by the comte de Blacas.[1] After Napoleon's defeats in 1813 the hopes of the royalists revived, and Louis issued a fresh manifesto, in which he promised to recognize the results of the Revolution. Negotiations were also opened with Bernadotte, who seemed willing to support his cause, but was really playing for his own hand.

In March 1814 the Allies entered Paris, and thanks to Talleyrand's negotiations the restoration of the Bourbons was effected, Louis XVIII. entering Paris on the 2nd of May 1814, after issuing the declaration of St Ouen, in which he promised to grant the nation a constitution (*octroyer une charte*). He was now nearly sixty, wearied by adversity, and a sufferer from gout and obesity. But though clear-sighted, widely read and a good diplomatist, his impressionable and sentimental nature made him too subject to personal and family influences. His concessions to the reactionary and clerical party of the *émigrés*, headed by the comte d'Artois and the duchesse d'Angoulême, aroused suspicions of his loyalty to the constitution, the creation of his *Maison militaire* alienated the army, and the constant presence of Blacas made the formation of a united ministry impossible. After the Hundred Days, during which the king was forced to flee to Ghent, the dismissal of Blacas was made one of the conditions of his second restoration. On the 8th of July he again entered Paris, "in the baggage train of the allied armies," as his enemies said, but in spite of this was received with the greatest enthusiasm[2] by a people weary of wars and looking for constitutional government. He was forced to retain Talleyrand and Fouché in his first ministry, but took the first opportunity of ridding himself of them when the elections of 1815 assured him of a strong royalist majority in the chamber (the *chambre introuvable*, a name given it by Louis himself). At this time he came into contact with the young comte (afterwards duc) Decazes, prefect of the police under Fouché, and minister of police in Richelieu's ministry, who now became his favourite and gained his entire confidence (see E. Daudet, *Louis XVIII. et le duc Decazes*). Having obtained a ministry in which he could trust, having as members the duc de Richelieu and Decazes, the king now gave it his loyal support and did his best to shield his ministers from the attacks of the royal family. In September 1816, alarmed at the violence of the *chambre introuvable*, he was persuaded to dissolve it. An attempt on the part of the Ultras to regain their ascendancy over the king, by conniving at the sudden return of Blacas from Rome to Paris,[3] ended in failure.

The events and ministerial changes of Louis XVIII.'s reign are described under the article FRANCE: *History*, but it may be said here that the king's policy throughout was one of prudence and common sense. His position was more passive than active, and consisted in giving his support as far as possible to the ministry of the day. While Decazes was still in power, the king's policy to a large extent followed his, and was rather liberal and moderate, but after the assassination of the duc de Berry (1820), when he saw that Decazes could no longer carry on the government, he sorrowfully acquiesced in his departure, showered honours upon him, and transferred his support to Richelieu, the head of the new ministry. In the absence of Decazes a new favourite was found to amuse the king's old age, Madame du Cayla (Zoé Talon, comtesse du Cayla), a protégée of the vicomte Sosthène de la Rochefoucauld and consequently a creature of the Ultras. As the king became more and more infirm, his power of resistance to the intrigues of the Ultras became weaker. The birth of a posthumous son to the duc de Berry (Sept. 1820), the death of Napoleon (5th of May 1821) and the resignation of Richelieu left him entirely in their hands, and after Villèle had formed a ministry of a royalist character the comte d'Artois was associated with the government, which passed more and more out of the king's hands. He died on the 16th of September 1824, worn out in body, but still retaining flashes of his former clear insight and scepticism. The character of Louis XVIII. may be summed up in the words of Bonaparte, quoted by Sorel (*L'Europe et la Rév. fr.* viii. 416 footnote), "C'est Louis XVI. avec moins de franchise et plus d'esprit." He had all the Bourbon characteristics, especially their love of power, combined with a certain nobility of demeanour, and a consciousness of his dignity as king. But his nature was cold, unsympathetic and calculating, combined with a talent for intrigue, to which was added an excellent memory and a ready wit. An interesting judgment of him is contained in *Queen Victoria's Letters*, vol. i., in a letter of Leopold I., king of the Belgians, to the queen before her accession, dated the 18th of November 1836, "Poor Charles X. is dead. . . . History will state that Louis XVIII. was a most liberal monarch, reigning with great mildness and justice to his end, but that his brother, from his despotic and harsh disposition, upset all the other had done and lost the throne. Louis XVIII. was a clever, hard-hearted man, shackled by no principle, very proud and false. Charles X. an honest man, a kind friend," &c. &c. This seems fairly just as a personal estimate, though it does not do justice to their respective political rôles.

BIBLIOGRAPHY.—There is no trustworthy or complete edition of the writings and correspondence of Louis XVIII. The *Mémoires de Louis XVIII. recueillis et mis en ordre par M. le duc de D. . . .* (12 vols., Paris, 1832–1833) are compiled by Lamothe-Langon, a well-known compiler of more or less apocryphal memoirs. From the hand of Louis XVIII. are: *Relation d'un voyage à Bruxelles et à Coblentz, 1791* (Paris, 1823, with dedication to d'Avaray); and *Journal de Marie-Thérèse de France, duchesse d'Angoulême, corrigé et annoté par Louis XVIII.*, ed. Imbert de St Amand (Paris, 1896). Some of his letters are contained in collections, such as *Lettres d'Artwell; correspondance politique et privée de Louis XVIII., roi de France* (Paris, 1830; letters addressed to d'Avaray); *Lettres et instructions de Louis XVIII. au comte de Saint-Priest*, ed. Barante (Paris, 1845); *Talleyrand et Louis XVIII., corr. pendant le congrès de Vienne, 1814–1815*, ed. Pallain (1881; trans., 2 vols., 1881); see also the corr. of Castlereagh, Metternich, J. de Maistre, the Wellington Dispatches, &c., and such collections as *Corr. diplomatique de Pozzo di Borgo avec le comte de Nesselrode* (2 vols., 1890–1897), the correspondence of C. de Rémusat, Villèle, &c. The works of E. Daudet are of the greatest importance, and based on original documents; the chief are: *La Terreur Blanche* (Paris, 1878); *Hist. de la restauration 1814–1830* (1882); *Louis XVIII. et le duc Decazes* (1899); *Hist. de l'émigration*, in three studies: (i.) *Les Bourbons et la Russie* (1886), (ii.) *Les Émigrés et la seconde coalition* (1886), (iii.) *Coblenz, 1789–1793* (1890). Developed from these with the addition of much further material is his *Hist. de l'émigration* (3 vols., 1904–1907). Also based on original documents is E. Romberg and A. Malet, *Louis XVIII. et les cent-jours à Gand* (1898). See also G. Stenger, *Le Retour des Bourbons* (1908); Cte. L. de Remâcle, *Bonaparte et les Bourbons. Relations secrèts des agents du cte. de Provence sous le consulat* (Paris, 1899). For various episodes, see Vicomte de Reiset, *La Comtesse de Balbi* (Paris, 1908; contains a long bibliography, chiefly of memoirs concerning the emigration, and is based on documents); J. B. H. R. Capefigue, *La Comtesse du Cayla* (Paris, 1866); J. Turquan, *Les Favorites de Louis XVIII.* (Paris, 1900); see also the chief memoirs of the period, such as those of Talleyrand, Chateaubriand, Guizot, duc de Broglie, Villèle, Vitrolles, Pasquier, the comtesse de Boigne (ed. Nicoullaud, Paris, 1907), the Vicomte L. F. Sosthène de la Rochefoucauld (15 vols., Paris, 1861–1864); and the writings of Benjamin Constant, Chateaubriand, &c.

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[1] Pierre-Louis-Casimir, comte (afterwards duc) de Blacas d'Aulps, was as rigidly royalist as d'Avaray, but more able. E. Daudet, *Hist. de l'émigration*, i. 458, quotes a judgment of him by J. de Maistre: "Il est né homme d'état et ambassadeur."

[2] See account by Decazes in E. Daudet, *Louis XVIII. et le duc Decazes*, pp. 48-49, and an interesting "secret and confidential" letter of Castlereagh to Liverpool (July 8, 1815) in the unpublished Foreign Office records: "The king sent for the duke and me this evening to the Thuilleries. . . . We found him in a state of great emotion and exaltation at the reception he had met with from his subjects, which appears to have been even more animated than on his former entrance. Indeed, during the long audience to which we were admitted, it was almost impossible to converse, so loud were the shouts of the people in the Thuilleries Gardens, which were full, though it was then dark. Previous to the king's dismissing us, he carried the duke and me to the open window. Candles were then brought, which enabled the people to see the king with the duke by his side. They ran from all parts of the Gardens, and formed a solid mass of an immense extent, rending the air with acclamations. The town is very generally illuminated, and I understand from men who have traversed the principal streets that every demonstration of joy was manifested by the inhabitants."

[3] It is as yet not proved that Blacas returned from his embassy in response to a summons from the Ultras. But whether it was on his own initiative or not, there can be no doubt as to the hopes which they built on his arrival (see Daudet, *Louis XVIII. et le duc Decazes*.

General Works.—See the histories of France; the Emigration, the Restoration and especially the very full bibliographies to chapters i., ii. and iii. of *Cambridge Modern History*, and Lavisse and Rambaud, *Hist. générale*, vol. x. (C. B. P.)

LOUIS I. (1326–1382), called "the great," king of Hungary and Poland, was the third son of Charles Robert, king of Hungary, and Elizabeth, daughter of the Polish king, Ladislaus Lokietek. In 1342 he succeeded his father as king of Hungary and was crowned at Székesfehérvár on the 21st of July with great enthusiasm. Though only sixteen he understood Latin, German and Italian as well as his mother tongue. He owed his relatively excellent education to the care of his mother, a woman of profound political sagacity, who was his chief counsellor in diplomatic affairs during the greater part of his long reign. Italian politics first occupied his attention. As a ruler of a rising great power in search of a seaboard he was the natural adversary of the Venetian republic, which already aimed at making the Adriatic a purely Venetian sea and resented the proximity of the Magyars in Dalmatia. The first trial of strength began in 1345, when the city of Zara placed herself under the protection of Hungary and was thereupon invested by the Venetians. Louis fought a battle beneath the walls of Zara (July 1st, 1346), which has been immortalized by Tintoretto, but was defeated and compelled to abandon the city to the republic. The struggle was renewed eleven years later when Louis, having formed, with infinite trouble, a league of all the enemies of Venice, including the emperor, the Habsburgs, Genoa and other Italian towns, attacked his maritime rival with such vigour that she sued for peace, and by the treaty of Zara (February 18th, 1358) ceded most of the Dalmatian towns and renounced the title of duke of Dalmatia and Croatia, hitherto borne by the doge. Far more important than the treaty itself was the consequent voluntary submission of the independent republic of Ragusa to the suzerainty of the crown of St Stephen the same year, Louis, in return for an annual tribute of 500 ducats and a fleet, undertaking to defend Ragusa against all her enemies. Still more glorious for Hungary was Louis's third war with Venice (1378–1381), when he was again aided by the Genoese. At an early stage of the contest Venice was so hardly pressed that she offered to do homage to Hungary for all her possessions. But her immense resources enabled her to rally her forces, and peace was finally concluded between all the powers concerned at the congress of Turin (1381), Venice virtually surrendering Dalmatia to Louis and undertaking to pay him an annual tribute of 7000 ducats. The persistent hostility of Venice is partially attributable to her constant fear lest Louis should inherit the crown of Naples and thus threaten her trade and her sea-power from two sides simultaneously. Louis's younger brother Andrew had wedded Joanna, grand-daughter and heiress of old King Robert of Naples, on whose death, in 1343, she reigned in her own right, refused her consort any share in the government, and is very strongly suspected of having secured his removal by assassination on the night of the 19th of September 1345. She then married Prince Louis of Taranto, and strong in the double support of the papal court at Avignon and of the Venetian republic (both of whom were opposed to Magyar aggrandisement in Italy) questioned the right of Louis to the two Sicilies, which he claimed as the next heir of his murdered brother. In 1347, and again in 1350, Louis occupied Naples and craved permission to be crowned king, but the papal see was inexorable and he was compelled to withdraw. The matter was not decided till 1378 when Joanna, having made the mistake of recognizing the antipope Clement VII., was promptly deposed and excommunicated in favour of Prince Charles of Durazzo, who had been brought up at the Hungarian court. Louis, always inexhaustible in expedients, determined to indemnify himself in the north for his disappointments in the south. With the Habsburgs, Hungary's natural rivals in the west, Louis generally maintained friendly relations. From 1358 to 1368, however, the restless ambition of Rudolph, duke of Austria, who acquired Tirol and raised Vienna to the first rank among the cities of Europe, caused Louis great uneasiness. But Louis always preferred arbitration to war, and the peace congresses of Nagyszombat (1360) and of Pressburg (1360) summoned by him adjusted all the outstanding differences between the central European powers. Louis's diplomacy, moreover, was materially assisted by his lifelong alliance with his uncle, the childless Casimir the Great of Poland, who had appointed him his successor; and on Casimir's death Louis was solemnly crowned king of Poland at Cracow (Nov. 17, 1370). This personal union of the two countries was more glorious than profitable. Louis could give little attention to his unruly Polish subjects and was never very happy among them. Immovably entrenched behind their privileges, they rendered him only the minimum of service; but he compelled their representatives, assembled at Kassa, to recognize his daughter Maria and her affianced husband, Count Sigismund of Brandenburg, as their future king and queen by locking the gates of the city and allowing none to leave it till they had consented to his wishes (1374). Louis is the first European monarch who came into collision with the Turks. He seems to have arrested their triumphant career (*c.* 1372), and the fine church erected by him at Maria-Zell is a lasting memorial of his victories. From the first he took a just view of the Turkish peril, but the peculiar local and religious difficulties of the whole situation in the Balkans prevented him from dealing with it effectually (see HUNGARY, *History*). Louis died suddenly at Nagyszombat on the 10th of September 1382. He left two daughters Maria and Jadwiga (the latter he destined for the throne of Hungary) under the guardianship of his widow, the daughter of the valiant ban of Bosnia, Stephen Kotromanić, whom he married in 1353, and who was in every way worthy of him.

See *Rationes Collectorum Pontif. in Hungaria, 1281–1375* (Budapest, 1887); Dano Gruber, *The Struggle of Louis I. with the Venetians for Dalmatia* (Croat.) (Agram, 1903); Antal Pór, *Life of Louis the Great* (Hung.) (Budapest, 1892); and *History of the Hungarian Nation* (Hung.) (vol. 3, Budapest, 1895). (R. N. B.)

LOUIS II. (1506–1526), king of Hungary and Bohemia, was the only son of Wladislaus II., king of Hungary and Bohemia, and the French princess Anne of Candale. Prematurely born at Buda on the 1st of July 1506, it required all the resources of medical science to keep the sickly child alive, yet he developed so precociously that at the age of thirteen he was well bearded and moustached, while at eighteen his hair was silvery white. His parts were good and he could speak and write six languages at a very early age, but the zeal of his guardians and tutors to make a man of him betimes nearly ruined his feeble constitution, while the riotous life led by him and his young consort, Maria of Austria, whom he wedded on the 13th of January 1522, speedily disqualified him for affairs, so that at last he became an object of ridicule at his own court. He was crowned king of Hungary on the 4th of June 1508, and king of Bohemia on the 11th of May 1509, and was declared of age when he succeeded his father on the 11th of December 1521. But during the greater part of his reign he was the puppet of the magnates and kept in such penury that he was often obliged to pawn his jewels to get proper food and clothing. His guardians, Cardinal Bakócz and Count George of Brandenburg-Anspach, shamefully neglected him, squandered the royal revenues and distracted the whole kingdom with their endless dissensions. Matters grew even worse on the death of Bakócz, when the magnates István Báthory, János Zapolya and István Verböczy fought each other furiously, and used the diets as their tools. Added to these troubles was the ever-present Turkish peril, which became acute after the king, with insensate levity, arrested the Ottoman envoy Berham in 1521 and refused to unite with Suleiman in a league against the Habsburgs. Nevertheless in the last extremity Louis showed more of manhood than any of his counsellors. It was he who restored something like order by intervening between the magnates and the gentry at the diet of 1525. It was he who collected in his camp at Tolna the army of 25,000 men which perished utterly on the fatal field of Mohács on the 29th of August 1526. He was drowned in the swollen stream of Csele on his flight from the field, being the second prince of the house of Jagiello who laid down his life for Hungary.

See *Rerum Hungaricarum libri* (vol. 2, ed. Ferencz Toldy, Budapest, 1867); and József Podhradczky, *King Louis* (Hung.) (Budapest, 1860). (R. N. B.)

LOUIS, the name of three kings of Naples, members of the house of Anjou.

Louis I., duke of Anjou and count of Maine (1339–1384), was the second son of John II., king of France, and was born at Vincennes on the 23rd of July 1339. Having been given the duchy of Anjou in 1356 he led a wing of the French army at the battle of Poitiers and was sent to England as a hostage after the conclusion of the treaty of Brétigny in 1360, but he broke his parole in 1363 and so brought about King John's return into captivity. He took part in the war against England which was renewed in 1369, uniting the rival houses of Foix and Armagnac in the common cause, and in other ways rendering good service to his brother, King Charles V. Anjou's entrance into the troubled politics of Italy was one result of the papal schism which opened in 1378. Anxious to secure the support of France, the antipope Clement VII. persuaded the queen of Naples, Joanna I., to name Louis as her heir, and about the same time the death of Charles V. (September 1380) placed the duke in the position of regent of France. Neglecting France to prosecute his ambitions in Italy, he collected money and marched on Naples; but although helped by Amadeus VI., count of Savoy, he was unable to drive his rival, Charles, duke of Durazzo, from Naples. His army was destroyed by disease and Louis himself died at Biseglia, near Bari, on the 20th of September 1384, leaving two sons, his successor, Louis II., and Charles, duke of Calabria.

Louis II., duke of Anjou (1377–1417), born at Toulon on the 7th of October 1377, took up the struggle for Naples after his father's death and was crowned king by Clement VII. in 1389. After carrying on the contest for some years his enemies prevailed and he was compelled to take refuge in France, where he took part in the intestine strife which was desolating that kingdom. A few years later he made other attempts to secure the kingdom of Naples, which was now in the possession of Ladislas, a son of his father's foeman, Charles of Durazzo, and he gained a victory at Roccoserra in May 1411. Soon, however, he was again driven back to France, and after sharing anew in the civil wars of his country he died at Angers on the 29th of April 1417. His wife was Yolande, a daughter of John I., king of Aragon, and his son was his successor, Louis III.

Louis III., duke of Anjou (1403–1434), born on the 25th of September 1403, made in his turn an attempt to conquer Naples. This was in 1420, and he had met with considerable success in his task when he died at Cosenza on the 15th of November 1434. In 1424 Louis received from King Charles VII. the duchy of Touraine.

Another titular king of Naples of this name was Louis, a son of Philip, prince of Taranto. In 1346 he became the husband of Joanna I., queen of Naples, and in 1352 he was crowned king. After making an attempt to conquer Sicily he died on the 26th of May 1362.

LOUIS (893–911), surnamed the "Child," king of the Franks, son of the emperor Arnulf, was born at Ottingen, designated by Arnulf as his successor in Germany in 897, and crowned on the 4th of February 900. Although he never received the imperial crown, he is sometimes referred to as the emperor Louis IV. His chief adviser was Hatto I., archbishop of Mainz; and during his reign the kingdom was ravaged by Hungarians and torn with internal strife. He appears to have passed his time in journeys from place to place, and in 910 was the nominal leader of an expedition against the Hungarians which was defeated near Augsburg. Louis, who was the last of the German Carolingians, died in August or September 911 and was buried at Regensburg.

See Regino von Prüm, "Chronicon," in the *Monumenta Germaniae historica. Scriptores*, Band i. (Hanover and Berlin, 1826); E. Dümmler, *Geschichte des ostfränkischen Reichs* (Leipzig, 1887–1888); O. Dietrich, *Beiträge zur Geschichte Arnolfs von Kärnthen und Ludwigs des Kindes* (Berlin, 1890); and E. Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881). (A. W. H.*)

LOUIS OF NASSAU (1538–1574), son of William, count of Nassau, and Juliana von Stolberg, and younger brother of William the Silent, took an active part in the revolt of the Netherlands against Spanish domination. He was one of the leaders of the league of nobles who signed the document known as "the Compromise" in 1566, and a little later was a member of the deputation who presented the petition of grievances called "the Request" to the regent, Margaret of Parma. It was on this occasion that the appellation of "the Beggars" (*les Gueux*) was first given to the opponents of King Philip's policy. On the arrival of Alva at Brussels, Count Louis, with his brother William, withdrew from the Netherlands and raised a body of troops in defence of the patriot cause. In the spring of 1568 Louis invaded Friesland, and at Heiligerlee, on the 23rd of May, completely defeated a Spanish force under Count Aremberg, who was killed. Alva then advanced to meet the invaders with a large army, and at Jemmingen (July 21), with very slight loss, annihilated the levies of Louis, who himself escaped by swimming from the field across an estuary of the Ems. He now joined the army of his brother William, which had in October to beat a hasty retreat before Alva's superior skill. Then Louis, in company with his brothers William and Henry, made his way across the French frontier to the camp of the Huguenot leader, Admiral Coligny. Louis took an active part in the campaign and fought heroically at Jarnac and Moncontour. In 1572 Louis, not deterred by previous disaster, raised a small force in France, and, suddenly entering Hainaut, captured Mons (May 23). Here he was besieged by Don Frederick of Toledo, Alva's natural son, who blockaded all approach to the town. William made an attempt to relieve his brother, but failed, and Mons had to surrender (September 17). Louis, who was sick with fever, withdrew to his ancestral home, Dillenburg, to recruit his health, and then once more to devote his energies to the raising of money and troops for another invasion of the Netherlands. In the hope of drawing away the Spaniards from the siege of Leiden by a diversion in the south, Louis, with his brothers John and Henry, at the head of a force of mixed nationalities and little discipline, crossed the frontier near Maastricht, and advanced as far as the Mookerheide near Nijmwegen. Here he was attacked by a body of Spanish veterans under an experienced leader, Sancho d'Avila, and speedily routed. In the disorderly flight both Louis and his younger brother Henry, refusing to abandon the field, lost their lives. Their bodies were never recovered. Thus perished at the age of thirty-six one of the most chivalrous and gifted of a gallant band of brothers, four of whom laid down their lives in their country's cause.

See P. J. Blok, *Lodewijk von Nassau, 1538–1574* (The Hague, 1689), and the *Cambridge Modern History*, vol. iii. chs. vi. and vii., and bibliography (1904); also A. J. Van der Aa, *Biographisck woordenboek der Nederlanden* (22 vols., Haarlem, 1852–1878).

LOUIS, JOSEPH DOMINIQUE, Baron (1755–1837), French statesman and financier, was born at Toul (Meurthe) on the 13th of November 1755. At the outbreak of the Revolution the abbé Louis (he had early taken orders) had already some reputation as a financial expert. He was in favour of the constitutional movement, and on the great festival of federation (July 14, 1790) he assisted Talleyrand, then bishop of Autun, to celebrate mass at the altar erected in the Champ de Mars. In 1792, however, he emigrated to England, where he spent his time studying English institutions and especially the financial system of Pitt. Returning to France on the establishment of the Consulate he served successively in the ministry of war, the council of state, and in the finance department in Holland and in Paris. Made a baron of the empire in 1809 he nevertheless supported the Bourbon restoration and was minister of finance in 1814–1815. Baron Louis was deputy from 1815 to 1824 and from 1827 to 1832. He resumed the portfolio of finance in 1815, which he held also in the Decazes ministry of 1818; he was the first minister of finance under the government of Louis Philippe, and held the same portfolio in 1831–1832. In 1832 he was made a peer of France and he died on the 26th of August 1837.

LOUIS PHILIPPE I., king of the French (1773–1850), was the eldest son of Louis Philip Joseph, duke of Orleans (known during the Revolution as Philippe Egalité) and of Louise Marie Adelaide de Bourbon, daughter of the duc de Penthièvre, and was born at the Palais Royal in Paris on the 6th of October 1773. On his father's side he was descended from the brother of Louis XIV., on his mother's from the count of Toulouse, "legitimated" son of Louis XIV. and Madame de Montespan. The legend that he was a supposititious child, really the son of an Italian police constable named Chiapponi, is dealt with elsewhere (see MARIA STELLA, countess of Newborough). The god-parents of the duke of Valois, as he was entitled till 1785, were Louis XVI. and Queen Marie Antoinette; his governess was the famous Madame de Genlis, to whose influence he doubtless owed many of the qualities which later distinguished him: his wide, if superficial knowledge, his orderliness, and perhaps his parsimony. Known since 1785 as the duc de Chartres, he was sixteen at the outbreak of the Revolution, into which—like his father—he threw himself with ardour. In 1790 he joined the Jacobin Club, in which the moderate elements still predominated, and was assiduous in attendance at the debates of the National Assembly. He thus became a *persona grata* with the party in power; he was already a colonel of dragoons, and in 1792 he was given a command in the army of the North. As a lieutenant-general, at the age of eighteen, he was present at the cannonade of Valmy (Sept. 20) and played a conspicuous part in the victory of Jemappes (Nov. 6).

The republic had meanwhile been proclaimed, and the duc de Chartres, who like his father had taken the name of *Egalité*, posed as its zealous adherent. Fortunately for him, he was too young to be elected deputy to the Convention, and while his father was voting for the death of Louis XVI. he was serving under Dumouriez in Holland. He shared in the disastrous day of Neerwinden (March 18, 1793); was an accomplice of Dumouriez in the plot to march on Paris and overthrow the republic, and on the 5th of April escaped with him from the enraged soldiers into the Austrian lines. He was destined not to return to France for twenty years. He went first, with his sister Madame Adelaide, to Switzerland where he obtained a situation for a few months as professor in the college of Reichenau under an assumed name,[1] mainly in order to escape from the fury of the *émigrés*. The execution of his father in November 1793 had made him duke of Orleans, and he now became the centre of the intrigues of the Orleanist party. In 1795 he was at Hamburg with Dumouriez, who still hoped to make him king. With characteristic caution Louis Philippe refused to commit himself by any overt pretensions, and announced his intention of going to America; but in the hope that something might happen in France to his advantage, he postponed his departure, travelling instead through the Scandinavian countries as far north as Lapland. But in 1796, the Directory having offered to release his mother and his two brothers, who had been kept in prison since the Terror, on condition that he went to America, he set sail for the United States, and in October settled in Philadelphia, where in February 1797 he was joined by his brothers the duc de Montpensier and the comte de Beaujolais. Two years were spent by them in travels in New England, the region of the Great Lakes, and of the Mississippi; then the news of the *coup d'état* of 18 Brumaire decided them to return to Europe. They returned in 1800, only to find Napoleon Bonaparte's power firmly established. Immediately on his arrival, in February 1800, the duke of Orleans, at the suggestion of Dumouriez, sought an interview with the comte d'Artois, through whose instrumentality he was reconciled with the exiled king Louis XVIII., who bestowed upon his brothers the order of the Saint Esprit. The duke, however, refused to join the army of Condé and to fight against France, an attitude in which he persisted throughout, while maintaining his loyalty to the king.[2] He settled with his brothers at Twickenham, near London, where he lived till 1807—for the most part in studious retirement.

On the 18th of May 1807 the duc de Montpensier died at Christchurch in Hampshire, where he had been taken for change of air, of consumption. The comte de Beaujolais was ill of the same disease and in 1808 the duke took him to Malta, where he died on the 29th of May. The duke now, in response to an invitation from King Ferdinand IV., visited Palermo where, on the 25th of November 1809 he married Princess Maria Amelia, the king's daughter. He remained in Sicily until the news of Napoleon's abdication recalled him to France. He was cordially received by Louis XVIII.; his military rank was confirmed, he was named colonel-general of hussars, and such of the vast Orleans estates as had not been sold were restored to him by royal ordinance. The object may have been, as M. Debidour suggests, to compromise him with the revolutionary parties and to bind him to the throne; but it is more probable that it was no more than an expression of the good will which the king had shown him ever since 1800. The immediate effect was to make him enormously rich, his wealth being increased by his natural aptitude for business until, after the death of his mother in 1821, his fortune was reckoned at some £8,000,000.

Meanwhile, in the heated atmosphere of the reaction, his sympathy with the Liberal opposition brought him again under suspicion. His attitude in the House of Peers in the autumn of 1815 cost him a two years' exile to Twickenham; he courted popularity by having his children educated *en bourgeois* at the public schools; and the Palais Royal became the rendezvous of all the leaders of that middle-class opinion by which he was ultimately to be raised to the throne.

His opportunity came with the revolution of 1830. During the three "July days" the duke kept himself discreetly in the background, retiring first to Neuilly, then to Raincy. Meanwhile, Thiers issued a proclamation pointing out that a Republic would embroil France with all Europe, while the duke of Orleans, who was "a prince devoted to the principles of the Revolution" and had "carried the tricolour under fire" would be a "citizen king" such as the country desired. This view was that of the rump of the chamber still sitting at the Palais Bourbon, and a deputation headed by Thiers and Laffitte waited upon the duke to invite him to place himself at the head of affairs. He returned with them to Paris on the 30th, and was elected by the deputies lieutenant-general of the realm. The next day, wrapped in a tricolour scarf and preceded by a drummer, he went on foot to the Hôtel de Ville—the headquarters of the republican party—where he was publicly embraced by Lafayette as a symbol that the republicans acknowledged the impossibility of realizing their own ideals and were prepared to accept a monarchy based on the popular will. Hitherto, in letters to Charles X., he had protested the loyalty of his intentions,[3] and the king now nominated him lieutenant-general and then, abdicating in favour of his grandson the comte de Chambord appointed him regent. On the 7th of August, however, the Chamber by a large majority declared Charles X. deposed, and proclaimed Louis Philippe "King of the French, by the grace of God and the will of the people."

The career of Louis Philippe as King of the French is dealt with elsewhere (see FRANCE: *History*). Here it must suffice to note something of his personal attitude towards affairs and the general effects which this produced. For the trappings of authority he cared little. To conciliate the revolutionary passion for equality he was content to veil his kingship for a while under a middle-class disguise. He erased the royal lilies from the panels of his carriages; and the Palais Royal, like the White House at Washington, stood open to all and sundry who cared to come and shake hands with the head of the state. This pose served to keep the democrats of the capital in a good temper, and so leave him free to consolidate the somewhat unstable foundation of his throne and to persuade his European fellow-sovereigns to acknowledge in him not a revolutionary but a conservative force. But when once his position at home and abroad had been established, it became increasingly clear that he possessed all the Bourbon tenaciousness of personal power. When a "party of Resistance" came into office with Casimir-Périer in March 1831, the speech from the throne proclaimed that "France has desired that the monarchy should become national, it does not desire that it should be powerless"; and the migration of the royal family to the Tuileries symbolized the right of the king not only to reign but to rule. Republican and Socialist agitation, culminating in a series of dangerous risings, strengthened the position of the king as defender of middle-class interest; and since the middle classes constituted the *pays légal* which alone was represented in Parliament, he came to regard his position as unassailable, especially after the suppression of the risings under Blanqui and Barbès in 1839. Little by little his policy, always supported by a majority in a house of representatives elected by a corrupt and narrow franchise, became more reactionary and purely dynastic. His position in France seeming to be unassailable, he sought to strengthen it in Europe by family alliances. The fact that his daughter Louise was the consort of Leopold I., king of the Belgians, had brought him into intimate and cordial relations with the English court, which did much to cement the *entente cordiale* with Great Britain. Broken in 1840 during the affair of Mehemet Ali (*q.v.*) the entente was patched up in 1841 by the Straits Convention and re-cemented by visits paid by Queen Victoria and Prince Albert to the Château d'Eu in 1843 and 1845 and of Louis Philippe to Windsor in 1844, only to be irretrievably wrecked by the affair of the "Spanish marriages," a deliberate attempt to revive the traditional Bourbon policy of French predominance in Spain. If in this matter Louis Philippe had seemed to sacrifice the international position of France to dynastic interests, his attempt to re-establish it by allying himself with the reactionary monarchies against the Liberals of Switzerland finally alienated from him the French Liberal opinion on which his authority was based. When, in February 1848, Paris rose against him, he found that he was practically isolated in France.

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[1] As M. Chabaud de la Tour. He was examined as to his fitness before being appointed. Gruyer, p. 165.

[2] This at least was his own claim and the *Orleanist* view. The matter became a question of partisan controversy, the legitimists asserting that he frequently offered to serve against France, but that his offers were contemptuously refused. A. Debidour in the article "Louis-Philippe" in *La Grande Encyclopédie* supports the latter view; but see Gruyer, *La Jeunesse*, and E. Daudet, "Une réconciliation de famille en 1800," in the *Revue des Deux Mondes*, Sept. 15, 1905, p. 301. M. Daudet gives the account of the interview left by the comte d'Artois, and he also makes it clear that Louis Philippe, while protesting his loyalty to the head of his house, did not disguise his opinion that a Restoration would only be possible if the king accepted the essential changes made by the Revolution.

[3] To say that these protestations were hypocritical is to assume too much. Personal ambition doubtless played a part; but he must have soon realized that the French people had wearied of "legitimism" and that a regency in the circumstances was impossible.

Charles X., after abdicating, had made a dignified exit from France, marching to the coast surrounded by the cavalry, infantry and artillery of his Guard. Louis Philippe was less happily situated. Escaping with the queen from the Tuileries by a back entrance, he made his way with her in disguise to Honfleur, where the royal couple found refuge in a gardener's cottage. They were ultimately smuggled out of the country by the British consul at Havre as Mr and Mrs Smith,[1] arriving at Newhaven "unprovided with anything but the clothes they wore." They settled at Claremont, placed at their disposal by Queen Victoria, under the *incognito* of count and countess of Neuilly. Here on the 26th of August 1850, Louis Philippe died.

The character of Louis Philippe is admirably traced by Queen Victoria in a memorandum of May 2, 1855, in which she compares him with Napoleon III. She speaks of his "vast knowledge upon all and every subject," and "his great activity of mind." He was, unlike Napoleon, "*thoroughly French* in character, possessing all the liveliness and talkativeness of that people." But she also speaks of the "tricks and over-reachings" practised by him, "who in great as well as in small things took a pleasure in being cleverer and more cunning than others, often when there was no advantage to be gained by it, and which was, unfortunately, strikingly displayed in the transactions connected with the Spanish marriages, which led to the king's downfall, and ruined him in the eyes of all Europe" (*Letters*, pop. ed., iii. 122).

Louis Philippe had eight children. His eldest son, the popular Ferdinand Philippe, duke of Orleans (b. 1810), who had married Princess Helena of Mecklenburg, was killed in a carriage accident on the 13th of July 1842, leaving two sons, the comte de Paris and the duc de Chartres. The other children were Louise, consort of Leopold I., king of the Belgians; Marie, who married Prince Alexander of Württemberg and died in 1839; Louis Charles, duc de Nemours; Clementine, married to the duke of Coburg-Kohary; François Ferdinand, prince de Joinville; Henri Eugène, duc d'Aumale (*q.v.*); Antoine Philippe, duc de Montpensier, who married the Infanta, younger sister of Queen Isabella of Spain.

AUTHORITIES.—F. A. Gruyer, *La Jeunesse du roi Louis-Philippe, d'après les pourtraits et des tableaux* (Paris, 1909), édition de luxe, with beautiful reproductions of portraits, miniatures, &c.; Marquis de Flers, *Louis-Philippe, vie anecdotique, 1773–1850* (Paris, 1891); E. Daudet, *Hist. de l'émigration* (3 vols., Paris, 1886–1890). Of general works on Louis Philippe's reign may be mentioned Louis Blanc, *Hist. de Dix Ans, 1830–1840* (5 vols., Paris, 1841–1844), from the republican point of view; J. O. d'Haussonville, *Hist. de la politique extérieure de la monarchie de juillet, 1830–1848* (2 vols., Paris, 1850); V. de Nouvion, *Hist. de Louis-Philippe* (4 vols., Paris, 1857–1861); F. Guizot, *France under Louis Philippe, 1841–1847* (Eng. trans., 1865); Karl Hillebrand, *Geschichte Frankreichs von der Thronbesteigung Louis Philippes, 1830–1841* (2 vols., Gotha, 1877–1879); V. du Bled, *Hist. de la monarchie de juillet* (2 vols., Paris, 1887); P. Thureau-Dangin, *Hist. de la monarchie de juillet* (Paris, 1887, &c.); A. Malet, "La France sous la monarchie de juillet," in Lavisse and Rambaud's *Hist. Générale*, vol. x. ch. x. (Paris, 1898); G. Weill, *La France sous la monarchie de juillet* (Paris, 1902); Emile Bourgeois, "The Orleans Monarchy," ch. xv. of vol. x., and "The Fall of Constitutionalism in France," ch. ii. of vol. xi. of the *Cambridge Modern History* (Cambridge, 1907 and 1909). Further works will be found in the bibliographies attached by M. Bourgeois to his chapters (vol. x. p. 844, vol. xi. p. 874; the latter including works on the revolution of 1848 and the Second Republic). To the list of published correspondence and memoirs there mentioned may be added the *Chronique* of the duchesse de Dino (Paris, 1909).

Louis Philippe himself published the *Journal du duc de Chartres, 1790–1791*; *Mon Journal, événements de 1815* (2 vols., 1849); *Discours, allocutions et réponses de S. M. Louis-Philippe, 1830–1846*; and after his death was issued his *Correspondance, mémoire et discours inédits* (Paris, 1863). (W. A. P.)

LOUISBURG, a town and port of entry of Cape Breton county, Nova Scotia, Canada, on the Sydney & Louisburg railway, 39 m. from Sydney. Pop. (1901) 1588. Under the French *régime*, Louisburg was second only to Quebec. A fortress was erected at enormous expense, and the city was the centre of the cod-fisheries. The fortress was, however, captured in 1745 by the American colonists, under Sir William Pepperrell (1696–1759), assisted by the British fleet, and again in 1758 by a British land and sea force under General Jeffrey Amherst (1717–1797) and Admiral Boscawen. The jealousy of the British settlement of Halifax led to its almost utter destruction, and only a few casemates now remain. Under English rule a fishing village grew up on the other side of the harbour, and has now become the winter shipping port of the Dominion Coal Company. The harbour is deep, spacious and open all the year round, though occasionally blocked by drift ice in the spring.

LOUISE [AUGUSTE WILHELMINE AMALIE LUISE] (1776–1810), queen of Prussia, was born on the 10th of March 1776 in Hanover, where her father, Prince Charles of Mecklenburg-Strelitz, was field-marshal of the household brigade. Her mother was a princess of Hesse-Darmstadt. In 1793 Louise met at Frankfort the crown prince of Prussia, afterwards King Frederick William III., who was so fascinated by her beauty, and by the nobleness of her character, that he asked her to become his wife. They were married on the 24th of December of the same year. As queen of Prussia she commanded universal respect and affection, and nothing in Prussian history is more pathetic than the dignity and unflinching courage with which she bore the sufferings inflicted on her and her family during the war between Prussia and France. After the battle of Jena she went with her husband to Königsberg, and when the battles of Eylau and Friedland had placed Prussia absolutely at the mercy of France, she made a personal appeal to Napoleon at his headquarters in Tilsit, but without success. Early in 1808 she accompanied the king from Memel to Königsberg, whence, towards the end of the year, she visited St Petersburg, returning to Berlin on the 23rd of December 1809. During the war Napoleon attempted to destroy the queen's reputation, but the only effect of his charges in Prussia was to make her more deeply beloved. On the 19th of July 1810 she died in her husband's arms, while visiting her father in Strelitz. She was buried in the garden of the palace at Charlottenburg, where a mausoleum, containing a fine recumbent statue by Rauch, was built over her grave. In 1840 her husband was buried by her side. The Louise Foundation (Luisenstift) for the education of girls was established in her honour, and in 1814 Frederick William III. instituted the Order of Louise (Luisenorden). In 1880 a statue of Queen Louise was erected in the Thiergarten at Berlin.

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[1] There is a vivid account in Mr Featherstonhaugh to Lord Palmerston, Havre, March 3, 1848, in *The Letters of Queen Victoria* (pop. ed., ii. 156).

See F. Adami, *Luise, Königin von Preussen* (7th ed., 1875); E. Engel, *Königin Luise* (1876); A. Kluckhohn, *Luise, Königin von Preussen* (1876); Mommsen and Treitschke, *Königin Luise* (1876); in English, Hudson, *Life and Times of Louisa, Queen of Prussia* (1874); G. Horn, *Das Buch von der Königin Luise* (Berlin, 1883); A. Lonke, *Königin Luise von Preussen* (Leipzig, 1903); H. von Petersdorff, "Königin Luise," *Frauenleben*, Bd. i. (Bielefeld, 1903, 2nd ed., 1904).

LOUISE OF SAVOY (1476–1531), duchess of Angoulême, mother of Francis I. of France, was daughter of a cadet of the house of Savoy, Philip, count of Bresse, afterwards duke of Savoy. Through her mother, Marguerite de Bourbon, she was niece of Pierre de Bourbon, sire de Beaujeu, afterwards duke of Bourbon. At the age of twelve she was married to Charles of Valois, count of Angoulême, great-grandson of King Charles V. The count died in 1496, leaving her the mother of two children, Marguerite (b. 1492) and Francis (b. 1494). The accession of Louis XII., who was childless, made Francis of Angoulême the heir-presumptive to the throne of France. Louise brought her children to the court, and received Amboise as her residence. She lived henceforth in fear lest Louis should have a son; and in consequence there was a secret rivalry between her and the queen, Anne of Brittany. Finally, her son became king on the 1st of January 1515 by the death of Louis XII. From him Louise received the county of Angoulême, which was erected into a duchy, the duchy of Anjou, and the counties of Maine and Beaufort. She was then given the title of "Madame." From 1515 to her death, she took the chief share in the government. The part she played has been variously judged, and is not yet completely elucidated. It is certain that Louise had a clear head, practical good sense and tenacity. In the critical situation after the battle of Pavia (1525) she proved herself equal to the emergency, maintained order in the kingdom, and manœuvred very skilfully to detach Henry VIII. of England from the imperial alliance. But she appears to have been passionate, exceedingly rapacious and ever careful of her own interest. In her malignant disputes with the constable de Bourbon on the question of his wife's succession, she goaded him to extreme measures, and her rapacity showed itself also in her dealings with the *surintendant des finances*, J. de Beaune, baron de Semblançay (d. 1527), who diverted the money intended for the French soldiers in Italy into the coffers of the queen, and suffered death in consequence. She died in 1531, and Francis reunited to the crown her domains, which comprised the Bourbonnais, Beaujolais, Auvergne, la Marche, Angoumois, Maine and Anjou.

There is extant a *Journal* of Louise of Savoy, the authenticity of which seems certain. It consists of brief notes—generally very exact and sometimes ironical—which go as far as the year 1522. The only trustworthy text is that published by Guichenon in his *Histoire généalogique de la maison de Savoie* (ed. of 1778–1780, vol. iv.).

See *Poésies de François I^{er} et de Louise de Savoie* . . ., ed. by Champollion-Figeac (1847); De Maulde, *Louise de Savoie et François I^{er}* (1895); G. Jacqueton, *La Politique extérieure de Louise de Savoie* . . . (1892); H. Hauser, "Étude critique sur le Journal de Louise de Savoie," in the *Revue historique*, vol. 86 (1904).

LOUISIADE ARCHIPELAGO, a chain of islands in the Pacific Ocean, extending south-eastward from the easternmost promontory of New Guinea, and included in the Australian territory of Papua (British New Guinea). The islands number over eighty, and are interspersed with reefs. They are rich in tropical forest products, and gold has been discovered on the chief island, Tagula or South-east (area 380 sq. m.) and on Misima or St Aignan. The natives are of Papuan type, and practise cannibalism. The islands were probably observed by Torres in 1606, but were named by L. A. de Bougainville in 1768 after Louis XV.

LOUISIANA, one of the Southern States of the United States of America, lying on the N. coast of the Gulf of Mexico. Beginning on the N., its boundary follows eastward the parallel of 33° N., separating Louisiana from Arkansas; then descends the Mississippi river, separating it from the state of Mississippi, southward to 31°; passes eastward on this parallel to the Pearl river, still with the state of Mississippi on the E.; and descends this river to the Gulf. On the W. the Sabine river, from the Gulf to 32° N., and, thence to the parallel of 33°, a line a little W. of (and parallel to) the meridian of 94° W., separate Louisiana from Texas. Including islands in the Gulf, the stretch of latitude is approximately 4° and of longitude 5°. The total area is 48,506 sq. m., of which 3097 sq. m. are water surface (including 1060 sq. m. of landlocked coastal bays called "lakes"). The coast line is about 1500 m.

Physical Features.—Geologically Louisiana is a very recent creation, and belongs to the "Coastal Plain Province." Most of the rocks or soils composing its surface were formed as submarine deposits; the easternmost and southernmost parts are true river deposits. These facts are the key to the state's chorography. The average elevation of the state above the sea is only about 75 ft., and practically the only parts more than 400 ft. high are hills in Sabine, Claiborne and Vernon parishes. The physiographic features are few and very simple. The essential elements are five[1]: diluvial plains, coast marshes, prairies, "bluffs" and "pine-hills" (to use the local nomenclature). These were successive stages in the geologic process which has created, and is still actively modifying, the state. They are all seen, spread from N. to S., west of the Mississippi, and also, save only the prairies, in the so-called "Florida parishes" E. of the Mississippi.

These different elements in the region W. of the Mississippi are arranged from N. to S. in the order of decreasing geologic age and maturity. Beginning with elevations of about 400 ft. near the Arkansas line, there is a gentle slope toward the S.E. The northern part can best be regarded as a low plateau (once marine sediments) sloping southward, traversed by the large diluvial valleys of the Mississippi, Red and Ouachita rivers, and recut by smaller tributaries into smaller plateaus and rather uniform flat-topped hills. The "bluffs" (remnants of an eroded plain formed of alluvion deposits over an old, mature and drowned topography) run through the second tier of parishes W. of the Mississippi above the Red river. Below this river prairie areas become increasingly common, constituting the entire S.W. corner of the state. They are usually only 20 to 30 ft. above the sea in this district, never above 70, and are generally treeless except for marginal timber along the sluggish, meandering streams. One of their peculiar features—the sandy circular "mounds," 2 to 10 ft. high and 20 to 30 or even 50 ft. in diameter, sometimes surmounted by trees in the midst of a treeless plain and sometimes arranged in circles and on radii, and decreasing in size with distance from the centre of the field—has been variously explained. The mounds were probably formed by some gentle eruptive action like that exhibited in the "mud hills" along the Mississippi below New Orleans; but no explanation is generally accepted. The prairies shade off into the coast marshes. This fringe of wooded swamp and sea marsh is generally 20 to 30, but in places even 50 and 60 m. in width. Where the marsh is open and grassy, flooded only at high tides or in rainy seasons, and the ground firm enough to bear cattle, it is used as range. Considerable tracts have also been diked and reclaimed for cotton, sugar and especially for rice culture. The tidal action of the gulf is so slight and the marshes are so low that perfect drainage cannot be obtained through tide gates, which must therefore be supplemented by pumping machinery when rains are heavy or landward winds long prevail. Slight ridges along the streams and bayous which traverse it, and occasional patches of slightly elevated prairie, relieve in a measure the monotonous expanse. It is in and along the borders of this coast swamp region that most of the rice and much of the sugar cane of the state are grown. Long bar-like "islands" (conspicuous high land rising above the marsh and prairie)—Orange, Petite Anse, Grand Cote, Cote Blanche and Belle Isle—offer very interesting topographical and geological problems. "Trembling prairies"—land that trembles under the tread of men or cattle—are common near the coast. Most of the swamp fringe is reclaimable. The marshes encroach most upon the parishes of St Charles, Orleans and Plaquemines. In St Charles the cultivable strip of land along the river is only about 3 m. wide. In Orleans the city of New Orleans occupies nearly all the high ground and encroaches on the swamps. In Plaquemines there is practically no cultivable land below Forts Jackson and St Philip, and above there is only a narrow strip.

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[1] A sixth, less characteristic, might be included, viz. the "pine flats," generally wet, which are N. of Lake Pontchartrain, between the alluvial lands and the pine hills, and, in the S.E. corner of the state, between the hills and the prairie.

The alluvial lands include the river flood plains. The principal rivers are the Mississippi, which flows nearly 600 m. through and along the border of the state, the Red river, the Ouachita (or Washita), Sabine and Pearl; all except the last are navigable at all stages of the water. There are many "bayous," several of which are of great importance, both for navigation and for drainage. They may be characterized as secondary outlets of the rivers or flood distributaries. Among them are Bayou Teche, Bayou Plaquemine, Atchafalaya Bayou,[1] Bayou Lafourche and Bayou Bœuf. Almost all secondary water-courses, particularly if they have sluggish currents, are known as bayous. Some might well be called lakes, and others rivers. The alluvial portion of the state, especially below the mouth of the Red river, is an intricate network of these bayous, which, before their closure by a levee system, served partially, in time of flood, to carry off the escaping surplus of river waters. They are comparatively inactive at all seasons; indeed, the action of the tides and back-waters and the tangle of vegetation in the sombre swamps and forests through which they run, often render their currents almost imperceptible at ordinary water. Navigable waters are said to penetrate all but four of the parishes of the state, their total length approximating 3800 m.

Each of the larger streams, as well as a large proportion of the smaller ones, is accompanied by a belt of bottom land, of greater or less width, lying low as regards the stream, and liable to overflow at times of high water. These flood plains form collectively what is known as the alluvial region, which extends in a broad belt down the Mississippi, from the mouth of the Ohio to the Gulf of Mexico, and up the Ouachita and its branches and the Red river to and beyond the limits of the state. Its breadth along the Mississippi within Louisiana ranges from 10 to 50 or 60 m., and that along the Red river and the Ouachita has an average breadth of 10 m. Through its great flood-plain the Mississippi river winds upon the summit of a ridge formed by its own deposits. In each direction the country falls away in a succession of minor undulations, the summits of the ridges being occupied by the streams and bayous. Nearly all of this vast flood-plain lies below the level of high water in the Mississippi, and, but for the protection afforded by the levees, every considerable rise of its waters would inundate vast areas of fertile and cultivated land. The low regions of Louisiana, including the alluvial lands and the coast swamps, comprise about 20,000 sq. m., or nearly one-half the area of the state. The remainder consists of the uplands of prairie and forest.

The alluvial region of the state in 1909 was mainly protected against overflow from the Mississippi river by 754 m. of levee on the Mississippi river within the state, and 84 m. on the Mississippi river, Cypress and Amos Bayou in Arkansas, forming part of the general system which extends through other states, 1000 m. up to the highlands about the junction of the Ohio river. The state and the national government co-operate in the construction and maintenance of this system, but the Federal government did not give material aid (the only exception being the grant of swamp lands in 1850) until the exceptionally disastrous flood in 1882. For about a century and a half before that time, levee building had been undertaken in a more or less spasmodic and tentative way, first by riparian proprietors, then by local combinations of public and private interests, and finally by the state, acting through levee districts, advised by a Board of Engineers. The Federal government, after its participation in the work, acted through a Board of Engineers, known as the "Mississippi River Commission." The system of 754 m. of Mississippi river levees, within the state, was built almost entirely after 1866, and represents an expenditure of about $43,000,000 for primary construction alone; of this sum, the national government contributed probably a third (the state expended about $24,000,000 on levees before the Civil War). Some of the levees, especially those in swampy regions where outlet bayous are closed, are of extraordinary solidity and dimensions, being 20 to 40 ft. high, or even more, across streams or bayous—formerly outlets—with bases of 8 or 10 ft. to one of height. The task of maintenance consists almost entirely in closing the gaps which occur when the banks on which the levees are built cave into the river. Levee systems on some of the interior or tributary rivers, aggregating some 602 m., are exclusively built and maintained by the state. Louisiana also contributes largely to the 84 m. of levee in Arkansas, necessary to its security from overflow. The improvement of bayous, channels, the construction of canals and the drainage of swamp lands also contribute to the protection of the state.

The lakes are mainly in three classes. First come the coast lagoons, many of which are merely land-locked salt-water bays, the waters of which rise and fall with the tides. Of this class are Pontchartrain, Borgne, Maurepas and Sabine. These are simply parts of the sea which have escaped the filling-in process carried on by the great river and the lesser streams. A second class, called "ox-bow" lakes, large in numbers but small in area, includes ordinary cut-off meanders along the Mississippi and Red rivers. A third class, those upon the Red river and its branches, are caused mainly by the partial stoppage of the water above Shreveport by the "raft," a mass of drift such as frequently gathers in western rivers, which for a distance of 45 m. almost completely closed the channel until it was broken up by government engineers. These lakes are much larger at flood season than at other times, and have been much reduced in size by the cutting of a channel through the raft. Lakes of this class are sometimes formed by the choking of the mouth of feeble tributaries by silt deposited by the Red river where the currents meet.

Mineral Resources.—Mineral resources are few, but important. In the Tertiary region are found small quantities of iron ore and an indifferent brown coal. The important mineral products are salt, sulphur, petroleum and natural gas. The deposit of rock salt on Petite Anse Island, in the coast swamp region, has been extensively worked since its discovery during the Civil War. The deposit is in places 1000 ft. thick, and yields salt of extraordinary purity (sometimes 99 % pure). There are large deposits also on Orange Island (in places at least 1800 ft. thick), on Week's Island, on Belle Isle and probably beneath the intervening marshes. In 1907 Louisiana ranked sixth among the salt-producing states of the country (after New York, Michigan, Ohio, Kansas and California), its output being valued at $226,892, only a few hundred dollars more than that of Texas. Near Lake Charles, at Sulphur, are very extraordinary sulphur deposits. The beds lie several (for the most part four to six) hundred feet underground and are of disputed origin. Many regard them as products of an extinct volcano; according to others they are of vegetable origin (they are found in conjunction with gypsum). They were discovered before 1870 by searchers after petroleum, but their exploitation remained in the experimental stage until about 1900. The sulphur is dissolved by superheated water forced down pipes, and the water with sulphur in solution is forced upward by hot air pressure through other pipes; the sulphur comes, 99 % pure, to the surface of the ground, where it is cooled in immense bins, and then broken up and loaded directly upon cars for shipment. These mines divide with the Sicilian mines the control of the sulphur market of the world. The value of the sulphur taken from the mines of Louisiana in 1907 was a little more than $5,000,000. Evidences of petroleum were discovered long ago, in the very field where in recent years the Beaumont and Vinton wells were bored. In 1909 Jennings was the chief field in Louisiana, lesser fields being at Welsh, Anse la Butte, Caddo and Vinton. The Jennings field, one of the greatest in the United States, produced up to and including 1907 more than 26,000,000 barrels of high-grade oil, twelve-thirteenths of which came from an area of only 50 acres, one well producing a tenth of the entire output. In 1907 the state produced 5,000,221 barrels of petroleum, valued at $4,063,033. Natural gas is found in Caddo parish, about 20 m. N. of Shreveport. The depth of the wells is from 840 to 2150 ft.; two wells completed in 1907 had a daily capacity estimated at 35,000,000 to 50,000,000 ft. Shreveport, Oil City, Blanchard, Mooringsport, Bossier City and Texarkana are supplied with natural gas by pipe lines from this field. Kaolin is found in the state; in 1907 the total value of all clay products was $928,579.

Climate.—The climate is semi-tropical and exceptionally equable over large areas. In the S. and S.E. the equable temperature is largely the effect of the network of bays, bayous and lakes, and throughout the state the climate is materially influenced by the prevailing southerly winds from the Gulf of Mexico. Some daily variation in the temperature of adjoining localities is caused by a dark soil in the one and a light soil in the other, but the differences of mean annual temperature are almost wholly due to differences of latitude and elevation. The mean annual temperature for a period of nineteen years (Jan. 1888 to Dec. 1906) ranged from 70° F. at Port Eads, in the extreme S.E., to 65° F. at Lake Providence, in the N.E. The mean temperature of July, the hottest month, is comparatively uniform over the state, varying only from 81° to 83°; the mean for January, the coldest month, varies from 46° in the extreme north to 56° in the extreme south. Even in the coldest localities eight or nine months are wholly free from frost, and in the coast parishes frost occurs only a few days in each year. Rainfall is usually heavy in the S.E., but it decreases toward the N.W. As much as 85·6 in. have fallen within a year at New Orleans, but in this locality the average for a year is about 57·6 in.; at Shreveport the average is 46 in., and for the entire state it is 55 in. Much more rain falls in summer than in any other season, but in some parts the heaviest rainfall is in the spring and in others in the winter. A light fall of snow is not uncommon in the northern parishes, but in the southern part of the state snow falls not oftener than once in three to five years. Hailstorms are infrequent everywhere, but especially so

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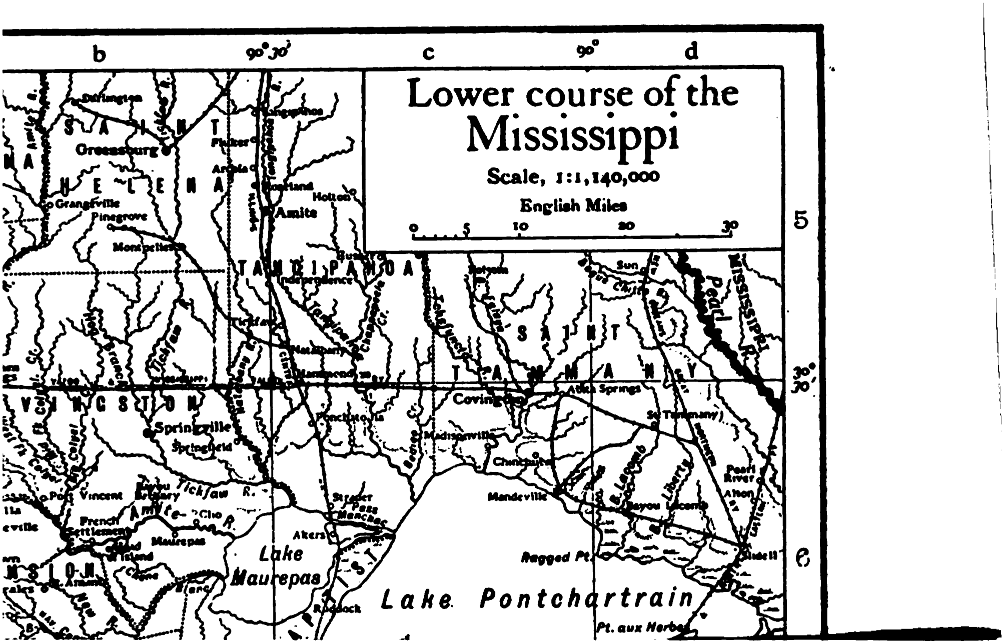
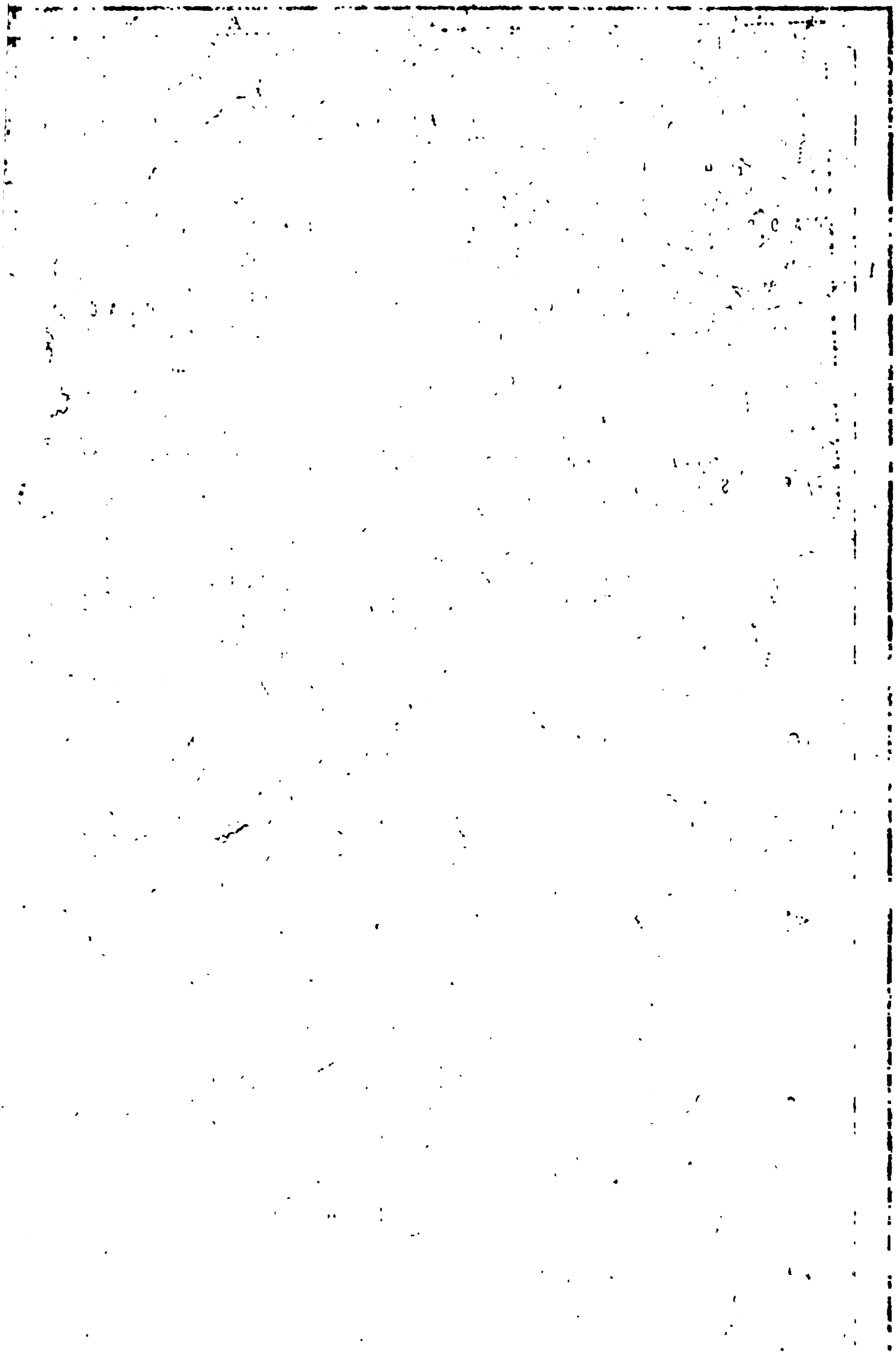
[1] The original channel of the Red river. It has been so useful in relieving the Mississippi of floods, that the Red river may possibly be permanently diverted again into the bayou artificially.


Lower course of the Mississippi
Scale, 1:1,140,000
English Miles
0 5 10 20 30
b
90° 30'
c
90°
d
5
6
30° 30'
SAINT HELENA
TANGIPAHOA
SAINT TAMMANY
LIVINGSTON
Greensburg
Amite
Covington
Springville
Ponchatoula
Madisonville
Mandeville
Slidell
Pearl River
Lake Maurepas
Lake Pontchartrain
Tickfaw R.
Pearl R.
Mississippi
Pt. aux Herbes
Ragged Pt.
Bayou Lacombe
Port Vincent
French Settlement
Maurepas
Abita Springs
Chinchuba
Akers
Manchac
Pass Manchac



in the south. Only a fourth to a half of the days of the different months are wholly or partly clear even in the north, and in the same district the monthly means of relative humidity vary from 65 to 70.

Fauna.—The entire state is included within the Austro-riparian life zone; the higher portions fall within the Carolinian area and the lower portions, including the Gulf and the Mississippi embayment almost to the N.E. corner of the state, constitute a special semi-tropical region. The native fauna of the state resembles in its general features that of the other Gulf states. The feral fauna was once rather varied. Black bears, wolves and deer are not yet extinct, and more rarely a "wild cat" (lynx) or "panther" (puma) is seen in the swamps. Of smaller mammals, raccoons, squirrels and opossums are very common. Every bayou contains alligators; and reptiles of various species, such as turtles, lizards, horned toads, rattlesnakes and moccasins are abundant. Shrimps, frogs (of great commercial importance), terrapin, clams and oysters are common. Only in very recent years have oysters, though plentiful, become of competitive importance in the national market; they are greatly favoured by state protective legislation. In 1904 a state oyster commission was created to supplant the independent control by the parishes. An important boundary dispute with Mississippi arose over beds lying near the state line. The state leases the beds at a low annual rental in tracts (limited for each person, firm or corporation to 1000 acres), and draws from them a considerable revenue. The avifauna is varied and abundant, comprising eagles, vultures (protected by law), hawks, owls, pelicans, cranes, turkeys, geese, "partridges" (called quail or "Bob White" elsewhere), ducks, &c., besides numerous smaller species, many of which are brilliant of plumage but harsh of voice.

Flora.—Heavy rainfall, high temperature and fertile soil combine to cover the greater part of the state, and particularly the alluvial regions and the coast swamps, with a most luxuriant subtropical vegetation, both arborescent and herbaceous. Louisiana is justly celebrated for the beauty and fragrance of its flowers. The range of temperature is not sufficient to give the variety of annual wild flowers of more northern climates; nevertheless flowers cover the bottom lands and uplands in great profusion. The upland flora is the more diversified. Flowering annuals are mainly aquatic. Water lilies, water hyacinths, which are an obstruction in many streams, and irises in rich variety give colour to the coast wastes and sombre bayous. Notable among the flora are roses, japonicas, hibiscus shrubs of various species, poinsettias, tea olives, crepe myrtle, jasmines, magnolias, camellias, oleanders, chrysanthemums, geraniums and plumbagos. The value and variety of the timber are very great. Much of the river swamp region is covered with cypress trees festooned with Spanish moss. The most common species in the alluvial regions and, to a less degree, in the drier portions of the swamps and in the stream bottoms of the prairies are various oaks, black, sweet and tupelo gum, holly, cotton-wood, poplar, magnolia sweet bay, the tulip tree, catalpa, black walnut, pecans, hickories, ash, beech and short-leaf pine. On drier and higher soils are the persimmon, sassafras, red maple, elm, black haw, hawthorn, various oaks (in all 10 species occur), hickories and splendid forests of long-leaf and loblolly yellow pine.

Forestry.—These forests are the greatest and finest of their kind remaining in the United States. In 1898 it was estimated by Henry Gannett (followed by the Federal census of 1900) that the timbered area covered 28,300 sq. m. Professor C. S. Sargent estimated in 1884 that the stand of short-leaf and long-leaf pines aggregated respectively 21,625 and 26,558 million feet. The timber product of 1900 ($17,294,444) was almost ten times that of 1880 ($1,764,640); and in 1905 the product value ($35,192,374) was more than twice that of 1900. Nevertheless, in 1900 the cypress forests remained practically untouched, only slight impression had been made upon the pine areas, and the hard-wood forests, except that they had been culled of their choicest oak, remained in their primal state (U.S. census). Between 1900 and 1905 furniture factories and planing mills became somewhat important. Pond pine occurs only near the Pearl river. Curly pine is fairly abundant. The eastern pine belt is composed of the long-leaf pine, interspersed with some loblolly. It covers an area of about 3900 sq. m. The south-western pine belt contains the heaviest growth of long-leaf pine timber in the world, covering an area of about 4200 sq. m., and occasionally interspersed with short-leaf pine. The short-leaf growth is especially heavy in the north-western portion of the state, while the long-leaf is found mainly in large masses N. and S. of the Red river around Alexandria as a centre. The cypress forests of the alluvial and overflowed lands in the S. of the state are among the largest and the most heavily timbered known. The hard-woods are found in the river bottoms throughout the state.

Agriculture and Soils.—Agriculture is the chief industry of the state. In 1900 26·2% of the land was in farms, and of this area about two-fifths was improved. The size of the average farm decreased in the two preceding decades from 171·3 to 95·4 acres. The percentage of farms operated by owners (*i.e.* owners, part owners, owners and tenants, and managers) fell from 64·8 to 42·1% from 1880 to 1900, and the percentage operated by cash tenants increased from 13·8 in 1880 to 24·9 in 1900, and by share tenants from 21·5 in 1880 to 33·0 in 1900; the percentage of farms operated by white farmers was 49·8 in 1900. The value of farm property, $198,536,906 in 1900, increased 79·8% in the preceding decade. The value of live stock in the latter year was $28,869,506. The total value of all farm products in 1899 was $72,667,302, of which $59,276,092 was the value of the distinctive crops—cotton, sugar and rice. The state bureau of agriculture in 1903 estimated that of the total area 14·9 millions of acres were timber land, 5·7 millions pasture and marsh, and 5·0 millions cultivated farm land.

In the N. there are many sandy districts in the uplands, also sandy clays; in the "second bottoms" of the streams fertile sandy loams; abundant tertiary marls in the north-central region; some gypsum in the cretaceous "islands"; and some fossiliferous marls with decomposed limestones. The prairies of south-western Louisiana have much yellow marl underlying them. Alluvial soil and bluff, the location of which has been indicated, are of primary agricultural importance. Reclaimed marsh-land and fresh alluvium (the so-called "front-lands" on rivers and bayous) are choice soil for Indian corn, sugar-cane, perique tobacco, semi-tropical fruits and cotton. The bluff lands are simply old alluvium now well drained and above all floods. The prairies of the S.W. are devoted almost exclusively to rice. On the hills yellow-leaf tobacco can be grown. Cereals and forage plants can be successfully grown everywhere, and varied and profitable agriculture is possible even on the "pine-barrens" or uplands of the N.; but more intelligent and more intensive farming is necessary than that practised by the average "piney-woods" farmer. The alluvial section of lower Louisiana is mostly devoted to sugar, and farther northward to Indian corn and cotton.

Cotton is the principal crop. In 1907 Louisiana ranked eighth in acreage of cotton (1,622,000 acres) among the states of the United States, and in 1907–1908 the cotton crop (675,428 bales) was eighth among the crops of the states. The average yield per acre varies from about ·45 to ·75 bale according to the season. In good seasons and exceptional localities the yield may approach a bale per acre, as in Assumption parish, and in the Mississippi valley at the junction of Louisiana, Mississippi and Arkansas. For many years there has been a reaction against the all-cotton farming system. In general, the small cotton farmer was at the mercy of the commission merchant, to whom he mortgaged his crops in advance; but this evil has lessened, and in some districts the system of advancing is either non-existent or very slightly developed.

In 1907–1908 all the sugar produced from cane grown in the United States came from Louisiana (335,000 long tons) and Texas (12,000 tons); in the same year cane sugar from Hawaii amounted to 420,000 tons, from Porto Rico to 217,000 tons and from the Philippines to 135,000 tons; and the total yield of beet sugar from the United States was 413,954 tons. Of all the cane grown, an amount between one-sixth and one-quarter—and that the best—must be reserved for seed every other year, and this is a great handicap to the state in competing with other cane regions and with the sugar beet. Of the total sugar consumption of the country in 1899–1904 Louisiana produced somewhat more than a fifteenth. Since about 1880 there have been central factories, and their increase has been a very prominent factor in the development of the industry, as it has been in Cuba. Though very much of the region S. of the Red river is fairly well suited to sugar-growing, it is still true that sugar cannot, over much of this area, be grown to so great advantage as other crops. Its hold upon the delta region is, however, almost unchallenged, especially since the rice farmers have found in the prairie lands that excel the delta for their purposes. Sugar is grown also in St Landry and the eastern part of Attakapas—a name formerly loosely applied to what are now St Mary, Iberia, Vermilion, St Martin and Lafayette parishes. Though introduced with success from Santo Domingo about the middle of the 18th century, the sugar industry practically dates from 1796, when Étienne Boré first succeeded in crystallizing and clarifying the syrup. Steam motive power was first introduced on the plantations in 1822. The average product of the ten seasons 1894–1904 was 299,745 tons. A state sugar experiment station is maintained at Audubon Park in New Orleans, its work embracing the development of seedlings, the improvement of cane varieties, the study of fungus diseases of the cane, the improvement of mill methods and the reconciliation of such methods (for example, the use of sulphur as a bleaching and clarifying agent) with the requirements of "pure food" laws. Good work has also been done by the Audubon sugar school of the state university, founded "for the highest scientific training in the growing of sugar cane and in the technology of sugar manufacture."

Tobacco might be grown profitably over a large part of the state, but in reality very little is grown. The strong, black perique of the delta—cultivated very generally in the lower alluvial region before the Civil War, but now almost exclusively in St James parish—is a famous leaf, grown since early colonial times. Bright or yellow plug and smoking leaf are grown on the pine uplands and pine "flats," and a small amount of cigar tobacco on the flats, prairies and "bluffs." The total value of the tobacco crop of 35,000 lb in 1907 was only $10,000, an amount exceeded by each of the other 24 tobacco-growing states, and the crop was about one-twentieth of 1 % of the product of the whole United States.

Rice farming, which had its beginning immediately after the Civil War and first became prominent in the 'seventies, has developed enormously since 1880. From 1879 to 1899 the product increased twenty-five fold. Formerly the grain was raised by preference in the river bottoms, which still yield, almost invariably, the earliest rice of the season and perhaps the finest. The "buckshot clays" of the backlands, which are so stiff that they can scarcely be ploughed until flooded and softened, and are remarkably retentive of moisture, are ideal rice soil; but none of the alluvial lands has an underlying hardpan, and they cannot as a rule be drained sufficiently to make the use of heavy harvesting machinery possible. In 1880 the prairies of the S.W. were opened to settlement by the railway. These prairies are traversed by ridges, which facilitate irrigation, and are underlaid by an impervious subsoil, which facilitates both effective storage and drainage. Thus the use of machinery became possible, and this revolutionized the entire industry. The year 1884 may be taken as the initial date of the new period, and the grain is now harvested exactly as is wheat in the west-central states. Previously the grain had ordinarily been cut with sickles and harvested by hand. The farms were also small, usually from 5 to 10 acres. They are now very much larger. All the prairies district—the centre of which is Crowley—is becoming one great rice field. Some rice also is grown on the lowlands of the Mississippi valley, notably in Plaquemines, Jefferson and Lafourche parishes. In the decade 1881–1890 Louisiana produced about half of the total yield of the country, and from 1891 to 1900 about five-sevenths. In 1904 and 1906 the Louisiana crop, about one-half of the total yield of the country, was larger than that of any other state; but in 1905 and in 1907 (6,192,955 lb and 7,378,000 lb respectively) the Louisiana crop was second in size to that of Texas. Carolina and Honduras rices were practically the only varieties until after 1896. Since that time select Japanese species, chosen for superior milling qualities, have been widely introduced, as the market prejudice in favour of head rice made the large percentage of broken rice a heavy handicap to the farmers. Hundreds of varieties have been tested by the state and federal agricultural experiment stations. A strong tendency to run to red rice (hardier, but not so marketable) has been a second great difficulty to overcome.

Irrigation is almost entirely confined to rice farms. In the prairie region there is abundant water at depths of 100 to 400 ft. beneath the surface, but this was little used for irrigation for the first few years of the development of this field, when water was pumped from the streams and canals. In 1902 nearly one-eighth of the acreage irrigated was by systems supplied from wells. The irrigated rice area increased 92·9 % from 1899 to 1902, and the construction cost of irrigation works ($4,747,359 in 1902; $12.25 per irrigated acre) 87·7 % in the same years. This increase was almost wholly in the prairie parishes. Of the total irrigated area for rice of 387,580 acres in 1902, 310,670 acres were in the parishes of Calcasieu, Acadia and Vermilion. In the Mississippi valley water is taken from the river by flumes in the levees or by siphons. The danger of floods and the difficulty of drainage make the extension of the practice unprofitable, and the opening of the prairies has made it unnecessary.

Many of the fruits of warm-temperate and semi-tropical lands, whether native or exotic, including oranges, olives, figs, grape-fruit, kumquats and pomegranates are cultivated. Oranges are grown especially on the coast. There are many fine groves on the Mississippi below New Orleans. The fig is a common door-yard tree as in other Gulf and South Atlantic states, and is never killed down by frost. Louisiana produced in 1899 only a fifth as great a value in subtropic fruits as Arizona and Texas combined. Orchard fruits are fairly varied, but, compared with other states, unimportant; and the production of small fruits is comparatively small, the largest crop being strawberries. Oranges and pears are seriously damaged by insect and fungus pests. The total value of fruit products in 1899 was $412,933. Among nuts the native pecan is exceptionally abundant, the product (637,470 lb in 1899) being much greater than that of any other state save Texas.

The total value of cereal products in 1899 was $14,491,796, including Indian corn valued at $10,327,723 and rice valued at $4,044,489; in 1907 it was more than $27,300,000, including Indian corn valued at $19,600,000, rice valued at $7,378,000 and oats valued at $223,000. Indian corn is grown only for home use. Dairying interests are not largely developed, and in Texas and the adjoining states the "Texas fever" and "charbon" have done great damage to cattle. Forage crops are little grown, though soil conditions are favourable. Cowpeas are a common fertilizer. Garden trucking is very slightly developed, but has been successful where it has been tried. The state maintains a crop pest commission, the duties of which include the inspection of all nursery stock sold in the state.

Manufactures.—The state's manufacturing interests have during the last few decades grown greatly in importance. From 1890 to 1900 the capital invested, the cost of materials used and the value of output (in 1900, $121,181,683) increased respectively 225·4, 147·3 and 109 6 %. The value of the factory products in 1900 was $111,397,919; in 1905 it was $186,379,592. Slightly above one-half of the product of 1900 was from New Orleans, and in 1905 about 45·4 %. A constitutional amendment of 1902 exempted from parochial and municipal taxes between 1900 and 1910 practically all factories and mines in the state, employing at least five hands. Manufacturing industries are for the most part closely related to the products of the soil, about two-thirds of the value of all manufactures in 1900 and in 1905 being represented by sugar and molasses refining, lumber and timber products, cotton-seed oil and cake, and rice cleaned and polished.

Rice is milled at New Orleans, Crowley, Abbeville, Gayden, Jennings and Lake Charles. Ramie fibre and jute are available for coarse cloth; cotton weaving is almost non-existent. The lumber industry is centred chiefly in Calcasieu parish. Lake Charles, Westlake, Bogalusa, Bon Ami, Carson, Fisher, Fullerton, Leesville, Oakdale and Pickering were the leading sawmill towns of the state in 1908. Of the rarer woods particular mention may be made of curly pine, yielding a wood of beautiful figure and polish; magnolia, hard, close-grained, of fine polish and of great lasting qualities; and cypress, light, strong, easily worked and never-rotting. The timber cut of 1900 was officially stated as 1,214,387 M. ft. B.M., of which two-thirds were of yellow pine and most of the remainder of cypress. In some localities, especially in the "Florida parishes," small quantities of rosin and turpentine are taken from the long-leaf pine, but this industry was unimportant in Louisiana before 1908. Sawdust, slabs, stumps and large quantities of logs are wasted. Other manufactures with a product value in 1905 of between $4,000,000 and $1,000,000 were: bags (not paper); foundry and machine-shop products; planing-mill products; railway cars, construction and repairs; malt liquors; men's clothing; cooperage; food preparations; roasted and ground coffee and spice; fertilizers; cigars and cigarettes; cotton goods; and manufactured ice.

Communications.—The length of railway in the state was 1740 m. in 1890 and 4943·55 m. at the end of 1908. By the state constitution of 1898 and by amendments of 1902 and 1904 tax exemptions for ten years were granted to newly-built railroads completed before 1909. The principal roads are the Missouri Pacific (St Louis, Iron Mountain & Southern, New Orleans & North-western and St Louis, Watkins & Gulf), the Southern Pacific (Morgan's Louisiana & Texas Railroad & Steamship Co. and the Louisiana Western), the Texas & Pacific, the Kansas City Southern, the Vicksburg, Shreveport & Pacific, the Louisiana Railway & Navigation Co., the Yazoo & Mississippi Valley, the Illinois Central, and the Louisiana & Arkansas. The Illinois Central, the first railway giving Louisiana connexion with the north, and of immense importance in the trade of New Orleans, has only about 100 m. of double track in the state. The problem of inland waterways has always been a most important one in northern, eastern and southern Louisiana, where there are systems of improved bayous, lakes and canals which, with the levees, make this region something like Holland, on a greater scale. Many bayous are convertible by improvement into excellent drainage and irrigation canals. The canal system is especially well developed in the parishes of the Mississippi delta, where, at the close of 1907, there were about 50 m. of these waterways of decided commercial importance. They serve the trade of Lake Pontchartrain and the Florida parishes, the lumber, coal, fish, oyster and truck trade of New Orleans, and to some extent are the highway of a miscellaneous coasting trade. The most important canal is probably the new Atchafalaya Bay canal (14 ft. deep), opened in 1907, connecting the Atchafalaya river and Morgan City with the Gulf of Mexico. In 1907 active preliminary work was begun on the Louisiana section of a great interstate inland waterway projected by the national government between the Mississippi and Rio Grande rivers, almost parallel to the Gulf Coast and running through the rice and truck-farm districts from the Teche to the Mermenton river (92 m.). The competition of the water lines is felt by all the railways, and the importance of water transportation is rapidly increasing. A state railroad commission, organized in 1899, has power to regulate railway, steamer, sleeping-car, express, telephone and telegraph rates within the state. Foreign commerce is almost wholly centred at New Orleans.

Population.—The population of the state increased in the ten decades from 1810 to 1910 successively by 100·4, 40·6, 63·4, 46·9, 36·7, 2·7, 29·3, 19·0, 23·5 and 19·9 %. In 1910 it was 1,656,388 (36·5 per sq. m.).[1] In 1900 47·1 % was of negro blood, as compared with 51·5 in 1890. In 1910 there were nine cities with more than 5000 inhabitants each: New Orleans (339,075); Shreveport (28,015); Baton Rouge (14,897), the capital; Lake Charles (11,449); Alexandria (11,213); Monroe (10,209); New Iberia (7449); Morgan (5477); Crowley (5099). The urban element is larger than in any other southern state, owing to the large population of New Orleans. The Acadians (see § *History* below) to-day are settled mainly in St Mary, Acadia and Vermilion parishes; lesser numbers are in Avoyelles and St Landry; and some are scattered in various other parishes. The parishes of St Mary, Iberia, Vermilion, St Martin and Lafayette are known as the Attakapas country from an Indian name. A colony of Germans sent over by John Law to the Arkansas removed to the Mississippi above New Orleans, and gave to its bank the name of the "German Coast," by which it is still known. In recent years there has been an immigration of Italians into Louisiana, which seems likely to prove of great social and economic importance. The industrial activity of the state has required more labour than has been available. The negroes have moved more and more from the country to the towns, where they easily secure work at good wages. Owing to the inadequate supply of labour two important immigration leagues of business men were formed in 1904 and 1905, and in 1907 the state government began officially to attempt to secure desirable foreign immigration, sending agents abroad to foster it. Roman Catholics greatly predominate among religious denominations, having in 1906 477,774 members out of a total of 778,901 for all denominations; in the same year there were 185,554 Baptists, 79,464 Methodists, 9070 Protestant Episcopalians and 8350 Presbyterians.

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[1] The population was 76,556 in 1810; 153,407 in 1820; 215,739 in 1830; 352,411 in 1840; 517,762 in 1850; 708,002 in 1860; 726,915 in 1870; 939,946 in 1880; 1,118,588 in 1890; and 1,381,825 in 1900.

Administration.—Since the admission of the state to the Union in 1812 there have been eight state constitutions (not counting that of 1861) admirably illustrating—and not less the Territorial government preceding them—the development of American democracy and the problems connected with the negroes. Under the Territorial government the legislative officers were not at first elective. The "parishes" date from 1807; they were based on an earlier Spanish division for religious purposes—whence the names of saints in parish nomenclature. The constitution of 1812 allowed the General Assembly to name the governor from the two candidates receiving the highest number of votes; gave the governor large powers of appointment, even of local functionaries; and required a property qualification for various offices, and even for voters. The constitution of 1845 made the popular suffrage final in the choice of the governor, abolished property qualifications, and began to pare executive powers for the benefit of the General Assembly or the people. From it dates also the constitutional recognition of the public schools. In 1852 even the judges of the supreme court were placed among the officers chosen by popular vote. The constitutions of 1864 and 1868 were of importance primarily as bearing on negro status and national politics. That of 1879 showed a profound distrust of legislative action, bred of reconstruction experiences. Nearly all special legislation was forbidden. The last constitution (1898, with 26 amendments 1898–1906), unlike all others after that of 1812, was not submitted to the people for ratification.

Under this constitution sessions of the General Assembly are biennial (meeting the second Monday in May in even-numbered years) and are limited to sixty days. The number of senators is fixed by the constitution at 39; the number of representatives is to be not more than 116 or less than 98. Any elector is eligible for election as a representative if he has been a citizen of the state for five years and a resident of the district or parish from which he is elected for two years immediately preceding the election; a change of residence from the district or parish from which he was elected vacates the seat of a representative or senator. A senator must be at least 25 years of age. Members of the legislature are elected for four years. Revenue or appropriation bills originate in the House of Representatives, but may be amended by the Senate. Contingent appropriations are forbidden, and the constitution contains a long list of subjects on which special laws may not be passed. The chief executive officers have four-year terms, neither the governor nor the treasurer being eligible for immediate re-election. The governor must be at least 30 years old and must have been a citizen of the United States and a resident of the state for 10 years next preceding his election. Within five days after the passage of any bill by the General Assembly he may veto this measure, which then becomes a law only if passed by a two-thirds vote of all members elected to each house of the General Assembly. The lieutenant governor (and then the secretary of state) succeeds to the office of governor if the governor is removed, dies or leaves the state. The five judges of the supreme court of the state are elected by the people for a term of twelve years. The supreme court is almost without exception a court of appeal with jurisdiction in cases involving at least $2000, in cases of divorce, in suits regarding adoption, legitimacy and custody of children and as regards the legality and constitutionality of taxes, fines, &c. The supreme court appoints courts of appeal to judge cases involving less than $2000. The constitution prohibits lotteries and the sale of lottery tickets.

The suffrage clauses are of particular interest, as they accomplish the practical disfranchisement of the negroes. The constitution requires that a voter must (in addition to other qualifications) either be able to show conclusively ability to read and write, or be the owner of property within the state assessed at not less than $300, on which, if personalty, all taxes are paid. But it excepts from these requirements—thus letting down the bars for illiterate whites excluded with negroes by the foregoing clauses—persons who were entitled to vote in some state on or before the 1st of January 1867 (*i.e.* before the adoption of the Fourteenth and Fifteenth Amendments of the United States Constitution); also the sons or grandsons of such voters, not under 21 years of age, on the 12th of May 1898; and males of foreign birth who have resided in the state for five years next preceding the date of application for registration and who were naturalized prior to 1898. The constitution provides that no person less than 60 years of age shall be permitted to vote unless he has paid an annual poll-tax of one dollar for the two years next preceding the year in which he offers to vote. Convicts not pardoned with an explicit restoration of suffrage privileges are disfranchised—a rare clause in the United States. Suffrage was by this constitution first extended to women tax-payers in questions "submitted to the tax-payers, as such." The creation of a railroad commission was ordered and the preparation of a code of criminal law.

The Louisiana Board of Levee Commissioners was organized in 1865. The state board of health was the first one effectively organized (1855) in the United States. It encountered many difficulties, and until the definite proof of the stegomyia hypothesis of yellow-fever inoculation made by the United States army surgeons in Cuba in 1900, the greatest problem seemed insoluble. Since that time conditions of health in New Orleans have been revolutionized (in 1907 state control of maritime quarantine on the Mississippi was supplanted by that of the national government), and smaller cities and towns have been stimulated to take action by her example. Sanitary institutes are held by the state board at various towns each year for the instruction of the public. Boards of appraisers and equalization oversee the administration of the tax system; the cost of collection, owing to the fee system for payment of collectors, was higher than in any other state of the Union until 1907, when the fees were greatly reduced. The state assessment in 1901 totalled $301,215,222 and in 1907 was $508,000,000. Schools and levees absorb about half of all revenues, leaving half for the payment of interest on the state debt (bonded debt on 1st of April 1908, $11,108,300) and for expenses of government. A general primary election law for the selection, by the voters, of candidates for state office came into effect in 1906.

Law.—Louisiana has been peculiar among the states of the Union in the history of the development of its legal system. In Louisiana alone (as the state is known to-day), out of all the territory acquired from France as the Louisiana Purchase in 1803, was the civil law so established under French and Spanish rule that it persisted under American dominion. In all the other states formed from the Purchase, the civil law, never existent practically, was early expressly abrogated, and the common law of England established in its place. After O'Reilly established his power in 1769 (see *History*, below), the Spanish law was supreme. All the old codes of the Peninsula, as well as the laws of the Indies and special royal decrees and schedules, were in force in the colony. The United States left the task of altering the laws to the people, as far as there was no conflict between them and the Constitution of the United States and fundamental American legal customs. Copies of the Spanish codes were very rare, and some of them could not be had in the colonies. Discussions of the Roman Institute and Pandects were common in the deliberations of the courts. Great confusion prevailed in the first years of American dominion owing to the diversities of languages and the grafting of such Anglo-Saxon institutions as the jury upon the older system. A provisional code of judicial procedure, prepared by Edward Livingston, was in effect in 1805 to 1825. The earliest digest, completed in 1808, was mainly a compilation of Spanish laws. The project of the *Code Napoléon*, however—the *code* itself not being available in Louisiana, though promulgated in France in 1804—was used by the compilers in the arrangement and substance of their work; and the French traditions of the colony, thus illustrated, were naturally introduced more and more into the organic commentaries and developments that grew up around the *Code Napoléon*. This evolution was little marked, so similar in large parts were the systems of France and Spain (although in other parts, due to the Gothic element in the Spanish, they were very different)—a similarity which explains the facility with which O'Reilly and his successors introduced the Spanish laws after 1769. The Louisiana code of 1808 was not, however, exhaustive; and the courts continued to go back to the old Spanish sources whenever the digest was inconclusive. Thus so late as 1819, when the legislature ordered the compilation of such parts of King Alfonso's *Siete Partidas* (the most common authority in the colony) as were considered in force, this compilation filled a considerable volume. In 1821 the legislature authorized Livingston to prepare the "Livingston Code" of criminal law and procedure, completed in 1824 (in French and English) and published in 1833, but never adopted by the state. In 1825 legislative sanction was given to the greater part of a civil code prepared by a commission (including Livingston) appointed in 1821, and the French element became steadily more important. In its present form the law shows plainly the Latin and English elements. English law has largely moulded, for example, criminal and commercial law and the law of evidence; the development of the law of corporations, damages, prohibitions and such extraordinary remedies as the mandamus has been very similar to that in other states; while in the fusion of law and equity, and the law of successions, family relations, &c., the civil law of Spain and France has been unaffected.

Education.—Schooling was very scant before the creation of the public schools in 1854. Very little was done for education in the French and Spanish period, although the Spanish governors made commendable efforts in this regard; the first American Territorial legislature began the incorporation of feeble "colleges" and "academies." To some of these the state gave financial aid ($1,613,898) before 1845. The public schools were flourishing at the outbreak of the Civil War. War and reconstruction threw upon them the new burden of the black children. The constitution of 1879 was illiberal in this respect, but a healthier public opinion soon prevailed. The money given by the state to the public schools is distributed among the parishes according to their school population, and the constitution of 1898 set a generous *minimum* to such aid. An annual poll-tax is also collected for the schools from every adult male. Local taxes, besides, are imposed, and these are becoming heavier. The parishes retain primary control of the schools. Institutes, summer schools and rural libraries have been introduced. The salaries of white teachers advanced from a monthly average of $38.87 in 1903 to $61.84 in 1906. The average attendance of enrolled black and white pupils is practically identical, but the enrolment of whites (about 52% in 1902) is somewhat higher and that of the blacks about a third lower than their ratio in the population. The school term for white children is much longer than for negroes, and white teachers are paid much better salaries—in 1906 the average monthly salary of a negro teacher was $29.15. The total enrolment is very low. But progress is now being made very rapidly in the improvement of the educational system. Higher schools include: the State University and Agricultural and Mechanical College (1860) at Baton Rouge (*q.v.*); Tulane University of Louisiana (1864) in New Orleans; Jefferson College (1864; Roman Catholic) at Convent; the College of the Immaculate Conception (1847; Roman Catholic) in New Orleans; St Charles College (1835; Roman Catholic) at Grand Couteau; St Joseph's College (1849; Roman Catholic) at Baton Rouge; the following colleges for women—Silliman Collegiate Institute (1852; Presbyterian) at Clinton, Mansfield Female College (1854; Methodist Episcopal, South) at Mansfield, the H. Sophie Newcomb Memorial College for women (a part of Tulane University) in New Orleans and the Louisiana Female College (1856; Baptist) at Keatchie; the State Normal School of Louisiana (1884) at Natchitoches and the New Orleans Normal and Training School; the South-western Louisiana Industrial Institute at Lafayette; the Louisiana Industrial Institute at Ruston; and, among schools for negroes, the Peabody State Normal and Industrial School at Alexandria and New Orleans University (1873; Methodist Episcopal), Luther College (Evangelical Lutheran), Leland University (1870; Baptist), Straight University (Congregational) and Southern University (1883; aided by the state), all in New Orleans.

Charitable and Penal Institutions.—The State Board of Charities and Correction, for which the constitution of 1898 first made provision, and which was organized under an act of 1904, is composed of six members, appointed by the governor for six years, with the governor as *ex-officio* chairman. The members of the board serve gratuitously, but elect a salaried secretary. The board has no administrative or executive power, but makes annual inspections of all public charitable, correctional or reformatory institutions, all private institutions which receive aid from, or are used by municipal or parochial authorities, and all private asylums for the insane; and reports annually to the governor on the actual condition of the institutions. Any suggestions as to improvements in institutions must be approved by the majority of the governing body of that institution before they may be put into effect. The charitable institutions include two charity hospitals—at New Orleans (1832) and Shreveport; an Eye, Ear, Nose and Throat Hospital, a Hôtel Dieu, the Touro Infirmary and a Home for Incurables, all at New Orleans; an Institute for the Deaf and Dumb (for whites—there is no state provision for negro deaf and dumb) and an Institute for the Blind, both at Baton Rouge; an Insane Hospital at Jackson and another at Pineville; and the Louisiana Retreat for the Insane at New Orleans. At Monroe there is a State Reform School, and at New Orleans a Coloured Industrial Home and School. There is also a state home for disabled Confederate soldiers at New Orleans on Bayou St John. The State Penitentiary is at Baton Rouge, and a House of Detention at New Orleans; and there are parish prisons. State convicts, and all places in which they are confined or employed, are under the supervision of a Board of Control appointed by the governor. This board may allow commutation or diminution of sentence for good behaviour, meritorious services or exemplary conduct. The leasing or hiring of state convicts is prohibited by the constitution, but parish convicts may be hired or leased for farm and factory work, work on roads and levees, and other public undertakings. Such convicts are classified according to physical ability and a minimum rate is fixed for their hire, for not more than ten hours a day. Many state convicts are employed in levee construction, and there are convict farms at Angola, Hope, Oakley and Monticello.

History.—The early history of Louisiana belongs to the romance of American history. It is possible that the mouth of the Mississippi was discovered in 1519 by Alonso Alvarez de Piñeda, but this interpretation of his vague manuscript remains conjectural; and that it was discovered by the expedition of Panfilo de Narvaez cannot be established. That Hernando de Soto entered the borders of the present state of Louisiana, and that his burial place in the Mississippi was where that river takes the waters of the Red, are probable enough, but incapable of conclusive proof. Survivors of de Soto's expedition, however, descended the Mississippi to its mouth in 1542. Spain set up no claim to the region, and when Robert Cavalier, Sieur de la Salle, came down the river in 1682 from the French possessions to the north, he took possession in the name of France, which hereby gained her first title to the vast drainage basin of the Mississippi. In honour of Louis XIV. the new possession was named "Louisiana"—a name then and until 1812 applied to a much larger area than that of the present state. La Salle attempted to settle a colony in 1684, but missed the Mississippi's mouth and landed in Texas, where he was murdered in 1687 by some of his followers. In 1697, after Ryswick, Pierre le Moyne d'Iberville (1662–1706) was chosen to lead another colony, which reached the Gulf coast early in 1699. Soon after Iberville had built Fort Maurepas (near the present city of Biloxi, Mississippi) in 1699, a fort was erected on the Mississippi river about 40 m. above the mouth.

This was the earliest settlement in what is now the state of Louisiana. It was unhealthy and unprosperous. From 1712 to 1717 "Louisiana," or the French possessions of the Mississippi valley, was held by Antoine Crozat (1655–1738) as a private grant from the king. It proved as great a drain upon his purse as it had proved to the crown, and he willingly parted with it to the so-called "Western Company," afterwards incorporated with the great Company of the Indies. The head of this company was John Law, who, after spreading glowing accounts of the new land, launched his famous "Mississippi scheme" (see Law, John. The company accomplished much for the colony of Louisiana. Jean Baptiste le Moyne, Sieur de Bienville (1680–1768), a brother of Iberville, was sent out as governor. For forty years he was the life of the colony. One of his first acts was to found the city of New Orleans on its present site in 1718. In this same year seven vessels were sent from France with stores and immigrants; eleven followed during the next year. Five hundred negroes from the Guinea coast were imported in 1719, and many hundreds more soon followed. The Law company eventually came to an end fatal to its creditors in France, but its misfortunes did not check the prosperity of "Louisiana." The company retained its grant of the colony until 1731, when it reverted to the crown. Meantime New Orleans had become the seat of government in 1722. In 1766 an official census showed a total population of 5552. The years of royal rule were uneventful. Cotton culture began in 1740, and sugar-cane was successfully introduced from Santo Domingo by the Jesuits in 1751. Tafia rum and a waxy, sticky sugar syrup subsequently became important products; but not until the end of the century were the means found to crystallize sugar and so give real prosperity to the industry.

By a secret treaty of the 3rd of November 1762, "Louisiana" was transferred from France to Spain. This treaty was not made public for a year and a half, and Spain did not take full possession of the colony until 1769. By a treaty between Spain and France on the one hand and Great Britain and Portugal on the other, signed at Paris in February 1763, all that portion lying E. of the Mississippi river, the Iberville river, and Lakes Maurepas and Pontchartrain was ceded to Great Britain. The international interests thus created, and others that sprang from them, heavily burdened the diplomacy, and even threatened the safety of the United States after they were placed in possession of the eastern bank of the Mississippi down to 31° in 1783.

The news of the cession of the colony to Spain roused strong discontent among the colonists. Antonio de Ulloa (1716–1795), a distinguished Spanish naval officer and scholar, came to New Orleans in 1766 to take possession for his king. Merchants, people, and many civil officers held toward him from the beginning a hostile attitude; the military, especially, refused to pass into the Spanish service as stipulated in the treaty; and Ulloa was compelled to continue in an ambiguous and anomalous position—which his lack of military force probably first compelled him to assume—ruling the colony through the French governor, Philippe Aubry (who loyally supported him throughout), without publicly exhibiting his powers. The fear of Spanish commercial laws powerfully stimulated resistance to the transfer, and though Ulloa made commercial and monetary concessions, they were not sufficient. When the colonists found protests at Paris unavailing, they turned to the idea of independence, but sought in vain the armed support of the British at Pensacola. Nevertheless they compelled Ulloa to leave the colony or exhibit his credentials. He took his leave in November 1768. The open resistance by the colonists (October 1768) was a carefully planned revolt. There is no doubt that the men who led the Creole opposition contemplated independence, and this gives the incident peculiar interest. In the summer of 1769 Alejandro O'Reilly came to New Orleans with a strong military force (3600 troops). Beginning his rule with an affability that allayed suspicions and securing from Aubry proofs against the popular leaders, he invited them to a reception and arrested them while they were his guests. Five were put to death and others were imprisoned at Havana. O'Reilly put down the rebellion with determination and in accord with the instructions of his king. Regarded without republican sympathies, and in the light of 18th-century doctrines of allegiance, his acts, however severe, in no way deserve the stigma of cruelty ordinarily put upon them. He was liberal and enlightened in his general rule.

Among the incidents of these troubled years was the arrival in Louisiana (after 1765) of some hundreds of French exiles from Acadia, who made their homes in the Attakapas country. There their descendants live to-day, still somewhat primitively, and still in somewhat of the glamour thrown over land and people by the *Evangeline* of Longfellow.

On the 18th of August 1769 Louisiana was formally transferred to Spain. Spanish law and Spanish tongue replaced the French officially, but the colony remained essentially French. The Spanish rulers made efforts to govern wisely and liberally, showing great complaisance, particularly in heeding the profit of the colony, even at the expense of Spanish colonial commercial regulations. The judicial system was much improved, a better grade of officials became the rule, many French Creoles were appointed to office, intermarriages of French and Spanish and even English were encouraged by the highest officials, and in general a liberal and conciliatory policy was followed, which made Louisiana under Spanish rule quiet and prosperous. Bernardo de Galvez (1756–1794), a brilliant young officer of twenty-one, when he became the governor of the colony, was one of the most liberal of the Spanish rulers and of all the most popular. During the American War of Independence he gave valuable aid to the United States; and when Spain finally joined in the war against Great Britain, Galvez, in a series of energetic and brilliant campaigns (1779–1781), captured all the important posts in the British colony of West Florida. The chief interest of the Spanish period lies in the advance of settlement in the western territories of the United States, the international intrigues—British, French and Spanish—involving the future of the valley, the demand of the United States for free navigation on the Mississippi, and the growing consciousness of the supreme importance of the river and New Orleans to the Union. With the Spanish governor Estevan Miro, who succeeded Galvez in 1785, James Wilkinson of Kentucky, arrested at New Orleans with a flat-boat of supplies in 1787, intrigued, promising him that Kentucky would secede from the United States and would join the Spanish; but Wilkinson was unsuccessful in his efforts to carry out this plan. In 1794 Spain, hard pressed by Great Britain and France, turned to the United States, and by the treaty of 1794 the Mississippi river was recognized by Spain as the western boundary of the United States, separating it from Louisiana, and free navigation of the Mississippi was granted to citizens of the United States, to whom was granted for three years the right "to deposit their merchandise and effects in the port of New Orleans, and to export them from thence without paying any other duty than a fair price for the hire of the stores." At the expiration of the three years the Spanish governor refused the use of New Orleans as a place of deposit, and contrary to the treaty named no other port in its place. Spanish rule, however, came unexpectedly to an end by the retrocession of Louisiana to France in 1800; and French dominion gave way in turn in 1803—as the result of a chain of events even more unexpected, startling, and for the United States fortunate—to the rule of the last-named country. On the 30th of November 1803 the representatives of the French republic received formal possession from the Spanish governor, and on the 20th of December lower Louisiana was transferred to the United States. (See LOUISIANA PURCHASE.)

By an Act of Congress of the 25th of March 1804,[1] that portion of the Louisiana Purchase S. of 33° was organized as the Territory of Orleans, and was given a government less democratic than might otherwise have been the case, because it was intended to prepare gradually for self-government the French and Spanish inhabitants of the territory, who desired immediate statehood. The foreign slave-trade was forbidden by this organic act. English was made the official language. The introduction of English law, and the changes made in the judicial and legal systems of Louisiana after 1804 have already been described.

The machinations of Aaron Burr are of interest in connexion with Louisiana annals, and likewise the settlement and revolutionizing of West Florida by Americans. In November 1811 a convention met at New Orleans and framed a constitution under which, on the 30th of April 1812, the Territory of Orleans became the state of Louisiana. A few days later the portion of West Florida between the Mississippi and Pearl rivers (the present "Florida Parishes") was included in its boundaries, making them as they are to-day. In this same year the first steamboat reached New Orleans. It descended the Ohio and Mississippi from Pittsburg, whence there had already been a thriving river trade to New Orleans for about thirty years. During the War of 1812 a decisive victory was won by the American forces at Chalmette, near New Orleans, on the 8th of January 1815. Up to 1860 the development of the state in population, agriculture and commerce was very rapid. Donaldsonville was the (nominal) capital in 1825–1831, Baton Rouge in 1849–1864 and again after 1882. At other times New Orleans has been the capital, and here too have always been various state offices which in other states ordinarily are in the state capital.

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[1] Other acts bearing on Territorial government are those of the 31st of October 1803 and the 23rd of March 1805.

By an ordinance of secession passed on the 26th of January 1861, Louisiana joined the Confederate States. In the first year there was very little military activity in the state, but in April 1862 Admiral D. G. Farragut, with a powerful fleet, ascended the Mississippi past Forts Jackson and St Philip, which defended the approach to New Orleans, and a military force under General B. F. Butler occupied that city The navigation of the river being secured by this success and by later operations in the north ending in July 1863 with the capture of Vicksburg and Port Hudson, the state was wholly at the mercy of the Union armies. The intervening months were signalized by the capture of Baton Rouge in May 1862—the Confederates vainly attempting to recapture it in August. Later, in April 1864, the Confederates under General Richard Taylor won a success against the Unionists under General N. P. Banks at Sabine Cross Roads near Mansfield and were themselves repulsed at Pleasant Hill, these battles being incidental to a campaign undertaken by the Union forces to crush opposition in western Louisiana. A large portion of the state was occupied by them in 1862–1865. There were various minor skirmishes in 1862 and 1863 (including the capture of the Federal camp at Berwick Bay in June 1863).

As early as December 1862 the Union military government, at President Lincoln's direction, had ordered elections for Congress, and the men chosen were admitted in February 1863. In March 1864 also a state government to supersede the military rule was established under the president's auspices. By 1863 two parties had arisen among the loyal classes: one of radicals, who demanded the calling of a constitutional convention and the abolition of slavery; the other of conservatives. The former prevailed, and by a convention that assembled in April 1864 a constitution was framed closely following that of 1852 but repudiating the debt incurred by Louisiana as one of the Confederate states and abolishing slavery. Two-thirds of the delegates were from New Orleans. The legislature was ordered to establish free schools for the blacks, and was empowered to give them the suffrage: neither of these provisions, however, was carried out. The extent of the Union control is shown by the fact that the legislature of 1864 represented half of the area and two-thirds of the population of the state. The army stood at the back of the new government, and by the end of 1864 Louisiana was apparently "reconstructed." But in 1864 the opposition of Congress to presidential reconstruction had clearly developed, so that the electoral votes of Louisiana (like those of Tennessee) for president were not counted. By the spring of 1866 the ex-Confederates had succeeded in gaining possession of most of the local government and most of the state offices, although not of the governorship. The Republican party naturally became extremely radical. The radicals wished to have negro suffrage in order to get possession of the government. They, therefore, wanted still another constitutional convention. A clause in the constitution of 1864 provided for the reconvening of the convention in certain circumstances, but this clause referred only to necessities prior to the establishment of a government, and had therefore determined. Nevertheless, the radicals, because it was impossible to call a convention through the medium of the state government, took advantage of this clause to reconvoke the old convention at New Orleans. The day set was the 30th of July 1866. The ex-Confederate party determined to prevent the gathering, but the idea of interference by force seems to have been abandoned. A street riot was precipitated, however, incidental to a procession of armed negroes; the metropolitan police fired upon the assembled convention; and altogether some 200 persons, mostly negroes, were killed. This incident raised the crucial question of national politics in 1866: namely, whether the states reconstructed by the president should not again be reconstructed.

This being settled affirmatively, Louisiana was reconstructed with vigour. A constitution of 1868 gave suffrage to the blacks, and disfranchised all whites made ineligible to office under the proposed Fourteenth Amendment to the national Constitution, and also (practically) those who had by word, pen or vote defended secession. Then the state ratified the Fourteenth Amendment, and was declared readmitted to the Union in July 1868. Probably no other southern state suffered equally with Louisiana from the corruption of "carpet-bag," "scalawag," negro legislatures. For four years (1868–1872) the government expenses increased to ten times their normal volume, taxation was enormously increased, and about $57,000,000 of debt was created. But a quarrel broke out among the Republicans (1872), the result of which was the installation of two governors and legislatures, one supported by the Democrats and Liberal Republicans and the other by the radical Republicans, the former being certainly elected by the people. The rivalry of these two state governments, clashes of arms, the recognition by the Federal authorities of the radical Republican government (Pinchback and Kellogg, successively governors) followed. One historic clash in New Orleans (on the 14th of September 1874) between the "White League" ("White Man's Party") and the Republican police is commemorated by a monument, and the day is regarded by Louisianans as a sort of state independence-day. Finally, in 1876, Francis Tillon Nicholls (b. 1834), a Democrat, was chosen governor, but the Republican candidate, S. B. Packard, claimed the election, and with a Republican legislature for a time occupied the State House. In the national election of 1876 there were double returns (Republican: 75,315 for Hayes and 70,508 for Tilden; and Democratic: 83,723 for Tilden and 77,174 for Hayes) from Louisiana, which, as was the case with the double electoral returns from Florida, Oregon and South Carolina, were adjudicated by the Electoral Commission in favour of the Republican electors voting for Hayes. Civil war being threatened within the state President Hayes sent to Louisiana a commission composed of Wayne McVeagh, Gen. J. R. Hawley, Charles B. Lawrence, J. M. Harlan, and John C. Brown, ex-Governor of Tennessee, which was instructed to promote "an acknowledgment of one government within the state." The rival legislatures united, organizing under the Nicholls government, which the commission found was upheld by public opinion. The president ordered the withdrawal of Federal troops from the capitol on the 20th of April 1877, and the white party was thus left in control.

After 1877 the state prospered markedly in all material respects. Of subsequent political events perhaps the most notable, besides the practical disfranchisement of the negroes, are those connected with the Louisiana State Lottery Company (1868–1893). For the renewal of its privileges in 1890 the company finally agreed to give the state $1,250,000 yearly, and despite strenuous opposition by a powerful party the legislature voted a renewal, but this measure was vetoed by the governor. The United States government, however, forbade lotteries the use of the mails, and the company withdrew its offers. The constitution of 1898 prohibits lotteries and the sale of lottery tickets within the state. In 1891 the lynching of eleven Italians at New Orleans gave rise to grave difficulties involving Italy, the United States, and the state of Louisiana. Since 1900 a white Republican Party has made some headway in Louisiana politics, but in national and state elections the state has been uninterruptedly and overwhelmingly Democratic since 1877.

GOVERNORS OF LOUISIANA[1]

French Domination 1682–1762.

A. le Moyne, Sieur de Sauvolle (died in office)	1699–1701
J. B. le Moyne, Sieur de Bienville	1701–1713
M. de Muys, appointed 1707, died en route, Bienville continuing to serve.	
Lamothe Cadillac	1713–1716
Sieur de Bienville, acting governor	1716–1717
De l'Épinay	1717–1718
Sieur de Bienville	1718–1724

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[1] Terms of *actual service in Louisiana*; Gayarré is the authority for the French and Spanish period.

Boisbriant, *ad interim*	1724–1726
Périer	1726–1733
Sieur de Bienville	1733–1743
Marquis de Vaudreuil	1743–1753
L. Billouart, Chevalier de Kerlerec	1753–1763
D'Abbadie	1763–1765
Philippe Aubry	1765–1769

Spanish Domination 1762 (1769)–1803.

Antonio de Ulloa[1]	1766–1768
Alejandro O'Reilly[2]	1769–1770
Luis de Unzaga	1770–1777
Bernardo de Galvez[3]	1777–1785
Estevan Miró (*ad interim* 1785–1786)	1785–1791
F. L. Hector, Baron de Carondelet	30 Dec. 1791–1797
M. Gayoso de Lemos (died in office)	1797–1799
Francisco Bouligny, José M. Vidal, acting military and civil-political governors	1799
Sebastian de Casa Calvo de la Puerta, Marquis de Casa Calvo	1799–1801
Júan M. de Salcedo	1801–1803

French Domination 1800–1803.[4]

Laussat, Colonial Prefect	30 Nov.–20 Dec. 1803

American Domination since 1803.
Territorial Period.

William C. C. Claiborne (appointed 1803)	1804–1812

Statehood Period.

William C. C. Claiborne, Democratic Republican	1812–1816
Jacques Villeré, Democratic Republican	1816–1820
Thomas B. Robertson, Democratic Republican (resigned)	1820–1822
Henry S. Thibodaux, Democratic Republican (acting)	1822–1824
Henry S. Johnson, Democratic Republican	1824–1828
Pierre Derbigny, Democratic Republican (died in office)	1828–1829
Armand Beauvais and Jacques Dupré (acting)	1829–1831
André B. Roman, Whig	1831–1835
Edward D. White, Whig	1835–1839
André B. Roman, Whig	1839–1843
Alfred Mouton, Whig	1843–1846
Isaac Johnson, Democrat	1846–1850
Joseph Walker, Democrat	1850–1853
Paul O. Hébert, Democrat	1853–1856
Robert C. Wickliffe, Democrat	1856–1860
Thomas O. Moore, Democrat	1860–1862
George F. Shepley, Military Governor	1862–1864
Henry W. Allen, Confederate	1864–1865
Michael Hahn, Unionist and Military	1864–1865
James M. Wells, Democrat (acting)	1865–1867
Benjamin F. Flanders, Military	1867
Joshua Baker, Military	1867–1868
Henry C. Warmoth, Republican	1868–1873
Pinckney B. S. Pinchback, Republican (acting)	1873
John McEnery,[5] Democrat-Liberal Republican	1873
William P. Kellogg, Radical Republican	1873–1877
Stephen B. Packard,[6] Radical Republican (contestant)	1877
Francis T. Nicholls, Democrat	1877–1880
Louis A. Wiltz, Democrat (died in office)	1880–1881
Samuel D. McEnery, Democrat (Lieutenant-Governor, succeeded)	1881–1884
Samuel D. McEnery, Democrat	1884–1888
Francis T. Nicholls, Democrat	1888–1892
Murphy J. Foster, Democrat	1892–1900
William W. Heard, Democrat	1900–1904
Newton C. Blanchard, Democrat	1904–1908
Jared Y. Sanders,[7] Democrat	1908

BIBLIOGRAPHY.—Compare the bibliography under NEW ORLEANS and consult also the following. For general description: *The Geology and Agriculture of Louisiana* (Baton Rouge, Agric. Exper. Station, pts. 1-6, 1892–1902); also publications of U.S. Geological Survey, *e.g. Water Supply and Irrigation Papers*, No. 101, "Underground Waters of Southern Louisiana" For fauna and flora: publications of U.S. Biological Survey (Department of Agriculture, Bibliographies). For climate: U.S. Department of Agriculture, *Climate and Crop Service*, Louisiana series (monthly). For soil and agriculture: the above state geological report and material on irrigation in publications of the U.S. Geological Survey and in the U.S. Census publications; also Commissioners of Agriculture of the State of Louisiana, *Annual Report* (Baton Rouge, biennial until 1899); State Agricultural Society, *Proceedings* (annual); Louisiana State University and Agricultural and Mechanical College, *Bulletin of the Agricultural Experiment Station* and *Biennial Report* of same (Baton Rouge); U.S. Department of Agriculture, various publications of the divisions of botany, agrostology, pomology, forestry, farmers' bulletins, &c. For manufactures and other industries: primarily the publications of the national Census, 1900, and preceding decades. For commerce and communications: Railroad Commissioners of Louisiana, *Annual Report* (New Orleans, 1900 ff.); U.S. Interstate Commerce Commission, *Statistics of Railways* (annual, Washington); on river navigation and river improvements, especially of the Mississippi, an enormous mass of material in the *Annual Reports* of the Chief of Engineers, U.S. Army (consult *Index to Reports* of same, 1866–1900, 3 vols., Washington, 1902, and cp. article on MISSISSIPPI RIVER); on river commerce see *U.S. Census of 1880*, vol. 4 (report on steam navigation of the United States by T. C. Purdy), and *Census of 1890* (report on transportation by T. J. Vivian; Rivers of the Mississippi Valley). For population: various national censuses and *Bulletins* of the Bureau of Census, 1900, *e.g.* No. 8, "Negroes in the United States"; on the Acadians, *In Acadia, The Acadians in Song and Story* (New Orleans, 1893; compiled by M. A. Johnston). For pictures of Creole life and traits, George W. Cable, *The Creoles of Louisiana* (New York, 1884), and his later writings; but Mr Cable's views of the Creoles are very unpopular in Louisiana; for other views of them, and for a guide to the English and Creole literature of Louisiana, consult Alcée Fortier, *Louisiana Studies—Literature, Customs and Dialects, History and Education* (New Orleans, 1894). For administration: see reports of the various executive officers of the state (Baton Rouge); the various constitutions are printed in the report of the Secretary of State, as well as in B. Perley Poore's *Constitutions* (2 vols., Washington, 1877); a special account of the government of the territorial period may be found in D. Y. Thomas, *History of Military Government in Newly Acquired Territory of the United States* (Columbia University Studies in History, Economics and Public Law, vol. xx. No. 2, 1904); for the Civil War and Reconstruction period compare below, also American Historical Association, *Annual Report*, 1892; (for courts during Civil War); also John R. Ficklen, *History and Civil Government of Louisiana* (Chicago, New York, *c.* 1899), a brief and popular account; on education, in addition to the Biennial Reports of the Board of Education, consult annual reports of the U.S. Commissioner of Education.

For history: the standard work is that of Charles E. A. Gayarré, coming down to the war, based on deep and scholarly research, and greatly altered in successive editions. The style is that of the classic school, that of Prescott and Motley, full of colour, characterization and spirit. The editions are as follows: *Romance of the History of Louisiana* (New York, 1837, 1848); *Histoire de la Louisiane* (2 vols., Nouvelle Orléans, 1846–1847); *Louisiana: its Colonial History and Romance* (N.Y., 1851); *Louisiana: its History as a French Colony*, Third Series of Lectures (N.Y., 1852); then, based upon the preceding, *History of Louisiana: The French Domination* (2 vols., N.Y., 1854) and *The Spanish Domination* (N.Y., 1854); *The American Domination* (N. Y., 1867); and third edition (4 vols., New Orleans, 1885). More important for the recent period is Alcée Fortier, *A History of Louisiana* (N.Y., 4 vols., 1904) devoting two volumes to American domination. The *History and General Description of New France* of P. F. X. de Charlevoix (best ed. by J. G. Shea, New York, 1866, 6 vols.) is a famous old work, but now negligible. Judge F. X. Martin's *History of Louisiana* (2 vols., New Orleans, 1827–1829, later ed. by J. F. Condon, continued to 1861, New Orleans, 1882) is also valuable and supplements Gayarré. Le Page du Pratz, author of *Histoire de la Louisiane* (3 vols., Paris, 1758; 2 vols., London, 1763), was the first historian of Louisiana. Berquin-Duvallon, *Vue de la colonie espagnole du Mississippi* (Paris, 1805; published in English under the name of John Davis, New York, 1806); L. N. Baudry de Lozières, *Voyage à la Louisiane* (Paris, 1802) and *Second Voyage à la Louisiane* (Paris, 1803) may be mentioned among the travels just preceding, and A. Stoddard, *Sketches of Louisiana* (New York, 1811), among those just following the establishment of American dominion. The *Histoire de la Louisiane, et de la cession de colonie par la France aux États-Unis* (Paris, 1829; in English, Philadelphia, 1830) by Barbé-Marbois has great importance in diplomatic history. The rarest and most valuable of early memoirs and much archive material are embodied in Benj. F. French's *Historical Collections of Louisiana* (5 series, N.Y., 1846–1853) and *Historical Collections of Louisiana and Florida*, New Series (N.Y., 1869, 1875). Documentary materials on the greater "Louisiana" between the Gulf of Mexico and Canada will be found in the *Jesuit Relations*, edited by R. G. Thwaites (Cleveland, 1896 ff.); and on early voyages in Pierre Margry, *Découvertes et établissements des Français* (6 vols., Paris, 1879–1888). John G. Shea published an edition of Louis Hennepin's *Description of Louisiana. . . . Translated from the Edition of 1683*, &c. (New York, 1880). On this greater "Louisiana" the student should also consult the works of Francis Parkman. And see publications of the Louisiana

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[1] Did not openly assume power or supersede Aubry.

[2] Captain-general charged to establish order and settle Unzaga as governor.

[3] At first, till 1779, only acting governor.

[4] Actual exercise of power 20 days.

[5] Counted out by partisan returning-board and not recognized by U.S. government.

[6] Not recognized by U.S. government.

[7] Elected U.S. Senator 1910: accepted, but afterward withdrew.

Historical Society (New Orleans). Of brief general histories there is that of J. R. Ficklen above cited, another by the same author in collaboration with Grace King (New Orleans, 1902) and another (more valuable) by Albert Phelps (Boston, 1905), in the American Commonwealth Series. For the Reconstruction period see bibliography under UNITED STATES.

LOUISIANA, a city of Pike county, Missouri, U.S.A., situated below the mouth of the Salt river, on the western bank of the Mississippi, about 90 m. N. of St. Louis. Pop. (1900) 5131, including 1075 negroes and 161 foreign-born; (1910) 4454, there is also a considerable suburban population. Louisiana is served by the Chicago, Burlington & Quincy and the Chicago & Alton railways, and by several lines of river steamboats. The river is spanned here by a railway bridge. The city is laid out fairly regularly in the river valley and on bluffs along the river, and has attractive residential districts, commanding good views. It has very active and varied industries, and is a trade centre for a large grain- and fruit-producing and stock-raising region, and has one of the largest nurseries in the United States. Louisiana was laid out in 1818, was the county-seat from that date until 1825, was incorporated as a town in 1845 and was chartered as a city in 1849.

LOUISIANA PURCHASE, a large portion of the area of the United States of America, purchased from the French Republic in 1803. The territory to which France held explorer's title originally included the entire valley of the Mississippi (see LOUISIANA); but the "Louisiana" which was ceded by her to Spain in 1762 (England refusing it, preferring the Floridas), retroceded to France in 1800,[1] and ceded by Napoleon to the United States—in violation of his pledge to Spain that he would not alienate the province—embraced only the portion W. of the river and the island of New Orleans on the E. (and, as might be claimed with some show of argument, West Florida to the Perdido river).

With the settlement of the trans-Alleghany region, the freedom of the Mississippi had become of vital importance to the western settlements, and Spain had recognized these interests in her treaty with the United States of 1795, by guaranteeing freedom of navigation and the privilege of deposit at New Orleans. The transfer of Louisiana from a weak neighbour to so powerful and ambitious a state as France was naturally unwelcome to the United States, and Robert R. Livingston, the American minister in Paris, was instructed by Secretary-of-State Madison to endeavour to prevent the consummation of the retrocession; or, should that be irrevocable, to endeavour to buy the Floridas (either from France, if they had passed with Louisiana, or through her goodwill from Spain)—or at least West Florida—and if possible New Orleans, so as to give the United States a secure position on the Mississippi, and insure the safety of her commerce. The United States was also trying to collect claims of her merchants for spoliations by French cruisers during the late war between France and Great Britain. In his preliminary propositions Livingston lightly suggested to Talleyrand a cession of Louisiana to satisfy these claims; following it with the more serious demand that France should pledge observance of the Spanish concession to the Mississippi trade. This pledge Napoleon readily gave. But during these negotiations a suspension by the Spanish governor of the right of deposit aroused extreme apprehension in America and resulted in warlike votes in Congress. Of these, and of London reports of a British expedition against New Orleans preparing in anticipation of the imminent rupture of the peace of Amiens, Livingston made most capable use; and pressed for a cession of West Florida, New Orleans and Louisiana north of the Arkansas river. But without New Orleans Louisiana was of little present worth, and Napoleon—the collapse of whose American colonial schemes seemed involved in his failure in Santo Domingo, who was persuaded he could not hold Louisiana against Great Britain, and who was already turning from projects of colonial empire toward his later continental policy—suddenly offered to Livingston the whole of the province. Livingston disclaimed wanting the part below the Arkansas. In even mentioning Louisiana he had gone outside his instructions. At this stage James Monroe became associated with him in the negotiations. They were quickly closed, Barbé Marbois acting for Napoleon, and by three conventions signed on the 30th of April 1803 the American ministers, without instructions, boldly accepted for their country a territory approximately 1,000,000 sq. m. in area—about five times the area of continental France. For this imperial domain, perhaps the richest agricultural region of the world, the United States paid 60,000,000 francs ($11,250,000) outright, and assumed the claims of her citizens against France to the extent of 20,000,000 francs ($3,750,000) additional; the interest payments incidental to the final settlement raising the total eventually to $27,267,622, or about four cents an acre.

Different writers have emphasized differently the various factors in this extraordinary diplomatic episode. Unquestionably the western people were ready to war for the navigation of the Mississippi; but, that being guaranteed, it seems certain that France might peaceably have taken and held the western shore. The acquisition was not a triumph of American diplomacy, but a piece of marvellous diplomatic good fortune; for the records abundantly prove, as Madison said, that the cause of success was a sudden policy of Napoleon, forced by European contingencies. Livingston alone of the public men concerned showed indubitably before the event a conception of the feasibility and desirability of the acquisition of a vast territory beyond the Mississippi. Jefferson had wished to buy the Floridas, but alarmed by the magnitude of the cession, declared his belief that the United States had no power to acquire Louisiana. Though such strict construction of the constitution was a cardinal dogma of the Democratic party, this dogma was abandoned outright in practice, Jefferson finding "but one opinion as to the necessity of shutting up the constitution" (or amending it, which was not done) and seeking justification of the means in the end. The Federalist party, heretofore broad-constructionists, became strict-constructionists under the temptation of factious politics, and a very notable political struggle was thus precipitated—notable among other things for strong expressions of sectionalism. The net result was the establishment of the doctrine of "implied powers" in interpreting the constitution; a doctrine under which the Supreme Court presently found power to acquire territory implied in the powers to wage war and make peace, negotiate treaties, and "dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States."

The exact limits of the acquisition were not definitely drawn. The French archives show that Napoleon regarded the Rio Grande as the W. boundary of the territory of which he was to take possession, and the United States up to 1819 ably maintained the same claim. She also claimed all West Florida as part of Louisiana—which, in the usage of the second half of the 18th century, it apparently was not. When she acquired the Floridas in 1819–1821 she abandoned the claim to Texas. The line then adopted between the American and Spanish possessions on the W. followed the Sabine river from the Gulf of Mexico to the parallel of 32° N., ran thence due N. to the Red river, followed this to the meridian of 100° W. and this line N. to the Arkansas river, thence along this to its source, thence N. to the parallel of 42°, and along this line to the Pacific. Such is the accepted description of the W. boundary of the Louisiana Purchase—waiving Texas—thus retrospectively determined, except that that boundary ran with the crest of the Rocky Mountains N. of its intersection with the parallel of 42°. No portion of the Purchase lay west of the mountains, although for some years after 1870 the official maps of the United States government erroneously included Oregon as so acquired—an error finally abandoned by 1900.

On the 20th of December 1803, at New Orleans, the United States took possession of the lower part of the province, and on the 9th of March 1804, at St Louis, of the upper. The entire region then contained possibly 80,000 residents. The treaty of cession required the incorporation of Louisiana in the Union, and the admission of its inhabitants, "as soon as possible, according to the principles of the Federal Constitution, to the enjoyment of all the rights, advantages and immunities of citizens of the United States." By act of the 26th of March 1804 the region below 33° N. was organized as the Territory of Orleans (see LOUISIANA), and that above as the District of Louisiana. The region above 33°, renamed in 1805 the Territory of Louisiana, and in 1812 the Territory of Missouri, was divided as time went on into many Indian reservations, territories and states. Thus were carved from the great domain of the Purchase Louisiana, Missouri, Arkansas, Iowa, Minnesota, North and South Dakota, Nebraska and Oklahoma in their entirety, and much the greatest part of Kansas, Colorado, Wyoming and Montana. There is justification for the saying of Thiers that the United States were "indebted for their birth and for their greatness"—at least for an early assurance of greatness—"to the long struggle between France and England." The acquisition of so vast a territory proved thus of immense influence in the history of the United States. It made it possible for them to hold a more independent and more dignified position between France and England during the Napoleonic wars; it established for ever in practice the doctrine of implied powers in the interpretation of the Federal Constitution; it gave the new republic a grand basis for material greatness; assured its dominance in North America; afforded the field for a magnificent experiment in expansion, and new doctrines of colonization; fed the national land hunger; incidentally moulded the slavery issue; and precipitated its final solution.

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[1] By the treaty of San Ildefonso, signed the 1st of October 1800. This was never ratified by Charles IV. of Spain, but the treaty of Madrid of the 21st of March 1801, which confirmed it, was signed by him on the 15th of October 1802.

It is generally agreed that after the Revolution and the Civil War, the Louisiana Purchase is the greatest fact in American history. In 1904 a world's fair, the Louisiana Purchase Exposition, was held at St Louis in commemoration of the cession. After one hundred years the wilderness then acquired had become the centre of the power and wealth of the Union. It contained in 1903 15,000,000 inhabitants, and its taxable wealth alone was four hundred times the fifteen millions given to Napoleon.

AUTHORITIES.—The official literature is in the *American State Papers, Foreign Relations*, vol. 2, and *Public Lands*, vol. 2; diplomatic papers reprinted in *House Document 431, 57th Congress, 2nd Session* (1903); to which add the *Histoire de la Louisiane et de la cession* (Paris, 1829; Eng. trans., Philadelphia, 1830), by François Barbé-Marbois. This book abounds in supposed "speeches" of Napoleon, and "sayings" by Napoleon and Livingston that would have been highly prophetic in 1803, though no longer so in 1829. They have been used liberally and indiscriminatingly by the most prominent American historians. See also T. Donaldson, *The Public Domain, House Miscellaneous Document 45, pt. 4, 47th Congress, 2nd Session*. For the boundary discussions by J. Q. Adams and Don L. de Onis, 1818–1819, *American State Papers, Foreign Relations*, vol. 4; also in Onis's *Official Correspondence between Don Luis de Onis . . and John Quincy Adams*, &c. (London, 1818), or *Memoria sobre las negociaciones entre España y los Estados Unidos que dieron motivo al tratado de 1819* (Madrid, 1820). See also discussion and map in *U.S. Census, 1900, Bulletin 74*; and the letters of Thomas Jefferson, James Madison, Rufus King and other statesmen of the time. By far the best general account of the diplomacy is in Henry Adams's *History of the United States*, vols. 1 and 2; and of Western conditions and American sentiment in J. B. McMaster's *History of the United States*, vols. 2 and 3. Consult also Justin Winsor, *Narrative and Critical History*, vol. 7; and various valuable periodical articles, especially in the *American Historical Review*, by F. J. Turner and others. Reference may be made to B. Hermann, *The Louisiana Purchase* (Washington, 1898), and Theodore Roosevelt's *Winning of the West*, vol. 4. Of the various special but popular accounts (by J. K. Hosmer, Ripley Hitchcock, R. Blanchard, K. E. Winship, &c.), not one is worthy of its subject, and all contain various inaccuracies.

LOUISVILLE, the largest city of Kentucky, U.S.A., and the county-seat of Jefferson county, on the Ohio river, 110 m. by rail and 130 m. by water S.W. of Cincinnati. Pop. (1890) 161,129; (1900) 204,731, of whom 21,427 were foreign-born (including 12,383 Germans and 4198 Irish) and 39,139 were negroes; (1910 census) 223,928.

Louisville occupies 40 sq. m. of a plain, about 70 sq. m. in extent, about 60 ft. above the low-water mark of the river, and nearly enclosed by hills. The city extends for 8 m. along the river (spanned here by three bridges), which falls 26 ft. in 2 m., but for 6 m. above the rapids spreads out into a beautiful sheet of quiet water about 1 m. wide. The streets intersect at right angles, are from 60 to 120 ft. wide, and are, for the most part, well-shaded. The wholesale district, with its great tobacco warehouses, is largely along Main Street, which runs E. and W. not far from the river; and the heart of the shopping district is along Fourth Street in the dozen blocks S. of Main Street. Adjoining the shopping district on the S. is the old residence section; the newer residences are on "The Highlands" at the E. end and also at the W. end. The city is served by the Baltimore & Ohio South-Western, the Chesapeake & Ohio, the Pittsburg, Cincinnati, Chicago & St Louis, the Louisville, Henderson & St Louis, the Illinois Central, the Chicago, Indiana & Louisville, the Cleveland, Cincinnati, Chicago & St Louis, the Southern and the Louisville & Nashville railways; by steamboat lines to Memphis, Cairo, Evansville, Cincinnati and Pittsburg; by an extensive system of inter-urban electric lines; and by ferries to Jeffersonville and New Albany, Indiana, two attractive residential suburbs.

Many of the business houses are old-fashioned and low. The principal public buildings are the United States government building, the Jefferson county court house and the city hall. In front of the court house stands a bronze statue of Thomas Jefferson, designed by Moses Ezekiel (b. 1844), and inside of the court house a marble statue of Henry Clay by Joel T. Hart (1810–1870). There are few or no large congested tenement-house districts; most of the wage-earners own their own homes or rent cottages. Louisville has an extensive park system, most of which was acquired after 1889 and is on the outskirts. From the heart of the city South Parkway, 150 ft. wide, extends S. 6 m. to the entrance to Iroquois Park (670 acres) on a wooded hill. At the E. end of Broadway is Cherokee Park (nearly 330 acres), near which is the beautiful Cave Hill Cemetery, containing the grave of George Rogers Clark, the founder of the city, and the graves of several members of the family of George Keats, the poet's brother, who lived in Louisville for a time; and at the W. end of Broadway, Shawnee Park (about 170 acres), with a long sandy river beach frequented by bathers. Central Park occupies the space of two city squares in the old fashionable residence districts. Through the efforts of a Recreation League organized in 1901 a few playgrounds are set apart for children. Louisville is a noted racing centre and has some fine tracks; the Kentucky Derby is held here annually in May.

The United States government has a marine hospital, and a life-saving station at the rapids of the river. The state has a school for the blind, in connexion with which is the American Printing House for the Blind. There are state hospitals and many other charitable institutions.

The principal educational institutions are the university of Louisville, which has a College of Liberal Arts (1907), a law department (1847), and a medical department (1837)—with which in 1907 were consolidated the Hospital College of Medicine (1873), the Medical Department of Kentucky University (1898), the Louisville Medical College (1869), and the Kentucky School of Medicine (1850); the Southern Baptist Theological Seminary (1859); the Presbyterian Theological Seminary of Kentucky, which was formed in 1901 by the consolidation of the Theological Seminary of the Presbyterian Church at Danville (1853) and the Louisville Presbyterian Theological Seminary (1893); the Louisville College of Pharmacy (1871), and the Louisville College of Dentistry (1887), a department of Central University. There are many musical clubs, and a spring festival for which a local chorus furnishes the nucleus, is held annually. The Louisville Public Library was established in 1902, and 1904 acquired the library, the small museum (containing the Troost collection of minerals) and the art gallery of the Polytechnic Society of Louisville (1878), which for many years had maintained the only public library in the city. The principal newspapers are the *Courier Journal* (Democratic, morning), the *Herald* (Republican, morning), the *Evening Post* (Independent Democratic), and the

Times (Democratic, evening). The *Courier Journal* is one of the most influential newspapers in the South. Henry Watterson became editor in 1868, when the *Courier* (1843), established and owned by Walter N. Haldeman, was consolidated with the *Journal* (1830), of which Watterson had become editor in 1867, and with the *Democrat* (1844).

The richness of the surrounding country in agricultural produce, timber, coal and iron, and its transport facilities have made Louisville a large commercial and manufacturing centre. The leaf-tobacco market is the largest in the world, most of the leaf-tobacco produced in Kentucky, which in 1900 was 34·9% of the entire crop of the United States, being handled in Louisville; the city's trade in whisky, mules and cement[1] is notably large, and that in pork, wheat, Indian corn, coal and lumber is extensive. The total value of the manufactured products increased from $54,515,226 in 1890 to $78,746,390 in 1900 or 44·4%, and between 1900 and 1905 the value of the factory-made product increased from $66,110,474 to $83,204,125, an increase of 25·9%. Large quantities of fine bourbon whisky are distilled here; in 1905 the value of the factory product of the city was $3,878,004. The most valuable manufacture in the same year was smoking and chewing tobacco (especially plug tobacco) and snuff valued at $11,635,367—which product with that of cigars and cigarettes ($1,225,347) constituted 15·5% of the value of the factory products of the city. Other important manufactures in 1905 were: packed meats, particularly pork; men's clothing, especially "Kentucky jeans"; flour and grist mill products; cotton-seed oil and cake; leather, especially sole leather; foundry and machine shop products; steam-railway cars; cooperage; malt liquors; carriages and wagons, especially farm wagons; and carriage and wagon materials; agricultural implements, especially ploughs; and plumbers' supplies, including cast-iron gas and water pipes. Besides, there were many other manufactures.

The city's water-supply is taken from the Ohio river a few miles above the city limits, and purified by large filtering plants. Nearly all the capital stock of the water-works company is owned by the municipality.

Louisville is governed under a charter of 1893, which is in the form of an act of the state legislature for the government of cities of the first class (Louisville is the only city of the first class in the state). The mayor is elected for four years, and appoints, subject to the approval of the board of aldermen, the controller and the members of the two principal executive boards—the board of public works and the board of public safety. The legislative power is vested in a general council composed of 12 aldermen and 24 councilmen. Both aldermen and councilmen serve without pay, and are elected on a general ticket for a term of two years; not more than two councilmen may be residents of the same ward, but there is no such limitation in regard to aldermen. The treasurer, tax-receiver, auditor, judge of the police court, clerk of the police court, members of the board of school trustees (1 from each legislative district) and members of the park commission are elected by popular vote; the assessor, by the general council. The duration of franchises given by the city is limited to 20 years.

History.—The site of the city was probably visited by La Salle in 1669 or 1670. In July 1773, Captain Thomas Bullitt,[2] acting under a commission from the College of William and Mary, surveyed a tract of 2000 acres, lying opposite the Falls of the Ohio, and laid out a town site upon this tract. Colonel William Preston, county surveyor of Fincastle county, within which the 2000-acre tract lay, refused to approve Captain Bullitt's survey, and had the lands resurveyed in the following year, nevertheless the tract was conveyed in December 1773 by Lord Dunmore to his friend Dr John Connolly, a native of Lancaster county, Pennsylvania, who had served in the British army, as commander of Fort Pitt (under Dunmore's appointment), was an instigator of Indian troubles which culminated in the Battle of Point Pleasant, and was imprisoned from 1775 until nearly the close of the War of American Independence for attempting under Dunmore's instructions to organize the "Loyal Foresters," who were to be sent against the rebellious colonists in the West. The city of Louisville was laid out on the upper half of this Connolly tract. It is possible that there was a settlement on what was afterward called Corn Island (which has now practically disappeared), at the Falls of the Ohio, as early as 1775; in May 1778, General George Rogers Clark, while proceeding, by way of the Ohio river, against the British posts in the Illinois territory, landed on this island and built block-houses for his stores and cabins for about twenty families of emigrants who had come with him. These emigrants (or the greater part of them) removed to the mainland in the winter of 1778–1779, and established themselves in a fort built within the present limits of Louisville. A town government was organized by them in April 1779, the settlement at this time being known as "the Falls of the Ohio." On the 14th of May 1780, the legislature of Virginia, in response to a petition of the inhabitants, declared that Connolly had forfeited his title, and incorporated the settlement under the name of Louisville, in recognition of the assistance given to the colonies in the War of Independence by Louis XVI. of France. In 1828 Louisville was chartered as a city; in 1851 it received a second city charter; in 1870, a third; and in 1893, a fourth. The city's growth was greatly promoted by the introduction of successful steam navigation on the Ohio in 1811 and still further by the opening of the canal around the rapids (generally called the "Falls of the Ohio"). This canal, which is 2½ m. in length and is known as the Louisville and Portland canal, was authorized by the legislature in 1825 and was opened in December 1830; between 1855 and 1872 Congress made appropriations for enlarging it, and in 1874 it passed entirely under Federal control. The first railway to serve the city, the Louisville & Frankfort, was completed in 1851. The 6th of August is locally known as "Bloody Monday"; on this day in 1855 some members of the Know Nothing Party incited a riot that resulted in the loss of several lives and of considerable property. In March 1890 a tornado caused great loss in life and property in the city. General Clark made his home in Louisville and the vicinity after his return from the Illinois country in 1779. Louisville was also the early home of the actress Mary Anderson; John James Audubon lived here in 1808–1812; and 5 m. E. of the city are the old home and the grave (with a monument) of Zachary Taylor.

See Reuben T. Durrett, *The Centenary of Louisville* (Louisville, 1893), being No. 8 of the Filson Club Publications; J. S. Johnston (ed.), *Memorial History of Louisville* (Chicago, 1896); and L. V. Rule, "Louisville, the Gateway City to the South," in L. P. Powell's *Historic Towns of the Southern States* (New York, 1900).

LOULÉ, a town of southern Portugal, in the district of Faro (formerly the province of Algarve); beautifully situated in an inland hilly district, 10 m N.N.W. of the seaport of Faro and 5 m. from São João da Venda on the Lisbon-Faro railway. Pop. (1900) 22,478. Apart from Lisbon, Oporto and Braga, Loulé is the most populous town in the kingdom. It is surrounded by walls and towers dating from the Moorish period. The neighbouring church of Nossa Senhora da Piedade is a favourite resort of pilgrims. Basket-making is the principal industry; leather, porcelain and various products of the palm, agave and esparto grass are also manufactured.

LOURDES, a town of south-western France in the department of Hautes-Pyrénées, at the foot of the Pyrenees, 12 m. S.S.W. of Tarbes on the main line of the Southern railway between that town and Pau. Pop. (1906) 7228. Lourdes is divided into an old and a new town by the Gave de Pau, which at this point leaves the valley of Argelès and turns abruptly to the west. The old quarter on the right bank surrounds on three sides a scarped rock, on which stands the fortress now used as a prison. Its large square keep of the 14th century is the chief survival of feudal times. Little is left of the old fortifications except a tower of the 13th or 14th century, surmounting a gateway known as the Tour de Garnabie. The old quarter is united with the new town by a bridge which is continued in an esplanade leading to the basilica, the church of the Rosary and the Grotto, with its spring of healing water. The present fame of Lourdes is entirely associated with this grotto, where the Virgin Mary is believed in the Roman Catholic world to have revealed herself repeatedly to a peasant girl named Bernadette Soubirous in 1858. A statue of the Virgin stands on a rock projecting above the grotto, the walls of which are covered with crutches and other votive offerings; the spot, which is resorted to by multitudes of pilgrims from all quarters of the world, is marked by a basilica built above the grotto and consecrated in 1876. In addition the church of the Rosary, a rich building in the Byzantine style, was erected in front of and below the basilica from 1884 to 1889. Not far from the grotto are several other caves, where prehistoric remains have been found. The Hospice de Notre-Dame de Douleurs is the chief of the many establishments provided for the accommodation of pilgrims.

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[1] Louisville cement, one of the best-known varieties of natural cement, was first manufactured in Shipping Port, a suburb of Louisville, in 1829 for the construction of the Louisville & Portland Canal; the name is now applied to all cement made in the Louisville District in Kentucky and Indiana. There is a large Portland cement factory just outside the city.

[2] Captain Thomas Bullitt (1730–1778), a Virginian, commanded a company under Washington at Great Meadows (July 4, 1754), was in Braddock's disastrous expedition in 1755, and after the defeat of Major James Grant in 1758 saved his disorganized army by a cleverly planned attack upon the pursuers. He became Adjutant-General of Virginia after the peace of 1763, and took part in the movements which forced Lord Dunmore to leave Norfolk. Subsequently he served in South Carolina under Colonel Lee.

Lourdes is a fortified place of the second class; and is the seat of the tribunal of first instance of the arrondissement of Argelès. There are marble and slate quarries near the town. The pastures of the neighbourhood support a breed of Aquitaine cattle, which is most highly valued in south-western France.

The origin of Lourdes is uncertain. From the 9th century onwards it was the most important place in Bigorre, largely owing to the fortress which is intimately connected with its history. In 1360 it passed by the treaty of Brétigny from French to English hands, and its governor was murdered by Gaston Phoebus viscount of Béarn, for refusing to surrender it to the count of Anjou. Nevertheless the fortress did not fall into the possession of the French till 1406 after a blockade of eighteen months. Again during the wars of religion the castle held out successfully after the town had been occupied by the troops of the Protestant captain Gabriel, count of Montgomery. From the reign of Louis XIV. to the beginning of the 19th century the castle was used as a state prison. Since the visions of Bernadette Soubirous, their authentication by a commission of enquiry appointed by the bishop of Tarbes, and the authorization by the pope of the cult of Our Lady of Lourdes, the quarter on the left bank of the Gave has sprung up and it is estimated that 600,000 pilgrims annually visit the town. The chief of the pilgrimages, known as the national pilgrimage, takes place in August.

Several religious communities have been named after Our Lady of Lourdes. Of these one, consisting of sisters of the third order of St Francis, called the Congregation of Our Lady of Lourdes (founded 1877), has its headquarters in Rochester, Minnesota. Another, the Order of Our Lady of Lourdes, was founded in 1883 for work in the archdiocese of New Orleans.

See G. Marès, *Lourdes et ses environs* (Bordeaux, 1894); Fourcade, *L'Apparition de la grotte de Lourdes* (Paris, 1862) and *L'Apparition . . . considérée au point de vue de l'art chrétien* (Bordeaux, 1862); Boissarie, *Lourdes, histoire médicale* (Paris, 1891); Bertrin, *Hist. critique des événements de Lourdes* (2nd ed., Paris, 1905), written under authority of the bishop of Tarbes; H. Lasserre, *Miraculous Episodes of Lourdes* (London, 1884, tr.); R. F. Clarke, *Lourdes and its Miracles* (*ib.*, 1889) and *Medical Testimony to the Miracles* (*ib.*, 1892); D. Barbé, *Lourdes hier, aujourd'hui, demain* (Paris, 1893; Eng. trans. by A. Meynell, London, 1894); J. R. Gasquet, *The Cures at Lourdes* (London, 1895); *Les Pèlerinages de Lourdes. Cantiques, insignes, costumes* (Lourdes, 1897); W. Leschner, *The Origin of Lourdes* (London, 1900). Zola's *Lourdes* (Paris, 1894), a criticism from the sceptical point of view, in the form of a realistic novel, has called forth many replies from the Catholic side.

LOURENÇO MARQUES, capital of Portuguese East Africa, or Mozambique, on the north bank of the Espirito Santo or English river, Delagoa Bay, and 396 m. by rail via Pretoria from Johannesburg. Pop. (1904) 9849, of whom 4691 were Europeans and 1690 Asiatics. The town is situated close to the mouth of the river in 25° 53′ S. and 32° 30′ E., and is built upon a low-lying spit of sand, formerly surrounded by swamps. The streets are regularly laid out and adorned by several fine buildings. The principal thoroughfare, the Avenida Aguiar, 2 m. long goes from the centre of the town to Reuben Point. The harbour is well equipped with piers, quays, landing sheds and electric cranes, which enable large steamers to discharge cargoes direct into the railway trucks. The depth of water at low tide is 18 ft. The streets are lit by electricity and there is an electric tramway system 7 m. in extent. At Reuben Point, which marks the spot where the English river enters the bay, are the lighthouse, barracks and the private residences of the wealthy citizens. At its mouth the English river is about 2 m. across. Lourenço Marques is the nearest seaport to the Rand gold mines. The port is 8374 m. from Southampton via Cape Town and 7565 m. via the Suez canal. It is served by British, Portuguese and German liners, the majority of the goods imported being shipped at Southampton, Lisbon or Hamburg. Over 50% of the import trade of Johannesburg is with Lourenço Marques. Great Britain and British possessions take some 40% of the import trade, Portugal, Germany, Norway, Sweden and America coming next in order. Most of the imports, being forwarded to the Transvaal, figure also as exports. The chief articles of import are food-stuffs and liquors, iron, mineral oils, inks and dyes, timber and live stock. These all form part of the transit trade. There is practically no export trade by sea save in coal, which is brought chiefly from the collieries at Middelburg in the Transvaal. At Port Matolla, 20 m. from the town, on the river of that name, one of the feeders of the English river, is a flourishing timber trade. The average value of the total trade of Lourenço Marques for the five years 1897–1899 and 1902–1903 (1900 and 1901 being years during which trade was disorganized by the Anglo-Boer War) was over £3,500,000. In 1905 the value of the trade of the port was £5,682,000; of this total the transit trade was worth over £4,500,000 and the imports for local consumption £1,042,000. The retail trade, and trade with the natives, is almost entirely in the hands of Indians. The chief import for local consumption is cheap wine from Portugal, bought by the Kaffirs to the extent of over £500,000 yearly. These natives form the bulk of the Africans who work in the Rand gold mines.

Lourenço Marques is named after a Portuguese navigator, who with a companion (Antonio Calderia) was sent in 1544 by the governor of Mozambique on a voyage of exploration. They explored the lower courses of the rivers emptying their waters into Delagoa Bay, notably the Espirito Santo. The various forts and trading stations which the Portuguese established, abandoned and reoccupied on the north bank of the river were all called Lourenço Marques. The existing town dates from about 1850, the previous settlement having been entirely destroyed by the natives. In 1871 the town was described as a poor place, with narrow streets, fairly good flat-roofed houses, grass huts, decayed forts and rusty cannon, enclosed by a wall 6 ft. high then recently erected and protected by bastions at intervals. The growing importance of the Transvaal led, however, to greater interest being taken in Portugal in the port. A commission was sent by the Portuguese government in 1876 to drain the marshy land near the settlement, to plant the blue gum tree, and to build a hospital and a church. It was not, however, until the end of the 19th century that any marked development took place in the town, and up to 1903 cargo had to be discharged in tugs and lighters.

In 1873–1877 Mr Burgers, president of the Transvaal, endeavoured, unsuccessfully, to get a railway built from Pretoria to Delagoa Bay. In 1878–1879 a survey was taken for a line from Lourenço Marques to the Transvaal, and in 1883 the Lisbon cabinet granted to Colonel Edward McMurdo, an American citizen, a concession—which took the place of others which had lapsed—for the building of a railway from Lourenço Marques to the Transvaal frontier, the Boer government having agreed (1883) to continue the line to Pretoria. Under this concession Colonel McMurdo formed in London in 1887 a company—the Delagoa Bay and East African Railway Company—to construct the line. Meantime a secret agreement had been come to between President Kruger and Portugal for the concession to the Transvaal of a "steam tramway" parallel to the projected railway, should the company not complete the line in the time specified. The company, however, built the line to the frontier shown on the Portuguese maps of 1883 within the time limit, the railway being opened on the 14th of December 1888. The frontier by this date had been fixed at Komati Poort, 5 m. farther from the coast. Portugal had previously agreed to grant the company "a reasonable extension of time" to complete the line if the frontier should be traced farther inland than shown on the 1883 maps. The Lisbon government required the extension to Komati Poort to be completed in eight months (five of which were in the rainy season), an impossible stipulation. The railway not being finished, the Portuguese seized the line on the 25th of June 1889 and cancelled the concession. Portugal in so doing acted, to all appearance, under pressure from the Transvaal. Great Britain and America at once protested, Portugal admitted the illegality of her act and consented to refer the amount of compensation to the decision of three Swiss jurists. This was in 1890, when Portugal paid £28,000 on account. It was not until the 29th of March 1900 that the award was made known. The arbitrators ordered Portugal to pay—in addition to the £28,000—a sum, including interest, of £950,000. The damages were promptly paid. Meantime the railway had been continued from Komati Poort and was opened for through traffic to Pretoria on the 8th of July 1895. In 1906–1910 another railway (47 m. long) was built from Lourenço Marques due west to the Swaziland frontier, being a link in a new line to shorten the distance by rail between the Rand and the sea by some 60 m.

See also Delagoa Bay and the authorities there cited. The text of the railway arbitration award was published in French at Berne in 1900. Annual reports on the trade of Lourenço Marques are issued by the British Foreign Office.

LOUSE (O. Eng. *lús*, cf. Du. *luis*, Ger. *Laus*, Dan. and Swed. *lus*), a term applied to small wingless insects, parasitic upon birds and mammals, and belonging strictly speaking to the order Anoplura, often included among the Hemiptera, though the term is frequently extended to the bird-lice constituting the sub-order Mallophaga, formerly included among the Neuroptera. Both agree in having nothing that can be termed a metamorphosis; they are active from the time of their exit from the egg to their death, gradually increasing in size, and undergoing several moults or changes of skin. The true lice (or Anoplura) are found on the bodies of many Mammalia, and occasion by their presence intolerable irritation. The number of genera is few. Two species of *Pediculus* are found on the human body, and are known ordinarily as the head-louse (*P. capitis*) and the body-louse (*P. vestimenti*); *P. capitis* is found on the head, especially of children. The eggs, laid on the hairs, and known as "nits," hatch in about eight days, and the lice are full grown in about a month. Such is their fecundity that it has been asserted that one female (probably of *P. vestimenti*) may in eight weeks produce five thousand descendants. Want of cleanliness favours their multiplication in a high degree—the idea once existed, and is probably still held by the very ignorant, that they are directly engendered from dirt. The irritation is caused by the rostrum of the insect being inserted into the skin, from which the blood is rapidly pumped up. A third human louse, known as the crab-louse (*Phthirius pubis*) is found amongst the hairs on other parts of the body, particularly those of the pubic region, but probably never on the head. The louse of monkeys is now generally considered as forming a separate genus (*Pedicinus*), but the greater part of those infesting domestic and wild quadrupeds are mostly grouped in the large genus *Haematopinus*, and very rarely is the same species found on different kinds of animals.

The bird-lice (Mallophaga) are far more numerous in species, although the number of genera is comparatively small. With the exception of the genus *Trichodectes*, the various species of which are found on mammalia, all infest birds (as their English names implies) (see Bird-Louse). Louse-infestation is known as phthiriasis in medical and veterinary terminology.

Authorities.—The following works are the most important: Denny, *Monographia Anoplurorum Britanniae* (London, 1843); Giebel, *Insecta Epizoa* (which contains the working-up of Nitzsch's posthumous materials; Leipzig, 1874); van Beneden, *Animal Parasites* (London, 1876); Piaget, *Les Pédiculines* (Leiden, 1880); Mégnin, *Les Parasites et les maladies parasitaires* (Paris, 1880); Neumann, *Parasites and Parasitic Diseases of Domesticated Animals* (1892); Osborn, *Pediculi and Mallophaga affecting Man and the Lower Animals* (Washington, 1891; U.S. Dept. Agr.); Enderlein, "Läuse-Studien," *Zool. Anz.* xxviii. (1904).

LOUTH, a maritime county in the province of Leinster, Ireland, bounded N.E. by Carlingford Bay and Co. Down, E. by the Irish Sea, S.W. by Meath, and N.W. by Monaghan and Armagh. It is the smallest county in Ireland, its area being 202,731 acres or about 317 sq. m. The greater part of the surface is undulating, with occasionally lofty hills; in the north-east, on the borders of Carlingford Lough, there is a mountain range approaching 2000 ft. in height. Many of the hills are finely wooded, and towards the sea the scenery, in the more elevated districts, is strikingly picturesque. With the exception of the promontory of Clogher Head, which rises abruptly to a height of 180 ft., the coast is for the most part low and sandy. The narrow and picturesque Carlingford Lough is navigable beyond the limits of the county, and Carlingford and Greenore are well-known watering-places on the county Louth shore. The Bay of Dundalk stretches to the town of that name and affords convenient shelter. The principal rivers, the Fane, the Lagan, the Glyde and the Dee, flow eastwards. None of these is navigable, but the Boyne, which forms the southern boundary of the county, is navigable for large vessels as far as Drogheda.

Almost all this county is occupied by an undulating lowland of much-folded Silurian shales and fine-grained sandstones; but Carboniferous Limestone overlies these rocks north and east of Dundalk. Dolerite and gabbro, in turn invaded by granite, have broken through the limestone north of Dundalk Bay, and form a striking and mountainous promontory. There is now no doubt that these rocks, with those on the adjacent moorland of Slieve Gullion, belong to the early Cainozoic igneous series, and may be compared with similar masses in the Isle of Skye. A raised beach provides a flat terrace at Greenore. Lead ore has been worked in the county, as in the adjacent parts of Armagh and Monaghan.

In the lower regions the soil is a very rich deep mould, admirably adapted both for cereals and green crops. The higher mountain regions are covered principally with heath. Agriculture generally is in an advanced condition, and the farms are for the most part well drained. The acreage of tillage is but little below that of pasture. Oats, barley, flax, potatoes and turnips are all satisfactorily cultivated. Cattle, sheep, pigs and poultry represent the bulk of the live stock. Linen manufactures are of some importance. The deep-sea and coast fishery has its headquarters at Dundalk, and the salmon fisheries at Dundalk (Castletown river) and Drogheda (river Boyne). These fisheries, together with oyster beds in Carlingford Lough, are of great value. The county is traversed from S. to N. by the Great Northern railway, with a branch westward from Dundalk; while the same town is connected with the port of Greenore by a line owned by the London & North-Western railway of England. From Greenore the London & North-Western railway passenger steamers run regularly to Holyhead. The town of Ardee is served by a branch from the Great Northern line at Dromin.

The population (71,914 in 1891; 65,820 in 1901) decreases at about an average rate, and a considerable number of the inhabitants emigrate. Of the total population about 92% are Roman Catholics. The principal towns are Dundalk (pop. 13,076), Drogheda (12,760) and Ardee (1883). The county includes six baronies and sixty-four parishes. Assizes are held at Dundalk and quarter sessions at Ardee, Drogheda and Dundalk. Louth was represented by two county and ten borough members in the Irish parliament; the two present divisions are the north and south, each returning one member. The county is in the Protestant dioceses of Armagh and Clogher and the Roman Catholic diocese of Armagh.

The territory which afterwards became the county Louth was included in the principality of Uriel, Orgial or Argial, which comprehended also the greater part of Meath, Monaghan and Armagh. The chieftain of the district was conquered by John de Courcy in 1183, and Louth or Uriel was among the shires generally considered to have been created by King John, and peopled by English settlers. Until the time of Elizabeth it was included in the province of Ulster. County Louth is rich in antiquarian remains. There are ancient buildings of all dates, and spears, swords, axes of bronze, ornaments of gold, and other relics have been discovered in quantities. Among Druidical remains is the fine cromlech of Ballymascanlan, between Dundalk and Greenore. Danish raths and other forts are numerous. It is said that there were originally twenty religious houses in the county. Of the remains of these the most interesting are at Monasterboice and Mellifont, both near Drogheda. At the former site are two churches, the larger dating probably from the 9th century, the smaller from the 13th; a fine round tower, 110 ft. in height, but not quite perfect; and three crosses, two of which, 27 and 15 ft. in height respectively, are adorned with moulding, sculptured figures and tracery, and are among the finest in Ireland. At Mellifont are the remains of the first Cistercian monastery founded in Ireland, in 1142, with a massive gatehouse, an octagonal baptistery and chapter-house. Carlingford and Drogheda have monastic remains, and at Dromiskin is a round tower, in part rebuilt. Ardee, an ancient town, incorporated in 1376, has a castle of the 13th century. At Dunbar a charter of Charles II. (1679) gave the inhabitants the right to elect a sovereign. Louth, 5½ m. S.W. from Dundalk, is a decayed town which gave its name to the county, and contains ruins of an abbey to which was attached one of the most noted early schools in Ireland.

LOUTH, a market-town and municipal borough in the E. Lindsey or Louth parliamentary division of Lincolnshire, England, on the river Lud, 141½ m. N. of London by the Grimsby branch of the Great Northern railway. Pop. (1901) 9518. By a canal, completed in 1763, there is water communication with the Humber. The Perpendicular church of St James, completed about 1515, with a spire 300 ft. in height, is one of the finest ecclesiastical buildings in the county. Traces of a building of the 13th century are perceptible. There are a town hall, a corn exchange and a market-hall, an Edward VI. grammar school, which is richly endowed, a commercial school founded in 1676, a hospital and several almshouses. Thorpe Hall is a picturesque building dated 1584. In the vicinity are the ruins of a Cistercian abbey (Louth Park). The industries include the manufacture of agricultural implements, iron-founding, brewing,-malting, and rope and brick-making. The town is governed by a mayor, 6 aldermen and 18 councillors. Area, 2749 acres.

Louth (*Ludes*, *Loweth*) is first mentioned in the Domesday record as a borough held, as it had been in Saxon times, by the bishop of Lincoln, who had a market there. The see retained the manor until it was surrendered by Bishop Holbeach to Henry VIII., who granted it to Edward, earl of Lincoln, but it was recovered by the Crown before 1562. Louth owed much of its early prosperity to the adjacent Cistercian abbey of Louth Park, founded in 1139 by Alexander bishop of Lincoln. The borough was never more than prescriptive, though burgesses were admitted throughout the middle ages and until 1711, their sole privilege being freedom from tolls. The medieval government of the town was by the manor court under the presidency of the bishop's high steward, the custom being for the reeve to be elected by eighteen ex-reeves. The original parish church was built about 1170. During the 13th and 14th centuries nine religious gilds were founded in the town. Fear of confiscation of the property of these gilds seems to have been one of the chief local causes of the Lincolnshire Rebellion, which broke out here in 1536. The disturbance began by the parishioners seizing the church ornaments to prevent their surrender. The bishop's steward, who arrived to open the manorial court for the election of a reeve, agreed to ride to ask the king the truth about the jewels, but this did not satisfy the people, who, while showing respect to a royal commission, seized and burnt the papers of the bishop's registrar. After swearing several country gentlemen to their cause, the rebels dispersed, agreeing to meet on the following day under arms. Edward VI. in 1551 incorporated Louth under one warden and six assistants, who were to be managers of the school founded by the same charter. This was confirmed in 1564 by Elizabeth, who granted the manor of Louth to the corporation with all rights and all the lands of the suppressed gilds at an annual fee-farm rent of £84. James I. gave the commission of the peace to the warden and one assistant in 1605; a further charter was obtained in 1830. Louth has never been a parliamentary borough. The markets said to have been held from ancient times and the three fairs on the third Sunday after Easter and the feasts of St Martin and St James were confirmed in 1551. Louth was a seat of the wool trade as early as 1297; the modern manufactures seem to have arisen at the end of the 18th century, when, according to the charter of 1830, there was a great increase in the population, manufactures, trade and commerce of the town.

See E. H. R. Tatham, *Lincolnshire in Roman Times* (Louth, 1902); Richard W. Goulding, *Louth Old Corporation Records* (Louth, 1891).

LOUVAIN (Flem. *Leuven*), a town of Belgium in the province of Brabant, of which it was the capital in the 14th century before the rise of Brussels. Pop. (1904) 42,194. Local tradition attributes the establishment of a permanent camp at this spot to Julius Caesar, but Louvain only became important in the 11th century as a place of residence for the dukes of Brabant. In 1356 Louvain was the scene of the famous *Joyeuse Entrée* of Wenceslas which represented the principal charter of Brabant. At that time it had a population of at least 50,000 and was very prosperous as the centre of the woollen trade in central Belgium. The gild of weavers numbered 2400 members. The old walls of Louvain were 4½ m. in circumference, and have been replaced by boulevards, but within them there is a considerable extent of cultivated ground. Soon after the *Joyeuse Entrée* a serious feud began between the citizens and the patrician class, and eventually the duke threw in his lot with the latter. After a struggle of over twenty years' duration the White Hoods, as the citizens called themselves, were crushed. In 1379 they massacred seventeen nobles in the town hall, but this crime brought down on them the vengeance of the duke, to whom in 1383 they made the most abject and complete surrender. With this civil strife the importance and prosperity of Louvain declined. Many weavers fled to Holland and England, the duke took up his residence in the strong castle of Vilvorde, and Brussels prospered at the expense of Louvain. What it lost in trade it partially recovered as a seat of learning, for in 1423, Duke John IV. of Brabant founded there a university and ever since Louvain University has enjoyed the first place in Belgium. It has always prided itself most on its theological teaching. In 1679 the university was established in the old Cloth Workers' Hall, a building dating from 1317, with long arcades and graceful pillars supporting the upper storeys. The library contains 70,000 volumes and some 500 manuscripts. Attached to the university are four residential colleges at which the number of students average two thousand. In the 16th century when the university was at the height of its fame it counted six thousand.

The most remarkable building in Louvain is the Hôtel de Ville, one of the richest and most ornate examples of pointed Gothic in the country. If less ornate than that of Oudenarde it is more harmonious in its details. It was the work of Mathieu de Layens, master mason, who worked at it from 1448 to 1463. The building is one of three storeys each with ten pointed windows forming the façade facing the square. Above is a graceful balustrade behind which is a lofty roof, and at the angles are towers perforated for the passage of the light. The other three sides are lavishly decorated with statuary. The interior is not noteworthy.

Opposite the Hôtel de Ville is the fine church of St Pierre, in the form of a cross with a low tower to which the spire has never been added. The existing edifice was built on the site of an older church between 1425 and 1497. It contains seven chapels, in two of which are fine pictures by Dierich Bouts formerly attributed to Memling. Much of the iron and brass work is by Jean Matseys. There is also an ancient tomb, being the monument of Henry I., duke of Brabant, who died in 1235. There are four other interesting churches in Louvain, viz. Ste Gertrude, St Quentin, St Michael and St Jacques. In the last-named is a fine De Crayer representing St Hubert. Some ruins on a hill exist of the old castle of the counts of Louvain whose title was merged in the higher style of the dukes of Brabant.

LOUVER, Louvre or Luffer, in architecture, the lantern built upon the roof of the hall in ancient times to allow the smoke to escape when the fire was made on the pavement in the middle of the hall. The term is also applied to the flat overlapping slips of wood, glass, &c., with which such openings are closed, arranged to give ventilation without the admission of rain. Openings fitted with louvers are now utilized for the purposes of ventilation in schools and manufactories.

The word has been derived from the French *l'ouvert*, the "open" space. This, Minsheu's guess, is now generally abandoned. The Old French form, of which the English is an adaptation, was *lover* or *lovier*. The medieval Latin *lodium*, *lodarium*, is suggested as the ultimate origin. Du Cange (*Glossarium*, s.v. "lodia") defines it as *tugurium*, *i.e.* a small hut. The English form "louvre" is due to a confusion with the name of the palace in Paris. The origin of that name is also unknown; *louverie*, place of wolves, is one of the suggestions, the palace being supposed to have originally been a hunting-box (see PARIS).

LOUVET, JEAN (*c.* 1370–*c.* 1440), called the president of Provence, occupied the position of president of the Chambre des Comptes at Aix in 1415. Towards the end of that year he went to Paris with Louis II. of Anjou, king of Sicily, attached himself to the dauphin Charles, and after having been chief steward of the household to Queen Isabella he turned against her. He was one of the principal agents of the Armagnac party, and became the most influential adviser of Charles VII. during the first years of his reign. But his rapacity gained him enemies, and when the constable Arthur, earl of Richmond, attained a preponderating influence over Charles VII. Louvet retired to his captaincy of Avignon. He still remained a personage of importance in his exile, and played an influential part even in his last years.

See Vallet de Viriville in the *Nouvelle Biographie générale*, and G. du Fresne de Beaucourt, *Histoire de Charles VII.* (1881–1891). (J. V.*)

LOUVET DE COUVRAI, JEAN BAPTISTE (1760–1797), French writer and politician, was born in Paris on the 12th of June 1760, the son of a stationer. He became a bookseller's clerk, and first attracted attention with a not very moral novel called *Les Amours du chevalier de Faublas* (Paris, 1787–1789). The character of the heroine of this book, Lodoïska, was taken from the wife of a jeweller in the Palais Royal, with whom he had formed a *liaison*. She was divorced from her husband in 1792 and married Louvet in 1793. His second novel, *Émilie de Varmont*, was intended to prove the utility and necessity of divorce and of the marriage of priests, questions raised by the Revolution. Indeed all his works were directed to the ends of the Revolution. He attempted to have one of his unpublished plays, *L'Anobli conspirateur*, performed at the Théâtre Français, and records naïvely that one of its managers, M. d'Orfeuil, listened to the reading of the first three acts "with mortal impatience," exclaiming at last: "I should need cannon in order to put that piece on the stage." A "sort of farce" at the expense of the army of the *émigrés*, *La Grande Revue des armées noire et blanche*, had, however, better success: it ran for twenty-five nights.

Louvet was, however, first brought into notice as a politician by his *Paris justifié*, in reply to a "truly incendiary" pamphlet in which Mounier, after the removal of the king to Paris in October 1789, had attacked the capital, "at that time blameless," and argued that the court should be established elsewhere. This led to Louvet's election to the Jacobin Club, for which, as he writes bitterly in his Memoirs, the qualifications were then "a genuine *civisme* and some talent." A self-styled *philosophe* of the true revolutionary type, he now threw himself ardently into the campaign against "despotism" and "reaction," *i.e.* against the moderate constitutional royalty advocated by Lafayette, the Abbé Maury and other "Machiavellians." On the 25th of December 1791 he presented at the bar of the Assembly his *Pétition contre les princes*, which had "a prodigious success in the senate and the empire." Elected deputy to the Assembly for the department of Loiret, he made his first speech in January 1792. He attached himself to the Girondists, whose vague deism, sentimental humanitarianism and ardent republicanism he fully shared, and from March to November 1792 he published, at Roland's expense, a bi-weekly *journal-affiche*, of which the title, *La Sentinelle*, proclaimed its mission to be to "enlighten the people on all the plots" at a time when, Austria having declared war, the court was "visibly betraying our armies." On the 10th of August he became editor of the *Journal des débats*, and in this capacity, as well as in the Assembly, made himself conspicuous by his attacks on Robespierre, Marat and the other Montagnards, whom he declares he would have succeeded in bringing to justice in September but for the poor support he received from the Girondist leaders. It is more probable, however, that his ill-balanced invective contributed to their ruin and his own; for him Robespierre was a "royalist," Marat "the principal agent of England," the Montagnards Orleanists in masquerade. His courageous attitude at the trial of Louis XVI., when he supported the "appeal to the people," only served still further to discredit the Girondists. He defended them, however, to the last with great courage, if with little discretion; and after the crisis of the 31st of May 1793 he shared the perils of the party who fled from Paris (see GIRONDISTS). His wife, "Lodoïska," who had actively co-operated in his propaganda, was also in danger.

After the fall of Robespierre, he was recalled to the Convention, when he was instrumental in bringing Carrier and the others responsible for the *Noyades* of Nantes to justice. His influence was now considerable; he was elected a member of the Committee of the Constitution, president of the Assembly, and member of the Committee of Public Safety, against the overgrown power of which he had in earlier days protested. His hatred of the Mountain had not made him reactionary; he was soon regarded as one of the mainstays of the "Jacobins," and *La Sentinelle* reappeared, under his auspices, preaching union among republicans. Under the Directory (1795) he was elected a member of the Council of Five Hundred, of which he was secretary, and also a member of the Institute. Meanwhile he had returned to his old trade and set up a bookseller's shop in the Palais Royal. But, in spite of the fact that he had once more denounced the Jacobins in *La Sentinelle*, his name had become identified with all that the combative spirits of the *jeunesse dorée* most disliked; his shop was attacked by the "young men" with cries of "*À bas la Loupe, à bas la belle Lodoïska, à bas les gardes du corps de Louvet!*" he and his wife were insulted in the streets and the theatres: "*À bas les Louvets et les Louvetants!*" and he was compelled to leave Paris. The Directory appointed him to the consulship at Palermo, but he died on the 25th of August 1797 before taking up his post.

In 1795 Louvet published a portion of his Memoirs under the title of *Quelques notices pour l'histoire et le récit de mes périls depuis le 31 mai 1793*. They were mainly written in the various hiding-places in which Louvet took refuge, and they give a vivid picture of the sufferings of the proscribed Girondists. They form an invaluable document for the study of the psychology of the Revolution; for in spite of their considerable literary art, they are artless in their revelation of the mental and moral state of their author, a characteristic type of the honest, sentimental, somewhat hysterical and wholly unbalanced minds nurtured on the abstractions of the *philosophes*. The first complete edition of the *Mémoires de Louvet de Couvrai*, edited, with preface, notes and tables, by F. A. Aulard, was published at Paris in 1889.

LOUVIERS, a town of north-western France, capital of an arrondissement in the department of Eure, 17½ m. S.S.E. of Rouen by road. Pop. (1906) 9449. Louviers is pleasantly situated in a green valley surrounded by wooded hills, on the Eure, which here divides into several branches. The old part of the town, built of wood, stands on the left bank of the river; the more modern portions, in brick and hewn stone, on the right. There are spacious squares, and the place is surrounded by boulevards. The Gothic church of Notre-Dame has a south portal which ranks among the most beautiful works of the kind produced in the 15th century; it contains fine stained glass of the 15th and 16th centuries and other works of art. The hôtel-de-ville, a large modern building, contains a museum and library. The chief industry is cloth and flannel manufacture. There are wool-spinning and fulling mills, thread factories and manufactories of spinning and weaving machinery, and enamel ware; leather-working, dyeing, metal-founding and bell-founding are also carried on. The town is the seat of a sub-prefect and has a court of first instance, a tribunal of commerce, a chamber of arts and manufactures, and a council of trade arbitrators.

Louviers (*Lovera*) was originally a *villa* of the dukes of Normandy and in the middle ages belonged to the archbishops of Rouen; its cloth-making industry first arose in the beginning of the 13th century. It changed hands once and again during the Hundred Years' War, and from Charles VII. it received extensive privileges, and the title of Louviers le Franc for the bravery of its inhabitants in driving the English from Pont de l'Arche, Verneuil and Harcourt. It passed through various troubles successively at the period of the League of the Public Weal under Louis XI., in the religious wars (when the parlement of Rouen sat for a time at Louviers) and in the wars of the Fronde.

See G. Petit, *Hist. de Louviers* (Louviers, 1877).

LOUVOIS, FRANÇOIS MICHEL LE TELLIER, MARQUIS DE (1641–1691), French statesman, war minister of Louis XIV., was born at Paris on the 18th of January 1641. His father, Michel le Tellier (*q.v.*), married him to an heiress, the marquise de Courtenvaux, and instructed him in the management of state business. The young man won the king's confidence, and in 1666 he succeeded his father as war minister. His talents were perceived by Turenne in the war of Devolution (1667–68), who gave him instruction in the art of providing armies After the peace of Aix-la-Chapelle, Louvois devoted himself to organizing the French army The years between 1668 and 1672, says Camille Rousset, "were years of preparation, when Lionne was labouring with all his might to find allies, Colbert to find money, and Louvois soldiers for Louis" The work of Louvois in these years is bound up with the historical development of the French army and of armies in general (see ARMY) Here need only be mentioned Louvois's reorganization of the military orders of merit, his foundation of the Hôtel des Invalides, and the almost forcible enrolment of the nobility and gentry of France, in which Louvois carried out part of Louis's measures for curbing the spirit of independence by service in the army or at court. The success of his measures is to be seen in the victories of the great war of 1672–78. After the peace of Nijmwegen Louvois was high in favour, his father had been made chancellor, and the influence of Colbert was waning. The ten years of peace between 1678 and 1688 were distinguished in French history by the rise of Madame de Maintenon, the capture of Strassburg and the revocation of the Edict of Nantes, in all of which Louvois bore a prominent part. The surprise of Strassburg in 1681 in time of peace was not only planned but executed by Louvois and Monclar A saving clause in the revocation of the Edict of Nantes, which provided for some liberty of conscience, if not of worship, Louvois sharply annulled with the phrase "Sa majesté veut qu'on fasse sentir les dernières rigueurs à ceux qui ne voudront pas se faire de sa religion." He claimed also the credit of inventing the dragonnades, and mitigated the rigour of the soldiery only in so far as the licence accorded was prejudicial to discipline. Discipline, indeed, and complete subjection to the royal authority was the political faith of Louvois. Colbert died in 1683, and had been replaced by Le Pelletier, an adherent of Louvois, in the controller-generalship of finances, and by Louvois himself in his ministry for public buildings, which he took that he might be the minister able to gratify the king's two favourite pastimes, war and building. Louvois was able to superintend the successes of the first years of the war of the League of Augsburg, but died suddenly of apoplexy after leaving the king's cabinet on July 16, 1691 His sudden death caused a suspicion of poison. Louvois was one of the greatest of the rare class of great war ministers. French history can only point to Carnot as his equal. Both had to organize armies out of old material on a new system, both were admirable contrivers of campaigns, and both devoted themselves to the material well-being of the soldiers. In private life and in the means employed for gaining his ends, Louvois was unscrupulous and shameless.

The principal authority for Louvois's life and times is Camille Rousset's *Histoire de Louvois* (Paris, 1872), a great work founded on the 900 volumes of his despatches at the Dépôt de la Guerre. Saint Simon from his class prejudices is hardly to be trusted, but Madame de Sévigné throws many side-lights on his times. *Testament politique de Louvois* (1695) is spurious.

LOUŸS, PIERRE (1870–   ), French novelist and poet, was born in Paris on the 10th of December 1870. When he was nineteen he founded a review, *La Conque*, which brought him into contact with the leaders of the Parnassians, and counted Swinburne, Maeterlinck, Mallarmé and others among its contributors. He won notoriety by his novel *Aphrodite* (1896), which gave a vivid picture of Alexandrian morals at the beginning of the Christian era. His *Chansons de Bilitis, roman lyrique* (1894), which purported to be a translation from the Greek, is a glorification of Sapphic love, which in subject-matter is objectionable in the highest degree, but its delicate decadent prose is typical of a modern French literary school, and some of the "songs" were set to music by Debussy and others. Later books are: *La Femme et le pantin* (1898), *Les Aventures du roi Pausole* (1900); *Sanguines* (1903), *Archipel* (1906) Louÿs married in 1899 Louise de Heredia, younger daughter of the poet

LOVAT, SIMON FRASER, 12TH BARON (*c.* 1667–1747), Scottish chief and Jacobite intriguer, was born about 1667 and was the second son of Thomas Fraser, third son of the 8th Lord Lovat The barony of Lovat dates from about 1460, in the person of Hugh Fraser, a descendant of Simon Fraser (killed at Halidon Hill in 1338) who acquired the tower and fort of Lovat near Beauly, Inverness-shire, and from whom the clan Fraser was called "Macshimi" (sons of Simon). Young Simon was educated at King's College, Aberdeen, and his correspondence afterwards gives proof, not only of a command of good English and idiomatic French, but of such an acquaintance with the Latin classics as to leave him never at a loss for an apt quotation from Virgil or Horace. Whether Lovat ever felt any real loyalty to the Stuarts or was actuated by self-interest it is difficult to determine, but that he was a born traitor and deceiver there can be no doubt. One of his first acts on leaving college was to recruit three hundred men from his clan to form part of a regiment in the service of William and Mary, in which he himself was to hold a command,—his object being to have a body of well-trained soldiers under his influence, whom at a moment's notice he might carry over to the interest of King James. Among other outrages in which he was engaged about this time was a rape and forced marriage committed on the widow of the 10th Lord Lovat with the view apparently of securing his own succession to the estates; and it is a curious instance of influence that, after being subjected by him to horrible ill-usage, she is said to have become seriously attached to him. A prosecution, however, having been instituted against him by Lady Lovat's family, Simon retired first to his native strongholds in the Highlands, and afterwards to France, where he found his way in July 1702 to the court of St Germain. In 1699, on his father's death, he assumed the title of Lord Lovat. One of his first steps towards gaining influence in France seems to have been to announce his conversion to the Catholic faith. He then proceeded to put the project of restoring the exiled family into a practical shape. Hitherto nothing seems to have been known among the Jacobite exiles of the efficiency of the Highlanders as a military force. But Lovat saw that, as they were the only part of the British population accustomed to the independent use of arms, they could be at once put in action against the reigning power. His plan therefore was to land five thousand French troops at Dundee, where they might reach the north-eastern passes of the Highlands in a day's march, and be in a position to divert the British troops till the Highlands should have time to rise. Immediately afterwards five hundred men were to land on the west coast, seize Fort William or Inverlochy, and thus prevent the access of any military force from the south to the central Highlands. The whole scheme indicates Lovat's sagacity as a military strategist, and his plan was continuously kept in view in all future attempts of the Jacobites, and finally acted on in the outbreak of 1745. The advisers of the Pretender seem to have been either slow to trust their coadjutor or to comprehend his project. At last, however, he was despatched (1703) on a secret mission to the Highlands to sound those of the chiefs who were likely to rise, and to ascertain what forces they could bring into the field. He found, however, that there was little disposition to join the rebellion, and he then apparently made up his mind to secure his own safety by revealing all that he knew to the government of Queen Anne. He persuaded the duke of Queensberry that his rival, the duke of Atholl, was in the Jacobite plot, and that if Queensberry supported him he could obtain evidence of this at St Germain. Queensberry foolishly entered into the intrigue with him against Atholl, but when Lovat had gone to France with a pass from

Queensberry the affair was betrayed to Atholl by Robert Ferguson, and resulted in Queensberry's discomfiture. The story is obscure, and is complicated by partisanship on either side, but Lovat was certainly playing a double game. His agility, however, was not remunerative. On returning to Paris suspicions got afloat as to Lovat's proceedings, and he was imprisoned in the castle of Angoulême He remained nearly ten years under supervision, till in November 1714 he made his escape to England. For some twenty-five years after this he was chiefly occupied in lawsuits for the recovery of his estates and the re-establishment of his fortune, in both of which objects he was successful. The intervals of his leisure were filled up by Jacobite and Anti-Jacobite intrigues, in which he seems to have alternately, as suited his interests, acted the traitor to both parties. But he so far obtained the confidence of the government as to secure the appointments of sheriff of Inverness and of colonel of an independent company. His disloyal practices, however, soon led to his being suspected; and he was deprived of both his appointments. When the rebellion of 1745 broke out, Lovat acted with characteristic duplicity. He represented to the Jacobites—what was probably in the main true—that though eager for their success his weak health and advanced years prevented him from joining the standard of the prince in person, while to the Lord President Forbes he professed his cordial attachment to the existing state of things, but lamented that his son, in spite of all his remonstrances, had joined the Pretender, and succeeded in taking with him a strong force from the clan of the Frasers. The truth was that the lad was unwilling to go, but was compelled by his father. Lovat's false professions of fidelity did not long deceive the government, and after the battle of Culloden he was obliged to retreat to the Highlands, after seeing from a distant height his castle of Dounie burnt by the royal army. Even then, broken down by disease and old age, carried on a litter and unable to move without assistance, his mental resources did not fail; and in a conference with several of the Jacobite leaders he proposed that they should raise a body of three thousand men, which would be enough to make their mountains impregnable, and at length force the government to give them advantageous terms. The project was not carried out, and Lovat, after enduring incredible hardships in his wanderings, was at last arrested on an island in Loch Morar. He was conveyed in a litter to London, and after a trial of five days sentence of death was pronounced on the 19th of March 1747. His execution took place on the 9th of April. His conduct to the last was dignified and even cheerful. Just before submitting his head to the block he repeated the line from Horace—

> "Dulce et decorum est pro patria mori."

His son Simon Fraser, Master of Lovat (1726–1782) (not to be confused with another Simon Fraser who saw somewhat similar service and was killed in 1777 at the battle of Saratoga), was a soldier, who at the beginning of the Seven Years' War raised a corps of Fraser Highlanders for the English service, and at the outbreak of the American War of Independence raised another regiment which took a prominent part in it. He fought under Wolfe in Canada, and also in Portugal, and rose to be a British major-general. The family estates were restored to him, but the title was not revived till 1837. On his death without issue, and also of his successor, his half-brother Archibald Campbell Fraser (1736–1815), the Lovat estates passed to the Frasers of Strichen, Aberdeenshire. The 16th Baron Lovat (b. 1871) raised a corps of mounted infantry (Lovat's Scouts) in the Boer war of 1899–1902.

See *Memoirs of Lord Lovat* (1746 and 1767); J. Hill Burton, *Life of Simon, Lord Lovat* (1847); J. Anderson, *Account of the Family of Frizell or Fraser* (Edinburgh, 1825); A. Mackenzie, *History of the Frasers of Lovat* (Inverness, 1896); Mrs A. T. Thomson, *Memoirs of the Jacobites* (1845-6); and W. C. Mackenzie, *Simon Fraser, Lord Lovat* (1908).

LOVE-BIRD, a name somewhat indefinitely bestowed, chiefly by dealers and their customers, on some of the smaller short-tailed parrots, from the affection which examples of opposite sexes exhibit towards each other. By many ornithologists the birds thus named, brought almost entirely from Africa and South America, have been retained in a single genus, *Psittacula*, though those belonging to the former country were by others separated as *Agapornis*. This separation, however, was neither generally approved nor easily justified, until Garrod (*Proc. Zool. Society*, 1874, p 593) assigned good anatomical ground, afforded by the structure of the carotid artery, for regarding the two groups as distinct, and thus removed the puzzle presented by the geographical distribution of the species of *Psittacula* in a large sense, though Huxley (*op cit.* 1868, p. 319) had suggested one way of meeting the difficulty. As the genus is now restricted, only one of the six species of *Psittacula* enumerated in the *Nomenclator Avium* of Sclater and Salvin is known to be found outside the Neotropical Region, the exception being the Mexican *P. cyanopygia*, and not one of the seven recognized by the same authors as forming the nearly allied genus *Urochroma* On the other hand, of *Agapornis*, from which the so-called genus *Poliopsitta* can scarcely be separated, five if not six species are known, all belonging to the Ethiopian Region, and all but one, *A. cana* (which is indigenous to Madagascar, and thence has been widely disseminated), are natives of Africa. In this group probably comes also *Psittinus*, with a single species from the Malayan Subregion One of the birds most commonly called love-birds, but with no near relationship to any of the above, being a long-tailed though very small parrot, is the budgerigar (*Melopsittacus undulatus*) now more familiar in Europe than most native birds, as it is used to "tell fortunes" in the streets, and is bred by hundreds in aviaries. Its native country is Australia. (A. N.)

LOVEDALE, a mission station in the Victoria East division of the Cape province, South Africa. It lies 1720 ft. above the sea on the banks of the Tyumie (Chumie) tributary of the Keiskama river, some 2 m. N. of Alice, a town 88 m. N.W. by rail of East London. The station was founded in 1824 by the Glasgow Missionary Society and was named after Dr John Love, one of the leading members of, and at the time secretary to, the society. The site first chosen was in the Ncera valley. But in 1834 the mission buildings were destroyed by the Kaffirs. On rebuilding, the station was removed somewhat farther north to the banks of the Tyumie. In 1846 the work at Lovedale was again interrupted, this time by the War of the Axe (see Cape Colony: *History*). On this occasion the buildings were converted into a fort and garrisoned by regular troops. Once more, in 1850, the Kaffirs threatened Lovedale and made an attack on the neighbouring Fort Hare,[1] built during the previous war.

Until 1841 the missionaries had devoted themselves almost entirely to evangelistic work; in that year the Lovedale Missionary Institute was founded by the Rev. W. Govan, who, save for brief intervals, continued at its head until 1870. He was then succeeded by the Rev. James Stewart (1831–1905), who had joined the mission in 1867, having previously (1861–1863), and partly in company with David Livingstone, explored the Zambezi regions. To Stewart, who remained at the head of the institute till his death, is due the existing organization at Lovedale. The institute, in addition to its purely church work—in which no sectarian tests are allowed—provides for the education of natives of both sexes in nearly all branches of learning (Stewart discontinued the teaching of Greek and Latin, adopting English as the classic); it also takes European scholars, no colour distinction being allowed in any department of the work. The institute gives technical training in many subjects and maintains various industries, including such diverse enterprises as farming and printing-works. It also maintains a hospital. The school buildings rival in accommodation and completeness those of the schools in large English cities. The sum paid in fees by scholars (of whom fully nine-tenths were Kaffirs) in the period 1841–1908 was £84,000. The educational and industrial methods initiated at Lovedale have been widely adopted by other missionary bodies. Lovedale is now a branch of the work of the United Free Church of Scotland.

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[1] This fort was named after Colonel John Hare (d. 1846) of the 27th Regiment, from 1838 lieutenant-governor of the eastern provinces and commander of the first division of the field force in the War of the Axe.

See R. Young, *African Wastes Reclaimed and Illustrated in the Story of the Lovedale Mission* (London, 1902); J. Stewart, *Lovedale, Past and Present* (London, 1884), and *Dawn in the Dark Continent* (London, 1903); J. Wells, *Stewart of Lovedale* (London, 1908).

LOVELACE, RICHARD (1618–1658), English poet, was born at Woolwich in 1618. He was a scion of a Kentish family, and inherited a tradition of military distinction, maintained by successive generations from the time of Edward III. His father, Sir William Lovelace, had served in the Low Countries, received the honour of knighthood from James I., and was killed at Grolle in 1628. His brother, Francis Lovelace, the "Colonel Francis" of *Lucasta*, served on the side of Charles I., and defended Caermarthen in 1644. His mother's family was legal; her grandfather had been chief baron of the exchequer. Richard was educated at the Charterhouse and at Gloucester Hall, Oxford, where he matriculated in 1634. Through the request of one of the queen's ladies on the royal visit to Oxford he was made M.A., though only in his second year at the university. Lovelace's fame has been kept alive by a few songs and the romance of his career, and his poems are commonly spoken of as careless improvisations, and merely the amusements of an active soldier. But the unhappy course of his life gave him more leisure for verse-making than opportunity of soldiering. Before the outbreak of the civil war in 1642 his only active service was in the bloodless expedition which ended in the Pacification of Berwick in 1640. On the conclusion of peace he entered into possession of the family estates at Bethersden, Canterbury, Chart and Halden in Kent. By that time he was one of the most distinguished of the company of courtly poets gathered round Queen Henrietta, who were influenced as a school by contemporary French writers of *vers de société* He wrote a comedy, *The Scholar*, when he was sixteen, and a tragedy, *The Soldier*, when he was twenty-one. From what he says of Fletcher, it would seem that this dramatist was his model, but only the prologue and epilogue to his comedy have been preserved. When the rupture between king and parliament took place, Lovelace was committed to the Gatehouse at Westminster for presenting to the Commons in 1642 a petition from Kentish royalists in the king's favour. It was then that he wrote his most famous song, "To Althea from Prison." He was liberated, says Wood, on bail of £40,000 (more probably £4000), and throughout the civil war was a prisoner on parole, with this security in the hands of his enemies. He contrived, however, to render considerable service to the king's cause. He provided his two brothers with money to raise men for the Royalist army, and befriended many of the king's adherents. He was especially generous to scholars and musicians, and among his associates in London were Henry Lawes and John Gamble, the Cottons, Sir Peter Lely, Andrew Marvell and probably Sir John Suckling. He joined the king at Oxford in 1645, and after the surrender of the city in 1646 he raised a regiment for the service of the French king. He was wounded at the siege of Dunkirk, and with his brother Dudley, who had acted as captain in his brother's command, returned to England in 1648. It is not known whether the brothers took any part in the disturbances in Kent of that year, but both were imprisoned at Petre House in Aldersgate. During this second imprisonment he collected and revised for the press a volume of occasional poems, many if not most of which had previously appeared in various publications. The volume was published in 1649 under the title of *Lucasta*, his poetical name—contracted from *Lux Casta*—for a lady rashly identified by Wood as Lucy Sacheverell, who, it is said, married another during his absence in France, on a report that he had died of his wounds at Dunkirk. The last ten years of Lovelace's life were passed in obscurity. His fortune had been exhausted in the king's interest, and he is said to have been supported by the generosity of friends. He died in 1658 "in a cellar in Longacre," according to Aubrey, who, however, possibly exaggerates his poverty. A volume of Lovelace's *Posthume Poems* was published in 1659 by his brother Dudley They are of inferior merit to his own collection.

The world has done no injustice to Lovelace in neglecting all but a few of his modest offerings to literature. But critics often do him injustice in dismissing him as a gay cavalier, who dashed off his verses hastily and cared little what became of them. It is a mistake to class him with Suckling; he has neither Suckling's easy grace nor his reckless spontaneity. We have only to compare the version of any of his poems in *Lucasta* with the form in which it originally appeared to see how fastidious was his revision. In many places it takes time to decipher his meaning. The expression is often elliptical, the syntax inverted and tortuous, the train of thought intricate and discontinuous. These faults—they are not of course to be found in his two or three popular lyrics, "Going to the Wars," "To Althea from Prison," "The Scrutiny"—are, however, as in the case of his poetical master, Donne, the faults not of haste but of over-elaboration. His thoughts are not the first thoughts of an improvisatore, but thoughts ten or twenty stages removed from the first, and they are generally as closely packed as they are far-fetched.

His poems were edited by W. C. Hazlitt in 1864.

LOVELL, FRANCIS LOVELL, VISCOUNT (1454–1487), supporter of Richard III., was son of John, 8th Baron Lovell. As a young man he served under Richard of Gloucester in the expedition to Scotland in 1480. After the death of Edward IV. he became one of his patron's strongest supporters. He had been created a viscount on the 4th of January 1483, and whilst still Protector Richard made him Chief Butler. As soon as Richard became king, Lovell was promoted to be Lord Chamberlain. Lovell helped in the suppression of Buckingham's rebellion, and as one of Richard's most trusted ministers was gibbeted in Collingbourne's couplet with Catesby and Ratcliffe:—

> "The catte, the ratte and Lovell our dogge
> Rulyth all England under a hogge."

He had command of the fleet which was to have stopped Henry Tudor's landing in 1485, but fought for Richard at Bosworth and after the battle fled to sanctuary at Colchester. Thence he escaped next year to organize a dangerous revolt in Yorkshire When that failed he fled to Margaret of Burgundy in Flanders. As a chief leader of the Yorkist party he had a foremost part in Lambert Simnel's enterprise. With John de la Pole, earl of Lincoln, he accompanied the pretender to Ireland and fought for him at Stoke on the 16th of June 1487. He was seen escaping from the battle, but was never afterwards heard of, Bacon relates that according to one report he lived long after in a cave or vault (*Henry VII.*, p. 37, ed. Lumby). More than 200 years later, in 1708, the skeleton of a man was found in a secret chamber in the family mansion at Minster Lovell in Oxfordshire. It is supposed that Francis Lovell had hidden himself there and died of starvation.

Collingbourne's couplet is preserved by Fabyan, *Chronicle*, p. 672. For the discovery at Minster Lovell see *Notes and Queries*, 2nd ser. i. and 5th ser. x. (C. L. K.)

LOVER, SAMUEL (1797–1868), Irish novelist, artist, songwriter and musician, was born in Dublin on the 24th of February 1797. His father was a stockbroker. Lover began life as an artist, and was elected in 1828 a member of the Royal Hibernian Academy—a body of which two years afterwards he became secretary. He acquired repute as a miniature painter, and a number of the local aristocracy sat to him for their portraits. His love for music showed itself at an early age. At a dinner given to the poet Tom Moore in 1818 Lover sang one of his own songs, which elicited special praise from Moore. One of his best-known portraits was that of Paganini, which was exhibited at the Royal Academy. He attracted attention as an author by his *Legends and Stories of Ireland* (1832), and was one of the first writers for the *Dublin University Magazine*. He went to London about 1835, where, among others, he painted Lord Brougham in his robes as lord chancellor. His gifts rendered him popular in society; and he appeared often at Lady Blessington's evening receptions. There he sang several of his songs, which were so well received that he published them (*Songs and Ballads*, 1839). Some of them illustrated Irish superstitions, among these being "Rory O'More," "The Angel's Whisper," "The May Dew" and "The Four-leaved Shamrock." In 1837 appeared *Rory O'More, a National Romance*, which at once made him a reputation as a novelist; he afterwards dramatized it for the Adelphi Theatre, London. In 1842 was published his best-known work, *Handy Andy, an Irish Tale*. Meanwhile his pursuits had affected his health; and in 1844 he gave up writing for some time, substituting instead public entertainments, called by him "Irish Evenings," illustrative of his own works. These were successful both in Great Britain and in America. In addition to publishing numerous songs of his own, Lover edited a collection entitled *The Lyrics of Ireland*, which appeared in 1858. He died on the 6th of July 1868. Besides the novels already mentioned he wrote *Treasure Trove* (1844), and *Metrical Tales and Other Poems* (1860).

His *Life* was written in 1874 by Bayle Bernard.

LOVERE, a town of Lombardy, Italy, in the province of Bergamo, at the north-west end of the Lago d' Iseo, 522 ft. above sea-level. Pop. (1901) 3306. It is a picturesque town, the houses having the overhanging wooden roofs of Switzerland united with the heavy stone arcades of Italy, while the situation is beautiful, with the lake in front and the semicircle of bold mountains behind. The church of Santa Maria in Valvendra, built in 1473, has frescoes by Floriano Ferramola of Brescia (d. 1528). The Palazzo Tadini contains a gallery of old pictures, some sculptures by Benzoni and Canova, and a zoological collection. Lovere possesses a silk-spinning factory, and the Stablimento Metallurgico Gregorini, a large iron-work and cannon foundry, employs 1600 workmen. Lovere is reached by steamer from Sarnico at the south end of the lake, and there is a steam tramway through the Val Camonica, which is highly cultivated, and contains iron- and silk-works. From Cividate, the terminus, the road goes on to Edolo (2290 ft.), whence passes lead into Tirol and the Valtellina.

LOW, SETH (1850-), American administrator and educationist, was born in Brooklyn, New York, on the 18th of January 1850. He studied in the Polytechnic Institute of Brooklyn and in Columbia University, where he graduated in 1870. He became a clerk (1870) and then a partner (1875) in his father's tea and silk-importing house, A. A. Low & Brothers, which went out of business in 1888. In 1878 he organized, and became president of, the Brooklyn Bureau of Charities. In 1882–1886 he was mayor of the city of Brooklyn, being twice elected on an independent ticket; and by his administration of his office he demonstrated that a rigid "merit" civil-service system was practicable—in September 1884 the first municipal civil-service rules in the United Service were adopted in Brooklyn. He was president of Columbia University from 1890 to 1901, and did much for it by his business administration, his liberality (he gave $1,000,000 for the erection of a library) and his especial interest in the department of Political Science. In his term Columbia became a well-organized and closely-knit university. Its official name was changed from Columbia College to Columbia University. It was removed to a new site on Morningside Heights, New York City. The New York College for the Training of Teachers became its Teachers' College of Columbia; a Faculty of Pure Science was added; the Medical School gave up its separate charter to become an integral part of the university; Barnard College became more closely allied with the university; relations were entered into between the university and the General, Union and Jewish theological seminaries of New York City and with Cooper Union, the Metropolitan Museum of Fine Arts and the American Museum of Natural History; and its faculty and student body became less local in character. Dr Low was a delegate to the Hague Peace Conference in 1899. He was prominent among those who brought about the chartering of Greater New York in 1897, and in this year was an unsuccessful candidate, on an independent ticket, for mayor of New York City; in 1900, on a fusion ticket, he was elected mayor and served in 1901–1903.

LOW, WILL HICOK (1853-), American artist and writer on art, was born at Albany, New York, on the 31st of May 1853. In 1873 he entered the atelier of J. L. Gérôme in the École des Beaux Arts at Paris, subsequently joining the classes of Carolus-Duran, with whom he remained until 1877. Returning to New York, he became a member of the Society of American Artists in 1878 and of the National Academy of Design in 1890. His pictures of New England types, and illustrations of Keats, brought him into prominence. Subsequently he turned his attention to decoration, and executed panels and medallions for the Waldorf-Astoria Hotel, New York, a panel for the Essex County Court House, Newark, New Jersey, panels for private residences and stained-glass windows for various churches, including St Paul's Methodist Episcopal Church, Newark, N.J. He was an instructor in the schools of Cooper Union, New York, in 1882–1885, and in the school of the National Academy of Design in 1889–1892. Mr Low, who is known to a wider circle as the friend of R. L. Stevenson, published some reminiscences, *A Chronicle of Friendships, 1873–1900* (1908). In 1909 he married Mary (Fairchild), formerly the wife of the sculptor MacMonnies.

LOWBOY, a small table with one or two rows of drawers, so called in contradistinction to the tallboy, or double chest of drawers. Both were favourite pieces of the 18th century, both in England and America; the lowboy was most frequently used as a dressing-table, but sometimes as a side-table. It is usually made of oak, walnut or mahogany, with brass handles and escutcheons. The more elegant examples of the Chippendale period have cabriole legs, claw-and-ball feet and carved knees, and are sometimes sculptured with the favourite shell motive beneath the centre drawer.

LOW CHURCHMAN, a term applied to members of the Church of England or its daughter churches who, while accepting the hierarchical and sacramental system of the Church, do not consider episcopacy as essential to the constitution of the Church, reject the doctrine that the sacraments confer grace *ex opere operato* (*e.g.* baptismal regeneration) and lay stress on the Bible as the sole source of authority in matters of faith. They thus differ little from orthodox Protestants of other denominations, and in general are prepared to co-operate with them on equal terms.

The name was used in the early part of the 18th century as the equivalent of "Latitudinarian," *i.e.* one who was prepared to concede much latitude in matters of discipline and faith, in contradistinction to "High Churchman," the term applied to those who took a high view of the exclusive authority of the Established Church, of episcopacy and of the sacramental system. It subsequently fell into disuse, but was revived in the 19th century when the Tractarian movement had brought the term "High Churchman" into vogue again in a modified sense, *i.e.* for those who exalted the idea of the Catholic Church and the sacramental system at the expense both of the Establishment and of the exclusive authority of Scripture. "Low Churchman" now became the equivalent of "Evangelical," the designation of the movement, associated with the name of Simeon, which laid the chief stress on the necessity of personal "conversion." "Latitudinarian" gave place at the same time to "Broad Churchman," to designate those who lay stress on the ethical teaching of the Church and minimize the value of orthodoxy. The revival of pre-Reformation ritual by many of the High Church clergy led to the designation "ritualist" being applied to them in a somewhat contemptuous sense; and "High Churchman" and "Ritualist" have often been wrongly treated as convertible terms. Actually many High Churchmen are not Ritualists, though they tend to become so. The High Churchman of the "Catholic" type is further differentiated from the "old-fashioned High Churchman" of what is sometimes described as the "high and dry" type of the period anterior to the Oxford Movement.

LOWE, SIR HUDSON (1769–1844), English general, was the son of an army surgeon, John Lowe, and was born at Galway on the 28th of July 1769. His mother was a native of that county His childhood was spent in various garrison towns but he was educated chiefly at Salisbury grammar school. He obtained a post as ensign in the East Devon Militia before his twelfth year, and subsequently entered his father's regiment, the 50th, then at Gibraltar (1787) under Governor-General O'Hara. After the outbreak of war with France early in 1793, Lowe saw active service successively in Corsica, Elba, Portugal and Minorca, where he was entrusted with the command of a battalion of Corsican exiles, called The Corsican Rangers. With these he did good work in Egypt in 1800–1801. After the peace of Amiens, Lowe, now a major, became assistant quartermaster-general; but on the renewal of war with France in 1803 he was charged, as lieutenant-colonel, to raise the Corsican battalion again and with it assisted in the defence of Sicily. On the capture of Capri he proceeded thither with his battalion and a Maltese regiment; but in October 1808 Murat organized an attack upon the island, and Lowe, owing to the unsteadiness of the Maltese troops and the want of succour by sea, had to agree to evacuate the island. The terms in which Sir William Napier and others have referred to Lowe's defence of Capri are unfair. His garrison consisted of 1362 men, while the assailants numbered between 3000 and 4000. In the course of the year 1809 Lowe and his Corsicans helped in the capture of Ischia and Procida, as well as of Zante, Cephalonia and Cerigo. For some months he acted as governor of Cephalonia and Ithaca, and later on of Santa Maura. He returned to England in 1812, and in January 1813 was sent to inspect a Russo-German legion then being formed, and he accompanied the armies of the allies through the campaigns of 1813 and 1814, being present at thirteen important battles. He won praise from Blücher and Gneisenau for his gallantry and judgment. He was chosen to bear to London the news of the first abdication of Napoleon in April 1814. He was then knighted and became major-general; he also received decorations from the Russian and Prussian courts. Charged with the duties of quartermaster-general of the army in the Netherlands in 1814–1815, he was about to take part in the Belgian campaign when he was offered the command of the British troops at Genoa; but while still in the south of France he received (on the 1st of August 1815) news of his appointment to the position of custodian of Napoleon, who had surrendered to H.M.S. "Bellerophon" off Rochefort. Lowe was to be governor of St Helena, the place of the ex-emperor's exile.

On his arrival there at Plantation House he found that Napoleon had already had scenes with Admiral Cockburn, of H.M.S. "Northumberland," and that he had sought to induce the former governor, Colonel Wilks, to infringe the regulations prescribed by the British government (see *Monthly Review*, January 1901). Napoleon and his followers at Longwood pressed for an extension of the limits within which he could move without surveillance, but it was not in Lowe's power to grant this request. Various matters, in some of which Lowe did not evince much tact, produced friction between them. The news that rescue expeditions were being planned by the Bonapartists in the United States led to the enforcement of somewhat stricter regulations in October 1816, Lowe causing sentries to be posted round Longwood garden at sunset instead of at 9 P.M. This was his great offence in the eyes of Napoleon and his followers. Hence their efforts to calumniate Lowe, which had a surprising success. O'Meara, the British surgeon, became Napoleon's man, and lent himself to the campaign of calumny in which Las Cases and Montholon showed so much skill. In one of the suppressed passages of his *Journal* Las Cases wrote that the exiles had to "reduce to a system our demeanour, our words, our sentiments, even our privations, in order that we might thereby excite a lively interest in a large portion of the population of Europe, and that the opposition in England might not fail to attack the ministry." As to the privations, it may be noted that Lowe recommended that the government allowance of £8000 a year to the Longwood household should be increased by one-half. The charges of cruelty brought against the governor by O'Meara and others have been completely refuted; and the most that can be said against him is that he was occasionally too suspicious in the discharge of his duties. After the death of Napoleon in May 1821, Lowe returned to England and received the thanks of George IV. On the publication of O'Meara's book he resolved to prosecute the author, but, owing to an unaccountable delay, the application was too late. This fact, together with the reserved behaviour of Lowe, prejudiced the public against him, and the government did nothing to clear his reputation. In 1825–1830 he commanded the forces in Ceylon, but was not appointed to the governorship when it fell vacant in 1830. In 1842 he became colonel of his old regiment, the 50th; he also received the G.C.M.G, He died in 1844.

See W. Forsyth, *History of the Captivity of Napoleon at St Helena* (3 vols., London, 1853); Gourgaud, *Journal inédite de Sainte-Hélène* (1815–1818; 2 vols., Paris, 1899); R. C. Seaton, *Napoleon's Captivity in relation to Sir Hudson Lowe* (London, 1903); Lieut.-Col. Basil Jackson, *Notes and Reminiscences of a Staff-Officer* (London, 1903); the earl of Rosebery, *Napoleon; the Last Phase* (London 1900); J. H. Rose, *Napoleonic Studies* (London, 1904). (J. Hl. R.)

LÖWE, JOHANN KARL GOTTFRIED (1796–1869), German composer, was born at Löbejün, near Halle, on the 30th of November 1796, and was a choir-boy at Köthen from 1807 to 1809, when he went to the Franke Institute at Halle, studying music with Türk. The beauty of Löwe's voice brought him under the notice of Madame de Staël, who procured him a pension from Jérôme Bonaparte, then king of Westphalia; this stopped in 1813, on the flight of the king. He entered the University of Halle as a theological student, but was appointed cantor at Stettin in 1820, and director of the town music in 1821, in which year he married Julie von Jacob, who died in 1823. His second wife, Auguste Lange, was an accomplished singer, and they appeared together in his oratorio performances with great success. He retained his office at Stettin for 46 years, when, after a stroke of paralysis, he was somewhat summarily dismissed. He retired to Kiel, and died on the 20th of April 1869. He undertook many concert tours during his tenure of the post at Stettin, visiting Vienna, London, Sweden, Norway and Paris. His high soprano voice (he could sing the music of the "Queen of Night" in *Die Zauberflöte* as a boy) had developed into a fine tenor. Löwe was a voluminous composer, and wrote five operas, of which only one, *Die drei Wünsche*, was performed at Berlin in 1834, without much success; seventeen oratorios, many of them for male voices unaccompanied, or with short instrumental interludes only; choral ballads, cantatas, three string quartets, a pianoforte trio; a work for clarinet and piano, published posthumously; and some piano solos. But the branch of his art by which he is remembered, and in which he must be admitted to have attained perfection, is the solo ballad with pianoforte accompaniment. His treatment of long narrative poems, in a clever mixture of the dramatic and lyrical styles, was undoubtedly modelled on the ballads of Zumsteeg, and has been copied by many composers since his day. His settings of the "Erlkönig" (a very early example), "Archibald Douglas," "Heinrich der Vogler," "Edward" and "Die Verfallene Mühle," are particularly fine.

LOWELL, ABBOTT LAWRENCE (1856–), American educationalist, was born in Boston, Massachusetts on the 13th of December 1856, the great-grandson of John Lowell, the "Columella of New England," and on his mother's side, a grandson of Abbott Lawrence. He graduated at Harvard College in 1877, with highest honours in mathematics; graduated at the Harvard Law School in 1880; and practised law in 1880–1897 in partnership with his cousin, Francis Cabot Lowell (b. 1855), with whom he wrote *Transfer of Stock in Corporations* (1884). In 1897 he became lecturer and in 1898 professor of government at Harvard, and in 1909 succeeded Charles William Eliot as president of the university. In the same year he was president of the American Political Science Association. In 1900 he had succeeded his father, Augustus Lowell (1830–1901), as financial head of the Lowell Institute of Boston. He wrote *Essays on Government* (1889), *Governments and Parties in Continental Europe* (2 vols., 1896), *Colonial Civil Service* (1900; with an account by H. Morse Stephens of the East India College at Haileybury), and *The Government of England* (2 vols., 1908).

His brother, Percival Lowell (1855–), the well-known astronomer, graduated at Harvard in 1876, lived much in Japan between 1883 and 1893, and in 1894 established at Flagstaff, Arizona, the Lowell Observatory, of whose *Annals* (from 1898) he was editor. In 1902 he became non-resident professor of astronomy at the Massachusetts Institute of Technology. He wrote several books on the Far East, including *Chosön* (1885), *The Soul of the Far East* (1886), *Noto, an Unexplored Corner* *of Japan* (1891), and *Occult Japan* (1895), but he is best known for his studies of the planet Mars—he wrote *Mars* (1895), *Mars and Its Canals* (1907), and *Mars, the Abode of Life* (1908)—and his contention that the "canals" of Mars are a sign of life and civilization on that planet (see MARS). He published *The Evolution of Worlds* in 1909.

LOWELL, CHARLES RUSSELL (1835–1864), American soldier, was born on the 2nd of January 1835 in Boston, Massachusetts. His mother, Anna Cabot Jackson Lowell (1819–1874), a daughter of Patrick Tracy Jackson, married Charles Russell Lowell, a brother of James Russell Lowell; she wrote verse and books on education. Her son graduated at Harvard in 1854, worked in an iron mill in Trenton, New Jersey, for a few months in 1855, spent two years abroad, and in 1858–1860 was local treasurer of the Burlington & Missouri river railroad. In 1860 he took charge of the Mount Savage Iron Works, in Cumberland, Maryland. He entered the Union army in June 1861 (commission May 14) as captain of the 3rd (afterwards 6th) U.S. cavalry; on the 15th of April 1863 he became colonel of the 2nd Massachusetts cavalry; he was wounded fatally at Cedar Creek on the 19th of October 1864, when he was promoted brigadier-general of U.S. Volunteers, and died on the next day at Middletown, Va. Lowell married in October 1863, Josephine Shaw (1843–1905), a sister of Colonel R. G. Shaw. Her home when she was married was on Staten Island, and she became deeply interested in the social problems of New York City. She was a member of the State Charities Aid Society, and from 1877 to 1889 was a member of the New York State Board of Charities, being the first woman appointed to that board. She founded the Charity Organization Society of New York City in 1882, and wrote *Public Relief and Private Charity* (1884) and *Industrial Arbitration and Conciliation* (1893).

See Edward E. Emerson (ed.), *The Life and Letters of Charles Russell Lowell* (Boston, 1907).

LOWELL, JAMES RUSSELL (1819–1891), American author and diplomatist, was born at Elmwood, in Cambridge, Massachusetts, on the 22nd of February 1819, the son of Charles Lowell (1782–1861).[1] On his mother's side he was descended from the Spences and Traills, who made their home in the Orkney Islands, his great-grandfather, Robert Traill, returning to England on the breaking out of hostilities in 1775. He was brought up in a neighbourhood bordering on the open country, and from his earliest years he found a companion in nature; he was also early initiated into the reading of poetry and romance, hearing Spenser and Scott in childhood, and introduced to old ballads by his mother. He had for schoolmaster an Englishman who held by the traditions of English schools, so that before he entered Harvard College he had a more familiar acquaintance with Latin verse than most of his fellows—a familiarity which showed itself later in his mock-pedantic accompaniment to *The Biglow Papers* and his macaronic poetry. He was a wide reader, but a somewhat indifferent student, graduating at Harvard without special honours in 1838. During his college course he wrote a number of trivial pieces for a college magazine, and shortly after graduating printed for private circulation the poem which his class asked him to write for their graduation festivities.

He was uncertain at first what vocation to choose, and vacillated between business, the ministry, medicine and law. He decided at last to practise law, and after a course at the Harvard law school, was admitted to the bar. While studying for his profession, however, he contributed poems and prose articles to various magazines. He cared little for the law, regarding it simply as a distasteful means of livelihood, yet his experiments in writing did not encourage him to trust to this for support. An unhappy adventure in love deepened his sense of failure, but he became betrothed to Maria White in the autumn of 1840, and the next twelve years of his life were deeply affected by her influence. She was a poet of delicate power, but also possessed a lofty enthusiasm, a high conception of purity and justice, and a practical temper which led her to concern herself in the movements directed against the evils of intemperance and slavery. Lowell was already looked upon by his companions as a man marked by wit and poetic sentiment; Miss White was admired for her beauty, her character and her intellectual gifts, and the two became thus the hero and heroine among a group of ardent young men and women. The first-fruits of this passion was a volume of poems, published in 1841, entitled *A Year's Life*, which was inscribed by Lowell in a veiled dedication to his future wife, and was a record of his new emotions with a backward glance at the preceding period of depression and irresolution. The betrothal, moreover, stimulated Lowell to new efforts towards self-support, and though nominally maintaining his law office, he threw his energy into the establishment, in company with a friend, Robert Carter, of a literary journal, to which the young men gave the name of *The Pioneer*. It was to open the way to new ideals in literature and art, and the writers to whom Lowell turned for assistance—Hawthorne, Emerson, Whittier, Poe, Story and Parsons, none of them yet possessed of a wide reputation—indicate the acumen of the editor. Lowell himself had already turned his studies in dramatic and early poetic literature to account in another magazine, and continued the series in *The Pioneer*, besides contributing poems; but after the issue of three monthly numbers, beginning in January 1843, the magazine came to an end, partly because of a sudden disaster which befell Lowell's eyes, partly through the inexperience of the conductors and unfortunate business connexions.

The venture confirmed Lowell in his bent towards literature. At the close of 1843 he published a collection of his poems, and a year later he gathered up certain material which he had printed, sifted and added to it, and produced *Conversations on some of the Old Poets*. The dialogue form was used merely to secure an undress manner of approach to his subject; there was no attempt at the dramatic. The book reflects curiously Lowell's mind at this time, for the conversations relate only partly to the poets and dramatists of the Elizabethan period; a slight suggestion sends the interlocutors off on the discussion of current reforms in church and state and society. Literature and reform were dividing the author's mind, and continued to do so for the next decade. Just as this book appeared Lowell and Miss White were married, and spent the winter and early spring of 1845 in Philadelphia. Here, besides continuing his literary contributions to magazines, Lowell had a regular engagement as an editorial writer on *The Pennsylvania Freeman*, a fortnightly journal devoted to the Anti-Slavery cause. In the spring of 1845 the Lowells returned to Cambridge and made their home at Elmwood. On the last day of the year their first child, Blanche, was born, but she lived only fifteen months. A second daughter, Mabel, was born six months after Blanche's death, and lived to survive her father; a third, Rose, died an infant. Lowell's mother meanwhile was living, sometimes at home, sometimes at a neighbouring hospital, with clouded mind, and his wife was in frail health. These troubles and a narrow income conspired to make Lowell almost a recluse in these days, but from the retirement of Elmwood he sent forth writings which show how large an interest he took in affairs. He contributed poems to the daily press, called out by the Slavery question; he was, early in 1846, a correspondent of the London *Daily News*, and in the spring of 1848 he formed a connexion with the *National Anti-Slavery Standard* of New York, by which he agreed to furnish weekly either a poem or a prose article. The poems were most frequently works of art, occasionally they were tracts; but the prose was almost exclusively concerned with the public men and questions of the day, and forms a series of incisive, witty and sometimes prophetic diatribes. It was a period with him of great mental activity, and is represented by four of his books which stand as admirable witnesses to the Lowell of 1848, namely, the second series of *Poems*, containing among others "Columbus," "An Indian Summer Reverie," "To the Dandelion," "The Changeling"; *A Fable for Critics*, in which, after the manner of Leigh Hunt's *The Feast of the Poets*, he characterizes in witty verse and with good-natured satire American contemporary writers, and in which, the publication being anonymous, he included himself; *The Vision of Sir Launfal*, a romantic story suggested by the Arthurian legends—one of his most popular poems; and finally *The Biglow Papers*.

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[1] See under LOWELL, JOHN.

Lowell had acquired a reputation among men of letters and a cultivated class of readers, but this satire at once brought him a wider fame. The book was not premeditated; a single poem, called out by the recruiting for the abhorred Mexican war, couched in rustic phrase and sent to the *Boston Courier*, had the inspiriting dash and electrifying rat-tat-tat of this new recruiting sergeant in the little army of Anti-Slavery reformers. Lowell himself discovered what he had done at the same time that the public did, and he followed the poem with eight others either in the *Courier* or the *Anti-Slavery Standard*. He developed four well-defined characters in the process—a country farmer, Ezekiel Biglow, and his son Hosea; the Rev. Homer Wilbur, a shrewd old-fashioned country minister; and Birdofredum Sawin, a Northern renegade who enters the army, together with one or two subordinate characters; and his stinging satire and sly humour are so set forth in the vernacular of New England as to give at once a historic dignity to this form of speech. (Later he wrote an elaborate paper to show the survival in New England of the English of the early 17th century.) He embroidered his verse with an entertaining apparatus of notes and mock criticism. Even his index was spiced with wit. The book, a caustic arraignment of the course taken in connexion with the annexation of Texas and the war with Mexico, made a strong impression, and the political philosophy secreted in its lines became a part of household literature. It is curious to observe how repeatedly this arsenal was drawn upon in the discussions in America about the "Imperialistic" developments of 1900. The death of Lowell's mother, and the fragility of his wife's health, led Lowell, with his wife, their daughter Mabel and their infant son Walter, to go to Europe in 1851, and they went direct to Italy. The early months of their stay were saddened by the death of Walter in Rome, and by the news of the illness of Lowell's father, who had a slight shock of paralysis. They returned in November 1852, and Lowell published some recollections of his journey in the magazines, collecting the sketches later in a prose volume, *Fireside Travels*. He took some part also in the editing of an American edition of the *British Poets*, but the low state of his wife's health kept him in an uneasy condition, and when her death (27th October 1853) released him from the strain of anxiety, there came with the grief a readjustment of his nature and a new intellectual activity. At the invitation of his cousin, he delivered a course of lectures on English poets before the Lowell Institute in Boston in the winter of 1855. This first formal appearance as a critic and historian of literature at once gave him a new standing in the community, and was the occasion of his election to the Smith Professorship of Modern Languages in Harvard College, then vacant by the retirement of Longfellow. Lowell accepted the appointment, with the proviso that he should have a year of study abroad. He spent his time mainly in Germany, visiting Italy, and increasing his acquaintance with the French, German, Italian and Spanish tongues. He returned to America in the summer of 1856, and entered upon his college duties, retaining his position for twenty years. As a teacher he proved himself a quickener of thought amongst students, rather than a close and special instructor. His power lay in the interpretation of literature rather than in linguistic study, and his influence over his pupils was exercised by his own fireside as well as in the relation, always friendly and familiar, which he held to them in the classroom. In 1856 he married Miss Frances Dunlap, a lady who had since his wife's death had charge of his daughter Mabel.

In the autumn of 1857 *The Atlantic Monthly* was established, and Lowell was its first editor. He at once gave the magazine the stamp of high literature and of bold speech on public affairs. He held this position only till the spring of 1861, but he continued to make the magazine the vehicle of his poetry and of some prose for the rest of his life; his prose, however, was more abundantly presented in the pages of *The North American Review* during the years 1862–1872, when he was associated with Mr Charles Eliot Norton in its conduct. This magazine especially gave him the opportunity of expression of political views during the eventful years of the War of the Union. It was in *The Atlantic* during the same period that he published a second series of *The Biglow Papers*. Both his collegiate and editorial duties stimulated his critical powers, and the publication in the two magazines, followed by republication in book form, of a series of studies of great authors, gave him an important place as a critic. Shakespeare, Dryden, Lessing, Rousseau, Dante, Spenser, Wordsworth, Milton, Keats, Carlyle, Thoreau, Swinburne, Chaucer, Emerson, Pope, Gray—these are the principal subjects of his prose, and the range of topics indicates the catholicity of his taste. He wrote also a number of essays, such as "My Garden Acquaintance," "A Good Word for Winter," "On a Certain Condescension in Foreigners," which were incursions into the field of nature and society. Although the great bulk of his writing was now in prose, he made after this date some of his most notable ventures in poetry. In 1868 he issued the next collection in *Under the Willows and other Poems*, but in 1865 he had delivered his "Ode recited at the Harvard Commemoration," and the successive centennial historical anniversaries drew from him a series of stately odes.

In 1877 Lowell, who had mingled so little in party politics that the sole public office he had held was the nominal one of elector in the Presidential election of 1876, was appointed by President Hayes minister resident at the court of Spain. He had a good knowledge of Spanish language and literature, and his long-continued studies in history and his quick judgment enabled him speedily to adjust himself to these new relations. Some of his despatches to the home government were published in a posthumous volume—*Impressions of Spain*. In 1880 he was transferred to London as American minister, and remained there till the close of President Arthur's administration in the spring of 1885. As a man of letters he was already well known in England, and he was in much demand as an orator on public occasions, especially of a literary nature; but he also proved himself a sagacious publicist, and made himself a wise interpreter of each country to the other. Shortly after his retirement from public life he published *Democracy and other Addresses*, all of which had been delivered in England. The title address was an epigrammatic confession of political faith as hopeful as it was wise and keen. The close of his stay in England was saddened by the death of his second wife in 1885. After his return to America he made several visits to England. His public life had made him more of a figure in the world; he was decorated with the highest honours Harvard could pay officially, and with degrees of Oxford, Cambridge, St Andrews, Edinburgh and Bologna. He issued another collection of his poems, *Heartsease and Rue*, in 1888, and occupied himself with revising and rearranging his works, which were published in ten volumes in 1890. The last months of his life were attended by illness, and he died at Elmwood on the 12th of August 1891. After his death his literary executor, Charles Eliot Norton, published a brief collection of his poems, and two volumes of added prose, besides editing his letters.

The spontaneity of Lowell's nature is delightfully disclosed in his personal letters. They are often brilliant, and sometimes very penetrating in their judgment of men and books, but the most constant element is a pervasive humour, and this humour, by turns playful and sentimental, is largely characteristic of his poetry, which sprang from a genial temper, quick in its sympathy with nature and humanity. The literary refinement which marks his essays in prose is not conspicuous in his verse, which is of a more simple character. There was an apparent conflict in him of the critic and the creator, but the conflict was superficial. The man behind both critical and creative work was so genuine, that through his writings and speech and action he impressed himself deeply upon his generation in America, especially upon the thoughtful and scholarly class who looked upon him as especially their representative. This is not to say that he was a man of narrow sympathies. On the contrary, he was democratic in his thought, and outspoken in his rebuke of whatever seemed to him antagonistic to the highest freedom. Thus, without taking a very active part in political life, he was recognized as one of the leaders of independent political thought. He found expression in so many ways, and was apparently so inexhaustible in his resources, that his very versatility and the ease with which he gave expression to his thought sometimes stood in the way of a recognition of his large, simple political ideality and the singleness of his moral sight.

Writings.—The *Works of James Russell Lowell*, in ten volumes (Boston and New York, Houghton, Mifflin & Co., 1890); *édition de luxe*, 61 vols. (1904); *Latest Literary Essays and Addresses* (1891); *The Old English Dramatists* (1892); *Conversations on some of the Old Poets* (Philadelphia, David M'Kay; reprint of the volume published in 1843 and subsequently abandoned by its author, 1893); *The Power of Sound: a Rhymed Lecture* (New York, privately printed, 1896); *Lectures on English Poets* (Cleveland, The Rowfant Club, 1899).

Memoirs.—*Letters of James Russell Lowell*, edited by Charles Eliot Norton, in two volumes (New York, Harper & Brothers, 1899); *Life of James Russell Lowell* (2 vols.), by Horace E. Scudder (Houghton, Mifflin & Co., 1901); *James Russell Lowell and his Friends* (Boston, 1899), by Edward Everett Hale. (H. E. S.*)

LOWELL, JOHN (1743–1802), American jurist, was born in Newburyport, Massachusetts, on the 17th of June 1743, and was a son of the Reverend John Lowell, the first pastor of Newburyport, and a descendant of Perceval Lowle or Lowell (1571–1665), who emigrated from Somersetshire to Massachusetts Bay in 1639 and was the founder of the family in New England. John Lowell graduated at Harvard in 1760, was admitted to the bar in 1763, represented Newburyport (1776) and Boston (1778) in the Massachusetts Assembly, was a member of the Massachusetts Constitutional Convention of 1779–1780 and, as a member of the committee appointed to draft a constitution, secured the insertion of the clause, "all men are born free and equal," which was interpreted by the supreme court of the state in 1783 as abolishing slavery in the state. In 1781–1783 he was a member of the Continental Congress, which in 1782 made him a judge of the court of appeals for admiralty cases; in 1784 he was one of the commissioners from Massachusetts to settle the boundary line between Massachusetts and New York; in 1789–1801 he was a judge of the U.S. District Court of Massachusetts; and from 1801 until his death in Roxbury on the 6th of May 1802 he was a justice of the U.S. Circuit Court for the First Circuit (Maine, New Hampshire, Massachusetts and Rhode Island).

His son, John Lowell (1769–1840), graduated at Harvard in 1786, was admitted to the bar in 1789 (like his father, before he was twenty years old), and retired from active practice in 1803. He opposed French influence and the policies of the Democratic party, writing many spirited pamphlets (some signed "The Boston Rebel," some "The Roxbury Farmer"), including: *The Antigallican* (1797), *Remarks on the Hon. J. Q. Adams's Review of Mr Ames's Works* (1809), *New England Patriot, being a Candid Comparison of the Principles and Conduct of the Washington and Jefferson Administrations* (1810), *Appeals to the People on the Causes and Consequences of War with Great Britain* (1811) and *Mr Madison's War* (1812). These pamphlets contain an extreme statement of the anti-war party and defend impressment as a right of long standing. After the war Lowell abandoned politics, and won for himself the title of "the Columella of New England" by his interest in agriculture—he was for many years president of the Massachusetts Agricultural Society. He was a benefactor of the Boston Athenaeum and the Massachusetts General Hospital.

Another son of the first John Lowell, Francis Cabot Lowell (1775–1817), the founder in the United States of cotton manufacturing, was born in Newburyport on the 7th of April 1775, graduated at Harvard in 1793, became a merchant in Boston, and, during the war of 1812, with his cousin (who was also his brother-in-law), Patrick Tracy Jackson, made use of the knowledge of cotton-spinning gained by Lowell in England (whither he had gone for his health in 1810) and devised a power loom. Experiments were successfully carried on at Waltham in 1814. Lowell worked hard to secure a protective tariff on cotton goods. The city of Lowell, Massachusetts, was named in his honour. He died in Boston on the 10th of August 1817.

Charles Lowell (1782–1861), brother of the last named, was born in Boston, graduated at Harvard in 1800, studied law and then theology, and after two years in Edinburgh and one year on the Continent was from 1806 until his death pastor of the West Congregational (Unitarian) Church of Boston, a charge in which Cyrus A. Bartol was associated with him after 1837. Charles Lowell had a rare sweetness and charm, which reappeared in his youngest son, James Russell Lowell (*q.v.*).

Francis Cabot Lowell's son, John Lowell (1799–1836), was born in Boston, travelled in India and the East Indies on business in 1816 and 1817, in 1832 set out on a trip around the world, and on the 4th of March 1836 died in Bombay. By a will made, said Edward Everett, "on the top of a palace of the Pharaohs," he left $237,000 to establish what is now known as the Lowell Institute (*q.v.*).

See the first lecture delivered before the Institute, Edward Everett's *A Memoir of Mr John Lowell, Jr.* (Boston, 1840).

A grandson of Francis Cabot Lowell, Edward Jackson Lowell (1845–1894), graduated at Harvard in 1867, was admitted to the Suffolk county (Mass.) bar in 1872, and practised law for a few years. He wrote *The Hessians and the Other German Auxiliaries of Great Britain in the Revolutionary War* (1884), *The Eve of the French Revolution* (1892) and the chapter, "The United States of America 1775–1782: their Political Relations with Europe," in vol. vii. (1888) of Winsor's *Narrative and Critical History of America.*

LOWELL, a city and one of the county-seats (Cambridge being the other) of Middlesex county, Massachusetts, U.S.A., situated in the N.E. part of the county at the confluence of the Concord and Merrimack rivers, about 25 m. N.W. of Boston. Pop. (1890) 77,696; (1900) 94,969, of whom 40,974 were foreign-born (14,674 being French Canadian, 12,147 Irish, 4485 English Canadian, 4446 English, 1203 Greek, 1099 Scotch); (1910 census), 106,294. Lowell is served by the Boston & Maine and the New York, New Haven & Hartford railways, and by interurban electric lines. The area of Lowell is 14·1 sq. m., much the larger part of which is S. of the Merrimack. The city is irregularly laid out. Its centre is Monument Square, in Merrimack Street, where are a granite monument to the first Northerners killed in the Civil War, Luther C. Ladd and A. O. Whitney (both of Lowell), whose regiment was mobbed in Baltimore on the 19th of April 1861 while marching to Washington; and a bronze figure of Victory (after one by Rauch in the Valhalla at Ratisbon), commemorating the Northern triumph in the Civil War. The Lowell textile school, opened in 1897, offers courses in cotton manufacturing, wool manufacturing, designing, chemistry and dyeing, and textile engineering; evening drawing schools and manual training in the public schools have contributed to the high degree of technical perfection in the factories. The power gained from the Pawtucket Falls in the Merrimack river has long been found insufficient for these. A network of canals supplies from 14,000 to 24,000 h.p.; and a small amount is also furnished by the Concord river, but about 26,000 h.p. is supplied by steam. In factory output ($46,879,212 in 1905; $41,202,984 in 1900) Lowell ranked fifth in value in 1905 and fourth in 1900 among the cities of Massachusetts; more than three-tenths of the total population are factory wage-earners, and nearly 19% of the population are in the cotton mills. Formerly Lowell was called the "Spindle City" and the "Manchester of America," but it was long ago surpassed in the manufacture of textiles by Fall River and New Bedford: in 1905 the value of the cotton product of Lowell, $19,340,925, was less than 60% of the value of cotton goods made at Fall River. Woollen goods made in Lowell in 1905 were valued at $2,579,363; hosiery and knitted goods, at $3,816,964; worsted goods, at $1,978,552. Carpets and textile machinery are allied manufactures of importance. There are other factories for machinery, patent medicines, boots and shoes, perfumery and cosmetics, hosiery and rubber heels. Lowell was the home of the inventor of rubber heels, Humphrey O'Sullivan.

The founders of Lowell were Patrick Tracy Jackson (1780–1847), Nathan Appleton (1779–1861), Paul Moody (1779–1831) and the business manager chosen by them, Kirk Boott (1790–1837). The opportunity for developing water-power by the purchase of the canal around Pawtucket Falls (chartered for navigation in 1792) led them to choose the adjacent village of East Chelmsford as the site of their projected cotton mills; they bought the Pawtucket canal, and incorporated in 1822 the Merrimack Manufacturing Company; in 1823 the first cloth was actually made, and in 1826 a separate township was formed from part of Chelmsford and was named in honour of Francis Cabot Lowell, who with Jackson had improved Cartwright's power loom, and had planned the mills at Waltham. In 1836 Lowell was chartered as a city. Lowell annexed parts of Tewksbury in 1834, 1874, 1888 and 1906, and parts of Dracut in 1851, 1874 and 1879. Up to 1840 the mill hands, with the exception of English dyers and calico printers, were New England girls. The "corporation," as the employers were called, provided from the first for the welfare of their employees, and Lowell has always been notably free from labour disturbances.

The character of the early employees of the mills, later largely displaced by French Canadians and Irish, and by immigrants from various parts of Europe, is clearly seen in the periodical, *The Lowell Offering*, written and published by them in 1840–1845. This monthly magazine, organized by the Rev. Abel Charles Thomas (1807–1880), pastor of the First Universalist Church, was from October 1840 to March 1841 made up of articles prepared for some of the many improvement circles or literary societies; it then became broader in its scope, received more spontaneous contributions, and from October 1842 until December 1845 was edited by Harriot F. Curtis (1813–1889), known by her pen name, "Mina Myrtle," and by Harriet Farley (1817–1907), who became manager and proprietor, and published selections from the *Offering* under the titles *Shells from the Strand of the Sea of Genius* (1847) and *Mind among the Spindles* (1849), with an introduction by Charles Knight. In 1854 she married John Intaglio Donlevy (d. 1872). Famous contributors to the *Offering* were Harriet Hanson (b. 1825) and Lucy Larcom (1824–1893). Harriet Hanson wrote *Early Factory Labor in New England* (1883) and *Loom and Spindle* (1898), an important contribution to the industrial and social history of Lowell. She was prominent in the anti-slavery and woman suffrage agitations in Massachusetts, and wrote *Massachusetts in the Woman Suffrage Movement* (1881). She married in 1848 William Stevens Robinson (1818–1876), who wrote in 1856–1876 the political essays signed "Warrington" for the *Springfield Republican*. Lucy Larcom,[1] born in Beverly, came to Lowell in 1835, where her widowed mother kept a "corporation" boarding-house, and where she became a "doffer," changing bobbins in the mills. She wrote much, especially for the *Offering*; became an ardent abolitionist and (in 1843) the friend of Whittier; left Lowell in 1846, and taught for several years, first in Illinois, and then in Beverly and Norton, Massachusetts. *An Idyl of Work* (1875) describes the life of the mills and *A New England Girlhood* (1889) is autobiographical; she wrote many stories and poems, of which *Hannah Binding Shoes* is best known.

Benjamin F. Butler was from boyhood a resident of Lowell, where he began to practise law in 1841. James McNeill Whistler was born here in 1834, and in 1907 his birthplace in Worthen Street was purchased by the Art Association to be used as its headquarters and as an art museum and gallery; it was dedicated in 1908, and in the same year a replica of Rodin's statue of Whistler was bought for the city.

See S. A. Drake, *History of Middlesex County*, 2, p. 53 et seq. (Boston, 1880); *Illustrated History of Lowell, Massachusetts* (Lowell, 1897); the books of Harriet H. Robinson and Lucy Larcom already named as bearing on the industrial conditions of the city between 1835 and 1850; and the famous description in the fourth chapter of Dickens's *American Notes*.

LOWELL INSTITUTE, an educational foundation in Boston, Massachusetts, U.S.A., providing for free public lectures, and endowed by the bequest of $237,000 left by John Lowell, junior, who died in 1836. Under the terms of his will 10% of the net income was to be added to the principal, which in 1909 was over a million dollars. None of the fund was to be invested in a building for the lectures; the trustees of the Boston Athenaeum were made visitors of the fund; but the trustee of the fund is authorized to select his own successor, although in doing so he must "always choose in preference to all others some male descendant of my grandfather John Lowell, provided there is one who is competent to hold the office of trustee, and of the name of Lowell," the sole trustee so appointed having the entire selection of the lecturers and the subjects of lectures. The first trustee was John Lowell junior's cousin, John Amory Lowell, who administered the trust for more than forty years, and was succeeded in 1881 by his son, Augustus Lowell, who in turn was succeeded in 1900 by his son Abbott Lawrence Lowell, who in 1909 became president of Harvard University.

The founder provided for two kinds of lectures, one popular, "and the other more abstruse, erudite and particular." The popular lectures have taken the form of courses usually ranging from half a dozen to a dozen lectures, and covering almost every subject. The fees have always been large, and many of the most eminent men in America and Europe have lectured there. A large number of books have been published which consist of those lectures or have been based upon them. As to the advanced lectures, the founder seems to have had in view what is now called university extension, and in this he was far in advance of his time; but he did not realize that such work can only be done effectively in connexion with a great school. In pursuance of this provision public instruction of various kinds has been given from time to time by the Institute. The first freehand drawing in Boston was taught there, but was given up when the public schools undertook it. In the same way a school of practical design was carried on for many years, but finally, in 1903, was transferred to the Museum of Fine Arts. Instruction for working men was given at the Wells Memorial Institute until 1908, when the Franklin Foundation took up the work. A Teachers' School of Science is maintained in co-operation with the Natural History Society. For many years advanced courses of lectures were given by the professors of the Massachusetts Institute of Technology, but in 1904 they were superseded by an evening school for industrial foremen. In 1907, under the title of "Collegiate Courses," a number of the elementary courses in Harvard University were offered free to the public under the same conditions of study and examination as in the university.

For the earlier period, see Harriett Knight Smith, *History of the Lowell Institute* (Boston, 1898).

LÖWENBERG, a town of Germany, in the Prussian province of Silesia, on the Bober, 39 m. E. of Görlitz by rail. Pop. 5682. It is one of the oldest towns in Silesia; its town hall dates from the 16th century, and it has a Roman Catholic church built in the 13th century and restored in 1862. The town has sandstone and gypsum quarries, breweries and woollen mills, and cultivates fruit and vegetables. Löwenberg became a town in 1217 and has been the scene of much fighting, especially during the Napoleonic wars. Near the town is the village and estate of Hohlstein, the property of the Hohenzollern family.

LÖWENSTEIN, a town of Germany, in the kingdom of Württemberg, capital of the mediatized county of that name, situated under the north slope of the Löwenstein range, 6 m. from Heilbronn. Pop. 1527. It is dominated by the ruined castle of the counts of Löwenstein, and enclosed by medieval walls. The town contains many picturesque old houses. There is also a modern palace. The cultivation of vines is the chief industry, and there is a brine spring (Theusserbad).

Löwenstein was founded in 1123 by the counts of Calw, and belonged to the Habsburgs from 1281 to 1441. In 1634 the castle was destroyed by the imperialists. The county of Löwenstein belonged to a branch of the family of the counts of Calw before 1281, when it was purchased by the German king Rudolph I., who presented it to his natural son Albert. In 1441 Henry, one of Albert's descendants, sold it to the elector palatine of the Rhine, Frederick I., and later it served as a portion for Louis (d. 1524), a son of the elector by a morganatic marriage, who became a count of the Empire in 1494. Louis's grandson Louis II. (d. 1611) inherited the county of Wertheim and other lands by marriage and called himself count of Löwenstein-Wertheim; his two sons divided the family into two branches. The heads of the two branches, into which the older and Protestant line was afterwards divided, were made princes by the king of Bavaria in 1812 and by the king of Württemberg in 1813; the head of the younger, or Roman Catholic line, was made a prince of the Empire in 1711. Both lines are flourishing, their present representatives being Ernst (b. 1854) prince of Löwenstein-Wertheim-Freudenberg, and Aloyse (b. 1871) prince of Löwenstein-Wertheim-Rosenberg. The lands of the family were mediatized after the dissolution of the Empire in 1806. The area of the county of Löwenstein was about 53 sq. m.

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[1] See D. D. Addison, *Lucy Larcom; Life, Letters and Diary* (Boston, 1897).

See C. Rommel, *Grundzüge einer Chronik der Stadt Löwenstein* (Löwenstein, 1893).

LOWESTOFT, a municipal borough, seaport and watering-place in the Lowestoft parliamentary division of Suffolk, England, 117½ m. N.E. from London by the Great Eastern railway. Pop. (1901) 29,850. It lies on either side of the formerly natural, now artificial outlet of the river Waveney to the North Sea, while to the west the river forms Oulton Broad and Lothing Lake. The northern bank is the original site. South Lowestoft arose on the completion of harbour improvements, begun in 1844, when the outlet of the Waveney, reopened in 1827, was deepened. The old town is picturesquely situated on a lofty declivity, which includes the most easterly point of land in England. The church of St Margaret is Decorated and Perpendicular. South Lowestoft has a fine esplanade, a park (Bellevue) and other adjuncts of a watering-place. Bathing facilities are good. There are two piers enclosing a harbour with a total area of 48 acres, having a depth of about 16 ft. at high tide. The fisheries are important and some 600 smacks belong to the port. Industries include ship and boat building and fitting, and motor engineering. The town is governed by a mayor, 8 aldermen and 24 councillors. Area 2178 acres.

Lowestoft (Lothu Wistoft, Lowistoft, Loistoft) owes its origin to its fisheries. In 1086 it was a hamlet in the demesne of the royal manor of Lothingland. The men of Lowestoft as tenants on ancient demesne of the crown possessed many privileges, but had no definite burghal rights until 1885. For several centuries before 1740 the fisheries were the cause of constant dispute between Lowestoft and Yarmouth. During the last half of the 18th century the manufacture of china flourished in the town. A weekly market on Wednesdays was granted to John, earl of Richmond, in 1308 together with an eight days' fair beginning on the vigil of St Margaret's day, and in 1445 John de la Pole, earl of Suffolk, one of his successors as lord of the manor, received a further grant of the same market and also two yearly fairs, one on the feast of St Philip and St James and the other at Michaelmas. The market is still held on Wednesdays, and in 1792 the Michaelmas fair and another on May-day were in existence. Now two yearly fairs for small wares are held on the 13th of May and the 11th of October. In 1643 Cromwell performed one of his earlier exploits in taking Lowestoft, capturing large supplies and making prisoners of several influential royalists. In the war of 1665 the Dutch under Admiral Opdam were defeated off Lowestoft by the English fleet commanded by the duke of York.

See *Victoria County History, Suffolk*; E. Gillingwater, *An Historical Account of the Town of Lowestoft* (ed. 1790).

LOWIN, JOHN (1576–1659), English actor, was born in London, the son of a carpenter. His name frequently occurs in Henslowe's Diary in 1602, when he was playing at the Rose Theatre in the earl of Worcester's company, and he was at the Blackfriars in 1603, playing with Shakespeare, Burbage and the others, and owning—by 1608—a share and a half of the twenty shares in that theatre. About 1623 he was one of the managers. He lived in Southwark, and Edward Alleyn speaks of his dining with him in 1620. "Lowin in his latter days kept an inn (the Three Pigeons) at Brentford, where he deyed very old." Two of his favourite parts were Falstaff, and Melanteus in *The Maid's Tragedy*.

LOWLAND, in physical geography, any broad expanse of land with a general low level. The term is thus applied to the landward portion of the upward slope from oceanic depths to continental highlands, to a region of depression in the interior of a mountainous region, to a plain of denudation or to any region in contrast to a highland. The Lowlands and Highlands of Scotland are typical.

LOWNDES, THOMAS (1692–1748), founder of the Lowndean professorship of astronomy at Cambridge university, England, was born in 1692, both his father and mother being Cheshire landowners. In 1725 he was appointed provost marshal of South Carolina, a post he preferred to fill by deputy. In 1727 Lowndes claimed to have taken a prominent part in inducing the British government to purchase Carolina, but he surrendered his patent when the transfer of the colony to the crown was completed. His patent was renewed in 1730, but he resigned it in 1733. He then brought various impractical schemes before the government to check the illicit trade in wool between Ireland and France; to regulate the paper currency of New England; and to supply the navy with salt from brine, &c. He died on the 12th of May 1748. By his will he left his inherited Cheshire properties to the university of Cambridge for the foundation of a chair of astronomy and geometry.

LOWNDES, WILLIAM THOMAS (1798–1843), English bibliographer, was born about 1798, the son of a London bookseller. His principal work, *The Bibliographer's Manual of English Literature*—the first systematic work of the kind—was published in four volumes in 1834. It took Lowndes fourteen years to compile, but, despite its merits, brought him neither fame nor money. Lowndes, reduced to poverty, subsequently became cataloguer to Henry George Bohn, the bookseller and publisher. In 1839 he published the first parts of *The British Librarian*, designed to supplement his early manual, but owing to failing health did not complete the work. Lowndes died on the 31st of July 1843.

LOW SUNDAY, the first Sunday after Easter, so called because of its proximity to the "highest" of all feasts and Sundays, Easter. It was also known formerly as White Sunday, being still officially termed by the Roman Catholic Church *Dominica in albis*, "Sunday in white garments," in allusion to the white garments anciently worn on this day by those who had been baptized and received into the Church just before Easter. Alb Sunday, Quasimodo and, in the Greek Church, Antipascha, and ἡ δευτεροπρώτη Κυριακή (literally "second-first Sunday," *i.e.* the second Sunday after the first) were other names for the day.

LOWTH, ROBERT (1710–1787), English divine and Orientalist, was born at Winchester on the 27th of November 1710. He was the younger son of William Lowth (1661–1732), rector of Buriton, Hampshire, a theologian of considerable ability. Robert was educated on the foundation of Winchester College, and in 1729 was elected to a scholarship at New College, Oxford. He graduated M.A. in 1737, and in 1741 he was appointed professor of poetry at Oxford, in which capacity he delivered the *Praelectiones Academicae de Sacra Poesi Hebraeorum*. Bishop Hoadly appointed him in 1744 to the rectory of Ovington, Hampshire, and in 1750 to the archdeaconry of Winchester. In 1753 he was collated to the rectory of East Woodhay, Hampshire, and in the same year he published his lectures on Hebrew poetry. In 1754 he received the degree of doctor of divinity from his university, and in 1755 he went to Ireland for a short time as first chaplain to the lord-lieutenant, the 4th duke of Devonshire. He declined a presentation to the see of Limerick, but accepted a prebendal stall at Durham and the rectory of Sedgefield. In 1758 he published his *Life of William of Wykeham*; this was followed in 1762 by *A Short Introduction to English Grammar*. In 1765, the year of his election into the Royal Societies of London and Göttingen, he engaged in controversy with William Warburton on the book of Job, in which he was held by Gibbon to have had the advantage. In June 1766 Lowth was consecrated bishop of St David's, and about four months afterwards he was translated to Oxford, where he remained till 1777, when he became bishop of London and dean of the Chapel Royal. In 1778 appeared his last work, *Isaiah, a new Translation, with a Preliminary Dissertation, and Notes, Critical, Philological, and Explanatory.* He declined the archbishopric of Canterbury in 1783, and died at Fulham on the 3rd of November 1787.

The *Praelectiones*, translated in 1787 by G. Gregory as *Lectures on the Sacred Poetry of the Hebrews*, exercised a great influence both in England and on the continent. Their chief importance lay in the idea of looking at the sacred poetry as poetry, and examining it by the ordinary standards of literary criticism. Lowth's aesthetic criticism was that of the age, and is now in great part obsolete, a more natural method having been soon after introduced by Herder. The principal point in which Lowth's influence has been lasting is his doctrine of poetic parallelism, and even here his somewhat mechanical classification of the forms of Hebrew sense-rhythm, as it should rather be called, is open to serious objections. Editions of the *Lectures* and of the *Isaiah* have been numerous, and both have been translated into German. A volume of *Sermons and other Remains*, with memoir by the topographer, Peter Hall (1802–1849), was published in 1834, and an edition of the *Popular Works* of Robert Lowth in 3 vols. appeared in 1843.

LOXODROME (from Gr. λοξός, oblique, and δρόμος, course), the line on the earth's surface making a constant angle with the meridian.

LOYALISTS or **TORIES**, in America, the name given to the colonists who were loyal to Great Britain during the War of Independence. In New England and the Middle Colonies loyalism had a religious as well as a political basis. It represented the Anglican as opposed to the Calvinistic influence. With scarcely an exception the Anglican ministers were ardent Loyalists, the writers and pamphleteers were the ministers and teachers of that faith, and virtually all the military or civil leaders were members of that church. The Loyalists north of Maryland represented the old Tory traditions. In the southern colonies, where Anglicanism predominated, the division did not follow religious lines so closely. In Virginia and South Carolina the Whig leaders were almost without exception members of the established church. Out of twenty Episcopal ministers in South Carolina only five were Loyalists. Although many of the wealthy Anglican planters of the tide-water section fought for the mother country, the Tories derived their chief support from the non-Anglican Germans and Scotch in the upper country. The natural leaders in these colonies were members of the same church as the governor and vied with him in their zeal for the support of that church. Since religion was not an issue, the disputes over questions purely political in character, such as taxation, distribution of land and appointment of officials, were all the more bitter. The settlers on the frontier were snubbed both socially and politically by the low-country aristocracy, and in North Carolina and South Carolina were denied courts of justice and any adequate representation in the colonial assembly. Naturally they refused to follow such leaders in a war in defence of principles in which they had no material interest. They did not drink tea and had little occasion for the use of stamps, since they were not engaged in commerce and had no courts in which to use legal documents. The failure of the British officers to realize that conditions in the south differed from those in the north, and the tendency on their part to treat all Dissenters as rebels, were partly responsible for the ultimate loss of their southern campaign. The Scotch-Irish in the south, influenced perhaps by memories of commercial and religious oppression in Ulster, were mostly in sympathy with the American cause.

Taking the Thirteen Colonies as a whole, loyalism drew its strength largely from the following classes: (1) the official class—men holding positions in the civil, military and naval services, and their immediate families and social connexions, as, for example, Lieutenant-Governor Bull in South Carolina, Governor Dunmore in Virginia and Governor Tryon in New York; (2) the professional classes—lawyers, physicians, teachers and ministers, such as Benjamin Kissam, Peter Van Schaack and Dr Azor Betts of New York and Dr Myles Cooper, president of King's College (now Columbia University); (3) large landed proprietors and their tenants, *e.g.* William Wragg in South Carolina and the De Lanceys, De Peysters and Van Cortlandts in New York; (4) the wealthy commercial classes in New York, Albany, Philadelphia, Baltimore and Charleston, whose business interests would be affected by war; (5) natural conservatives of the type of Joseph Galloway of Pennsylvania, and numerous political trimmers and opportunists. Before 1776 the Loyalists may be divided into two groups. There was a minority of extremists led by the Anglican ministers and teachers, who favoured an unquestioning obedience to all British legislation. The moderate majority disapproved of the mother country's unwise colonial policy and advocated opposition to it through legally organized bodies. Many even sanctioned non-importation and non-exportation agreements, and took part in the election of delegates to the First Continental Congress. The aggressive attitude of Congress, the subsequent adoption of the Declaration of Independence, and the refusal to consider Lord Howe's conciliatory propositions finally forced them into armed opposition. Very few really sanctioned the British policy as a whole, but all felt that it was their first duty to fight for the preservation of the empire and to leave constitutional questions for a later settlement. John Adams's estimate that one-third of all the people in the thirteen states in 1776 were Loyalists was perhaps approximately correct. In New England the number was small, perhaps largest in Connecticut and in the district which afterwards became the state of Vermont. New York was the chief stronghold. The "De Lancey party" or the "Episcopalian party" included the majority of the wealthy farmers, merchants and bankers, and practically all communicants of the Anglican church. New Jersey, Pennsylvania, Delaware, Maryland and Virginia contained large and influential Loyalist minorities; North Carolina was about equally divided; South Carolina probably, and Georgia certainly, had Loyalist majorities. Some of the Loyalists joined the regular British army, others organized guerilla bands and with their Indian allies inaugurated a reign of terror on the frontier from New York to Georgia. New York alone furnished about 15,000 Loyalists to the British army and navy, and about 8500 militia, making in all 23,500 Loyalist troops. This was more than any other colony supplied, perhaps more than all the others combined. Johnson's "Loyal Greens" and Butler's "Tory Rangers" served under General St Leger in the Burgoyne campaign of 1777, and the latter took part in the Wyoming and Cherry Valley massacres of 1778. The strength of these Loyalists in arms was weakened in New York by General Sullivan's success at Newtown (now Elmira) on the 29th of August 1779, and broken in the north-west by George Rogers Clark's victories at Kaskaskia and Vincennes in 1778 and 1779, and in the south by the battles of King's Mountain and Cowpens in 1780. Severe laws were passed against the Loyalists in all the states. They were in general disfranchised and forbidden to hold office or to practise law. Eight of the states formally banished certain prominent Tories either conditionally or unconditionally, and the remaining five, Connecticut, New Jersey, Delaware, Maryland and Virginia, did practically the same indirectly. Social and commercial ostracism forced many others to flee. Their property was usually confiscated for the support of the American cause. They went to England, to the West Indies, to the Bahamas, to Canada and to New York, Newport, Charleston and other cities under British control. According to a trustworthy estimate 60,000 persons went into exile during the years from 1775 to 1787. The great majority settled in Nova Scotia and in Upper and Lower Canada, where they and their descendants became known as "United Empire Loyalists." Those who remained in the United States suffered for many years, and all the laws against them were not finally repealed until after the War of 1812. The British government, however, endeavoured to look after the interests of its loyal colonists. During the war a number of the prominent Loyalists (*e.g.* Joseph Galloway) were appointed to lucrative positions, and rations were issued to many Loyalists in the cities, such as New York, which were held by the British. During the peace negotiations at Paris the treatment of the Loyalists presented a difficult problem, Great Britain at first insisting that the United States should agree to remove their disabilities and to act toward them in a spirit of conciliation. The American commissioners, knowing that a treaty with such provisions would not be accepted at home, and that the general government had, moreover, no power to bind the various states in such a matter, refused to accede; but in the treaty, as finally ratified, the United States agreed (by Article V.) to recommend to the legislatures of the various states that Loyalists should "have free liberty to go to any part or parts of any of the thirteen United States, and therein to remain twelve months, unmolested in their endeavours to obtain the restitution of such of their estates, rights and properties as may have been confiscated," that acts and laws in the premises be reconsidered and revised, and that restitution of estates, &c., should be made. The sixth article provided "that there shall be no future confiscations made, nor any prosecutions commenced against any person" for having taken part in the war; and that those in confinement on such charges should be liberated. In Great Britain opponents of the government asserted that the Loyalists had virtually been betrayed; in America the treaty aroused opposition as making too great concessions to them. Congress made the promised recommendations, but they were unheeded by the various states, in spite of the advocacy by Alexander Hamilton and others of a conciliatory treatment of the Loyalists; and Great Britain, in retaliation, refused until 1796 to evacuate the western posts as the treaty prescribed. Immediately after the war parliament appointed a commission of five to examine the claims of the Loyalists for compensation for services and losses; and to satisfy these claims and to establish Loyalists in Nova Scotia and Canada the British government expended fully £6,000,000.

See C. H. van Tyne, *The Loyalists in the American Revolution* (New York, 1902), which contains much valuable information but does not explain adequately the causes of loyalism. More useful in this respect is the monograph by A. C. Flick, *Loyalism in New York during the American Revolution* (New York, 1901). On the biographical side see Lorenzo Sabine, *Biographical Sketches of Loyalists of the American Revolution* (2 vols., Boston, 1864); on the literary side, M. C. Tyler, *Literary History of the American Revolution, 1763–1783* (2 vols., New York, 1897).

LOYALTY, allegiance to the sovereign or established government of one's country, also personal devotion and reverence to the sovereign and royal family. The English word came into use in the early part of the 15th century in the sense of fidelity to one's oath, or in service, love, &c.; the later and now the ordinary sense appears in the 16th century. The O. Fr. *loialté*, mod. *loyauté*, is formed from *loial*, loyal, Scots *leal*, Lat. *legalis*, legal, from *lex*, law. This was used in the special feudal sense of one who has full legal rights, a *legalis homo* being opposed to the *exlex*, *utlegatus*, or outlaw. Thence in the sense of faithful, it meant one who kept faithful allegiance to his feudal lord, and so loyal in the accepted use of the word.

LOYALTY ISLANDS (Fr. *Iles Loyalty* or *Loyauté*), a group in the South Pacific Ocean belonging to France, about 100 m. E. of New Caledonia, with a total land area of about 1050 sq. m. and 20,000 inhabitants. It consists of Uea or Uvea (the northernmost), Lifu (the largest island, with an area of 650 sq. m.), Tiga and several small islands and Maré or Nengone. They are coral islands of comparatively recent elevation, and in no place rise more than 250 ft. above the level of the sea. Enough of the rocky surface is covered with a thin coating of soil to enable the natives to grow yams, taro, bananas, &c., for their support; cotton thrives well, and has even been exported in small quantities, but there is no space available for its cultivation on any considerable scale. Fresh water, rising and falling with the tide, is found in certain large caverns in Lifu, and by sinking to the sea-level a supply may be obtained in any part of the island. The chief product of the islands are bananas; the chief export sandal-wood.

The Loyalty islanders are Melanesians; the several islands have each its separate language, and in Uea one tribe uses a Samoan and another a New Hebridean form of speech. The Loyalty group was discovered at the beginning of the 19th century, and Dumont d'Urville laid down the several islands in his chart. For many years the natives had a reputation as dangerous cannibals, but they are now among the most civilized Melanesians. Christianity was introduced into Maré by native teachers from Rarotonga and Samoa; missionaries were settled by the London Missionary Society at Mare in 1854, at Lifu in 1859 and at Uea in 1865: Roman Catholic missionaries also arrived from New Caledonia; and in 1864 the French, considering the islands a dependency of that colony, formally instituted a commandant. An attempt was made by this official to put a stop to the English missions by violence; but the report of his conduct led to so much indignation in Australia and in England that the emperor Napoleon, on receipt of a protest from Lord Shaftesbury and others, caused a commission of inquiry to be appointed and free liberty of worship to be secured to the Protestant missions. A further persecution of Christians in Uea, during 1875, called forth a protest from the British government.

LOYOLA, ST IGNATIUS OF (1491–1556), founder of the Society of Jesus. Inigo Lopez de Recalde, son of Beltran, lord of the noble houses of Loyola and Oñaz, was born, according to the generally accepted opinion, on the 24th of December 1491 at the castle of Loyola, which is situated on the river Urola, about 1 m. from the town of Azpeitia, in the province of Guipuzcoa. He was the youngest of a family of thirteen. As soon as he had learnt the elements of reading and writing, he was sent as a page to the court of Ferdinand and Isabella; afterwards, until his twenty-sixth year, he took service with Antonio Maurique, duke of Nagera, and followed the career of arms. He was free in his relations with women, gambled and fought; but he also gave indications of that courage, constancy and prudence which marked his after life. In a political mission to settle certain disputes in the province he showed his dexterity in managing men.

Despite the treaty of Noyon (1516), Charles V. kept Pampeluna, the capital of Navarre. André de Foix, at the head of the French troops, laid siege to the town in 1521 and Ignatius was one of the defending garrison. In the hour of danger, the claims of religion reasserted themselves on the young soldier, and, following a custom when no priest was at hand, he made his confession to a brother officer, who in turn also confessed to him. During the final assault on the 19th of May 1521 a cannon ball struck him, shattering one of his legs and badly wounding the other. The victorious French treated him kindly for nearly two weeks, and then sent him in a litter to Loyola. The doctors declared that the leg needed to be broken and set again; and the operation was borne without a sign of pain beyond a clenching of his fist. His vanity made him order the surgeons to cut out a bone which protruded below the knee and spoilt the symmetry of his leg. He was lame for the rest of his days. Serious illness followed the operations, and, his life being despaired of, he received the last sacraments on the 28th of June. That night, however, he began to mend, and in a few days he was out of danger. During convalescence two books that were to influence his life were brought to him. These were a Castilian translation of *The Life of Christ* by Ludolphus of Saxony, and the popular *Flowers of the Saints*, a series of pious biographies. He gradually became interested in these books, and a mental struggle began. Sometimes he would pass hours thinking of a certain illustrious lady, devising means of seeing her and of doing deeds that would win her favour; at other times the thoughts suggested by the books got the upper hand. He began to recognize that his career of arms was over: so he would become the knight of Christ. He determined to make the pilgrimage to Jerusalem and to practise all the austerities that he read of in *The Flowers of the Saints*. Expiating his sins was not so much his aim as to accomplish great deeds for God. During the struggle that went on in his soul, he began to take note of his psychological state; and this was the first time that he exercised his reason on spiritual things; the experience thus painfully gained he found of great use afterwards in directing others. One night while he lay awake, he tells us, he saw the likeness of the Blessed Virgin with her divine Son; and immediately a loathing seized him for the former deeds of his life, especially for those relating to carnal desires; and he asserts that for the future he never yielded to any such desires. This was the first of many visions. Ignatius proposed after returning from Jerusalem to join the Carthusian order at Seville as a lay brother. About the same time Martin Luther was in the full course of his protest against the papal supremacy and had already burnt the pope's bull at Worms. The two opponents were girding themselves for the struggle; and what the Church of Rome was losing by the defection of the Augustinian was being counterbalanced by the conversion of the founder of the Society of Jesus.

As soon as Ignatius had regained strength, he started ostensibly to rejoin the duke of Nagera, but in reality to visit the great Benedictine abbey of Montserrato, a famous place of pilgrimage. On the way, he was joined by a Moor, who began to jest at some of the Christian doctrines, especially at the perpetual virginity of the Blessed Virgin. Ignatius was no controversialist; and the Moor rode off victorious. The chivalrous nature of Ignatius was aroused. Seized with a longing to pursue and kill the Moor on account of his insulting language, Ignatius, still doubting as to his best course, left the matter to his mule, which at the dividing of the ways took the path to the abbey, leaving the open road which the Moor had taken. Before reaching Montserrato, Ignatius purchased some sackcloth for a garment and hempen shoes, which, with a staff and gourd, formed the usual pilgrim's dress. Approaching the abbey he resolved to do as his favourite hero Amadis de Gaul did—keep a vigil all night before the Lady altar and then lay aside his worldly armour to put on that of Christ. He arrived at the abbey just about the feast of St Benedict (the 21st of March 1522), and there made a confession of his life to a priest belonging to the monastery. He found in use for the pilgrims a translation of the *Spiritual Exercises* of the former abbot, Garcia di Cisneros (d. 1510); and this book evidently gave Ignatius the first idea of his more famous work under the same title. Leaving his mule to the abbey, and giving away his worldly clothes to a beggar, he kept his watch in the church during the night of the 24th–25th of March, and placed on the Lady altar his sword and dagger. Early the next morning he received the Holy Eucharist and left before any one could recognize him, going to the neighbouring town of Manresa, where he first lived in the hospice. Here began a series of heavy spiritual trials which assailed him for many months. Seven hours a day he spent on his knees in prayer and three times a day he scourged his emaciated body. One day, almost overcome with scruples, he was tempted to end his miseries by suicide. At another time, for the same reason, he kept an absolute fast for a week. He tells us that, at this time, God wrought with him as a master with a schoolboy whom he teaches. But his energies were not confined to himself. He assisted others who came to him for spiritual advice; and seeing the fruit reaped from helping his neighbour, he gave up the extreme severities in which he had delighted and began to take more care of his person, so as not needlessly to offend those whom he might influence for good.

During his stay at Manresa, he lived for the most part in a cell at the Dominican convent; and here, evidently, he had severe illnesses. He recounts the details of at least two of these attacks, but says nothing about the much-quoted swoon of eight days, during which he is supposed to have seen in vision the scheme of the future Society. Neither does he refer in any way to the famous cave in which, according to the Ignatian myth, the *Spiritual Exercises* were written. Fortunately we have the first-hand evidence of his autobiography, which is a surer guide than the lines written by untrustworthy disciples. Ignatius remained at Manresa for about a year, and in the spring of 1523 set out for Barcelona on his way to Rome, where he arrived on Palm Sunday. After two weeks he left, having received the blessing of Pope Adrian VI., and proceeded by Padua to Venice, where he begged his bread and slept in the Piazza di San Marco until a rich Spaniard gave him shelter and obtained an order from the doge for a passage in a pilgrim ship bound for Cyprus, whence he could get to Jaffa. In due course Ignatius arrived at Jerusalem, where he intended to remain, in order continuously to visit the holy places and help souls. For this end he had obtained letters of recommendation to the guardian, to whom, however, he only spoke of his desire of satisfying his devotion, not hinting his other motive. The Franciscans gave him no encouragement to remain; and the provincial threatened him with excommunication if he persisted. Not only had the friars great difficulty in supporting themselves, but they dreaded an outbreak from the fanatical Turks who resented some imprudent manifestations of Loyola's zeal. Ignatius returned to Venice in the middle of January 1524; and, determining to devote himself for a while to study, he set out for Barcelona, where he arrived in Lent. Here he consulted Isabella Roser, a lady of high rank and piety, and also the master of a grammar school. These both approved his plan; the one promised to teach him without payment and the other to provide him with the necessaries of life. Here, in his thirty-third year, he began to learn Latin, and after two years his master urged him to go to Alcalá to begin philosophy. During his stay of a year and a half in this university, besides his classes, he found occasion to give to some companions his *Spiritual Exercises* in the form they had then taken and certain instructions in Christian doctrine. On account of these discourses Ignatius came into conflict with the Inquisition. He and his companions were denounced as belonging to the sects of *Sagati* and *Illuminati*. Their mode of life and dress was peculiar and hinted at innovation. But, always ready to obey authority, Ignatius was able to disarm any charges that, now and at other times, were brought against him. The Inquisition merely advised him and his companions to dress in a less extraordinary manner and to go shod. Four months later he was suddenly cast into prison; and, after seventeen days, he learnt that he was falsely accused of sending two noble ladies on a pilgrimage to Jaen. During their absence, from the 21st of April 1527 to the 1st of June, he remained in prison, and was then set free with a prohibition against instructing others until he had spent four years in study.

Seeing his way thus barred at Alcalá, he went with his companions to Salamanca. Here the Dominicans, doubting the orthodoxy of the new-comers, had them put into prison, where they were chained foot to foot and fastened to a stake set up in the middle of the cell. Some days afterwards Ignatius was examined and found without fault. His patience won him many friends; and when he and his companions remained in prison while the other prisoners managed to escape, their conduct excited much admiration. After twenty-two days they were called up to receive sentence. No fault was found in their life and teaching; but they were forbidden to define any sins as being mortal or venial until they had studied for four years. Hampered again by such an order, Ignatius determined to go to Paris to continue his studies. Up to the present he was far from having any idea of founding a society. The only question before him now was whether he should join an order, or continue his wandering existence. He decided upon Paris for the present, and before leaving Salamanca he agreed with his companions that they should wait where they were until he returned; for he only meant to see whether he could find any means by which they all might give themselves to study. He left Barcelona and, travelling on foot to Paris, he arrived there in February 1528. The university of Paris had reached its zenith at the time of the council of Constance (1418), and was now losing its intellectual leadership under the attacks of the Renaissance and the Reformation. In 1521 the university had condemned Luther's *Babylonish Captivity*, and in 1527 Erasmus's *Colloquies* met with the same fate. Soon after his arrival, Ignatius may have seen in the Place de Grève the burning of Louis de Berquin for heresy.[1] At this period there were between twelve and fifteen thousand students attending the university, and the life was an extraordinary mixture of licentiousness and devout zeal. When Ignatius arrived in Paris, he lodged at first with some fellow-countrymen; and for two years attended the lectures on humanities at the collège de Montaigu, supporting himself at first by the charity of Isabella Roser; but, a fellow-lodger defrauding him of his stock, he found himself destitute and compelled to beg his bread. He retired to the hospice of St Jacques; and, following the advice of a Spanish monk, spent his vacations in Flanders, where he was helped by the rich Spanish merchants. At Bruges he became acquainted with the famous Spanish scholar, Juan Luis Vives, with whom he lodged. In the summer of 1530 he went to London, where he received alms more abundantly than elsewhere. As he could only support himself at Paris with difficulty, it was impossible to send for his companions in Salamanca. Others, however, joined him in Paris, and to some of them he gave the *Spiritual Exercises*, with the result that the Inquisition made him give up speaking on religious subjects during the time he was a student. At the end of 1529 he came into contact with the men who were eventually to become the first fathers of the Society of Jesus. He won over the Savoyard Pierre Lefèvre (Faber), whose room he shared, and the Navarrese Francis Xavier, who taught philosophy in the college of St Barbara. Afterwards he became acquainted with the young Castilian, Diego Laynez, who had heard of him at Acalá and found him out in Paris. With Laynez came two other young men, the Toledan Alfonso Salmeron and the Portuguese Simon Rodriguez. Nicholas Bobadilla, a poor Spaniard who had finished his studies, was the next to join him. The little company of seven determined to consecrate their union by vows. On the 15th of August 1534, the Feast of the Assumption, they assembled in the crypt of the church of St Mary on Montmartre, and Faber, the only one who was a priest, said Mass. They then took the vows of poverty and chastity, and pledged themselves to go to the Holy Land as missionaries or for the purpose of tending the sick; or if this design should prove impracticable, to go to Rome and place themselves at the disposal of the pope for any purpose. But, whatever may have been the private opinion of Ignatius, there was on this occasion no foundation of any society. The vows were individual obligations which could be kept quite apart from membership in a society. A provision was made that if, after waiting a year at Venice, they were unable to go to Jerusalem, this part of the vow should be cancelled and they should at once betake themselves to Rome.

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[1] Louis de Berquin, who died on the 17th of April 1529, belonged to a noble family of Artois. He was a man of exemplary life and a friend of Erasmus and the humanists, besides being a *persona grata* at the court of Louise of Savoy and Francis I. His main offence was that he attacked the monks and clergy, and that he advocated the reading of the Scriptures by the people in the vulgar tongue.—(W. A. P.)

At this time Ignatius was again suffering from his former imprudent austerities; and he was urged to return for a while to his native air. He left Paris for Spain in the autumn of 1535, leaving Faber in charge of his companions to finish their studies. During the absence of Ignatius, Faber gained three more adherents. But before leaving Paris Ignatius heard once more that complaints had been lodged against him at the Inquisition; but these like the others were found to be without any foundation. When he arrived near Loyola he would not go to the castle, but lived at the public hospice at Azpeitia, and began his usual life of teaching Christian doctrine and reforming morals. Falling ill again he went to other parts of Spain to transact business for his companions. Then, sailing from Valencia to Genoa, he made his way to Venice, where he arrived during the last days of 1535. Here he waited for a year until his companions could join him, and meanwhile he occupied himself in his usual good works, gaining several more companions and meeting Giovanni Piero Caraffa, afterwards Paul IV., who had lately founded the Theatines. What happened between the two does not appear; but henceforth Caraffa seems to have borne ill will towards Ignatius and his companions. At Venice Ignatius was again accused of heresy, and it was said that he had escaped from the Inquisition in Spain and had been burnt in effigy at Paris. These charges he met successfully by insisting that the nuncio should thoroughly inquire into the matter.

After a journey of fifty-four days his companions arrived at Venice in January 1537; and here they remained until the beginning of Lent, when Ignatius sent them to Rome to get money for the proposed voyage to Palestine. He himself stayed behind, as he feared that, if he went with them, Caraffa at Rome, together with Dr Ortiz, a German opponent in Paris and now Charles V.'s ambassador at the Vatican, would prejudice the pope against them. But Ortiz proved a friend and presented them to Paul III., who gave them leave to go to Palestine to preach the Gospel, bestowing upon them abundant alms. He likewise gave licence for those not yet priests to be ordained by any catholic bishop on the title of poverty. They had returned to Venice where Ignatius and the others were ordained priests on the 24th of June 1537, after having renewed their vows of poverty and chastity to the legate Verallo. Ignatius, now a priest, waited for eighteen months before saying Mass, which he did for the first time on the 25th of December 1538 in the church of Santa Maria Maggiore in Rome.

The year of waiting passed away without any chance of going to the Holy Land. Finding it impossible to keep this part of their vow, the fathers met at Vicenza, where Ignatius was staying in a ruined monastery; and here after deliberation it was determined that he, Laynez and Faber should go to Rome to place the little band at the disposal of the pope. It was now that the Society began to take some visible form. A common rule was devised and a name adopted. Ignatius declared that having assembled in the name of Jesus, the association should henceforth bear the name of the "Company of Jesus." The word used shows Loyola's military ideal of the duties and methods of the nascent society.

On the road to Rome a famous vision took place, as to which we have the evidence of Ignatius himself. In a certain church, a few miles before Rome, whilst in prayer he was aware of a stirring and a change in his soul; and so openly did he see God the Father placing him with Christ, that he could not dare to doubt that God the Father had so placed him. Subsequent writers add that Christ, looking at him with a benign countenance, said: "I shall be propitious to you"; while others add the significant words, "at Rome." Ignatius, however, says nothing about so important a matter; indeed he understood the vision to mean that many things would be adverse to them, and told his companions when they reached the city that he saw the windows there closed against him. He also said: "We must of necessity proceed with caution; and we must not make the acquaintance of women unless they be of very high rank." They arrived in Rome in October 1537; and lived at first in a little cottage in a vineyard and near the Trinità dei Monti. The pope appointed Faber to teach Holy Scripture, and Laynez scholastic theology, in the university of the Sapienza. Ignatius was left free to carry on his spiritual work, which became so large that he was obliged to call his other companions to Rome. During the absence of the pope, a certain hermit began to spread heresy and was opposed by Ignatius and his companions. In revenge the hermit brought up the former accusations concerning the relations to the Inquisition, and proclaimed Ignatius and his friends to be false, designing men and no better than concealed heretics. The matter was examined and the legate ordered the suit to be quashed. But this did not suit Ignatius. It was necessary for his own good repute and the future of his work that a definitive sentence should be pronounced and his name cleared once and for all. The legate demurred; but on the pope's return sentence was formally given in his favour.

The life of Ignatius is now mainly identified with the formation and growth of his Society (see JESUITS), but his zeal found other outlets in Rome. He founded institutions for rescuing fallen women, started orphanages and organized catechetical instructions. He obtained, after difficulty, the official recognition of his Society from Paul III. on the 27th of September 1540, and successfully steered it through many perils that beset it in its early days. He was unanimously elected the first general in April 1541; and on the 22nd of that month received the first vows of the Society in the church of San Paolo *fuori la mura*. Two works now chiefly occupied the remainder of his life: the final completion of the *Spiritual Exercises* and the drawing up of the *Constitutions*, which received their final form after his death. These two are so constantly connected that the one cannot be understood without the other. The *Constitutions* are discussed in the article on the Jesuits. In these he taught his followers to respond to the call; by the *Spiritual Exercises* he moulded their character.

The Book of the Spiritual Exercises has been one of the world-moving books. In its strict conception it is only an application of the Gospel precepts to the individual soul. Its object is to convince a man of sin, of justice and of judgment. The idea of the book is not original to Ignatius At Montserrato he had found in use a popular translation of the *Exercitatorio de la vida spiritual* (1500), written in Latin by Abbot Garcias de Cisneros (d. 1510), and divided into three ways or periods during which purity of soul, enlightenment and union are to be worked for; a fourth part is added on contemplation. This book evidently afforded the root idea of the Ignatian and more famous book. But the differences are great. While taking the title, the idea of division by periods and the subjects of most of the meditations from the older work, Ignatius skilfully adapted it to his own requirements. Above all the methods of the two are essentially different. The Benedictine work follows the old monastic tradition of the direct intercourse of the soul with God. Ignatius, with his military instinct and views of obedience, intervenes with a director who gives the exercises to the person who in turn receives them. If this introduction of the director is essential to the end for which Ignatius framed his *Exercises*, in it we also find dangers. A director, whose aim is only the personal advantage of the one who is receiving. the exercises, will be the faithful interpreter of his founder's intentions: but in the case of one whose *esprit de corps* is unbalanced, the temporary and pecuniary advantage of the Society may be made of more importance than that of the exercitant. Another danger may come when minuteness of direction takes away the wholesome sense of responsibility. Apart from these abuses the *Spiritual Exercises* have proved their value over and over again, and have received the sincerest form of flattery in countless imitations. The original parts of the book are principally to be found in the meditations, which are clearly Ignatian in conception as well as method. These are *The Reign of Christ*, wherein Christ as an earthly king calls his subjects to war: and *Two Standards*, one of Jesus Christ and the other of Lucifer. Besides these there are various additions to the series of meditations, which are mostly the practical results of the experiences which Ignatius went through in the early stages of his conversion. He gives various methods of prayer; methods of making an election; his series of rules for the discernment of spirits; rules for the distribution of alms and the treatment of scruples; tests of orthodoxy. These additions are skilfully worked into the series of meditations; so that when the exercitant by meditation has moved his soul to act, here are practical directions at hand.

The exercises are divided into four series of meditations technically called " weeks," each of which may last as long as the director considers necessary to achieve the end for which each week is destined. But the whole period is generally concluded in the space of a month. The first week is the foundation, and has to do with the consideration of the end of man, sin, death, judgment and hell. Having purified the soul from sin and obtained a detestation thereof, the second week treats of the kingdom of Christ, and is meant to lead the soul to make an election of the service of God. The third and fourth weeks are intended to confirm the soul in the new way chosen, to teach how difficulties can be overcome, to inflame it with the love of God and to help it to persevere.

The Book of the Spiritual Exercises was not written at Manresa, although there is in that place an inscription testifying to the supposed fact. Ignatius was constantly adding to his work as his own personal experience increased, and as he watched the effects of his method on the souls of those to whom he gave the exercises. The latest critics, even those of the Society itself, give 1548 as the date when the book received its final touches; though Father Roothaan gives Rome, the 9th of July 1541, as the date at the end of the ancient MS. version. Ignatius wrote originally in Spanish, but the book was twice translated into Latin during his lifetime. The more elegant version (known as the common edition) differs but slightly from the Spanish. Francisco Borgia, while duke of Gandia, petitioned Paul III. to have the book examined and approved. The pope appointed censors for both translations, who found the work to be replete with piety and holiness, highly useful and wholesome. Paul III. on receiving this report confirmed it on the 31st of July 1548 by the breve *Pastoralis officii cura*. This book, which is rightly called the spiritual arm of the Society, was the first book published by the Jesuits.

The progress of the Society of Jesus in Loyola's lifetime was rapid (see JESUITS). Having always had an attraction for a life of prayer and retirement, in 1547 he tried to resign the generalship, and again in 1550, but the fathers unanimously opposed the project. One of his last trials was to see in 1556 the election as pope of his old opponent Caraffa, who soon showed his intention of reforming certain points in the Society that Ignatius considered vital. But at this difficult crisis he never lost his peace of mind. He said: "If this misfortune were to fall upon me, provided it happened without any fault of mine, even if the Society were to melt away like salt in water, I believe that a quarter of an hour's recollection in God would be sufficient to console me and to re-establish peace within me." It is clear that Ignatius never dreamed of putting his Society before the church nor of identifying the two institutions.

In the beginning of 1556 Ignatius grew very weak and resigned the active government to three fathers, Polanco, Madrid and Natal. Fever laid hold of him, and he died somewhat suddenly on the 31st of July 1556, without receiving or asking for the last sacraments. He was beatified in 1609 by Paul V. and canonized in 1628 by Gregory XV. His body lies under the altar in the north transept of the Gesù in Rome.

His portrait is well known. The olive complexion, a face emaciated by austerities, the large forehead, the brilliant and small eyes, the high bald head tell their own tale. He was of medium height and carried himself so well that his lameness was hardly noticeable. His character was naturally impetuous and enthusiastic, but became marked with great self-control as he gradually brought his will under his reason. There was always that love of overcoming difficulty inherent in a chivalrous nature; and this also accounts for that desire of surpassing every one else that marked his early days. Whilst other Christians, following St Paul, were content to do all things for the glory of God, Ignatius set himself and his followers to strive after the greater glory. Learning by his own experience and errors, he wisely developed a sovereign prudence which nicely adjusted means to the end in view. He impressed on his followers the doctrine that in all things the end was to be considered. Never would Ignatius have countenanced so perverted an idea as that the end justified the means, for with his spiritual light and zeal for God's glory he saw clearly that means in themselves unjust were opposed to the very end he held in view. As a ruler he displayed the same common sense. Obedience he made one of his great instruments, yet he never intended it to be a galling yoke. His doctrine on the subject is found in the well-known letter to the Portuguese Jesuits in 1553, and if this be read carefully together with the *Constitutions* his meaning is clear. If he says that a subject is to allow himself to be moved and directed, under God, by a superior just as though he were a corpse or as a staff in the hands of an old man, he is also careful to say that the obedience is only due in all things " wherein it cannot be defined (as it is said) that any kind of sin appears." The way in which his teaching on obedience is practically carried out is the best corrective of the false ideas that have arisen from misconceptions of its nature. His high ideas on the subject made him a stern ruler. There are certain instances in his life which, taken by themselves, show a hardness in treating individuals who would not obey; but as a rule, he tempered his authority to the capacity of those with whom he had to deal. When he had to choose between the welfare of the Society and the feelings of an individual it was clear to which side the balance would fall.

There was in his character a peculiar mixture of conservatism and a keen sense of the requirements of the day. In intellectual matters he was not in advance of his day. The Jesuit system of education, set forth in the *Ratio studiorum*, owes nothing to him. While he did not reject any approved learning, he abhorred any intellectual culture that destroyed or lessened piety. He wished to secure uniformity in the judgment of the Society even in points left open and free by the church: " Let us all think in the same way, let us all speak in the same manner if possible." Bartole, the official biographer of Ignatius, says that he would not permit any innovation in the studies; and that, were he to live five hundred years, he would always repeat " no novelties " in theology, in philosophy or in logic—not even in grammar. The revival of learning had led many away from Christ; intellectual culture must be used as a means of bringing them back. The new learning in religion had divided Christendom; the old learning of the faith, once delivered to the saints, was to reconcile them. This was the problem that faced Ignatius, and in his endeavour to effect a needed reformation in the individual and in society his work and the success that crowned it place him among the moral heroes of humanity.

BIBLIOGRAPHY.—The Ignatian literature is very large. Fortunately we have in the *Acta quaedam* what is in effect the autobiography of the saint. This has been translated into English under the title of *The testament of Ignatius Loyola, being sundry acts of our Father Ignatius, under God, the first founder of the Society of Jesus, taken down from the Saint's own lips by Luis Gonsales* (London, 1900);

above account of Ignatius is taken in most places directly from this, which is not only the best of all sources but also a valuable corrective of the later and more imaginative works. Next to the *Acta quaedam* comes in value Polanco's *Vita Ignatii Loiolae*, which is published in the *Monumenta historica Societatis Jesu* now in progress. Polanco was the saint's secretary towards the end of his life. Ribadeneira, who as a youth had been associated with the founder, wrote his *Vida del S. Ignacio de Loyola* (Madrid, 1594), based on an early Latin work (Naples, 1572). Bartole, the official biographer, wrote his *Della vita e dell' instituto di S. Ignatio* (Rome, 1650, 1659); Genelli wrote *Das Leben des heiligen Ignatius von Loyola* (Innsbruck, 1848); Nicolas Orlandinus gives a life in the first volume of the *Historiae Societatis Jesu* (Rome, 1615). It would be impossible to give a list even of the other lives, most of which are without value as histories, being written mainly for edification. But the student may be referred to the modern books Henri Joli's *St Ignace de Loyola* (Paris, 1899), which is based on the best authorities, and to H. Müller's curious *Les Origines de la Compagnie de Jésus* (Paris, 1898), in which the author tries to establish a Mahommedan origin for many of the ideas adopted by the saint.

The literature connected with the *Spiritual Exercises* is also large. It will be sufficient here to mention: *A Book of Spiritual Exercises, written by Garcias de Cisneros* (London, 1876); the official Latin text in the third volume of the Avignon edition of the *Constitutions* (1830); Roothaan's *Exercitia spiritualia S. P. Ignatii de Loyola, cum versione litterali ex autographo Hispanico, notis illustrata* (Namur, 1841); Diertino, *Historia exercitiorum S. P. Ignatii de Loyola* (1887). Especially worthy of notice is P. Watrigant's *La Genèse des exercices de Saint Ignace de Loyola*, republished from *Les Études* (20th May, 20th July, 20th October 1897). (E. Tn.)

LOZENGE (from the Fr. *losenge*, or *losange*; the word also appears in Span. *losanje*, and Ital. *losanga*; perhaps derived from a word meaning a stone slab laid on a grave, which appears in forms such as Provençal *lousa*, Span. *losa*, the ultimate origin of which is unknown, the Lat. *lapis*, stone, or *laus*, praise, in the sense of epitaph, have been suggested), properly a four equal-sided figure, having two acute and two obtuse angles, a rhomb or "diamond." The figure is frequently used as a bearing in heraldry and especially as a shield so shaped on which the arms of a widow or spinster are emblazoned. It is used also to denote the diamond-shaped facets of a precious stone when cut, also the diamond panes of a casement window. In the 14th century the "lozenge pattern" was a favourite design for decoration. The word is also applied to a small tablet of sugar, originally diamond shaped, containing either medical drugs or some simple flavouring, or to a tablet of any concentrated substance, such as a meat-lozenge. In the reign of James I. of Scotland (1406–1437) a Scotch gold coin having a lozenge-shaped shield with the arms of Scotland on the obverse side was called a "lozenge-lion."

LOZÈRE, a department of south-eastern France belonging to the central plateau, composed of almost the whole of Gévaudan and of some portions of the old dioceses of Uzès and Alais, districts all formerly included in the province of Languedoc. Pop. (1906) 128,016. Area, 1999 sq. m. It is bounded N. by Cantal and Haute-Loire, E. by Ardèche and Gard, S. by Gard and Aveyron and W. by Aveyron and Cantal. Lozère is mountainous throughout and in average elevation is the highest of all the French departments. It has three distinct regions—the Cévennes proper to the south-east, the *causses* to the south-west and the mountain tracts which occupy the rest of its area. The Cévennes begin (within Lozère) with Mont Aigoual, which rises to a height of more than 5100 ft.; parallel to this are the mountains of Bougès, bold and bare on their southern face, but falling gently with wooded slopes towards the Tarn which roughly limits the Cévennes on the north. To the north of the Tarn is the range of Lozère, including the peak of Finiels, the highest point of the department (5584 ft.). Farther on occurs the broad marshy plateau of Montbel, which drains southward to the Lot, northwards to the Allier, eastward by the Chassezac to the Ardèche. From this plateau extend the mountains of La Margeride, undulating granitic tablelands partly clothed with woods of oak, beech and fir, and partly covered with pastures, to which flocks are brought from lower Languedoc in summer. The highest point (Truc de Randon) reaches 5098 ft. Adjoining the Margeride hills on the west is the volcanic range of Aubrac, a pastoral district where horned cattle take the place of sheep; the highest point is 4826 ft. The *causses* of Lozère, having an area of about 564 sq. m., are calcareous, fissured and arid, but separated from each other by deep and well-watered gorges, contrasting with the desolate aspect of the plateaus. The *causse* of Sauveterre, between the Lot and the Tarn, ranges from 3000 to 3300 ft. in height; that of Méjan has nearly the same average altitude, but has peaks some 1000 ft. higher. Between these two *causses* the Tarn valley is among the most picturesque in France. Lozère is watered entirely by rivers rising within its own boundaries, being in this respect unique. The climate of Lozère varies greatly with the locality. The mean temperature of Mende (50° F.) is below that of Paris; that of the mountains is always low, but on the *causses* the summer is scorching and the winter severe; in the Cévennes the climate becomes mild enough at their base (656 ft.) to permit the growth of the olive. Rain falls in violent storms, causing disastrous floods. On the Mediterranean versant there are 76 in., in the Garonne basin 46 and in that of the Loire only 28. Sheep and cattle-rearing and cheese-making are the chief occupations. Bees are kept, and, among the Cévennes, silkworms. Large quantities of chestnuts are exported from the Cévennes, where they form an important article of diet. In the valley of the Lot wheat and fruit are the chief products; elsewhere rye is the chief cereal, and oats, barley, meslin and potatoes are also grown. Fruit trees and leguminous plants are irrigated by small canals (*béals*) on terraces made and maintained with much labour. Lead, zinc and antimony are found. Saw-milling, the manufacture of wooden shoes and wool-spinning are carried on; otherwise industries are few and unimportant. Of mineral springs, those of Bagnols-les-Bains are most frequented. The line of the Paris-Lyon company from Paris to Nîmes traverses the eastern border of the department, which is also served by the Midi railway with the line from Neussargues to Béziers via Marvéjols. The arrondissements are Mende, Florac and Marvéjols; the cantons number 24, the communes 198. Lozère forms the diocese of Mende and part of the ecclesiastical province of Albi. It falls within the region of the XVI. army corps, the circumscriptions of the *académie* (educational division) of Montpellier and the appeal court of Nîmes. Mende (*q.v.*) is its most important town.

LUANG-PRABANG, a town of French Indo-China, capital of the Lao state of that name, on the left bank of the Me Kong river. It lies at the foot of the pagoda hill which rises about 200 ft. above the plain on the promontory of land round which the Nam Kan winds to the main river. It has a population of about 9000 and contains the "palace" of the king of the state and several pagodas. In 1887 it was taken and sacked by the Haw or Black Flags, robber bands of Chinese soldiery, many of them survivors of the Taiping rebellion. In 1893 Siam was compelled to renounce her claims to the left bank of the Me Kong, including Luang-Prabang and the magnificent highlands of Chieng Kwang. That portion of the state which was on the right bank of the Me Kong was not affected by the treaty, except in so far as a portion of it fell within the sixteen miles' zone within which Siam agreed not to keep troops. Trade is in the hands of Chinese or Shan traders; hill rice and other jungle products are imported from the surrounding districts by the Kha or hill people. The exports, which include rubber, gum benjamin, silk, wax, sticklac, cutch, cardamon, a little ebony, cinnamon, indigo, rhinoceros and deer horns, ivory and fish roe, formerly all passed by way of Paklai to the Me Nam, and so to Bangkok, but have now almost entirely ceased to follow that route, the object of the French government being to deflect the trade through French territory. Luang-Prabang is the terminus of navigation on the upper Me Kong and the centre of trade thereon.

LUBAO, a town in the south-western part of the province of Pampanga, Luzon, Philippine Islands, about 30 m. N.W. of Manila. Pop. (1903) 19,063. Lubao is served by the Manila & Dagupan railway, and has water communication with Manila by tidal streams and Manila Bay. Its products are, therefore, readily marketed. It lies in a low, fertile plain, suited to the growing of rice and sugar. Many of the inhabitants occupy themselves in the neighbouring nipa swamps, either preparing the nipa leaves for use in house construction, or distilling "nipa-wine" from the juice secured by tapping the blossom stalks. The language is Pampangan.

LÜBBEN, a town of Germany, in the Prussian province of Brandenburg, on the Spree, 47 m. S.S.E. of Berlin, on the railway to Görlitz. Pop. (1905) 7173. It is the chief town of the Spreewald, and has saw-mills and manufactories of hosiery, shoes and paper, and is famous for its *gurken*, or small pickling cucumbers. The poet Paul Gerhardt (1607–1676) was pastor here and is buried in the parish church.

LÜBECK, a state and city (*Freie und Hansestadt Lübeck*) of Germany. The *principality* of Lübeck, lying north of the state, is a constituent of the grand-duchy of Oldenburg (*q.v.*). The state is situated on an arm of the Baltic between Holstein and Mecklenburg-Schwerin. It consists of the city of Lübeck, the town of Travemünde, 49 villages and the country districts, embraces 115 sq. m. of territory, and had a population in 1907 of 109,265, of which 93,978 were included in the city and its immediate suburbs. The state lies in the lowlands of the Baltic, is diversified by gently swelling hills, and watered by the Trave and its tributaries, the Wakenitz and the Stecknitz. The soil is fertile, and, with the exception of forest land (14% of the whole area), is mostly devoted to market gardening. Trade is centred in the city of Lübeck.

The constitution of the free state is republican, and, by the fundamental law of 1875, amended in 1905 and again in 1907, consists of two assemblies. (1) The Senate of fourteen members, of whom eight must belong to the learned professions, and six of these again must be jurists, while of the remaining six, five must be merchants. The Senate represents the sovereignty of the state and is presided over by the *Oberbürgermeister*, who during his two years' term of office bears the title of "magnificence." (2) The House of Burgesses (Bürgerschaft), of 120 members, elected by free suffrage and exercising its powers partly in its collective capacity and partly through a committee of thirty members. Purely commercial matters are dealt with by the chamber of commerce, composed of a *praeses*, eighteen members and a secretary. This body controls the exchange and appoints brokers, shipping agents and underwriters. The executive is in the hands of the Senate, but the House of Burgesses has the right of initiating legislation, including that relative to foreign treaties; the sanction of both chambers is required to the passing of any new law. Lübeck has a court of first instance (*Amtsgericht*) and a high court of justice (*Landgericht*); from the latter appeals lie to the Hanseatic court of appeal (*Oberlandesgericht*) at Hamburg, and from this again to the supreme court of the empire (*Reichsgericht*) in Leipzig. The people are nearly all Lutherans, and education is compulsory between the ages of six and fourteen.

The estimated revenue for the year 1908–1909 amounted to about £650,000, and the expenditure to a like sum. The public debt amounted, in 1908, to about £2,518,000. Lübeck has one vote in the federal council (*Bundesrat*) of the German Empire, and sends one representative to the imperial parliament (*Reichstag*).

History of the Constitution.—At the first rise of the town justice was administered to the inhabitants by the *Vogt* (*advocatus*) of the count of Holstein. Simultaneously with its incorporation by Henry the Lion, duke of Saxony, who presented the city with its own mint toll and market, there appears a magistracy of six, chosen probably by the *Vogt* from the *Schöffen* (*scabini*, *probi homines*). The members of the town council had to be freemen, born in lawful wedlock, in the enjoyment of estates in freehold and of unstained repute. Vassals or servants of any lord, and tradespeople, were excluded. A third of the number had annually to retire for a year, so that two-thirds formed the sitting council. By the middle of the 13th century there were two burgomasters (*magistri burgensium*). Meanwhile, the number of magistrates (*consules*) had increased, ranging from twenty to forty and upwards. The council appointed its own officers in the various branches of the administration. In the face of so much self-government the *Vogt* presently disappeared altogether. There were three classes of inhabitants, full freemen, half freemen and guests or foreigners. People of Slav origin being considered unfree, all intermarriage with them tainted the blood; hence nearly all surnames point to Saxon, especially Westphalian, and even Flemish descent. The magistracy was for two centuries almost exclusively in the hands of the merchant aristocracy, who formed the companies of traders or "nations," such as the *Bergen-fahrer*, *Novgorod-fahrer*, *Riga-fahrer* and *Stockholm-fahrer*. From the beginning, however, tradesmen and handicraftsmen had settled in the town, all of them freemen of German parentage and with property and houses of their own. Though not eligible for the council, they shared to a certain extent in the self-government through the aldermen of each corporation or gild, of which some appear as early as the statutes of 1240. Naturally, there arose much jealousy between the gilds and the aristocratic companies, which exclusively ruled the republic. After an attempt to upset the merchants had been suppressed in 1384, the gilds succeeded, under more favourable circumstances, in 1408. The old patrician council left the city to appeal to the Hansa and to the imperial authorities, while a new council with democratic tendencies, elected chiefly from the gilds, took their place. In 1416, however, owing to the pressure brought to bear by the Hansa, by the emperor Sigismund and by Eric, king of Denmark, there was a restoration. The aristocratic government was again expelled under the dictatorship of Jürgen Wullenweber (*c.* 1492–1537), till the old order was re-established in 1535. In the constitution of 1669, under the pressure of a large public debt, the great companies yielded a specified share in the financial administration to the leading gilds of tradesmen. Nevertheless, the seven great companies continued to choose the magistrates by co-optation among themselves. Three of the four burgomasters and two of the senators, however, had henceforth to be graduates in law. The constitution, set aside only during the French occupation, has subsequently been slowly reformed. From 1813 the popular representatives had some share in the management of the finances. But the reform committee of 1814, whose object was to obtain an extension of the franchise, had made little progress, when the events of 1848 led to the establishment of a representative assembly of 120 members, elected by universal suffrage, which obtained a place beside the senatorial government. The republic has given up its own military contingent, its coinage and its postal dues to the German Empire; but it has preserved its municipal self-government and its own territory, the inhabitants of which enjoy equal political privileges with the citizens.

The City of Lübeck.—Lübeck, the capital of the free state, was formerly the head of the Hanseatic League. It is situated on a gentle ridge between the rivers Trave and Wakenitz, 10 m. S.W. of the mouth of the former in the bay of Lübeck, 40 m. by rail N.E. of Hamburg, at the junction of lines to Eutin, Büchen, Travemünde and Strassburg (in Mecklenburg-Schwerin) and consists of an inner town and three suburbs. The former ramparts between the Trave and the old town ditch have been converted into promenades. The city proper retains much of its ancient grandeur, despite the tendency to modernize streets and private houses. Foremost among its buildings must be mentioned its five chief churches, stately Gothic edifices in glazed brick, with lofty spires and replete with medieval works of art—pictures, stained glass and tombs. Of them, the Marienkirche, built in the 13th century, is one of the finest specimens of early Gothic in Germany. The cathedral, or *Domkirche*, founded in 1173, contains some curious sarcophagi and a magnificent altar-piece in one of the chapels, while the churches of St James (*Jakobikirche*), of St Peter (*Petrikirche*) and of St Aegidius (*Aegidienkirche*) are also remarkable. The *Rathaus* (town hall) of red and black glazed brick, dating from various epochs during the middle ages, is famous for its staircase, the vaulted wine cellar of the city council beneath and magnificent wood carving. There should also be mentioned the *Schiffershaus*; the medieval gates (Holstentor, Burgtor); and the Hospital of the Holy Ghost, remarkable for ancient frescoes and altars in rich wood carving, the entrance hall of which is a 15th-century chapel, restored in 1866 and decorated in 1898. The museum preserves the most remarkable municipal archives in existence as well as valuable collections of historical documents.

The poet, Emanuel Geibel (1889), and the painter, Johann Friedrich Overbeck (1789–1869), were natives of Lübeck. This city is famous for the number and wealth of its charitable institutions. Its position as the first German emporium of the west end of the Baltic has been to some extent impaired by Hamburg and Bremen since the construction of the North Sea and Baltic Canal, and by the rapid growth and enterprise of Stettin. In order to counterbalance their rivalry, the quays have been extended, a canal was opened in 1900 between the Trave and the Elbe, the river up to the wharves has been deepened to 25 ft. or more. The river is kept open in winter by ice-breakers. A harbour was made in 1899–1900 on the Wakenitz Canal for boats engaged in inland traffic, especially on the Elbe and Elbe-Trave Canal. Lübeck trades principally with Denmark, Sweden, Finland, Russia, the eastern provinces of Prussia, Great Britain and the United States. The imports amounted in value to about £4,850,000 in 1906 and the exports to over £10,000,000. The chief articles of import are coal, grain, timber, copper, steel and wine, and the exports are manufactured goods principally to Russia and Scandivania. The industries are growing, the chief being breweries and distilleries, saw-mills and planing-mills, shipbuilding, fish-curing, the manufacture of machinery, engines, bricks, resin, preserves, enamelled and tin goods, cigars, furniture, soap and leather. Pop. (1885) 55,399; (1905) 91,541.

History.—Old Lübeck stood on the left bank of the Trave, where it is joined by the river Schwartau, and was destroyed in 1138. Five years later Count Adolphus II. of Holstein founded new Lübeck, a few miles farther up, on the peninsula Buku, where the Trave is joined on the right by the Wakenitz, the emissary of the lake of Ratzeburg. An excellent harbour, sheltered against pirates, it became almost at once a competitor for the commerce of the Baltic. Its foundation coincided with the beginning of the advance of the Low German tribes of Flanders, Friesland and Westphalia along the southern shores of the Baltic—the second great emigration of the colonizing Saxon element. In 1140 Wagria, in 1142 the country of the Polabes (Ratzeburg and Lauenburg), had been annexed by the Holtsaetas (the Transalbingian Saxons). From 1166 onwards there was a Saxon count at Schwerin. Frisian and Saxon merchants from Soest, Bardowiek and other localities in Lower Germany, who already navigated the Baltic and had their factory in Gotland, settled in the new town, where Wendish speech and customs never entered. About 1157 Henry the Lion, duke of Saxony, forced his vassal, the count of Holstein, to give up Lübeck to him; and in 1163 he removed thither the episcopal see of Oldenburg (Stargard), founding at the same time the dioceses of Ratzeburg and Schwerin. He issued the first charter to the citizens, and constituted them a free Saxon community having their own magistrate, an advantage over all other towns of his dominions. He invited traders of the north to visit his new market free of toll and custom, providing his subjects were promised similar privileges in return. From the beginning the king of Denmark granted them a settlement for their herring fishery on the coast of Schoonen. Adopting the statutes of Soest in Westphalia as their code, Saxon merchants exclusively ruled the city. In concurrence with the duke's *Vogt* (*advocatus*) they recognized only one right of judicature within the town, to which nobles as well as artisans had to submit. Under these circumstances the population grew rapidly in wealth and influence by land and sea, so that, when Henry was attainted by the emperor, Frederick I., who came in person to besiege Lübeck in 1181, this potentate," in consideration of its revenues and its situation on the frontier of the Empire," fixed by charter, dated the 19th of September 1188, the limits, and enlarged the liberties, of the free town. In the year 1201 Lübeck was conquered by Waldemar II. of Denmark. But in 1223 it regained its liberty, after the king had been taken captive by the count of Schwerin. In 1226 it was made a free city of the Empire by Frederick II., and its inhabitants took part with the enemies of the Danish king in the victory of Bornhövede in July 1227. The citizens repelled the encroachments of their neighbours in Holstein and in Mecklenburg. On the other hand their town, being the principal emporium of the Baltic by the middle of the 13th century, acted as the firm ally of the Teutonic knights in Livonia. Emigrants founded new cities and new sees of Low German speech among alien and pagan races; and thus in the course of a century the commerce of Lübeck had supplanted that of Westphalia. In connexion with the Germans at Visby, the capital of Gotland, and at Riga, where they had a house from 1231, the people of Lübeck with their armed vessels scoured the sea between the Trave and the Neva. They were encouraged by papal bulls in their contest for the rights of property in wrecks and for the protection of shipping against pirates and slave-hunters. Before the close of the century the statutes of Lübeck were adopted by most Baltic towns having a German population, and Visby protested in vain against the city on the Trave having become the court of appeal for nearly all these cities, and even for the German settlement in Russian Novgorod. In course of time more than a hundred places were embraced in this relation, the last vestiges of which did not disappear until the beginning of the 18th century. From about 1299 Lübeck presided over a league of cities, Wismar, Rostock, Stralsund, Greifswald and some smaller ones, and this Hansa of towns became heir to a Hansa of traders simultaneously on the eastern and the western sea, after Lübeck and her confederates had been admitted to the same privileges with Cologne, Dortmund and Soest at Bruges and in the steelyards of London, Lynn and Boston. The union held its own, chiefly along the maritime outskirts of the Empire, rather against the will of king and emperor, but nevertheless Rudolph of Habsburg and several of his successors issued new charters to Lübeck. As early as 1241 Lübeck, Hamburg and Soest had combined to secure their highways against robber knights. Treaties to enforce the public peace were concluded in 1291 and 1338 with the dukes of Brunswick, Mecklenburg and Pomerania, and the count of Holstein. Though the great federal armament against Waldemar IV., the destroyer of Visby, was decreed by the city representatives assembled at Cologne in 1367, Lübeck was the leading spirit in the war which ended with the surrender of Copenhagen and the peace concluded at Stralsund on the 24th of May 1370. Her burgomaster, Brun Warendorp, who commanded the combined naval and land forces, died on the field of battle. In 1368 the seal of the city, a double-headed eagle, which in the 14th century took the place of the more ancient ship, was adopted as the common seal of the confederated towns (*civitates maritimae*), some seventy in number. Towards the end of the 15th century the power of the Hanseatic League began to decline, owing to the rise of Burgundy in the west, of Poland and Russia in the east and the emancipation of the Scandinavian kingdom from the union of Calmar. Still Lübeck, even when nearly isolated, strove to preserve its predominance in a war with Denmark (1501–12), supporting Gustavus Vasa in Sweden, lording it over the north of Europe during the years 1534 and 1535 in the person of Jürgen Wullenweber, the democratic burgomaster, who professed the most advanced principles of the Reformation, and engaging with Sweden in a severe naval war (1536–70).

But the prestige and prosperity of the town were beginning to decline. Before the end of the 16th century the privileges of the London Steelyard were suppressed by Elizabeth. As early as 1425 the herring, a constant source of early wealth, began to forsake the Baltic waters. Later on, by the discovery of a new continent, commerce was diverted into new directions. Finally, with the Thirty Years' War, misfortunes came thick. The last Hanseatic diet met at Lübeck in 1630, shortly after Wallenstein's unsuccessful attack on Stralsund; and from that time merciless sovereign powers stopped free intercourse on all sides. Danes and Swedes battled for the possession of the Sound and for its heavy dues. The often changing masters of Holstein and Lauenburg abstracted much of the valuable landed property of the city and of the chapter of Lübeck. Towards the end of the 18th century there were signs of improvement. Though the Danes temporarily occupied the town in 1801, it preserved its freedom and gained some of the chapter lands when the imperial constitution of Germany was broken up by the act of February 1803, while trade and commerce prospered for a few years. But in November 1806, when Blücher, retiring from the catastrophe of Jena, had to capitulate in the vicinity of Lübeck, the town was sacked by the French. Napoleon annexed it to his empire in December 1810. But it rose against the French in March 1813, was re-occupied by them till the 5th of December, and was ultimately declared a free and Hanse town of the German Confederation by the act of Vienna of the 9th of June 1815. The Hanseatic League, however, having never been officially dissolved, Lübeck still enjoyed its traditional connexion with Bremen and Hamburg. In 1853 they sold their common property, the London Steelyard; until 1866 they enlisted by special contract their military contingents for the German Confederation, and down to 1879 they had their own court of appeal at Lübeck. Lübeck joined the North German Confederation in 1866, profiting by the retirement from Holstein and Lauenburg of the Danes, whose interference had prevented as long as possible a direct railway between Lübeck and Hamburg. On the 27th of June 1867 Lübeck concluded a military convention with Prussia, and on the 11th of August 1868 entered the German Customs Union (*Zollverein*), though reserving to itself certain privileges in respect of its considerable wine trade and commerce with the Baltic ports.

See E. Deecke, *Die Freie und Hansestadt Lübeck* (4th ed., Lübeck, 1881) and *Lübische Geschichten und Sagen* (Lübeck, 1891); M. Hoffmann, *Geschichte der Freien und Hansestadt Lübeck* (Lübeck, 1889–1892) and *Chronik von Lübeck* (Lübeck, 1908); *Die Freie und Hansestadt Lübeck*, published by *Die geographische Gesellschaft in Lübeck* (Lübeck, 1891); C. W. Pauli, *Lübecksche Zustände im Mittelalter* (Lübeck, 1846–1878); J. Geffcken, *Lübeck in der Mitte des 16ten Jahrhunderts* (Lübeck, 1905); P. Hasse, *Die Anfange Lübecks* (Lübeck, 1893); H. Bödeker, *Geschichte der Freien und Hansestadt Lübeck* (Lübeck, 1898); A. Holm, *Lübeck, die Freie und Hansestadt* (Bielefeld, 1900); G. Waitz, *Lübeck unter Jürgen Wullenweber* (Berlin, 1855–1856); Klug, *Geschichte Lübecks während der Vereinigung mit dem französischen Kaiserreich* (Lübeck, 1857); F. Frensdorff, *Die Stadt- und Gerichtsverfassung Lübecks im 12. und 13. Jahrhundert* (Lübeck, 1861); the *Urkundenbuch der Stadt Lübeck* (Lübeck, 1843–1904); the *Lübecker Chroniken* (Leipzig, 1884–1903); and the *Zeitschrift des Vereins für lübeckische Geschichte* (Lübeck, 1860 fol.).

(R. P.; P. A. A.)

LUBLIN, a government of Russian Poland, bounded N. by Siedlce, E. by Volhynia (the Bug forming the boundary), S. by Galicia, and W. by Radom (the Vistula separating the two). Area, 6499 sq. m. The surface is an undulating plain of Cretaceous deposits, 800 to 900 ft. in altitude, and reaching in one place 1050 ft. It is largely covered with forests of oak, beech and lime, intersected by ravines and thinly inhabited. A marshy lowland extends between the Vistula and the Wieprz. The government is drained by the Vistula and the Bug, and by their tributaries the Wieprz, San and Tanev. Parts of the government, being of black earth, are fertile, but other parts are sandy. Agriculture is in good condition. Many Germans settled in the government before immigration was stopped in 1887; in 1897 they numbered about 26,000. Rye, oats, wheat, barley and potatoes are the chief crops, rye and wheat being exported. Flax, hemp, buckwheat, peas, millet and beetroot are also cultivated. Horses are carefully bred. In 1897 the population was 1,165,122, of whom 604,886 were women. The Greek Orthodox (chiefly Little Russians in the south-east) amounted to 20·1% of the whole; Roman Catholics (*i.e.* Poles) to 62·8%; Jews to 14·2%; and Protestants to 2·8%. The urban population was 148,196 in 1897. The estimated population in 1906 was 1,362,500. Industrial establishments consist chiefly of distilleries, sugar-works, steam flour-mills, tanneries, saw-mills and factories of bent-wood furniture. Domestic industries are widely developed in the villages. River navigation employs a considerable portion of the population. The government is divided into ten districts, the chief towns of which, with their populations in 1897, are—Lublin, capital of the province (50,152); Biegoray (6286); Cholm (19,236); Hrubieszow (10,699); Yanów (7927); Krasnystaw or Kraznostav (8879); Lubartow (5249); Nóva-Alexandrya or Pulawy (3892); Samostye (12,400); and Tomaszów (6224).

LUBLIN, a town of Russian Poland, capital of the government of the same name, 109 m. by rail S.E. of Warsaw, on a small tributary of the Wieprz. Pop. (1873) 28,900; (1897) 50,152. It is the most important town of Poland after Warsaw and Lodz, being one of the chief centres of the manufacture of thread-yarn, linen and hempen goods and woollen stuffs; there is also trade in grain and cattle. It has an old citadel, several palaces of Polish nobles and many interesting churches, and is the headquarters of the XIV. army corps, and the see of a Roman Catholic bishop. The cathedral dates from the 16th century. Of the former fortifications nothing remains except the four gates, one dating from 1342.

Lublin was in existence in the 10th century, and has a church which is said to have been built in 986. During the time the Jagellon dynasty ruled over Lithuania and Poland it was the most important city between the Vistula and the Dnieper, having 40,000 inhabitants (70,000 according to other authorities) and all the trade with Podolia, Volhynia and Red Russia. Indeed, the present town is surrounded with ruins, which prove that it formerly covered a much larger area. But it was frequently destroyed by the Tatars (*e.g.* 1240) and Cossacks (*e.g.* 1477). In 1568–1569 it was the seat of the stormy convention at which the union between Poland and Lithuania was decided. In 1702 another convention was held in Lublin, in favour of Augustus II. and against Charles XII. of Sweden, who carried the town by assault and plundered it. In 1831 Lublin was taken by the Russians. The surrounding country is rich in reminiscences of the struggle of Poland for independence.

LUBRICANTS. Machines consist of parts which have relative motion and generally slide and rub against each other. Thus the axle of a cart or railway vehicle is pressed against a metallic bearing surface supporting the body of the vehicle, and the two opposed surfaces slide upon each other and are pressed together with great force. If the metallic surfaces be clean, the speed of rubbing high, and the force pressing the surfaces together considerable, then the latter will abrade each other, become hot and be rapidly destroyed. It is possible, however, to prevent the serious abrasion of such opposing surfaces, and largely to reduce the frictional resistance they oppose to relative motion by the use of *lubricants* (Lat. *lubricare*, *lubricus*, slippery). These substances are caused to insinuate themselves between the surfaces, and have the property of so separating them as to prevent serious abrasion. The solid and semi-solid lubricants seem to act as rollers between the surfaces, or form a film between them which itself suffers abrasion or friction. The liquid lubricants, however, maintain themselves as liquid films between the surfaces, upon which the bearing floats. The frictional resistance is then wholly in the fluid. Even when lubricants are used the friction, *i.e.* the resistance to motion offered by the opposing surfaces, is considerable. In the article Friction will be found a statement of how friction is measured and the manner in which it is expressed. The coefficient of friction is obtained by dividing the force required to cause the surfaces to slide over each other by the load pressing them together. For clean unlubricated surfaces this coefficient may be as great as 0·3, whilst for well-lubricated cylindrical bearings it may be as small as 0·0006. Engineers have, therefore, paid particular attention to the design of bearings with the object of reducing the friction, and thus making use of as much as possible of the power developed by prime movers. The importance of doing this will be seen when it is remembered that the energy wasted is proportional to the coefficient of friction, and that the durability of the parts depends upon the extent to which they are separated by the lubricant and thus prevented from injuring each other.

There is great diversity in the shapes of rubbing surfaces, the loads they have to carry vary widely, and the speed of rubbing ranges from less than one foot to thousands of feet per minute. There is also a large number of substances which act as lubricants, some being liquids and others soft solids. In many instruments or machines where the surfaces in contact which have to slide upon each other are only lightly pressed together, and are only occasionally given relative motion, the lubricant is only needed to prevent abrasion. Microscopes and mathematical instruments are of this kind. In such cases, the lubricant which keeps the surfaces from abrading each other is a mere contamination film, either derived from the air or put on when the surfaces are finished. When such lubricating films are depended upon, the friction surfaces should be as hard as possible and, if practicable, of dissimilar metals. In the absence of a contamination film, most metals, if rubbed when in contact, will immediately adhere to each other. A large number of experiments have been made to ascertain the coefficient of friction under these imperfect conditions of lubrication. Within wide limits of load, the friction is proportional to the pressure normal to the surfaces and is, therefore, approximately independent of the area of the surfaces in contact. Although the static coefficient is often less than the kinetic at very low speeds, within wide limits the latter coefficient decreases with increasing speed. These laws apply to all bearings the velocity of rubbing of which is very small, or which are lubricated with solid or semi-solid materials.

When the speed of rubbing is considerable and the contamination film is liable to be destroyed, resort is had to lubricants which possess the power of keeping the surfaces apart, and thereby reducing the friction. The constant application of such substances is necessary in the case of such parts of machine tools as slide rests, the surfaces of which only move relatively to each other at moderate speeds, but which have to carry heavy loads. In all ordinary cases, the coefficient of friction of flat surfaces, such as those of slide blocks or pivot bearings, is high, owing to the fact that the lubricant is not easily forced between the surfaces. In the case of cylindrical bearing surfaces, such as those of journals and spindles, owing to the fact that the radius of the bearing surface is greater than that of the journal or spindle, the lubricant, if a liquid, is easily drawn in and entirely separates the surfaces (see LUBRICATION). Fortunately, cylindrical bearings are by far the most common and important form of bearing, and they can be so lubricated that the friction coefficient is very low. The lubricant, owing to its viscosity, is forced between the surfaces and keeps them entirely apart. This property of viscosity is one of the most important possessed by liquid lubricants. Some lubricants, such as the oils used for the light spindles of textile machinery, are quite thin and limpid, whilst others, suitable for steam engine cylinders and very heavy bearings, are, at ordinary temperatures, as thick as treacle or honey. Generally speaking, the greater the viscosity of the lubricant the greater the load the bearing will carry, but with thick lubricants the frictional coefficient is correspondingly high. True lubricants differ from ordinary liquids of equal viscosity inasmuch as they possess the property of "oiliness." This is a property which enables them to maintain an unbroken film between surfaces when the loads are heavy. It is possessed most markedly by vegetables and animal oils and fats, and less markedly by mineral oils. In the case of mineral lubricating oils from the same source, the lower the specific gravity the greater the oiliness of the liquid, as a rule. Mixtures of mineral oil with animal or vegetable oil are largely used, one class of oil supplying those qualities in which the other is deficient. Thus the mineral oils, which are comparatively cheap and possess the important property of not becoming oxidized into gummy or sticky substances by the action of the air, which also are not liable to cause spontaneous ignition of cotton waste, &c., and can be manufactured of almost any desired viscosity, but which on the other hand are somewhat deficient in the property of oiliness, are mixed with animal or vegetable oils which possess the latter property in marked degree, but are liable to gum and become acid and to cause spontaneous ignition, besides being comparatively expensive and limited in quantity. Oils which become acid attack the bearings chemically, and those which oxidize may become so thick that they fail to run on to the bearings properly.

The following table shows that the permissible load on bearings varies greatly:—

Description of Bearing.	Load in lb per sq. in.
Hard steel bearings on which the load is intermittent, such as the crank pins of shearing machines	3000
Bronze crosshead neck journals	1200
Crank pins of large slow engines	800–900
Crank pins of marine engines	400–500
Main crank-shaft bearings, slow marine	600
Main crank-shaft bearings, fast marine	400
Railway coach journals	300–400
Fly-wheel shaft journals	150–200
Small engine crank pins	150–200
Small slide blocks, marine engines	100
Stationary engine slide block	25–125
Stationary engine slide block, usually	30–60
Propeller thrust bearings	50–70
Shafts in cast iron steps, high speed	15

Solid Lubricants.—Solid substances, such as graphite or plumbago, soapstone, &c., are used as lubricants when there is some objection to liquids or soft solids, but the surfaces between which they are placed should be of very hard materials. They are frequently mixed with oils or greases, the lubricating properties of which they improve.

Semi-solid Lubricants.—The contrast in lubricating properties between mineral and fatty oils exists also in the case of a pure mineral grease like vaseline and an animal fat such as tallow, the latter possessing in a far greater degree the property of greasiness. A large number of lubricating greases are made by incorporating or emulsifying animal and vegetable fats with soap and water; also by thickening mineral lubricating oils with soap. Large quantities of these greases are used with very good results for the lubrication of railway waggon axles, and some of them are excellent lubricants for the bearings of slow moving machinery. Care must be taken, however, that they do not contain excess of water and are not adulterated with such useless substances as china clay; also, that they melt as a whole, and that the oil does not run down and leave the soap. This is liable to occur with badly made greases, and hot bearings are the result. Except in special cases, greases should not be used for quick-running journals, shafts or spindles, on account of the high frictional resistance which they offer to motion. In the case of fats and greases whose melting points are not much above the temperature of surrounding objects it generally happens that the lubricating films are so warmed by friction that they actually melt and act as oils. These lubricants are generally forced into the bearings by a form of syringe fitted with a spring piston, or are squeezed between the faces by means of a screw-plug.

Liquid Lubricants.—Generally speaking, all bearings which it is necessary should run with as little friction as possible must be supplied with liquid lubricants. These may be of animal, vegetable or mineral origin. The mineral oils are mixtures of hydrocarbons of variable viscosity, flashing-point, density and oiliness. They are obtained by distillation from American, Russian and other petroleums. The fixed oils obtained from animal and vegetable substances are not volatile without decomposition, and are found ready made in the tissues of animals and plants. Animal oils are obtained from the adipose tissue by simple heat or by boiling with water. They are usually either colourless or yellow. The oils of plants occur usually in the seeds or fruit, and are obtained either by expression or by means of solvents such as ether or petroleum. They are of various shades of yellow and green, the green colour being due to the presence of chlorophyll. The fundamental difference between fixed oils and mineral oils exists in their behaviour towards oxygen. Mineral oils at ordinary temperatures are indifferent to oxygen, but all fixed oils combine with it and thicken or gum more or less, generating heat at the same time. Such oils are, therefore, dangerous if dropped upon silk, cotton or woollen waste or other combustible fibrous materials, which are thus rendered liable to spontaneous ignition.

Liquid lubricants are used for all high speed bearings. In some cases the rubbing surfaces work in a bath of the lubricant, which can then reach all the rubbing parts with certainty. Small engines for motor cars or road waggons are often lubricated in this way. In the case of individual bearings, such as those of railway vehicles, a pad of cotton, worsted and horse hair is kept saturated with the lubricant and pressed against the under side of the journal. The journal is thus kept constantly wetted with oil, and the film is forced beneath the brass as the axle rotates. In many cases, oil-ways and grooves are cut in the bearings, and the lubricant is allowed to run by gravity into them and thus finds its way between the opposing surfaces. To secure a steady feed various contrivances are adopted, the most common being a wick of cotton or worsted used as a siphon. In cases where it is important that little if any wear should take place, the lubricant is forced by means of a pump between the friction surfaces and a constant film of oil is thereby maintained between them.

For the spindles of small machines such as clocks, watches and other delicate mechanisms, which are only lubricated at long intervals and are often exposed to extremes of temperature, the lubricant must be a fluid oil as free as possible from tendency to gum or thicken by oxidation or to corrode metal, and must often have a low freezing-point. It must also possess a maximum of "oiliness." The lubricants mostly used for such purposes are obtained from porpoise or dolphin jaw oils, bean oil, hazel nut oil, neatsfoot oil, sperm oil or olive oil. These oils are exposed for some time to temperatures as low as the mechanism is required to work at, and the portion which remains fluid is separated and used. Free acid should be entirely eliminated by chemical refining. A little good mineral oil may with advantage be mixed with the fatty oil.

For all ordinary machinery, ranging from the light ring spindles of textile mills to the heavy shafts of large engines, mineral oils are almost universally employed, either alone or mixed with fatty oils, the general rule being to use pure mineral oils for bath, forced or circulating pump lubrication, and mixed oils for drop, siphon and other less perfect methods of lubrication. Pure mineral oils of relatively low viscosity are used for high speeds and low pressures, mixed oils of greater viscosity for low speeds and high pressures. In selecting oils for low speeds and great pressures, viscosity must be the first consideration, and next to that "oiliness." If an oil of sufficiently high viscosity be used, a mineral oil may give a result as good or better than a pure fixed oil; a mixed oil may give a better result than either. If a mineral oil of sufficient viscosity be not available, then a fixed oil or fat may be expected to give the best result.

In special cases, such as in the lubrication of textile machines, where the oil is liable to be splashed upon the fabric, the primary consideration is to use an oil which can be washed out without leaving a stain. Pure fixed oils, or mixtures composed largely of fixed oils, are used for such purposes.

In other special cases, such as marine engines working in hot places, mixtures are used of mineral oil with rape or other vegetable oil artificially thickened by blowing air through the heated oil, and known as "blown" oil or "soluble castor oil."

In the lubrication of the cylinders and valves of steam, gas and oil engines, the lubricant must possess as much viscosity as possible at the working temperature, must not evaporate appreciably and must not decompose and liberate fatty acids which would corrode the metal and choke the steam passages with metallic soaps; for gas and oil engines the lubricant must be as free as possible from tendency to decompose and deposit carbon when heated. For this reason steam cylinders and valves should be lubricated with pure mineral oils of the highest viscosity, mixed with no more fixed oil than is necessary to ensure efficient lubrication. Gas and oil engines also should be lubricated with pure mineral oils wherever possible.

For further information on the theory and practice of lubrication and on the testing of lubricants, see *Friction and Lost Work in Machinery and Mill Work*, by R. H. Thurston (1903); and *Lubrication and Lubricants*, by L. Archbutt and R. M. Deeley (1906).

(R. M. D.)

LUBRICATION. Our knowledge of the action of oils and other viscous fluids in diminishing friction and wear between solid surfaces from being purely empirical has become a connected theory, based on the known properties of matter, subjected to the definition of mathematical analysis and verified by experiment. The theory was published in 1886 (*Phil. Trans.*, 1886, 177, pp. 157-234); but it is the purpose of this article not so much to explain its application, as to give a brief account of the introduction of the misconceptions that so long prevailed, and of the manner in which their removal led to its general acceptance.

Friction, or resistance to tangential shifting of matter over matter, whatever the mode and arrangement, differs greatly according to the materials, but, like all material resistance, is essentially limited. The range of the limits in available materials has a primary place in determining mechanical possibilities, and from the earliest times they have demanded the closest attention on the part of all who have to do with structures or with machines, the former being concerned to find those materials and their arrangements which possess the highest limits, and the latter the materials in which the limits are least. Long before the reformation of science in the 15th and 16th centuries both these limits had formed the subject of such empirical research as disclosed numerous definite although disconnected circumstances under which they could be secured; and these, however far from the highest and lowest, satisfied the exigencies of practical mechanics at the time, thus initiating the method of extending knowledge which was to be subsequently recognized as the only basis of physical philosophy. In this purely empirical research the conclusion arrived at represented the results for the actual circumstance from which they were drawn, and thus afforded no place for theoretical discrepancies. However, in the attempts at generalization which followed the reformation of science, opportunity was afforded for such discrepancies in the mere enunciation of the circumstances in which the so-called laws of friction of motion are supposed to apply. The circumstances in which the great amount of empirical research was conducted as to the resistance between the clean, plane, smooth surfaces of rigid bodies moving over each other under pressure, invariably include the presence of air at atmospheric pressure around, and to some extent between, the surfaces; but this fact had received no notice in the enunciation of these laws, and this constitutes a theoretical departure from the conditions under which the experience had been obtained. Also, the theoretical division of the law of frictional resistance into two laws—one dealing with the limit of rest, and the other asserting that the friction of motion, which is invariably less in similar circumstances than that of rest, is independent of the velocity of sliding—involves the theoretical assumption that there is no asymptotic law of diminution of the resistance, since, starting from rest, the rate of sliding increases. The theoretical substitution of ideal rigid bodies with geometrically regular surfaces, sliding in contact under pressure at the common regular surface, for the aërated surfaces in the actual circumstances, and the theoretical substitution of the absolute independence of the resistance of the rate of sliding for the limited independence in the actual circumstances, prove the general acceptance of the conceptions—(1) that matter can slide over matter under pressure at a geometrically regular surface; (2) that, however much the resistance to sliding under any particular pressure (the co-efficient of friction) may depend on the physical properties of the materials, the sliding under pressure takes place at the geometrically regular surface of contact of the rigid bodies; and (3) as the consequence of (1) and (2), that whatever the effect of a lubricant, such as oil, might have, it could be a physical surface effect. Thus not only did these general theoretical conceptions, resulting from the theoretical laws of friction, fail to indicate that the lubricant may diminish the resistance by the mere mechanical separation of the surfaces, but they precluded the idea that such might be the case. The result was that all subsequent attempts to reduce the empirical facts, where a lubricant was used, to such general laws as might reveal the separate functions of the complex circumstances on which lubrication depends, completely failed. Thus until 1883 the science of lubrication had not advanced beyond the empirical stage.

This period of stagnation was terminated by an accidental phenomenon observed by Beauchamp Tower, while engaged on his research on the friction of the journals of railway carriages. His observation led him to a line of experiments which proved that in these experiments the general function of the lubricant was the mechanical separation of the metal surfaces by a layer of fluid of finite thickness, thus upsetting the preconceived ideas as expressed in the laws of the friction of motion. On the publication of Tower's reports (*Proc. Inst. M.E.*, November 1883), it was recognized by several physicists (*B.A. Report*, 1884, pp. 14, 625) that the evidence they contained afforded a basis for further study of the actions involved, indicating as it did the circumstances—namely, the properties of viscosity and cohesion possessed by fluids—account of which had not been taken in previous conclusions. It also became apparent that continuous or steady lubrication, such as that of Tower's experiments, is only secured when the solid surfaces separated by the lubricant are so shaped that the thickness at the ingoing side is greater than that at the outgoing side.

When the general equations of viscous fluids had been shown as the result of the labours of C. L. M. H. Navier,[1] A. L. Cauchy,[2] S. D. Poisson,[3] A. J. C. Barré de St Venant,[4] and in 1845 of Sir G. Gabriel Stokes,[5] to involve no other assumption than that the stresses, other than the pressure equal in all directions, are linear functions of the distortional rates of strain multiplied by a constant coefficient, it was found that the only solutions of which the equations admitted, when applied to fluids flowing between fixed boundaries, as water in a pipe, were singular solutions for steady or steady periodic motion, and that the conclusions they entailed, that the resistance would be proportional to the velocity, were for the most part directly at variance with the common experience that the resistances varied with the square of the velocity. This discrepancy was sometimes supposed to be the result of eddies in the fluid, but it was not till 1883 that it was discovered by experiments with colour bands that, in the case of geometrically similar boundaries, the existence or non-existence of such eddies depended upon a definite relation between the mean velocity (U) of the fluid, the distance between the boundaries, and the ratio of the coefficient of viscosity to the density (μ/ρ), expressed by $\mathrm{UD}\rho/\mu=\mathrm{K}$, where K is a physical constant independent of units, which has a value between 1900 and 2000, and for parallel boundaries D is four times the area of the channel divided by the perimeter of the section (*Phil. Trans.*, 1883, part iii. 935–982). K is thus a criterion at which the law of resistance to the mean flow changes suddenly (as U increases), from being proportional to the flow, to a law involving higher powers of the velocity at first, but as the rates increase approaching an asymptote in which the power is a little less that the square.

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[1] *Mém. de l'Acad.* (1826), 6, p. 389.

[2] *Mém. des sav. étrang.* I. 40.

[3] *Mém. de l'Acad.* (1831), 10, p. 345.

[4] *B.A. Report* (1846)

[5] *Cambridge Phil. Trans.* (1845 and 1857).

This sudden change in the law of resistance to the flow of fluid between solid boundaries, depending as it does on a complete change in the manner of the flow—from direct parallel flow to sinuous eddying motion—serves to determine analytically the circumstances as to the velocity and the thickness of the film under which any fluid having a particular coefficient of viscosity can act the part of a lubricant. For as long as the circumstances are such that $\mathrm{UD}\rho/\mu$ is less than K, the parallel flow is held stable by the viscosity, so that only one solution is possible—that in which the resistance is the product of μ multiplied by the rate of distortion, as $\mu\frac{du}{dy}$; in this case the fluid has lubricating properties. But when the circumstances are such that $\mathrm{UD}\rho/\mu$ is greater than K, other solutions become possible, and the parallel flow becomes unstable, breaks down into eddying motion, and the resistance varies as ρu^n, which approximates to $\rho u^{1\cdot78}$ as the velocity increases; in this state the fluid has no lubricating properties. Thus, within the limits of the criterion, the rate of displacement of the momentum of the fluid is insignificant as compared with the viscous resistance, and may be neglected; while outside this limit the direct effects of the eddying motion completely dominate the viscous resistance, which in its turn may be neglected. Thus K is a criterion which separates the flow of fluid between solid surfaces as definitely as the flow of fluid is separated from the relative motions in elastic solids, and it is by the knowledge of the limit on which this distinction depends that the theory of viscous flow can with assurance be applied to the circumstance of lubrication.

Until the existence of this physical constant was discovered, any theoretical conclusions as to whether in any particular circumstances the resistance of the lubricant would follow the law of viscous flow or that of eddying motion was impossible. Thus Tower, being unaware of the discovery of the criterion, which was published in the same year as his reports, was thrown off the scent in his endeavour to verify the evidence he had obtained as to the finite thickness of the film by varying the velocity. He remarks in his first report that, "according to the theory of fluid motion, the resistance would be as the square of the velocity, whereas in his results it did not increase according to this law." The rational theory of lubrication does not, however, depend solely on the viscosity within the interior of fluids, but also depends on the surface action between the fluid and the solid. In many respects the surface actions, as indicated by surface tension, are still obscure, and there has been a general tendency to assume that there may be discontinuity in the velocity at the common surface. But whatever these actions may be in other respects, there is abundant evidence that there is no appreciable discontinuity in the velocity at the surfaces as long as the fluid has finite thickness. Hence in the case of lubrication the velocities of the fluid at the surfaces of the solids are those of the solid. In as far as the presence of the lubricant is necessary, such properties as cause oil in spite of its surface tension to spread even against gravity over a bright metal surface, while mercury will concentrate into globules on the bright surface of iron, have an important place in securing lubrication where the action is intermittent, as in the escapement of a clock. If there is oil on the pallet, although the pressure of the tooth causes this to flow out laterally from between the surfaces, it goes back again by surface tension during the intervals; hence the importance of using fluids with low surface tension like oil, or special oils, when there is no other means of securing the presence of the lubricant.

The differential equations for the equilibrium of the lubricant are what the differential equations of viscous fluid in steady motion become when subject to the conditions necessary for lubrication as already defined—(1) the velocity is below the critical value; (2) at the surfaces the velocity of the fluid is that of the solid; (3) the thickness of the film is small compared with the lateral dimensions of the surfaces and the radii of curvature of the surfaces. By the first of these conditions all the terms having ρ as a factor may be neglected, and the equations thus become the equations of equilibrium of the fluid; as such, they are applicable to fluid whether incompressible or elastic, and however the pressure may affect the viscosity. But the analysis is greatly simplified by omitting all terms depending on compressibility and by taking μ constant; this may be done without loss of generality in a qualitative sense. With these limitations we have for the differential equation of the equilibrium of the lubricant:—

$$\left.\begin{aligned}&0=\frac{dp}{dx}-\mu\nabla^2u,\ \&\mathrm{c.},\ \&\mathrm{c.},\ 0=\frac{du}{dx}+\frac{dv}{dy}+\frac{dw}{dz}\\&0=p_{yx}-\mu\left(\frac{du}{dy}+\frac{dv}{dx}\right),\ \&\mathrm{c.},\ \&\mathrm{c.}\end{aligned}\right\}\qquad(1)$$

These are subject to the boundary conditions (2) and (3). Taking x as measured parallel to one of the surfaces in the direction of relative motion, y normal to the surface and z normal to the plane of xy by condition (3), we may without error disregard the effect of any curvature in the surfaces. Also v is small compared with u and w, and the variations of u and w in the directions x and z are small compared with their variation in the direction y. The equations (1) reduce to

$$\left.\begin{aligned}&0=\frac{dp}{dx}-\mu\frac{d^2u}{dy^2},\ 0=\frac{dp}{dy},\ 0=\frac{dp}{dz}-\mu\frac{d^2w}{dy^2},\ 0=\frac{du}{dx}+\frac{dv}{dy}+\frac{dw}{dz}\\&0=p_{yx}-\mu\frac{du}{dy},\ 0=p_{yz}-\mu\frac{dw}{dy},\ p_{zz}=0.\end{aligned}\right\}\qquad(2)$$

For the boundary conditions, putting $f(x, z)$ as limiting the lateral area of the lubricant, the conditions at the surfaces may be expressed thus:—

$$\left.\begin{aligned}&\text{when } y=0,\quad u=\mathrm{U}_0,\quad w=0,\quad v=0\\&\text{when } y=h,\quad u=\mathrm{U}_1,\quad w=0,\quad v_1=\mathrm{U}_1\frac{dh}{dx}+\mathrm{V}_1\\&\text{when } f(x,\ z)=0,\quad p=p_0\end{aligned}\right\}\qquad(3)$$

Then, integrating the equations (2) over y, and determining the constants by equations (3), we have, since by the second of equations (2) p is independent of y,

$$\left.\begin{aligned}&u=\frac{1}{2\mu}\frac{dp}{dx}(y-h)y+\mathrm{U}_0\frac{h-y}{h}+\mathrm{U}_1\frac{y}{h}\\&w=\frac{1}{2\mu}\frac{dp}{dz}(y-h)y\end{aligned}\right\}\qquad(4)$$

Then, differentiating equations (4) with respect to x and z respectively, and substituting in the 4th of equations (2), and integrating from $y=0$ to $y=h$, so that only the values of v at the surfaces may be required, we have for the differential equation of normal pressure at any point x, z, between the boundaries:—

$$\frac{d}{dx}\left(h^3\frac{dp}{dz}\right)+\frac{d}{dz}\left(h^3\frac{dp}{dz}\right)=6\mu\left\{(\mathrm{U}_0+\mathrm{U}_1)\frac{dh}{dx}+2\mathrm{V}_1\right\}\qquad(5)$$

Again differentiating equations (4), with respect to x and z respectively, and substituting in the 5th and 6th of equations (2), and putting f_x and f_z for the intensities of the tangential stresses at the lower and upper surfaces:—

$$\left.\begin{aligned}&f_x=\mu(\mathrm{U}_1-\mathrm{U}_0)\frac{1}{h}\mp\frac{h}{2}\frac{dp}{dx}\\&f_z=\mp\frac{h}{2}\frac{dp}{dx}\end{aligned}\right\}\qquad(6)$$

Equations (5) and (6) are the general equations for the stresses at the boundaries at x, z, when h is a continuous function of x and z, μ and ρ being constant.

For the integration of equations (6) to get the resultant stresses and moments on the solid boundaries, so as to obtain the conditions of their equilibrium, it is necessary to know how x and z at any point on the boundary enter into h, as well as the equation $f(x, z)=0$, which determines the limits of the lubricating film. If y, the normal to one of the surfaces, has not the same direction for all points of this surface, in other words, if the surface is not plane, x and z become curvilinear co-ordinates, at all points perpendicular to y. Since, for lubrication, one of the surfaces must be plane, cylindrical, or a surface of revolution, we may put $x=\mathrm{R}\theta$, $y=r-\mathrm{R}$, and z perpendicular to the plane of motion. Then, if the data are sufficient, the resultant stresses and moments between the surfaces are obtained by integrating the intensity of the stress and moments of intensity of stress over the surface.

This, however, is not the usual problem that arises. What is generally wanted is to find the thickness of the film where least (h_0) and its angular position with respect to direction of load, to resist a definite load with a particular surface velocity. If the surfaces are plane, the general solution involves only one arbitrary constant, the least thickness (h_0); since in any particular case the variation of h with x is necessarily fixed, as in this case lubrication affords no automatic adjustment of this slope. When both surfaces are curved in the plane of motion there are at least two arbitrary constants, h_0, and ϕ the angular position of h_0 with respect to direction of load; while if the surfaces are both curved in a plane perpendicular to the direction of motion as well as in the plane of motion, there are three arbitrary constants, h_0, ϕ_0, z_0. The only constraint necessary is to prevent rotation in the plane of motion of one of the surfaces, leaving this surface free to move in any direction and to adjust its position so as to be in equilibrium under the load.

The integrations necessary for the solutions of these problems are practicable—complete or approximate—and have been effected for circumstances which include the chief cases of practical lubrication, the results having been verified by reference to Tower's experiments. In this way the verified theory is available for guidance outside the limits of experience as well as for determining the limiting conditions. But it is necessary to take into account certain subsidiary theories. These limits depend on the coefficient of viscosity, which diminishes as the temperature increases. The total work in overcoming the resistance is spent in generating heat in the lubricant, the volume of which is very small. Were it not for the escape of heat by conduction through the lubricant and the metal, lubrication would be impossible. Hence a knowledge of the empirical law of the variation of the viscosity of the lubricant with temperature, the coefficients of conduction of heat in the lubricant and in the metal, and the application of the theory of the flow of heat in the particular circumstances, are necessary adjuncts to the theory of lubrication for determining the limits of lubrication. Nor is this all, for the shapes of the solid surfaces vary with the pressure, and more particularly with the temperature.

The theory of lubrication has been applied to the explanation of the slipperiness of ice (*Mem. Manchester Lit. and Phil. Soc.*, 1899).

(O. R.)

LUCAN [Marcus Annaeus Lucanus], (A.D. 39–65), Roman poet of the Silver Age, grandson of the rhetorician Seneca and nephew of the philosopher, was born at Corduba. His mother was Acilia; his father, Marcus Annaeus Mela, had amassed great wealth as imperial procurator for the provinces. From a memoir which is generally attributed to Suetonius we learn that Lucan was taken to Rome at the age of eight months and displayed remarkable precocity. One of his instructors was the Stoic philosopher, Cornutus, the friend and teacher of Persius. He was studying at Athens when Nero recalled him to Rome and made him quaestor. These friendly relations did not last long. Lucan is said to have defeated Nero in a public poetical contest; Nero forbade him to recite in public, and the poet's indignation made him an accomplice in the conspiracy of Piso. Upon the discovery of the plot he is said to have been tempted by the hope of pardon to denounce his own mother. Failing to obtain a reprieve, he caused his veins to be opened, and expired repeating a passage from one of his poems descriptive of the death of a wounded soldier. His father was involved in the proscription, his mother escaped, and his widow Polla Argentaria survived to receive the homage of Statius under Domitian. The birthday of Lucan was kept as a festival after his death, and a poem addressed to his widow upon one of these occasions and containing information on the poet's work and career is still extant (Statius's *Silvae*, ii. 7, entitled *Genethliacon Lucani*).

Besides his principal performance, Lucan's works included poems on the ransom of Hector, the nether world, the fate of Orpheus, a eulogy of Nero, the burning of Rome, and one in honour of his wife (all mentioned by Statius), letters, epigrams, an unfinished tragedy on the subject of Medea and numerous miscellaneous pieces. His minor works have perished except for a few fragments, but all that the author wrote of the *Pharsalia* has come down to us. It would probably have concluded with the battle of Philippi, but breaks off abruptly as Caesar is about to plunge into the harbour of Alexandria. The *Pharsalia* opens with a panegyric of Nero, sketches the causes of the war and the characters of Caesar and Pompey, the crossing of the Rubicon by Caesar, the flight of the tribunes to his camp, and the panic and confusion in Rome, which Pompey has abandoned. The second book describes the visit of Brutus to Cato, who is persuaded to join the side of the senate, and his marriage a second time to his former wife Marcia, Ahenobarbus's capitulation at Corfinium and the retirement of Pompey to Greece. In the third book Caesar, after settling affairs in Rome, crosses the Alps for Spain. Massilia is besieged and falls. The fourth book describes the victories of Caesar in Spain over Afranius and Petreius, and the defeat of Curio by Juba in Africa. In the fifth Caesar and Antony land in Greece, and Pompey's wife Cornelia is placed in security at Lesbos. The sixth book describes the repulses of Caesar round Dyrrhachium, the seventh the defeat of Pompey at Pharsalia, the eighth his flight and assassination in Egypt, the ninth the operations of Cato in Africa and his march through the desert, and the landing of Caesar in Egypt, the tenth the opening incidents of the Alexandrian war. The incompleteness of the work should not be left out of account in the estimate of its merits, for, with two capital exceptions, the faults of the *Pharsalia* are such as revision might have mitigated or rendered. No such pains, certainly, could have amended the deficiency of unity of action, or supplied the want of a legitimate protagonist. The *Pharsalia* is not true to history, but it cannot shake off its shackles, and is rather a metrical chronicle than a true epic. If it had been completed according to the author's design, Pompey, Cato and Brutus must have successively enacted the part of nominal hero, while the real hero is the arch-enemy of liberty and Lucan, Caesar. Yet these defects, though glaring, are not fatal or peculiar to Lucan. The false taste, the strained rhetoric, the ostentatious erudition, the tedious harangues and far-fetched or commonplace reflections so frequent in this singularly unequal poem, are faults much more irritating, but they are also faults capable of amendment, which the writer might not improbably have removed. Great allowance should also be made in the case of one who is emulating predecessors who have already carried art to its last perfection. Lucan's temper could never have brooked mere imitation; his versification, no less than his subject, is entirely his own; he avoids the appearance of outward resemblance to his great predecessor with a persistency which can only have resulted from deliberate purpose, but he is largely influenced by the declamatory school of his grandfather and uncle. Hence his partiality for finished antithesis, contrasting strongly with his generally breathless style and turbid diction. Quintilian sums up both aspects of his genius with pregnant brevity, "Ardens et concitatus et sententiis clarissimus," adding with equal justice, "Magis oratoribus quam poetis annumerandus." Lucan's oratory, however, frequently approaches the regions of poetry, *e.g.* the apotheosis of Pompey at the beginning of the ninth book, and the passage in the same book where Cato, in the truest spirit of the Stoic philosophy, refuses to consult the oracle of Jupiter Ammon. Though in many cases Lucan's rhetoric is frigid, hyperbolical, and out of keeping with the character of the speaker, yet his theme has a genuine hold upon him; in the age of Nero he celebrates the republic as a poet with the same energy with which in the age of Cicero he might have defended it as an orator.

But for him it might almost have been said that the Roman republic never inspired the Roman muse.

Lucan never speaks of himself, but his epic speaks for him. He must have been endowed with no common ambition, industry and self-reliance, an enthusiastic though narrow and aristocratic patriotism, and a faculty for appreciating magnanimity in others. But the only personal trait positively known to us is his conjugal affection, a characteristic of Seneca also.

Lucan, together with Statius, was preferred even to Virgil in the middle ages. So late as 1493 his commentator Sulpitius writes: "Magnus profecto est Maro, magnus Lucanus; adeoque prope par, ut quis sit major possis ambigere." Shelley and Southey, in the first transport of admiration, thought Lucan superior to Virgil; Pope, with more judgment, says that the fire which burns in Virgil with an equable glow breaks forth in Lucan with sudden, brief and interrupted flashes. Of late, notwithstanding the enthusiasm of isolated admirers, Lucan has been unduly neglected, but he has exercised an important influence upon one great department of modern literature by his effect upon Corneille, and through him upon the classical French drama.

AUTHORITIES.—The *Pharsalia* was much read in the middle ages, and consequently it is preserved in a large number of manuscripts, the relations of which have not yet been thoroughly made out. The most recent critical text is that of C. Hosius (2nd ed. 1906), and the latest complete commentaries are those of C. E. Haskins (1887, with a valuable introduction by W. E. Heitland) and C. M. Francken (1896). There are separate editions of book i. by P. Lejay (1894) and book vii. by J. P. Postgate (1896). Of earlier editions those of Oudendorp (which contains the continuation of the *Pharsalia* to the death of Caesar by Thomas May, 1728), Burmann (1740), Bentley (1816, posthumous) and Weber (1829) may be mentioned. There are English translations by C. Marlowe (book i. only, 1600), Sir F. Gorges (1614), Thomas May (1626), N. Rowe (1718) and Sir E. Ridley (2nd ed. 1905), the two last being the best.

(R. G.; J. P. P.)

LUCANIA, in ancient geography, a district of southern Italy, extending from the Tyrrhenian Sea to the Gulf of Tarentum. To the north it adjoined Campania, Samnium and Apulia, and to the south it was separated by a narrow isthmus from the district of Bruttii. It thus comprised almost all the modern province of the Basilicata, with the greater part of the province of Salerno and a portion of that of Cosenza. The precise limits were the river Silarus on the north-west, which separated it from Campania, and the Bradanus, which flows into the Gulf of Tarentum, on the north-east; while the two little rivers Laus and Crathis, flowing from the ridge of the Apennines to the sea on the west and east, marked the limits of the district on the side of the Bruttii.

Almost the whole is occupied by the Apennines, here an irregular group of lofty masses. The main ridge approaches the western sea, and is continued from the lofty knot of mountains on the frontiers of Samnium, nearly due south to within a few miles of the Gulf of Policastro, and thenceforward is separated from the sea by only a narrow interval till it enters the district of the Bruttii. Just within the frontier of Lucania rises Monte Pollino, 7325 ft., the highest peak in the southern Apennines. The mountains descend by a much more gradual slope to the coastal plain of the Gulf of Tarentum. Thus the rivers which flow to the Tyrrhenian Sea are of little importance compared with those that descend towards the Gulf of Tarentum. Of these the most important are—the Bradanus (Bradano), the Casuentus (Basiento), the Aciris (Agri), and the Siris (Sinno). The Crathis, which forms at its mouth the southern limit of the province, belongs almost wholly to the territory of the Bruttii, but it receives a tributary, the Sybaris (Coscile), from the mountains of Lucania. The only considerable stream on the western side is the Silarus (Sele), which constitutes the northern boundary, and has two important tributaries in the Calor (Calore) and the Tanager (Negro) which joins it from the south.

The district of Lucania was so called from the people bearing the name Lucani (Lucanians) by whom it was conquered about the middle of the 5th century B.C. Before that period it was included under the general name of Oenotria, which was applied by the Greeks to the southernmost portion of Italy. The mountainous interior was occupied by the tribes known as Oenotrians and Chones, while the coasts on both sides were occupied by powerful Greek colonies which doubtless exercised a protectorate over the interior (see MAGNA GRAECIA). The Lucanians were a southern branch of the Samnite or Sabelline race, who spoke the Osca Lingua (*q.v.*). We know from Strabo that they had a democratic constitution save in time of war, when a dictator was chosen from among the regular magistrates. A few Oscan inscriptions survive, mostly in Greek characters, from the 4th or 3rd century B.C., and some coins with Oscan legends of the 3rd century (see Conway, *Italic Dialects*, p. 11 sqq.; Mommsen, *C.I.L.* x. p. 21; Roehl, *Inscriptiones Graecae Antiquissimae*, 547). The Lucanians gradually conquered the whole country (with the exception of the Greek towns on the coast) from the borders of Samnium and Campania to the southern extremity of Italy. Subsequently the inhabitants of the peninsula, now known as Calabria, broke into insurrection, and under the name of Bruttians established their independence, after which the Lucanians became confined within the limits already described. After this we find them engaged in hostilities with the Tarentines, and with Alexander, king of Epirus, who was called in by that people to their assistance, 326 B.C. In 298 B.C. (Livy x. 11 seq.) they made alliance with Rome, and Roman influence was extended by the colonies of Venusia (291 B.C.), Paestum (273), and above all Tarentum (272). Subsequently they were sometimes in alliance, but more frequently engaged in hostilities, during the Samnite wars. On the landing of Pyrrhus in Italy (281 B.C.) they were among the first to declare in his favour, and found themselves exposed to the resentment of Rome when the departure of Pyrrhus left his allies at the mercy of the Romans. After several campaigns they were reduced to subjection (272 B.C.). Notwithstanding this they espoused the cause of Hannibal during the Second Punic War (216 B.C.), and their territory during several campaigns was ravaged by both armies. The country never recovered from these disasters, and under the Roman government fell into decay, to which the Social War, in which the Lucanians took part with the Samnites against Rome (90–88 B.C.) gave the finishing stroke. In the time of Strabo the Greek cities on the coast had fallen into insignificance, and owing to the decrease of population and cultivation the malaria began to obtain the upper hand. The few towns of the interior were of no importance. A large part of the province was given up to pasture, and the mountains were covered with forests, which abounded in wild boars, bears and wolves. There were some fifteen independent communities, but none of great importance.

For administrative purposes under the Roman empire, Lucania was always united with the district of the Bruttii. The two together constituted the third region of Augustus.

The towns on the east coast were—Metapontum, a few miles south of the Bradanus; Heraclea, at the mouth of the Aciris; and Siris, on the river of the same name. Close to its southern frontier stood Sybaris, which was destroyed in 510 B.C., but subsequently replaced by Thurii. On the west coast stood Posidonia, known under the Roman government as Paestum; below that came Elea or Velia, Pyxus, called by the Romans Buxentum, and Laus, near the frontier of the province towards Bruttium. Of the towns of the interior the most considerable was Potentia, still called Potenza. To the north, near the frontier of Apulia, was Bantia (Aceruntia belonged more properly to Apulia); while due south from Potentia was Grumentum, and still farther in that direction were Nerulum and Muranum. In the upland valley of the Tanagrus were Atina, Forum Popilii and Consilinum; Eburi (Eboli) and Volceii (Buccino), though to the north of the Silarus, were also included in Lucania. The Via Popillia traversed the district from N. to S., entering it at the N.W. extremity; the Via Herculia, coming southwards from the Via Appia and passing through Potentia and Grumentum, joined the Via Popillia near the S.W. edge of the district: while another nameless road followed the east coast and other roads of less importance ran W. from Potentia to the Via Popillia, N.E. to the Via Appia and E. from Grumentum to the coast at Heraclea. (T. As.)

LUCARIS, CYRILLOS (1572–1637), Greek prelate and theologian, was a native of Crete. In youth he travelled, studying at Venice and Padua, and at Geneva coming under the influence of the reformed faith as represented by Calvin. In 1602 he was elected patriarch of Alexandria, and in 1621 patriarch of Constantinople. He was the first great name in the Orthodox Eastern Church since 1453, and dominates its history in the 17th century. The great aim of his life was to reform the church on Calvinistic lines, and to this end he sent many young Greek theologians to the universities of Switzerland, Holland and England. In 1629 he published his famous *Confessio*, Calvinistic in doctrine, but as far as possible accommodated to the language and creeds of the Orthodox Church. It appeared the same year in two Latin editions, four French, one German and one English, and in the Eastern Church started a controversy which culminated in 1691 in the convocation by Dositheos, patriarch of Jerusalem, of a synod by which the Calvinistic doctrines were condemned. Lucaris was several times temporarily deposed and banished at the instigation of his orthodox opponents and of the Jesuits, who were his bitterest enemies. Finally, when Sultan Murad was about to set out for the Persian War, the patriarch was accused of a design to stir up the Cossacks, and to avoid trouble during his absence the sultan had him killed by the Janissaries (June 1637). His body was thrown into the sea, recovered and buried at a distance from the capital by his friends, and only brought back to Constantinople after many years.

The orthodoxy of Lucaris himself continued to be a matter of debate in the Eastern Church, even Dositheos, in view of the reputation of the great patriarch, thinking it expedient to gloss over his heterodoxy in the interests of the Church.

See the article "Lukaris" by Ph. Meyer in Herzog-Hauck, *Realencyklop.* (3rd ed., Leipzig, 1902), which gives further authorities.

LUCARNE, a French architectural term for a garret window, also for the lights or small windows in spires.

LUCAS, SIR CHARLES (d. 1648), English soldier, was the son of Sir Thomas Lucas of Colchester, Essex. As a young man he saw service in the Netherlands under the command of his brother, and in the "Bishops' War" he commanded a troop of horse in King Charles I.'s army. In 1639 he was made a knight. At the outbreak of the Civil War Lucas naturally took the king's side, and at the first cavalry fight, Powick Bridge, he was wounded. Early in 1643 he raised a regiment of horse, with which he defeated Middleton at Padbury on July 1st. In January 1644 he commanded the forces attacking Nottingham, and soon afterwards, on Prince Rupert's recommendation, he was made lieutenant-general of Newcastle's Northern army. When Newcastle was shut up in York, Lucas and the cavalry remained in the open country, and when Rupert's relieving army crossed the mountains into Yorkshire he was quickly joined by Newcastle's squadrons. At Marston Moor Lucas swept Fairfax's Yorkshire horse before him, but later in the day he was taken prisoner. Exchanged during the winter, he defended Berkeley Castle for a short time against Rainsborough, but was soon in the field again. As lieutenant-general of all the horse he accompanied Lord Astley in the last campaign of the first war, and, taken prisoner at Stow-on-the-Wold, he engaged not to bear arms against parliament in the future. This parole he must be held to have broken when he took a prominent part in the seizure of Colchester in 1648. That place was soon invested, and finally fell, after a desperate resistance, to Fairfax's army. The superior officers had to surrender "at mercy," and Lucas and Sir George Lisle were immediately tried by court martial and sentenced to death. The two Royalists were shot the same evening in the Castle of Colchester.

See Lloyd, *Memoirs of Excellent Personages* (1669); and Earl de Grey, *A Memoir of the Life of Sir Charles Lucas* (1845).

LUCAS, CHARLES (1713–1771), Irish physician and politician, was the son of a country gentleman of small means in Co. Clare. Charles opened a small business as an apothecary in Dublin, and between 1735 and 1741 he began his career as a pamphleteer by publishing papers on professional matters which led to legislation requiring inspection of drugs. Having been elected a member of the common council of Dublin in 1741 he detected and exposed encroachments by the aldermen on the electoral rights of the citizens, and entered upon a controversy on the subject, but failed in legal proceedings against the aldermen in 1744. With a view to becoming a parliamentary candidate for the city of Dublin he issued in 1748–1749 a series of political addresses in which he advocated the principles of Molyneux and Swift; and he made himself so obnoxious to the government that the House of Commons voted him an enemy to the country, and issued a proclamation for his arrest, thus compelling him to retire for some years to the continent. Having studied medicine at Paris, Lucas took the degree of M.D. at Leiden in 1752. In the following year he started practice as a physician in London, and in 1756 he published a work on medicinal waters, the properties of which he had studied on the continent and at Bath. The essay was reviewed by Dr Johnson, and although it was resented by the medical profession it gained a reputation and a considerable practice for its author. In 1760 he renewed his political pamphleteering; and having obtained a pardon from George III., he proceeded to Dublin, where he received a popular welcome and a Doctor's degree from Trinity College. He was elected member for the city of Dublin in 1761, his colleague in the representation being the recorder, Henry Grattan's father. On the appointment of Lord Halifax as lord lieutenant in the same year Lucas wrote him a long letter (19th of Sept. 1761, MSS. Irish State Paper Office) setting forth the grievances which Ireland had suffered in the past, chiefly on account of the exorbitant pensions enjoyed by government officials. The cause of these evils he declared to be the unrepresentative character of the Irish constitution; and among the remedies he proposed was the shortening of parliaments. Lucas brought in a bill in his first session to effect this reform, but was defeated on the motion to have the bill sent to England for approval by the privy council; and he insisted upon the independent rights of the Irish parliament, which were afterwards in fuller measure successfully vindicated by Grattan. He also defended the privileges of the Irish Protestants in the press, and especially in the *Freeman's Journal*, founded in 1763. His contributions to the press, and his *Addresses to the Lord Mayor* and other political pamphlets made him one of the most popular writers in Ireland of his time, although he was anti-catholic in his prejudices, and although, as Lecky observes, "there is nothing in his remains to show that he possessed any real superiority either of intellect or knowledge, or even any remarkable brilliancy of expression." He died on the 4th of November 1771, and was accorded a public funeral. As an orator Charles Lucas appears to have had little power, and he made no mark in the House of Commons.

See R. R. Madden, *Hist. of Irish Periodical Literature from the End of the 17th to the Middle of the 19th Century* (2 vols., London, 1867); Francis Hardy, *Memoirs of the Earl of Charlemont* (2 vols., London, 1812); W. E. H. Lecky, *History of Ireland in the Eighteenth Century*, vols. i. and ii. (5 vols., London, 1892).

LUCAS, JOHN SEYMOUR (1849–   ), English painter, was born in London, and was a student in the Royal Academy Schools. He was elected an associate of the academy in 1886 and academician in 1898, and became a constant exhibitor of pictures of historical and domestic incidents, notably of the Tudor and Stuart periods, painted with much skill and with close attention to detail. One of his most important works is a panel in the Royal Exchange, presented by the corporation of London, representing William the Conqueror granting the first charter to the city; and one of his earlier pictures, "After Culloden: Rebel Hunting," is in the National Gallery of British Art.

LUCAS VAN LEYDEN (*c.* 1494–1533), Dutch painter, was born at Leiden, where his father Huig Jacobsz gave him the first lessons in art. He then entered the painting-room of Cornelis Engelbrechtszen of Leiden, and soon became known for his capacity in making designs for glass, engraving copper-plates, painting pictures, portraits and landscapes in oil and distemper. According to van Mander he was born in 1494, and painted at the age of twelve a "Legend of St Hubert" for which he was paid a dozen florins. He was only fourteen when he finished a plate representing Mahomet taking the life of Sergius, the monk, and at fifteen he produced a series of nine plates for a "Passion," a "Temptation of St Anthony," and a "Conversion of St Paul." The list of his engravings in 1510, when, according to van Mander, he was only sixteen, includes subjects as various as a celebrated "Ecce Homo," "Adam and Eve expelled from Paradise," a herdsman and a milkmaid with three cows, and a little naked girl running away from a barking dog. Whatever may be thought of the tradition embodied in van Mander's pages as to the true age of Lucas van Leyden, there is no doubt that, as early as 1508, he was a master of repute as a copper-plate engraver. It was the time when art found patrons among the public that could ill afford to buy pictures, yet had enough interest in culture to satisfy itself by means of prints. Lucas van Leyden became the representative man for the public of Holland as Dürer for that of Germany; and a rivalry grew up between the two engravers, which came to be so close that on the neutral market of Italy the products of each were all but evenly quoted. Vasari affirmed that Dürer surpassed Lucas as a designer, but that in the use of the graver they were both unsurpassed, a judgment which has not been reversed. But the rivalry was friendly. About the time when Dürer visited the Netherlands Lucas went to Antwerp, which then flourished as an international mart for productions of the pencil and the graver, and it is thought that he was the master who took the freedom of the Antwerp gild in 1521 under the name of Lucas the Hollander. In Dürer's diary kept during his travels in the Low Countries, we find that at Antwerp he met Lucas, who asked him to dinner, and that Dürer accepted. He valued the art of Lucas at its true figure, and exchanged the Dutchman's prints for eight florins' worth of his own. In 1527 Lucas made a tour of the Netherlands, giving dinners to the painters of the gilds of Middleburg, Ghent, Malines and Antwerp. He was accompanied during the trip by Mabuse, whom he imitated in his style as well as in his love of rich costume. On his return home he fell sick and remained ailing till his death in 1533, and he believed that poison had been administered to him by some envious comrade.

A few days before his death Lucas van Leyden was informed of the birth of a grandson, first-born of his only daughter Gretchen. Gretchen's fourth son **Jean de Hoey** followed the profession of his grandfather, and became well known at the Parisian court as painter and chamberlain to the king of France, Henry IV.

As an engraver Lucas van Leyden deserves his reputation. He has not the genius, nor had he the artistic tact, of Dürer; and he displays more cleverness of expression than skill in distribution or in refinement in details. But his power in handling the graver is great, and some of his portraits, especially his own, are equal to anything by the master of Nuremberg. Much that he accomplished as a painter has been lost, because he worked a good deal upon cloth in distemper. In 1522 he painted the "Virgin and Child with the Magdalen and a Kneeling Donor," now in the gallery of Munich. His manner was then akin to that of Mabuse. The "Last Judgment" in the town-gallery of Leiden is composed on the traditional lines of Cristus and Memling, with monsters in the style of Jerom Bosch and figures in the stilted attitudes of the South German school; the scale of colours in yellow, white and grey is at once pale and gaudy, the quaintest contrasts are produced by the juxtaposition of alabaster flesh in females and bronzed skin in males, or black hair by the side of yellow, or rose-coloured drapery set sharply against apple-green or black; yet some of the heads are painted with great delicacy and modelled with exquisite feeling. Dr Waagen gave a favourable opinion of a triptych now at the Hermitage at St Petersburg, executed, according to van Mander, in 1531, representing the "Blind Man of Jericho healed by Jesus Christ." Here too the German critic observed the union of faulty composition with great finish and warm flesh-tints with a gaudy scale of colours. The same defects and qualities will be found in such specimens as are preserved in public collections, among which may be mentioned the "Card Party" at Wilton House, the "Penitent St Jerome" in the gallery of Berlin, and the hermits "Paul" and "Anthony" in the Liechtenstein collection at Vienna. There is a characteristic "Adoration of the Magi" at Buckingham Palace.

LUCCA (anc. *Luca*), a town and archiepiscopal see of Tuscany, Italy, capital of the province of Lucca, 13 m. by rail N.E. of Pisa. Pop. (1901) 43,566 (town); 73,465 (commune). It is situated 62 ft. above the level of the sea, in the valley of the Serchio, and looks out for the most part on a horizon of hills and mountains. The fortifications, pierced by four gates, were begun in 1504 and completed in 1645, and long ranked among the most remarkable in the peninsula. They are still well-preserved and picturesque, with projecting bastions planted with trees.

The city has a well-built and substantial appearance, its chief attraction lying in the numerous churches, which belong in the main to a well-marked basilican type, and present almost too richly decorated exteriors, fine apsidal ends and quadrangular campaniles, in some cases with battlemented summits, and windows increasing in number as they ascend. In style they are an imitation of the Pisan. It is remarkable that in the arcades a pillar generally occupies the middle of the façade. The cathedral of St Martin was begun in 1063 by Bishop Anselm (later Pope Alexander II.); but the great apse with its tall columnar arcades and the fine campanile are probably the only remnants of the early edifice, the nave and transepts having been rebuilt in the Gothic style in the 14th century, while the west front was begun in 1204 by Guidetto (lately identified with Guido Bigarelli of Como), and "consists of a vast portico of three magnificent arches, and above them three ranges of open galleries covered with all the devices of an exuberant fancy." The ground plan is a Latin cross, the nave being 273 ft. in length and 84 ft. in width, and the transepts 144 ft. in length. In the nave is a little octagonal temple or chapel, which serves as a shrine for the most precious of the relics of Lucca, a cedar-wood crucifix, carved, according to the legend, by Nicodemus, and miraculously conveyed to Lucca in 782. The Sacred Countenance (*Volto Santo*), as it is generally called, because the face of the Saviour is considered a true likeness, is only shown thrice a year. The chapel was built in 1484 by Matteo Civitali, a local sculptor of the early Renaissance (1436–1501); he was the only master of Tuscany outside Florence who worked thoroughly in the Florentine style, and his creations are among the most charming works of the Renaissance. The cathedral contains several other works by him—the tomb of P. da Noceto, the altar of S. Regulus and the tomb of Ilaria del Carretto by Jacopo della Quercia of Siena (described by Ruskin in *Modern Painters*, ii.), the earliest of his extant works (1406), and one of the earliest decorative works of the Renaissance. In one of the chapels is a fine Madonna by Fra Bartolommeo; in the municipal picture gallery are a fine "God the Father" and another Madonna by him; also some sculptures by Civitali, and some good wood carving, including choir stalls. In the cathedral choir is good stained glass of 1485. The church of St Michael, founded in the 8th century, and built of marble within and without, has a lofty and magnificent western façade (1188)—an architectural screen rising much above the roof of the church. The interior is good but rather bare. The church of St Martino at Arliano near Lucca belongs to the first half of the 8th century; it is of basilican plan (see G. T. Rivoira, *Origini dell' Architettura Lombarda*, iii. [Rome, 1901] 138). St Frediano or Frigidian dates originally from the 7th century, but was built in the Romanesque style in 1112–1147, though the interior, originally with four aisles and nave, shows traces of the earliest structure; the front occupies the site of the ancient apse; in one of its chapels is the tomb of Santa Zita, patroness of servants and of Lucca itself. In S. Francesco, a fine Gothic church, is the tomb of Castruccio Castracane. San Giovanni (originally of the 12th century), S. Cristoforo, San Romano (rebuilt in the 17th century, by Vincenzo Buonamici), and Santa Maria Forisportam (of the 12th century) also deserve mention.

Among the secular buildings are the old ducal palace, begun in 1578 by Ammanati, and now the residence of the prefect and seat of the provincial officers and the public picture gallery; the early Renaissance Palazzo Pretorio, or former residence of the podestà, now the seat of the civil and correctional courts; the palace, erected in the 15th century by a member of the Guinigi family, of brick, in the Italian Gothic style, and now serving as a poor-house; the 16th-century palace of the marquis Guidiccioni, now used as a depository for the archives, the earliest documents going back to A.D. 790. The Palazzo Mansi contains a collection of Dutch pictures. There are several other fine late 16th-century palaces. The principal market-place in the city (*Piazza del Mercato*) has taken possession of the arena of the ancient amphitheatre, the outer arches of which can still be seen in the surrounding buildings. The whole building, belonging probably to the early Empire, measured 135 by 105 yds., and the arena 87½ by 58 yds. The outline of the ancient theatre can be traced in the Piazza delle Grazie, and some of its substructure walls are preserved. The ancient forum was on the site of the Piazza S. Michele in the centre of the town; remains of a small public building or shrine were found not far off in 1906 (L. Pernier in *Notizie degli Scavi*, 1906, p. 117). The rectangular disposition of the streets in the centre of the town is a survival of Roman times. Besides the academy of sciences, which dates from 1584, there are several institutions of the same kind—a royal philomathic academy, a royal academy of arts and a public library of 50,000 volumes. The archiepiscopal library and archives are also important, while the treasury contains some fine goldsmith's work, including the 14th-century Croce dei Pisani, made by the Pisans for the cathedral.

The river Serchio affords water-power for numerous factories. The most important industries are the manufacture of jute goods (carried on at Ponte a Moriano in the Serchio valley, 6 m. N. of Lucca), tobacco, silks and cottons. The silk manufacture, introduced at Lucca about the close of the 11th century, and in the early part of the 16th the means of subsistence for 30,000 of its inhabitants, now gives employment (in reeling and throwing) to only about 1500. The bulk of the population is engaged in agriculture. The water supply is maintained by an aqueduct built in 1823–1832 with 459 arches, from the Pisan mountains.

The ancient Luca, commanding the valley of the Serchio, is first mentioned as the place to which Sempronius retired in 218 B.C. before Hannibal; but there is some doubt as to the correctness of Livy's statement, for, though there were continual wars with the Ligurians, after this time, it is not mentioned again until we are told that in 177 B.C. a Latin colony was founded there in territory offered by the Pisans for the purpose.[1] It must have become a municipium by the *lex Julia* of 90 B.C., and it was here that Julius Caesar in 56 B.C. held his famous conference with Pompey and Crassus, Luca then being still in Liguria, not in Etruria. A little later a colony was conducted hither by the triumvirs or by Octavian; whether after Philippi or after Actium is uncertain. In the Augustan division of Italy Luca was assigned to the 7th region (Etruria); it is little mentioned in the imperial period except as a meeting-point of roads—to Florentia (see CLODIA, VIA), Luna and Pisae. The road to Parma given in the itineraries, according to some authorities, led by Luna and the Cisa pass (the route taken by the modern railway from Sarzana to Parma), according to others up the Serchio valley and over the Sassalbo pass (O. Cuntz in *Jahreshefte des oesterr. arch. Instituts*, 1904, 53). Though plundered and deprived of part of its territory by Odoacer, Luca appears as an important city and fortress at the time of Narses, who besieged it for three months in A.D. 553, and under the Lombards it was the residence of a duke or marquis and had the privilege of a mint. The dukes gradually extended their power over all Tuscany, but after the death of the famous Matilda the city began to constitute itself an independent community, and in 1160 it obtained from Welf VI., duke of Bavaria and marquis of Tuscany, the lordship of all the country for 5 m. round, on payment of an annual tribute. Internal discord afforded an opportunity to Uguccione della Faggiuola, with whom Dante spent some time there, to make himself master of Lucca in 1314, but the Lucchesi expelled him two years afterwards, and handed over their city to Castruccio Castracane, under whose masterly tyranny it became "for a moment the leading state of Italy," until his death in 1328 (his tomb is in S. Francesco). Occupied by the troops of Louis of Bavaria, sold to a rich Genoese Gherardino Spinola, seized by John, king of Bohemia, pawned to the Rossi of Parma, by them ceded to Martino della Scala of Verona, sold to the Florentines, surrendered to the Pisans, nominally liberated by the emperor Charles IV. and governed by his vicar, Lucca managed, at first as a democracy, and after 1628 as an oligarchy, to maintain "its independence alongside of Venice and Genoa, and painted the word Libertas on its banner till the French Revolution." In the beginning of the 16th century one of its leading citizens, Francesco Burlamacchi, made a noble attempt to give political cohesion to Italy, but perished on the scaffold (1548); his statue by Ulisse Cambi was erected on the Piazza San Michele in 1863. As a principality formed in 1805 by Napoleon in favour of his sister Elisa and her husband Bacchiocchi, Lucca was for a few years wonderfully prosperous. It was occupied by the Neapolitans in 1814; from 1816 to 1847 it was governed as a duchy by Maria Luisa, queen of Etruria, and her son Charles Louis; and it afterwards formed one of the divisions of Tuscany.

The bishops of Lucca, who can be traced back to 347, received exceptional marks of distinction, such as the pallium in 1120, and the archiepiscopal cross from Alexander II. In 1726 Benedict XIII. raised their see to the rank of an archbishopric, without suffragans.

See A. Mazzarosa, *Storia di Lucca* (Lucca, 1833); E. Ridolfi, *L'Arte in Lucca studiata nella sua Cattedrale* (1882); *Guidi di Lucca; La Basilica di S. Michele in Foro in Lucca.* (T. As.)

LUCCA, BAGNI DI (Baths of Lucca, formerly *Bagno a Corsena*), a commune of Tuscany, Italy, in the province of Lucca, containing a number of famous watering-places. Pop. (1901) 13,685. The springs are situated in the valley of the Lima, a tributary of the Serchio; and the district is known in the early history of Lucca as the Vicaria di Val di Lima. Ponte Serraglio (16 m. N. of Lucca by rail) is the principal village (pop. 1312), but there are warm springs and baths also at Villa, Docce Bassi, Bagno Caldo, &c. The springs do not seem to have been known to the Romans. Bagno a Corsena is first mentioned in 1284 by Guidone de Corvaia, a Pisan historian (Muratori, *R.I.S.* vol. xxii.). Fallopius, who gave them credit for the cure of his own deafness, sounded their praises in 1569; and they have been more or less in fashion since. The temperature of the water varies from 98° to 130° Fahr.; in all cases it gives off carbonic acid gas and contains lime, magnesium and sodium products. In the village of Bagno Caldo there is a hospital constructed largely at the expense of Nicholas Demidoff in 1826. In the valley of the Serchio, 3 m. below Ponte a Serraglio, is the medieval Ponte del Diavolo (1322) with its lofty central arch.

LUCCEIUS, LUCIUS, Roman orator and historian, friend and correspondent of Cicero. A man of considerable wealth and literary tastes, he may be compared with Atticus. Disgusted at his failure to become consul in 60, he retired from public life, and devoted himself to writing a history of the Social and Civil Wars. This was nearly completed, when Cicero earnestly requested him to write a separate history of his (Cicero's) consulship. Cicero had already sung his own praises in both Greek and Latin, but thought that a panegyric by Lucceius, who had taken considerable interest in the affairs of that critical period, would have greater weight. Cicero offered to supply the material, and hinted that Lucceius need not sacrifice laudation to accuracy. Lucceius almost promised, but did not perform. Nothing remains of any such work or of his history. In the civil war he took the side of Pompey; but, having been pardoned by Caesar, returned to Rome, where he lived in retirement until his death.

Cicero's *Letters* (ed. Tyrrell and Purser), especially *Ad Fam.* v. 12; and Orelli, *Onomasticon Tullianum.*

LUCCHESINI, GIROLAMO (1751–1825), Prussian diplomatist, was born at Lucca on the 7th of May 1751, the eldest son of Marquis Lucchesini. In 1779 he went to Berlin where Frederick the Great gave him a court appointment, making use of him in his literary relations with Italy. Frederick William II., who recognized his gifts for diplomacy, sent him in 1787 to Rome to obtain the papal sanction for the appointment of a coadjutor to the bishop of Mainz, with a view to strengthening the German Fürstenbund. In 1788 he was sent to Warsaw, and brought about a rapprochement with Prussia and a diminution of Russian influence at Warsaw. He was accredited ambassador to the king and republic of Poland on the 12th of April 1789.

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[1] Some confusion has arisen owing to the similarity of the names Luca and Luna; the theory of E. Bormann in *Corp. Inscrip. Latin.* (Berlin, 1888), xi. 295 is here followed.

Frederick William was at that time intriguing with Turkey, then at war with Austria and Russia. Lucchesini was to rouse Polish feeling against Russia, and to secure for Prussia the concourse of Poland in the event of war with Austria and Russia. All his power of intrigue was needed in the conduct of these hazardous negotiations, rendered more difficult by the fact that Prussian policy excluded the existence of a strong Polish government. A Prusso-Polish alliance was concluded in March 1790. Lucchesini had been sent in January of that year to secure the alliance of Saxony against Austria, and in September he was sent to Sistova, where representatives of the chief European powers were engaged in settling the terms of peace between Austria and Turkey, which were finally agreed upon on the 4th of August 1791. Before he returned to Warsaw the Polish treaty of which he had been the chief author had become a dead letter owing to the engagements made between Prussia and Austria at Reichenbach in July 1790, and Prussia was already contemplating the second partition of Poland. He was recalled at the end of 1791, and in July 1792 he joined Frederick William in the invasion of France. He was to be Prussian ambassador in Paris when the allied forces should have reinstated the authority of Louis XVI. He was opposed alike to the invasion of France and the Austrian alliance, but his prepossessions did not interfere with his skilful conduct of the negotiations with Kellermann after the allies had been forced to retire by Dumouriez's guns at Valmy, nor with his success in securing the landgrave of Hesse-Darmstadt's assistance against France. In 1793 he was appointed ambassador to Vienna, with the ostensible object of securing financial assistance for the Rhenish campaign. He accompanied Frederick William through the Polish campaign of 1793–94, and in the autumn returned to Vienna. His anti-Austrian bias made him extremely unpopular with the Austrian court, which asked in vain for his recall in 1795. In 1797, after a visit to Italy in which he had an interview with Napoleon at Bologna, these demands were renewed and acceded to. In 1800 he was sent by Frederick William III. on a special mission to Paris. Despatches in which he expressed his distrust of Bonaparte's peaceful professions and his conviction of the danger of the continuance of a neutral policy were intercepted by the first consul, who sought his recall, but eventually accepted him as regular ambassador (1802). He consistently sought friendly relations between France and Prussia, but he warned his government in 1806 of Napoleon's intention of restoring Hanover to George III. and of Murat's aggressions in Westphalia. He was superseded as ambassador in Paris in September just before the outbreak of war. After the disaster of Jena on the 14th of October he had an interview with Duroc near Wittenberg to seek terms of peace. After two unsuccessful attempts at negotiation, the first draft being refused by Napoleon, the second by Frederick William, he joined the Prussian court at Königsberg only to learn that his services were no longer required. He then joined the court of Elisa, grand duchess of Tuscany, at Lucca and Florence, and after Napoleon's fall devoted himself to writing. He died on the 20th of October 1825.

He published in 1819 three volumes, *Sulle cause et gli effetti della confederasione rhenana*, at Florence, but revealed little that was not already available in printed sources. His memoirs remained in MS. His despatches are edited by Bailleu in *Preussen und Frankreich* (Leipzig, 1887, *Publikationen aus den preussischen Staatsarchiven*).

LUCENA, a town of southern Spain, in the province of Cordova, 37 m. S.S.E. of Cordova, on the Madrid-Algeciras railway. Pop. (1900) 21,179. Lucena is situated on the Cascajar, a minor tributary of the Genil. The parish church dates from the beginning of the 16th century. The chief industries are the manufacture of matches, brandy, bronze lamps and pottery, especially the large earthenware jars (*tinajas*) used throughout Spain for the storage of oil and wine, some of which hold more than 300 gallons. There is considerable trade in agricultural produce, and the horse fair is famous throughout Andalusia. Lucena was taken from the Moors early in the 14th century; it was in the attempt to recapture it that King Boabdil of Granada was taken prisoner in 1483.

LUCERA, a town and episcopal see of Apulia, Italy, 12½ m. W.N.W. by rail of Foggia. Pop. (1901) 16,962. It is situated upon a lofty plateau, the highest point of which (823 ft.), projecting to the W., was the ancient citadel, and is occupied by the well-preserved castle erected by Frederick II., and rebuilt by Pierre d'Angicourt about 1280. The cathedral, originally Romanesque, but restored after 1300 is in the Gothic style; the façade is good, and so is the ciborium. The interior was restored in 1882. The town occupies the site of the ancient Luceria, the key of the whole country. According to tradition the temple of Minerva, founded by Diomede, contained the Trojan Palladium, and the town struck numerous bronze coins; but in history it is first heard of as on the Roman side in the Samnite Wars (321 B.C.), and in 315 or 314 B.C. a Latin colony was sent here. It is mentioned in subsequent military history, and its position on the road from Beneventum, via Aecae (mod. *Troja*) to Sipontum, gave it some importance. Its wool was also renowned. It now contains no ancient remains above ground, though several mosaic pavements have been found and there are traces of the foundations of an amphitheatre outside the town on the E. The town-hall contains a statue of Venus, a mosaic and some inscriptions (but cf. Th. Mommsen's remarks on the local neglect of antiquities in *Corp. Inscr. Lat.* ix. 75). In 663 it was destroyed by Constans II., and was only restored in 1223 by Frederick II., who transported 20,000 Saracens hither from Sicily. They were at first allowed religious freedom, but became Christians under compulsion in 1300. Up to 1806 Lucera was the capital of the provinces of Basilicata and Molise. (T. As.)

LUCERNE (Ger. *Luzern*; Ital. *Lucerna*), one of the cantons of central Switzerland. Its total area is 579·3 sq. m., of which 530·2 sq. m. are classed as "productive" (forests covering 120·4 sq. m., and vineyards ·04 sq. m.). It contains no glaciers or eternal snows, its highest points being the Brienzer Rothhorn (7714 ft.) and Pilatus (6995 ft.), while the Rothstock summit (5453 ft.) and the Kaltbad inn, both on the Rigi, are included in the canton, the loftiest point of the Rigi range (the Kulm) being entirely in Schwyz. The shape of the canton is an irregular quadrilateral, due to the gradual acquisition of rural districts by the town, which is its historical centre. The northern portion, about 15½ sq. m., of the Lake of Lucerne is in the canton. Its chief river is the Reuss, which flows through it for a short distance only receiving the Kleine Emme that flows down through the Entlebuch. In the northern part the Wigger, the Suhr and the Wynen streams flow through shallow valleys, separated by low hills. The canton is fairly well supplied with railways. The lakes of Sempach and Baldegg are wholly within the canton, which also takes in small portions of those of Hallwil and of Zug.

In 1900 the population numbered 146,519, of which 143,337 were German-speaking, 2204 Italian-speaking and 747 French-speaking, while 134,020 were Romanists, 12,085 Protestants and 319 Jews. Its capital is Lucerne (*q.v.*); the other towns are Kriens (pop. 5951), Willisau (4131), Ruswil (3928), Littau (3699), Emmen (3162) and Escholzmatt (3127). The peasants are a fine race, and outside the chief centres for foreign visitors have retained much of their primitive simplicity of manners and many local costumes. In the Entlebuch particularly the men are of a robust type, and are much devoted to wrestling and other athletic exercises. That district is mainly pastoral and is famous for its butter and cheese. Elsewhere in the canton the pastoral industry (including swine-breeding) is more extended than agriculture, while chiefly in and around Lucerne there are a number of industrial establishments. The *industrie des étrangers* is greatly developed in places frequented by foreign visitors. The population as a whole is Conservative in politics and devotedly Romanist in religion. But owing to the settlement of many non-Lucerne hotel-keepers and their servants in the town of Lucerne the capital is politically Radical.

The canton ranks officially third in the Swiss confederation next after Zürich and Bern. It was formerly in the diocese of Constance, and is now in that of Basel. It contains 5 administrative districts and 107 communes. The existing cantonal constitution dates in its main features from 1875. The legislature or *Grossrath* consists of members elected in 55 electoral circles, in the proportion of 1 to every 1000 souls (or fraction over 500) of the Swiss population, and lasts for 4 years. On the 4th of April 1909 proportional representation was adopted for elections of members of the *Grossrath*. Since 1905 the executive of 7 members is elected by a popular vote for 4 years, as are the 2 members of the federal *Ständerath* and the 7 members of the federal *Nationalrath*. Five thousand citizens can demand a facultative referendum as to all legislative projects and important financial decrees, or as to the revision of the cantonal constitution, while the same number can also revoke the mandate of the cantonal legislature before its proper term of office has ended, though this revocation does not affect the executive. Four thousand citizens have the right of "initiative" as to constitutional amendments or legislative projects.

The canton is composed of the various districts which the town acquired, the dates being those at which the particular region was finally secured—Weggis (1380), Rothenburg, Kriens, Horw, Sempach and Hochdorf (all in 1394), Wolhusen and the Entlebuch (1405), the so-called "Habsburger region" to the N.E. of the town of Lucerne (1406), Willisau (1407), Sursee and Beromünster (1415), Malters (1477) and Littau (1481), while in 1803, in exchange for Hitzkirch, Merenschwand (held since 1397) was given up. (W. A. B. C.)

LUCERNE, the capital of the Swiss canton of the same name. It is one of the principal tourist centres of Switzerland, being situated on the St Gotthard railway line, by which it is 59 m. from Basel and 180 m. from Milan. Its prosperity has always been bound up with the St Gotthard Pass, so that the successive improvements effected on that route (mule path in the 13th century, carriage road 1820–1830, and railway tunnel in 1882) have had much effect on its growth. It is beautifully situated on the banks of the river Reuss, just as it issues from the Lake of Lucerne, while to the south-west rises the rugged range of Pilatus, balanced on the east by the more smiling ridge of the Rigi and the calm waters of the lake. The town itself is very picturesque. On the rising ground to its north still stand nine of the towers that defended the old town wall on the Musegg slope. The Reuss is still crossed by two quaint old wooden bridges, the upper being the Kapellbrücke (adorned by many paintings illustrating the history of Switzerland and the town and clinging to the massive Wasserthurm) and the lower the Mühlenbrücke (also with paintings, this time of the Dance of Death). The old Hofbrücke (on the site of the Schweizerhof quay) was removed in 1852, when the process of embanking the shore of the lake began, the result being a splendid series of quays, along which rise palatial hotels. The principal building is the twin-towered Hofkirche (dedicated to St Leger or Leodegar) which, though in its present form it dates only from 1633–1635, was the centre round which the town gradually gathered; originally it formed part of a Benedictine monastery, but since 1455 has been held by a college of secular canons. It has a fine 17th-century organ. The 16th-century town-hall (Rathhaus) now houses the cantonal museum of antiquities of all dates. Both the cantonal and the town libraries are rich in old books, the latter being now specially devoted to works (MS. or printed) relating to Swiss history before 1848. The Lion monument, designed by Thorwaldsen, dedicated in 1821, and consisting of a dying lion hewn out of the living sandstone, commemorates the officers and men of the Swiss Guard (26 officers and about 760 men) who were slain while defending the Tuileries in Paris in 1792, and is reflected in a clear pool at its foot. In the immediate neighbourhood is the Glacier Garden, a series of potholes worn in the sandstone rock bed of an ancient glacier. Among modern buildings are the railway station, the post office and the Museum of War and Peace, all in the new quarter on the left bank of the Reuss. In the interior of the town are many quaint old private houses. In 1799 the population numbered but 4337, but had doubled by 1840. Since then the rise has been rapid and continuous, being 29,255 in 1900. The vast majority are German-speaking (in 1900 there were 1242 Italian-speaking and 529 French-speaking persons) and Romanists (in 1900 there were 4933 Protestants and 299 Jews).

The nucleus of the town was a Benedictine monastery, founded about 750 on the right bank of the Reuss by the abbey of Murbach in Alsace, of which it long remained a "cell." It is first mentioned in a charter of 840 under the name of "Luciaria," which is probably derived from that of the patron saint of the monastery, St Leger or Leodegar (in O. Ger. *Leudegar* or *Luigar*)—the form "Lucerrun" is first found in 1252. Under the shadow of this monastery there grew up a small village. The germs of a municipal constitution appear in 1252, while the growing power of the Habsburgs in the neighbourhood weakened the ties that bound Lucerne to Murbach. In 1291 the Habsburgs finally purchased Lucerne from Murbach, an act that led a few weeks later to the foundation of the Swiss Confederation, of which Lucerne became the fourth member (the first town to be included) in 1332. But it did not get rid of all traces of Habsburg domination till after the glorious victory of Sempach (1386). That victory led also to the gradual acquisition of territory ruled by and from the town. At the time of the Reformation Lucerne clave to the old faith, of which ever since it has been the great stronghold in Switzerland. The papal nuncio resided here from 1601 to 1873. In the 16th century, as elsewhere in Switzerland, the town government fell into the hands of an aristocratic oligarchy, whose power, though shaken by the great peasant revolt (1653) in the Entlebuch, lasted till 1798. Under the Helvetic republic (1798–1803) Lucerne was the seat of the central government, under the Act of Mediation (1803–1814) one of the six "Directorial" cantons and from 1815 to 1848 one of the three ruling cantons. The patrician government was swept away by the cantonal constitution of 1831. But in 1841 the Conservatives regained power, called in the Jesuits (1844) and so brought about the Sonderbund War (1847) in which they were defeated, the decisive battle taking place at Gisikon, not far from Lucerne. Since 1848 Lucerne has been in disfavour with the Radicals who control the federal government, and has not been chosen as the site of any great federal institution. The Radicals lost power in the canton in 1871, after which date the Conservatives became predominant in the canton, though in the town the Radicals were in the majority.

See J. J. Blumer, *Staats-und Rechtsgeschichte d. schweiz. Demokratien* (3 vols., St Gall, 1850–1859); A. L. Gassmann, *Das Volkslied im Luzerner Wiggerthal u. Hinterland* (Basel, 1906); *Geschichtsfreund* (organ of the Historical Society of the Forest Cantons) from 1843. A. von Liebenau, *Charakterbilder aus Luzern's Vergangenheit* (2 vols., Lucerne, 1884–1891); T. von Liebenau, *Das alte Luzern* (Lucerne, 1881) and "Der luzernische Bauernkrieg vom 1653" (3 articles in vols. xviii.-xx., 1893–1895, of the *Jahrbuch f. Schweizerische Geschichte*); *Heimathkunde für den Kanton Luzern* (6 vols., Lucerne, 1867–1883); A. Lütolf, *Sagen, Bräuche, Legenden aus d. Fünf Orten* (Lucerne, 1862); K. Pfyffer, *Der Kanton Luzern* (2 vols., 1858–1859) and *Geschichte d. Stadt u. Kanton Luzern* (2 vols., new ed., 1861); A. P. von Segesser, *Rechtsgeschichte d. Stadt u. Republik Luzern* (4 vols., 1850–1858) and *45 Jahre (1841–1887) im Luzernischen Staatsdienst* (Bern, 1887); J. Sowerby, *The Forest Cantons of Switzerland* (London, 1892). (W. A. B. C.)

LUCERNE, LAKE OF, the name usually given by foreigners to the principal lake of Central Switzerland. In French it is called the *Lac des Quatre Cantons*, and in German the *Vierwaldstättersee*, this term being often wrongly translated "Lake of the Four Forest Cantons," whereas it means the "Lake of the Four Valleys"—*valles*—which form the four Cantons of Lucerne, Unterwalden, Uri and Schwyz. It takes its name from the town of Lucerne, which is situated at its west end, just where the Reuss issues from the lake, after having entered it at Flüelen at the east end and so practically formed it; the Muota enters the lake at Brunnen (northern shore) and the two mountain streams called the Engelberg and the Sarnen Aa at Buochs and Alpnachstad respectively (S.). The lake is generally supposed to be, on the whole, the most beautiful in Switzerland. This is partly due to the steep limestone mountains between which it lies, the best known being the Rigi (5906 ft.) to the N., and Pilatus (6995 ft.) to the S.W., and to the great promontories that thrust themselves into its waters, such as those of Horw (S.), of Bürgenstock (S.), of Meggenhorn (N.) and of Seelisberg (S.), and partly to the irregularity of its shape. It is, in fact, composed of four main basins (with two side basins), which represent four different valleys, orographically distinct, and connected only by narrow and tortuous channels. There is, first, the most easterly basin, the *Bay of Uri*, extending from Flüelen on the south to Brunnen on the north. At Brunnen the great delta of the Muota forces the lake to the west, so that it forms the *Bay of Gersau* or the *Gulf of Buochs*, extending from the promontory of Seelisberg (E.) to that of the Bürgenstock (W.). Another narrow strait between the two "Noses" (*Nasen*) leads westwards to the *Basin of Weggis*, enclosed between the Rigi (N.) and the Bürgenstock promontory (S.). This last named bay forms the eastern arm of what is called the Cross of Lucerne, the western arm of which is formed by the Bay of Lucerne, while the northern arm is the Bay of Küssnacht and the southern that of *Hergiswil*, prolonged S.W. by the *Bay of Alpnach*, with which it is joined by a very narrow channel, spanned by the Acher iron bridge. The Bay of Uri offers the sternest scenery, but is the most interesting, by reason of its connexion with early Swiss history—at Brunnen the Everlasting League of 1315 was really made, while the legendary place of meeting of the founders of Swiss freedom was the meadow of the Rütli on the west (purchased by the Confederation in 1859), and the site of Tell's leap is marked by the Chapel of Tell (E.). Nearly opposite Brunnen, close to the west shore, an isolated rock (the *Schillerstein* or *Mythenstein*) now bears an inscription in honour of Friedrich Schiller, the author of the famous play of *William Tell* (1804). In the Bay of Gersau the most interesting spot is the village of Gersau (N.), which formed an independent republic from 1390 to 1798, but in 1818 was finally united to the canton of Schwyz. In the next basin to the west is Weggis (N.), also for long in the middle ages a small independent state; to the S.E. of Weggis, on the north shore of the lake, is Vitznau, whence a rack railway (1871) leads up to the top of the Rigi (4½ m.), while S.W. of Weggis, on the south shore of the lake, is Kehrsiten, whence an electric railway leads up to the great hotels on the Bürgenstock promontory (2854 ft.). The town of Lucerne is connected with Flüelen by the main line of the St Gotthard railway (32 m.), though only portions of this line (from Lucerne to Küssnacht, 10½ m., and from Brunnen to Flüelen, 7 m.) run along the shore; Brunnen is also connected with Flüelen by the splendid carriage road known as the Axenstrasse (7½ m.) and is the starting-point of an electric line (1905) up to Morschach (S.E.) and the great hotels of Axenstein and Axenfels near it. On the promontory between Lucerne and Küssnacht stands the castle of New Habsburg (modern), while from Küssnacht a carriage road leads through the remains of the "Hollow Way" (*Hohle Gasse*), the scene of the legendary murder of Gessler by William Tell. The west shore of the southern arm, or the basin of Hergiswil and the Bay of Alpnach, is traversed from Horw to Alpnachstad by the Brünig railway (5½ m.), which continues towards Sarnen (Obwalden) and the Bernese Oberland, S.W. from Alpnachstad, whence a rack railway leads N.W. up Pilatus (2¾ m.). Opposite Hergiswil, but on the east shore of the Basin of Hergiswil, is Stanstad, the port of Stans (Nidwalden), which is connected by an electric line with Engelberg (14 m.). The first steamer was placed on the lake in 1835. Lucerne is the only town of importance, but several spots serve as ports for neighbouring towns or large villages (Brunnen for Schwyz, Flüelen for Altdorf, Stanstad for Stans, Alpnachstad for Sarnen). Most of the villages on the shores are frequented in summer by visitors (Gersau also in winter), especially Hertenstein, Weggis, Gersau, Brunnen, Beckenried and Hergiswil, while great hotels, commanding magnificent views, have been built on heights above it, such as the Bürgenstock, Seelisberg, and near Morschach, above Brunnen, besides those on the Rigi, Pilatus and the Stanserhorn. The area of the lake is about 44½ sq. m., its length about 24 m., its greatest width only 2 m. and its greatest depth 702 ft., while the surface of the water is 1434 ft. above sea-level. Of the total area about 15½ sq. m. are in the Canton of Lucerne, 13 sq. m. in that of Nidwalden, 7½ sq. m. in that of Uri, 7½ sq. m. in that of Schwyz, and about 1 sq. m. in that of Obwalden. (W. A. B. C.)

LUCERNE, **Purple Medick** or **Alfalfa**, known botanically as *Medicago sativa*, a plant of the natural order Leguminosae. In England it is still commonly called "lucerne," but in America "alfalfa," an Arabic term ("the best fodder"), which, owing to its increasing cultivation in the western hemisphere, has come into widening usage since the introduction of the plant by the Spaniards. It is an erect perennial herb with a branched hollow stem 1 to 2 ft. high, trifoliolate leaves, short dense racemes of small yellow, blue or purple flowers, and downy pods coiled two or three times in a loose spiral. It has a characteristic long tap-root, often extending 15 ft. or more into the soil. It is a native of the eastern Mediterranean region, but was introduced into Italy in the 1st century A.D., and has become more widely naturalized in Europe; it occurs wild in hedges and fields in Britain, where it was first cultivated about 1650. It seems to have been taken from Spain to Mexico and South America in the 16th century, but the extension of its cultivation in the Western States of the American Union practically dates from the middle of the 19th century, and in Argentina its development as a staple crop is more recent. It is much cultivated as a forage crop in France and other parts of the continent of Europe, but has not come into such general use in Britain, where, however, it is frequently met with in small patches in districts where the soil is very light, with a dry subsoil. Its thick tap-roots penetrate very deeply into the soil; and, if a good cover is once obtained, the plants will yield abundant cuttings of herbage for eight or ten years, provided they are properly top-dressed and kept free from perennial weeds. The time to cut it is, as with clover and sainfoin, when it is in early flower.

Lucerne (*Medicago sativa*).

1, Flower, enlarged.
2, Half-ripe fruit.
3, Fruit, enlarged.

In the United States alfalfa has become the staple leguminous forage crop throughout the western half of the country. Some idea of the increase in its cultivation may be obtained from the figures for Kansas, where in 1891 alfalfa was cultivated over 34,384 acres, while in 1907 the number was 743,050. The progress of irrigation has been an important factor in many districts. The plant requires a well-drained soil (deep and permeable as possible), rich in lime and reasonably free from weeds.

See, for practical directions as to cultivation, *Farmers' Bulletin* 339 of the U.S. Department of Agriculture, by J. M. Westgate (Washington, December 1908).

LUCHAIRE, DENIS JEAN ACHILLE (1846–1908), French historian, was born in Paris on the 24th of October 1846. In 1879 he became a professor at Bordeaux and in 1889 professor of medieval history at the Sorbonne; in 1895 he became a member of the *Académie des sciences morales et politiques*, where he obtained the Jean Reynaud prize just before his death on the 14th of November 1908. The most important of Achille Luchaire's earlier works is his *Histoire des institutions monarchiques de la France sous les premiers Capétiens* (1883 and again 1891); he also wrote a *Manuel des institutions françaises: période des Capétiens directs* (1892); *Louis VI. le Gros, annales de sa vie et de son règne* (1890); and *Étude sur les actes de Louis VII.* (1885). His later writings deal mainly with the history of the papacy, and took the form of an elaborate work on Pope Innocent III. This is divided into six parts: (i.) *Rome et Italie*

(1904); (ii.) *La Croisade des Albigeois* (1905); (iii.) *La Papauté et l'empire* (1905); (iv.) *La Question d'Orient* (1906); (v.) *Les Royautés vassales du Saint-Siège* (1908); and (vi.) *Le Concile de Latran et la réforme de l'Église* (1908). He wrote two of the earlier volumes of E. Lavisse's *Histoire de France.*

LUCHU ARCHIPELAGO (called also Riukiu, Loo-choo and Liukiu), a long chain of islands belonging to Japan, stretching from a point 80 m. S. of Kiushiu to a point 73 m. from the N.E. coast of Formosa, and lying between 24° and 30° N. and 123° and 130° E. Japanese cartographers reckon the Luchu islands as 55, having a total coast-line of 768 m., an area of 935 sq. m., and a population of about 455,000. They divide them into three main groups, of which the northern is called Oshima-shoto; the central, Okinawa-gunto; and the southern, Sakishima-retto. The terms *shoto, gunto* and *retto* signify "archipelago," "cluster of islands" and "string of islands" respectively. The last-named group is subdivided into Miyako-gunto and Yayeyama-gunto. The principal islands of these various groups are:—

	Oshima-shoto—	
Amami-Oshima	34 m. long and	17 m. broad
Tokuno-shima	16 „	8½ „
	Okinawa-gunto—	
Okinawa-shima (Great Luchu)	63½ m. long and	14½ m. broad
Kume-shima	9½ „	7½ „
Okinoerabu-shima	9½ „	5 „
Ihiya-shima	5 „	2½ „
	Miyako-gunto—	
Miyako-shima	12½ m. long and	12 m. broad
Erabu-shima	4½ „	3½ „
	Yayeyama-gunto—	
Ishigaki-shima	24½ m. long and	14½ m. broad
Iriomoto-shima	14½ „	14 „
Yonakuni-shima	7½ „	3½ „

The remaining islands of the archipelago are of very small size, although often thickly populated. Almost at the extreme north of the chain are two islands with active volcanoes: Nakano-shima (3485 ft.) and Suwanose-shima (2697 ft.), but the remaining members of the group give no volcanic indications, and the only other mountain of any size is Yuwan-dake (2299 ft.) in Amami-Oshima. The islands "are composed chiefly of Palaeozoic rocks—limestones and quartzites found in the west, and clay, slate, sandstone and pyroxenite or amphibolite on the east. . . . Pre-Tertiary rocks have been erupted through these. The outer sedimentary zone is of Tertiary rocks."[1] The capital is Shuri in Okinawa, an old-fashioned place with a picturesque castle. The more modern town of Nafa, on the same island, possesses the principal harbour and has considerable trade.

The scenery of Luchu is unlike that of Japan. Though so close to the tropics, the islands cannot be said to present tropical features: the bamboo is rare; there is no high grass or tangled undergrowth; open plains are numerous; the trees are not crowded together; lakes are wanting; the rivers are insignificant; and an unusual aspect is imparted to the scenery by numerous coral crags. The temperature in Nafa ranges from a mean of 82° F. in July to 60° in January. The climate is generally (though not in all the islands) pleasant and healthy, in spite of much moisture, the rainfall being very heavy.

The fauna includes wild boars and deer, rats and bats. Excellent small ponies are kept, together with cattle, pigs and goats. The majority of the islands are infested with venomous snakes called *habu* (*Trimeresurus*), which attain a length of 6 to 7 ft. and a diameter of from 2½ to 3 in. Their bite generally causes speedy death, and in the island of Amami-Oshima they claim many victims every year. The most important cultivated plant is the sugar-cane, which provides the principal staple of trade.

Luchu is noted for the production of particularly durable vermilion-coloured lacquer, which is much esteemed for table utensils in Japan. The islands also manufacture certain fabrics which are considered a speciality. These are *Riukiu-tsumugi*, a kind of fine pongee; the so-called *Satsuma-gasuri*, a cotton fabric greatly used for summer wear; *basho-fu*, or banana-cloth (called also *aka-basho*), which is woven from the fibre of a species of banana; and *hoso-jofu*, a particularly fine hempen stuff, made in Miyako-shima, and demanding such difficult processes that six months are required to weave and dye a piece 9½ yds. long.

People.—Although the upper classes in Luchu and Japan closely resemble each other, there are palpable differences between the lower classes, the Luchuans being shorter and better proportioned than the Japanese; having higher foreheads, eyes not so deeply set, faces less flattened, arched and thick eyebrows, better noses, less marked cheek-bones and much greater hairiness. The last characteristic has been attributed to the presence of Ainu blood, and has suggested a theory that when the Japanese race entered south-western Japan from Korea, they drove the Ainu northwards and southwards, one portion of the latter finding their way to Luchu, the other to Yezo. Women of the upper class never appear in public in Luchu, and are not even alluded to in conversation, but women of the lower orders go about freely with uncovered faces. The Luchu costume resembles that of Japan, the only marked difference being that the men use two hairpins, made of gold, silver, pewter or wood, according to the rank of the wearer. Men shave their faces until the age of twenty-five, after which moustache and beard are allowed to grow, though the cheeks are kept free from hair. Their burial customs are peculiar and elaborate, and their large sepulchres, generally mitre-shaped, and scattered all over the country, according to Chinese fashion, form a striking feature of the landscape. The marriage customs are also remarkable. Preliminaries are negotiated by a middleman, as in China and Japan, and the subsequent procedure extends over several days. The chief staple of the people's diet is the sweet potato, and pork is the principal luxury. An ancient law, still in force, requires each family to keep four pigs. In times of scarcity a species of sago (obtained from the *Cycas revoluta*) is eaten. There is a remarkable absence of religious influence in Luchu. Places of worship are few, and the only function discharged by Buddhist priests seems to be to officiate at funerals. The people are distinguished by gentleness, courtesy and docility, as well as by marked avoidance of crime. With the exception of petty thefts, their Japanese administrators find nothing to punish, and for nearly three centuries no such thing as a lethal weapon has been known in Luchu. Professor Chamberlain states that the Luchuan language resembles the Japanese in about the same degree as Italian resembles French, and says that they are sister tongues, many words being identical, others differing only by letter changes which follow certain fixed analogies, and sentences in the one being capable of translation into the other word for word, almost syllable for syllable.

History.—Tinsunshi, "Grandson of Heaven," is the mythical founder of the Luchu monarchy. Towards the close of the 12th century his descendants were driven from the throne by rebellion, but the old national party soon found a victorious leader in Shunten, son of Tametomo, a member of the famous Minamoto family, who, having been expelled from Japan, had come to Luchu and married there. The introduction of the arts of reading and writing are assigned to Shunten's reign. Chinese invasions of Luchu may be traced back to A.D. 605, but they did not result in annexation; and it was in 1372 that China first obtained from the Luchuans recognition of supremacy. Luchuan relations with Japan had long been friendly, but at the end of the 16th century the king refused Japan assistance against Korea, and in 1609 the prince of Satsuma invaded the islands with 3000 men, took the capital by storm, captured the king and carried him off to Kagoshima. A few years later he was restored to his throne on condition of acknowledging Japanese suzerainty and paying tribute. The Luchuans nevertheless continued to pay tribute to China also.

The Chinese government, however, though taking a benevolent interest in the welfare of the islanders, never attempted to bring them under military sway. The incongruity of this state of affairs did not force itself upon Japan's attention so long as her own empire was divided into a number of semi-independent principalities. But in 1879 the Japanese government, treating Luchu as an integral part of the mikado's dominions, dethroned its prince, pensioned him as the other feudal chiefs had been pensioned, and converted Luchu into a prefecture under the name of Okinawa. This name signifies "extended rope," and alludes to the attenuated nature of the archipelago. China remonstrating, a conference was held in Peking, when plenipotentiaries of the two empires signed an agreement to the effect that the archipelago should be divided equally between the claimants. The Chinese government, however, refused to ratify this compromise, and the Japanese continued their measures for the effective administration of all the islands. Ultimately (1895) Formosa also came into Japan's possession, and her title to the whole chain of islands ceased to be disputed.

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[1] Note in *Geographical Journal*, xx., on S. Yoshiwara, "Raised Coral Reefs in the Islands of the Riukiu Curve," in *Journ. Coll. of Science, Imp. Univ., Tokyo* (1901).

Though Captain Broughton, of H.M.S. "Providence," was wrecked on Miyako-shima and subsequently visited Nafa in 1797, it was not till the "Alceste" and "Lyra" expedition in 1816–1817, under Captains Basil Hall and Murray Maxwell, that detailed information was obtained about Luchu. The people at that time showed a curious mixture of courtesy and shyness. From 1844 efforts were made by both Catholic (French) and Protestant missionaries to Christianize them, but though hospitable they made it clear that these efforts were unwelcome. Further visits were made by British vessels under Captain Beechey (1826) and Sir Edward Belcher (1845). The American expedition under Commodore M. C. Perry (1853) added largely to knowledge of the islands, and concluded a treaty with the Luchuan government.

See Basil Hall, *Account of a Voyage of Discovery to the West Coast of Corea and the Great Loo-choo Island* (London, 1818); Comm. M. C. Perry, *Narrative of the Expedition of an American Squadron to the China Seas and Japan, 1852–1854* (Washington, 1856); B. H. Chamberlain, "The Luchu Islands and their Inhabitants," in the *Geographical Journal*, vol. v. (1895); "Contributions to a Bibliography of Luchu," in *Trans. Asiatic Soc. Japan*, xxiv. (1896); C. S. Leavenworth, "History of the Loo-choo Islands," *Journ. China Br. Royal Asiatic Soc.* xxxvi. (1905).

LUCIA (or Lucy), **ST**, virgin and martyr of Syracuse, whose name figures in the canon of the mass, and whose festival is celebrated on the 13th of December. According to the legend, she lived in the reign of Diocletian. Her mother, having been miraculously cured of an illness at the sepulchre of St Agatha in Catania, was persuaded by Lucia to distribute all her wealth to the poor. The youth to whom the daughter had been betrothed forthwith denounced her to Pascasius, the prefect, who ordered that she should be taken away and subjected to shameful outrage. But it was found that no force which could be applied was able to move her from the spot on which she stood; even boiling oil and burning pitch had no power to hurt her, until at last she was slain with the sword. The most important documents concerning St Lucy are the mention in the *Martyrologium Hieronymianum* and the ancient inscription discovered at Syracuse, in which her festival is indicated. Many paintings represent her bearing her eyes in her hand or on a salver. Some artists have even represented her blind, but nothing in her *Acta* justifies this representation. It is probable that it originated in a play upon words (Lucia, from Lat. *lux*, light), just as St Clair is invoked in cases of eye-disease.

See O. Caietanus, *Vitae sanctorum Siculorum*, i. 114-121 (Palermo, 1657); Ioannes de Ioanne, *Acta sincera sanctae Luciae* (Palermo, 1758); *Analecta Bollandiana*, xxii. 492; Cahier, *Caractéristiques des saints*, i. 105 (Paris, 1867). (H. De.)

LUCIAN (d. 312), Christian martyr, was born, like the famous, heathen writer of the same name, at Samosata. His parents, who were Christians, died when he was in his twelfth year. In his youth he studied under Macarius of Edessa, and after receiving baptism he adopted a strictly ascetic life, and devoted himself with zeal to the continual study of scripture. Settling at Antioch when Malchion was master of the Greek school he became a presbyter, and, while supporting himself by his skill as a rapid writer, became celebrated as a teacher, so that he is regarded as the founder of the famous theological school of Antioch. He did not escape suspicion of heresy, and is represented as the connecting link between Paul of Samosata and Arius. Indeed, on the deposition of the former (A.D. 268) he was excluded from ecclesiastical fellowship by three successive bishops of Antioch, while Arius seems to have been among his pupils (Theodoret, *Hist. Eccl.* i. 3, 4). He was, however, restored before the outbreak of persecution, and the reputation won by his high character and learning was confirmed by his courageous martyrdom. He was carried to Nicomedia before Maximin Daza, and persisting in his faith perished on the 7th of January 312, under torture and hunger, which he refused to satisfy with food offered to idols. His defence is preserved by Rufinus (ix. 6; on Eusebius, *Hist. Eccl.* ix. 9). His remains were conveyed to Drepanum in Bithynia, and under Constantine the town was founded anew in his honour with the name of Helenopolis, and exempted from taxes by the emperor (A.D. 327) (see *Chron. Pasch.*, Bonn ed., p. 527). Here in 387, on the anniversary of his death, Chrysostom delivered the panegyrical homily from which, with notices in Eusebius, Theodoret and the other ecclesiastical historians, the life by Jerome (*Vir. Ill.* cap. 77), but especially from the account by S. Metaphrastes (cited at length in Bernhardy's notes to Suidas, *s.v.* [illegible]), the facts above given are derived. See also, for the celebration of his day in the Syriac churches, Wright, *Cat. of Syr. MSS.* p. 283.

Jerome says that Lucian wrote *Libelli de fide* and several letters, but only a short fragment of one epistle remains (*Chron. Pasch.*, ed. Dindorf, i. 516). The authorship of a confession of faith ascribed to Lucian and put forth at the semi-Arian synod of Antioch (A.D. 341) is questioned. Lucian's most important literary labour was his edition of the Greek Old Testament corrected by the Hebrew text, which, according to Jerome (*Adv. Ruf.* ii. 77), was in current use from Constantinople to Antioch. That the edition of Lucian is represented by the text used by Chrysostom and Theodoret, as well as by certain extant MSS., such as the Arundelian of the British Museum, was proved by F. Field (*Prol. ad Origenis Hexapla*, cap. ix.). Before the publication of Field's *Hexapla*, Lagarde had already directed his attention to the Antiochian text (as that of Lucian may be called) and ultimately published the first part (Genesis, 2 Esdras, Esther) of a provisional reconstructed text. The distinguishing marks of the Lucianic recension are thus summarized by S. R. Driver, *Notes on Heb. Text of Samuel*, p. li. seq.: (1) The substitution of synonyms for the words employed by the Septuagint; (2) the occurrence of double renderings; (3) the occurrence of renderings "which, presuppose a Hebrew original self-evidently superior in the passages concerned to the existing Massoretic text," a peculiarity which makes it very important for the criticism of the Hebrew Bible. From a statement of Jerome in his preface to the gospels it seems probable that Lucian had also a share in fixing the Syrian recension of the New Testament text, but of this it is impossible to speak with certainty. He was associated in his work with the Hebraist Dorotheus.

See, generally, A. Harnack's art. in Hauck-Herzog, *Realencyk.* vol. xi., and for "remains" Routh, *Rel. Sac.* iv. 3-17. A full account of his recension of the Septuagint is given in H. B. Swete's *Introduction to the Old Testament in Greek*, p. 81 sqq.; and a good account of his doctrinal position in the prolegomena to the volume on *Athanasius* in the series of Nicene and Post-Nicene Fathers (p. xxviii.) and A. Harnack's *History of Dogma*, especially vol. iv.

LUCIAN [Λουκιανός] (*c.* A.D. 120–180), Greek satirist of the Silver Age of Greek literature, was born at Samosata on the Euphrates in northern Syria. He tells us in the *Somnium* or *Vita Luciani*, 1, that, his means being small, he was at first apprenticed to his maternal uncle, a statuary, or rather sculptor of the stone pillars called Hermae. Having made an unlucky beginning by breaking a marble slab, and having been well beaten for it, he absconded and returned home. Here he had a dream or vision of two women, representing Statuary and Literature. Both plead their cause at length, setting forth the advantages and the prospects of their respective professions; but the youth chooses Παιδεία, and decides to pursue learning. For some time he seems to have made money as a *ῥήτωρ*, following the example of Demosthenes, on whose merits and patriotism he expatiates in the dialogue *Demosthenis Encomium*. He was very familiar with the rival schools of philosophy, and he must have well studied their teachings; but he lashes them all alike, the Cynics, perhaps, being the chief object of his derision. Lucian was not only a sceptic; he was a scoffer and a downright unbeliever. He felt that men's actions and conduct always fall far short of their professions and therefore he concluded that the professions themselves were worthless, and a mere guise to secure popularity or respect. Of Christianity he shows some knowledge, and it must have been somewhat largely professed in Syria at the close of the 2nd century.[1] In the *Philopatris* (*q.v.*), though the dialogue so called is generally regarded as spurious, there is a statement of the doctrine of the Trinity,[2] and the "Galilaean who had ascended to the third heaven" (12), and "renewed" (ἀνεκαίνισεν) by the waters of baptism, may possibly allude to St Paul. The doctrines of the Λόγος and the "Light of the world," and that God is in heaven making a record of the good and bad actions of men,[1] seem to have come from the same source, though the notion of a written catalogue of human actions to be used in judgment was familiar to Aeschylus and Euripides.

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[1] In the *Alexander* (25) we are told that the province of Pontus, due north of Syria, was "full of Christians."

[2] *Philopatris*, 12, ὑψιμέδοντα Θεὸν μέγαν ἄμβροτον οὐρανίωνα, υἱὸν Πατρός, Πνεῦμα ἐκ πατρὸς ἐκπορευόμενον, ἓν ἐκ τριῶν καὶ ἐξ ἑνὸς τρία, a passage which bears on the controverted procession "a Patre Filioque."

As a satirist and a wit Lucian occupies in prose literature the unique position which Aristophanes holds in Greek poetry. But whether he is a mere satirist, who laughs while he lashes, or a misanthrope, who hates while he derides, is not very clear. In favour of the former view it may be said that the two main objects of his ridicule are mythology and the sects of philosophy; in favour of the latter, his bitter exposure of imposture and chicanery in the *Alexander*, and the very severe attacks he makes on the "humbug" of philosophy,[2] which he everywhere assails with the most acrimonious and contemptuous epithets.

As a writer Lucian is fluent, easy and unaffected, and a close follower of the best Attic models, such as Plato and the orators. His style is simpler than Plutarch's, and some of his compositions, especially the *Dialogues of the Gods* (pp. 204-287) and *of the Marine Deities* (288-327), and, above all, the *Dialogues of the Dead* (329-454), are models of witty, polished and accurate Greek composition. Not less clever, though rather lax in morality, are the *ἑταιρικοὶ διάλογοι* (pp. 280-325), which remind us somewhat of the letters of Alciphron. The sarcasms on the popular mythology, the conversations of Pluto, Hermes, Charon and others of the powers in Hades, show a positive disbelief in any future state of existence. The model Lucian followed in these dialogues, as well in the style as in the sparkling and playful repartee, was the Platonic conversations, founded on the drama, of which the dialogue may be called the prose representative. Aristotle never adopted it, perhaps regarding it as beneath the true dignity of philosophy. The dialogue, in fact, was revived and improved by Lucian,[3] the old traditions of the λογοποιοί and λογογράφοι, and, above all, the immense influence of rhetoric as an art, having thrown some discredit on a style of composition which, as introduced by Plato, had formed quite a new era in Greek prose composition. For rhetoric loved to talk, expatiate and declaim, while dialectic strove to refute by the employment of question and answer, often in the briefest form.

Lucian evinces a perfect mastery over a language as wonderful in its inflections as in its immense and varied vocabulary; and it is a well-merited praise of the author to say that to a good Greek scholar the pages of Lucian are almost as easy and as entertaining as an English or French novel. It is true that he employs some forms and compounds which were not in use in the time of Plato or Demosthenes, and, as one who lived under Roman rule, has a tendency towards Latinisms. But his own sentiments on the propriety of diction are shown by his reproof to Lexiphanes, "if anywhere you have picked up an out-of-the-way word, or coined one which you think good, you labour to adapt the sense of it, and think it a loss if you do not succeed in dragging it in somewhere, even when it it not really wanted."

Lucian founded his style, or obtained his fluency, from the successful study of rhetoric, by which he appears to have made a good income from composing speeches which attracted much attention. At a later period in life he seems to have held a lucrative legal office in Egypt, which he retained till his death.

His extant works are so numerous that of some of the principal only a short sketch can be given. More than 80 pieces have come down to us under his name (including three collections of 71 shorter dialogues), of which about 20 are spurious or of doubtful authorship. To understand them aright we must remember that the whole moral code, the entire "duty of man," was included, in the estimation of the pagan Greek, in the various schools of philosophy. As these were generally rivals, and the systems they taught were more or less directly antagonistic, truth presented itself to the inquirer, not as one, but as manifold. The absurdity and the impossibility of this forms the burden of all Lucian's writings. He could only form one conclusion, viz. that there is no such thing as truth.

One of the best written and most amusing treatises of antiquity is Lucian's *True History*, forming a rather long narrative in two books, which suggested Swift's *Gulliver's Travels*, Rabelais's *Voyage of Pantagruel* and Cyrano de Bergerac's *Journey to the Moon*. It is composed, the author tells us in a brief introduction, not only as a pastime and a diversion from severer studies, but avowedly as a satire on the poets and logographers who had written so many marvellous tales. He names Ctesias and Homer; but Hellanicus and Herodotus, perhaps other λογοποιοί still earlier, appear to have been in his mind.[4] The only true statement in his *History*, he wittily says (p. 72), is that it contains nothing but lies from beginning to end.

The main purport of the story is to describe a voyage to the moon. He set out, he tells us, with fifty companions, in a well-provisioned ship, from the "Pillars of Hercules," intending to explore the western ocean. After eighty days' rough sailing they came to an island on which they found a Greek inscription, "This was the limit of the expedition of Heracles and Dionysus"; and the visit of the wine-god seemed attested by some miraculous vines which they found there. After leaving the island they were suddenly carried up, ship and all, by a whirlwind into the air, and on the eighth day came in sight of a great round island shining with a bright light (p. 77), and lying a little above the moon. In a short time they are arrested by a troop of gigantic "horse-vultures" and brought as captives to the "man in the moon," who proves to be Endymion. He is engaged in a war with the inhabitants of the sun, which is ruled by King Phaëthon, the quarrel having arisen from an attempt to colonize the planet Venus (Lucifer). The voyagers are enlisted as "Moonites," and a long description follows of the monsters and flying dragons engaged in the contest. A fight ensues, in which the slaughter is so great that the very clouds are tinged with red (p. 84). The long description of the inhabitants of the moon is extremely droll and original. After descending safely into the sea, the ship is swallowed by a huge "sea serpent" more than 100 miles long. The adventures during the long confinement in the creature's belly are most amusing; but at last they sail out through the chinks between the monster's teeth, and soon find themselves at the "Fortunate Islands." Here they meet with the spirits of heroes and philosophers of antiquity, on whom the author expatiates at some length. The tale comes to an abrupt end with an allusion to Herodotus in the promise that he "will tell the rest in his next books."

Another curious and rather long treatise is entitled *Λούκιος ἢ Ὄνος*, the authorship of which is regarded as doubtful. Parts of the story are coarse enough; the point turns on one Lucius visiting in a Thessalian family, in which the lady of the house was a sorceress. Having seen her changed into a bird by anointing herself with some potent drug, he resolves to try a similar experiment on himself, but finds that he has become an ass, retaining, however, his human senses and memory. The mistake arose from his having filched the wrong ointment; however, he is assured by the attendant, Palaestra, that if he can but procure roses to eat, his natural form will be restored. In the night a party of bandits break into the house and carry off the stolen goods into the mountains on the back of the unfortunate donkey, who gets well beaten for stumbling on the rough road. Seeing, as he fancies, some roses in a garden, he goes in quest of them, and again gets beaten as a thief by the gardener (p. 585). After many adventures with the bandits, he attempts to run away, but is caught. A council is held, and he is condemned to die together with a captive girl who had essayed to escape on his back. Suddenly, however, soldiers appear, and the bandits are arrested (p. 595). Again the ass escapes "to the great and populous city of Beroea in Macedonia" (p.603). Here he is sold to a strolling conjurer, afterwards to a market-gardener; and both experiences are alike painful. Again he passes into the possession of a cook, where he gets fat and sleek on food more suited to his concealed humanity than the hard fare he has of late lived upon (p. 614). At last, during an exhibition in the theatre, he sees some roses being carried past, and, making a successful rush to devour them, he recovers his former shape. "I am Lucius," he exclaims to the wondering president of the exhibition, "and my brother's name is Caius. It was a Thessalian witch that changed me into a donkey." Thus all ends well, and he returns safe to his country.

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[1] *Philopatris*, 13. Aesch. *Eum.* 265, δελτογράφῳ δὲ πάντ' ἐπωπᾷ φρενί.

[2] In *Hermotimus* (51) Hermotimus says to Lycinus (who must be assumed to represent Lucian himself), *ὑβριστὴς ἀεὶ σύ, καὶ οὐκ οἶδ' ὅ τι παθὼν μισεῖς φιλοσοφίαν καὶ ἐς τοὺς φιλοσοφοῦντας ἀποσκώπτεις.* In *Icaromenippus* (5; see also 29) he says he always guessed who were the best physical philosophers "by their sour-faced looks, their paleness of complexion and the length of their beards."

[3] He says (speaking as *Σύρος* in *Bis accusatus*, 34) that he found dialogue somewhat out of repute from the too numerous questions (*i.e.* employed by Plato), and brought it up to a more human and natural standard, substituting banter and repartee for dialectic quibbles and close logical reasoning.

[4] He says (p. 127) that he saw punished in Hades, more severely than any other sinners, writers of false narratives, among whom were Ctesias of Cnidus and Herodotus. Yet in the short essay inscribed *Herodotus* (p. 831), he wishes it were possible for him to imitate the many excellencies of that writer.

The treatise *On the Syrian Goddess* (Mylitta, the moon-goddess, the Semitic Aphrodite) is written in the Ionic dialect in imitation perhaps of the style of Herodotus, though the resemblance is by no means close. The writer professes to be an Assyrian (p. 452), and to describe the wonders in the various temples of Palestine and Syria; he descants on the eunuchs of Syria and the origin of the self-imposed privation of manhood professed and practised by the Galli. The account of the temples, altars and sacrifices is curious, if really authentic; after the manner of Pausanias it is little more than a list, with the reasons in most cases added, or the origin of the custom explained.

De Morte Peregrini is a narrative of one Proteus, a Cynic, who after professing various doctrines, and among them those of Christianity, ended his own life by ascending a burning pyre (see PEREGRINUS PROTEUS).

Bis accusatus ("Twice Accused") is a dialogue beginning with a satire on the folly of the popular notion that the gods alone are happy. Zeus is represented as disproving this by enumerating the duties that fall to their lot in the government of the world, and Hermes remarks on the vast crowds of philosophers of rival sects, by whose influence the respect and worship formerly paid to the gods have seriously declined. A trial is supposed to be held under the presidency of the goddess *Δίκη*, between the Academy, the Porch, the schools of the Cynics and Epicureans, and Pleasure, Revelry, Virtue, Luxury, &c., as variously impugned or defended by them. Then Conversation and Rhetoric come before the court, each having an action for defamation to bring against Syrus the essayist, who of course is Lucian himself (p.823). His defence is heard, and in both cases he is triumphantly acquitted. This essay is brilliant from its clever parodies of Plato and Demosthenes, and the satire on the Socratic method of arguing by short questions and answers.

The *Lover of Lying* (Φιλοψευδής) discusses the reason why some persons seem to take pleasure in falsehood for its own sake. Under the category of lying all mythology (*e.g.* that of Homer and Hesiod) is included, and the question is asked, why the hearers of such stories are amused by them? Quack remedies, charms and miraculous cures are included among the most popular kinds of falsehood; witchcraft, spiritualism, exorcism, expulsion of devils, spectres, are discussed in turn, and a good ghost story is told in p. 57. An anecdote is given of Democritus, who, to show his disbelief in ghosts, had shut himself up in a tomb, and when some young men, dressed up with death's heads, came to frighten him at night, he did not even look up, but called out to them, "Stop your joking" (p. 59). This treatise, a very interesting one, concludes with the reflection that truth and sound reason are the only remedies for vain and superstitious terrors.

The dialogue *Navigium seu Vota* ("The Ship or the Wishes") gives an apparently authentic account of the measurements and fittings of an Egyptian ship which has arrived with a cargo of corn at the Peiraeus, driven out of its course to Italy by adverse winds. The full length is 180 ft., the breadth nearly 50, the depth from deck to the bottom of the hold 43 ft. The "wishes" turn on a party of friends, who have been to see the ship, declaring what they would most desire to possess. One would have the ship filled with gold, another a fine house with gold plate; a third would be a "tyrant" with a large force devoted to his interests; a fourth would like to make himself invisible, enter any house that he pleased, and be transported through the air to the objects of his affection. After hearing them all, the first speaker, Lycinus (Lucian), says that he is content with the privilege of laughing heartily at the vanity of human wishes, especially when they are those of professed philosophers.

The dialogue between Philo and Lycinus, *Convivium seu Lapithae*, is a very amusing description of a banquet, at which a party of dignified philosophers quarrelled over their viands at a marriage feast, and came to blows. The style is a good imitation of Plato, and the scene reminds one of the "clients' dinner" in the fifth satire of Juvenal. Matters come to a climax by the attempt of one of the guests, Zenothemis, to secure for himself a fatter fowl which had been served to his next neighbour Hermon. Each seizes his bird and hits the other with it in the face, at the same time pulling his beard. Then a general fight ensues. The story is a satire on philosophy, the favourite topic of a writer who believed neither in gods nor in men.

The *Piscator* ("Fisherman"), a dialogue between Lucian, Socrates, Pythagoras, Empedocles, Plato and others, commences with a general attack on the author as the enemy of philosophy. Socrates proposes that the culprit should be tried, and that Philosophia should assist in the prosecution. Lucian declares that he does not know where such a person lives, long as he has been looking for her (11). She is found at last, but declares Lucian has never disparaged her, but only impostors and pretenders under her name (15). He makes a long defence (pp. 598-606), abusing the philosophers in the sort of language in which some schools of theologians abuse the monks of the middle ages (34). The trial is held in the Acropolis of Athens, and the sham philosophers, dreading a verdict against them, throw themselves from the rock. A Cynic flings away his scrip in the hurry, and on examination it is found to contain, not books or loaves of bread, but gold coins, dice and fragrant essences (44). At the end Lucian baits his hook with a fig and a gold coin, and catches gluttonous strollers in the city while seated on the wall of the Acropolis.

The *Voyage Home* (Κατάπλους) opens with the complaint that Charon's boat is kept waiting for Hermes, who soon appears with his troop of ghosts. Among them is a *τύραννος*, one Megapenthes, who, as his name is intended to express, mourns greatly over the life he has just left. Amusing appeals are made by other souls for leave to return to life, and even bribes are offered to the presiding goddess of destiny, but Clotho is inexorable. The moral of the piece is closely like that of the parable of Dives and Lazarus: the rich and prosperous bewail their fate, while the poor and afflicted find rest from their troubles, and have no desire to return to them. The *τύραννος* here is the man clothed in purple and fine linen, and Lucian shows the same bitter dislike of tyrants which Plato and the tragic writers display. The heavy penalty is adjudged to Megapenthes that he may ever remember in the other world the misdeeds done in life.

The *Sales of Lives* is an auction held by Zeus to see what price the lives of philosophers of the rival sects will bring. A Pythagorean, who speaks in the Ionic dialect, first undergoes an examination as to what he can teach, and this contains an enumeration of the doctrines usually ascribed to that sect, including metempsychosis. He is valued at 7s. 6d., and is succeeded by Diogenes, who avows himself the champion of truth, a cosmopolitan (8), and the enemy of pleasure. Socrates brings two talents, and is purchased by Dion, tyrant of Syracuse (19). Chrysippus, who gives some specimens of his clever quibbles,[1] is bought for fifty pounds, Aristotle for nearly a hundred, while Pyrrho the sceptic (or one of his school), who professes to "know nothing," brings four pounds, "*because* he is dull and stupid and has no more sense than a grub" (27). But the man raises a doubt, "whether or not he has really been bought," and refuses to go with the purchaser till he has fully considered the matter.

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[1] *E.g.* "A stone is a body; a living creature is a body; you are a living creature; therefore you are a stone." Again: "Is every body possessed of life?" "No." "Is a stone possessed of life?" "No." "Are *you* a body?" "Yes." "A *living* body?" "Yes." "Then, if a living body, you are not a stone."

Timon is a very amusing and witty dialogue. The misanthrope, once wealthy, has become a poor farm-labourer, and reproaches Zeus for his indifference to the injustice of man. Zeus declares that the noisy disputes in Attica have so disgusted him that he has not been there for a long time (9). He tells Hermes to conduct Plutus to visit Timon, and see what can be done to help him. Plutus, who at first refuses to go, is persuaded after a long conversation with Hermes, and Timon is found by them digging in his field (31). Poverty is unwilling to resign her votary to wealth; and Timon himself is with difficulty persuaded to turn up with his mattock a crock of gold coins. Now that he has once more become rich, his former flatterers come cringing with their congratulations and respects, but they are all driven off with broken heads or pelted with stones. Between this dialogue and the *Plutus* of Aristophanes there are many close resemblances.

Hermotimus (pp. 739-831) is one of the longer dialogues, Hermotimus, a student of the Stoic philosophy for twenty years (2), and Lucian (Lycinus) being the interlocutors. The long time—forty years at the least—required for climbing up to the temple of virtue and happiness, and the short span of life, if any, left for the enjoyment of it, are discussed. That the greatest philosophers do not always attain perfect indifference, the Stoic *ultimatum*, is shown by the anecdote of one who dragged his pupil into court to make him pay his fee (9), and again by a violent quarrel with another at a banquet (11). Virtue is compared to a city with just and good and contented inhabitants; but so many offer themselves as guides to the right road to virtue that the inquirer is bewildered (26). What is truth, and who are the right teachers of it? The question is argued at length, and illustrated by a peculiar custom of watching the pairs of athletes and setting aside the reserved combatant (*πάρεδρος*) at the Olympian games by the marks on the ballots (40-43). This, it is argued, cannot be done till all the ballots have been examined; so a man cannot select the right way till he has tried all the ways to virtue. But to know the doctrines of all the sects is impossible in the term of a life (49). To take a taste of each, like trying a sample of wine, will not do, because the doctrines taught are not, like the crock of wine, the same throughout, but vary or advance day by day (59). A suggestion is made (68) that the searcher after truth should begin by taking lessons in the science of discrimination, so as to be a good judge of truth before testing the rival claims. But who is a good teacher of such a science? (70). The general conclusion is that philosophy is not worth the pursuit. "If I ever again," says Hermotimus, "meet a philosopher on the road, I will shun him, as I would a mad dog."

The *Anacharsis* is a dialogue between Solon and the Scythian philosopher, who has come to Athens to learn the nature of the Greek institutions. Seeing the young men performing athletic exercises in the Lyceum, he expresses his surprise at such a waste of energy. This gives Socrates an opportunity of descanting at length on training as a discipline, and emulation as a motive for excelling. Love of glory, Solon says, is one of the chief goods in life. The argument is rather ingenious and well put; the style reminds us of the minor essays of Xenophon.

The *Alexander* or *False Prophet* is the subject of a separate article (see ALEXANDER the PAPHLAGONIAN).

These are the chief of Lucian's works. Many others, *e.g.* *Prometheus*, *Menippus*, *Life of Demonax*, *Toxaris*, *Zeus Tragoedus*, *The Dream or the Cock*, *Icaromenippus* (an amusing satire on the physical philosophers), are of considerable literary value. (F. A. P.)

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LUCIFER (d. 370/1), bishop of Cagliari (hence called *Caralitanus*), an ardent supporter of the cause of Athanasius. After the unfavourable result of the synod of Arles in 353 he volunteered to endeavour to obtain a new and impartial council. He was accordingly sent by Pope Liberius, with Pancratius the presbyter and Hilarius the deacon, but could not prevent the condemnation of Athanasius, which was renewed at Milan in 355. For his own persistent adherence to the orthodox creed he was banished to Germanicia in Commagene; he afterwards lived at Eleutheropolis in Palestine, and finally in the upper Thebaid. His exile came to an end with the publication of Julian's edict in 362. From 363 until his death in 371 he lived at Cagliari in a state of voluntary separation from ecclesiastical fellowship with his former friends Eusebius of Vercelli, Athanasius and the rest, on account of their mild decision at the synod of Alexandria in 362 with reference to the treatment of those who had unwillingly Arianized under the persecutions of Constantius. Lucifer was hardly sufficiently educated to appreciate the real question at issue, and the sect which he thus founded did not continue long after his death. It is doubtful whether it ever formulated any distinctive doctrine; certainly it developed none of any importance. The memory of Lucifer is still cherished in Sardinia; but, although popularly regarded there as a saint, he has never been canonized.

The controversial writings of Lucifer, dating from his exile, are chiefly remarkable for their passionate zeal, and for the boldness and violence of the language addressed to the reigning emperor, whom he did not scruple to call the enemy of God and a second Saul, Ahab and Jeroboam. Their titles, in the most probable chronological order, are *De non parcendis in Deum delinquentibus*, *De regibus apostaticis*, *Ad Constantium Augustum pro Athanasio libri ii.*, *De non conveniendo cum haereticis* and *Moriendum esse pro Filio Dei*. Their quotations of Scripture are of considerable value to the critical student of the Latin text before Jerome. They were first collected and edited by Tilius (Paris, 1568); the best edition is that of W. Hartel in the Vienna *Corpus, Script. Eccl. Lat.* (1886). See also G. Krüger, *Lucifer Bischof von Cagliari und das Schisma der Luciferianer* (Leipzig, 1886); F. G. Kenyon, *Textual Criticism*, pp. 181, 221.

LUCIFER (the Latinized form of Gr. φωσφόρος, "light-bearer"), the name given to the "morning star," *i.e.* the planet Venus when it appears above the E. horizon before sunrise, and sometimes also to the "evening star," *i.e.* the same planet in the W. sky after sundown, more usually called Hesperus (*q.v.*). The term "day star" (so rendered in the Revised Version) was used poetically by Isaiah for the king of Babylon: "How art thou fallen from heaven, O Lucifer, son of the morning! how art thou cut down to the ground, which didst weaken the nations" (Is. xiv. 12, Authorized Version). The words ascribed to Christ in Luke x. 18: "I beheld Satan as lightning fall from heaven" (cf. Rev. ix. 1), were interpreted by the Christian Fathers as referring to the passage in Isaiah; whence, in Christian theology, Lucifer came to be regarded as the name of

Satan before his fall. This idea finds its most magnificent literary expression in Milton's *Paradise Lost*. In this sense the name is most commonly associated with the familiar phrase "as proud as Lucifer."

LUCILIUS, GAIUS (*c.* 180–103 B.C.), the earliest Roman satirist, of whose writings only fragments remain, was born at Suessa Aurunca in Campania. The dates assigned by Jerome for his birth and death are 148 and 103 or 102 B.C. But it is impossible to reconcile the first of these dates with other facts recorded of him, and the date given by Jerome must be due to an error, the true date being about 180 B.C. We learn from Velleius Paterculus that he served under Scipio at the siege of Numantia in 134. We learn from Horace that he lived on the most intimate terms of friendship with Scipio and Laelius, and that he celebrated the exploits and virtues of the former in his satires. Fragments of those books of his satires which seem to have been first given to the world (books xxvi.-xxix.) clearly indicate that they were written in the lifetime of Scipio. Some of these bring the poet before us as either corresponding with, or engaged in controversial conversation with, his great friend. One line—

Percrepa pugnam Popilli, facta Corneli cane—

in which the defeat of M. Popillius Laenas, in 138, is contrasted with the subsequent success of Scipio, bears the stamp of having been written while the news of the capture of Numantia was still fresh. It is in the highest degree improbable that Lucilius served in the army at the age of fourteen; it is still more unlikely that he could have been admitted into the familiar intimacy of Scipio and Laelius at that age. It seems a moral impossibility that between the age of fifteen and nineteen—*i.e.* between 133 and 129, the year of Scipio's death—he could have come before the world as the author of an entirely new kind of composition, and one which, to be at all successful, demands especially maturity of judgment and experience. It may further be said that the well-known words of Horace (*Satires*, ii. 1, 33), in which he characterizes the vivid portraiture of his life, character and thoughts, which Lucilius bequeathed to the world,

quo fit ut omnis
Votiva pateat veluti descripta tabella
Vita senis,[1]

lose much of their force unless *senis* is to be taken in its ordinary sense—which it cannot be if Lucilius died at the age of forty-six. He spent the greater part of his life at Rome, and died, according to Jerome, at Naples. Lucilius belonged to the equestrian order, a fact indicated by Horace's notice of himself as "infra Lucili censum." Though not himself belonging to any of the great senatorial families, he was in a position to associate with them on equal terms. This circumstance contributed to the boldness, originality and thoroughly national character of his literary work. Had he been a "semi-Graecus," like Ennius and Pacuvius, or of humble origin, like Plautus, Terence or Accius, he would scarcely have ventured, at a time when the senatorial power was strongly in the ascendant, to revive the rôle which had proved disastrous to Naevius; nor would he have had the intimate knowledge of the political and social life of his day which fitted him to be its painter. Another circumstance determining the bent of his mind was the character of the time. The origin of Roman political and social satire is to be traced to the same disturbing and disorganizing forces which led to the revolutionary projects and legislation of the Gracchi.

The reputation which Lucilius enjoyed in the best ages of Roman literature is proved by the terms in which Cicero and Horace speak of him. Persius, Juvenal and Quintilian vouch for the admiration with which he was regarded in the first century of the empire. The popularity which he enjoyed in his own time is attested by the fact that at his death, although he had filled none of the offices of state, he received the honour of a public funeral. His chief claim to distinction is his literary originality. He may be called the inventor of poetical satire, as he was the first to impress upon the rude inartistic medley, known to the Romans by the name of *satura*, that character of aggressive and censorious criticism of persons, morals, manners, politics, literature, &c. which the word satire has ever since denoted. In point of form the satire of Lucilius owed nothing to the Greeks. It was a legitimate development of an indigenous dramatic entertainment, popular among the Romans before the first introduction of the forms of Greek art among them; and it seems largely also to have employed the form of the familiar epistle. But the style, substance and spirit of his writings were apparently as original as the form. He seems to have commenced his poetical career by ridiculing and parodying the conventional language of epic and tragic poetry, and to have used the language commonly employed in the social intercourse of educated men. Even his frequent use of Greek words, phrases and quotations, reprehended by Horace, was probably taken from the actual practice of men, who found their own speech as yet inadequate to give free expression to the new ideas and impressions which they derived from their first contact with Greek philosophy, rhetoric and poetry. Further, he not only created a style of his own, but, instead of taking the substance of his writings from Greek poetry, or from a remote past, he treated of the familiar matters of daily life, of the politics, the wars, the administration of justice, the eating and drinking, the money-making and money-spending, the scandals and vices, which made up the public and private life of Rome in the last quarter of the 2nd century B.C. This he did in a singularly frank, independent and courageous spirit, with no private ambition to serve, or party cause to advance, but with an honest desire to expose the iniquity or incompetence of the governing body, the sordid aims of the middle class, and the corruption and venality of the city mob. There was nothing of stoical austerity or of rhetorical indignation in the tone in which he treated the vices and follies of his time. His character and tastes were much more akin to those of Horace than of either Persius or Juvenal. But he was what Horace was not, a thoroughly good hater; and he lived at a time when the utmost freedom of speech and the most unrestrained indulgence of public and private animosity were the characteristics of men who took a prominent part in affairs. Although Lucilius took no active part in the public life of his time, he regarded it in the spirit of a man of the world and of society, as well as a man of letters. His ideal of public virtue and private worth had been formed by intimate association with the greatest and best of the soldiers and statesmen of an older generation.

The remains of Lucilius extend to about eleven hundred, mostly unconnected lines, most of them preserved by late grammarians, as illustrative of peculiar verbal usages. He was, for his time, a voluminous as well as a very discursive writer. He left behind him thirty books of satires, and there is reason to believe that each book, like the books of Horace and Juvenal, was composed of different pieces. The order in which they were known to the grammarians was not that in which they were written. The earliest in order of composition were probably those numbered from xxvi. to xxix., which were written in the trochaic and iambic metres that had been employed by Ennius and Pacuvius in their *Saturae*. In these he made those criticisms on the older tragic and epic poets of which Horace and other ancient writers speak. In them too he speaks of the Numantine War as recently finished, and of Scipio as still living. Book i., on the other hand, in which the philosopher Carneades, who died in 128, is spoken of as dead, must have been written after the death of Scipio. Most of the satires of Lucilius were written in hexameters, but, so far as an opinion can be formed from a number of unconnected fragments, he seems to have written the trochaic tetrameter with a smoothness, clearness and simplicity which he never attained in handling the hexameter. The longer fragments produce the impression of great discursiveness and carelessness, but at the same time of considerable force. He appears, in the composition of his various pieces, to have treated everything that occurred to him in the most desultory fashion, sometimes adopting the form of dialogue, sometimes that of an epistle or an imaginary discourse, and often to have spoken in his own name, giving an account of his travels and adventures, or of amusing scenes that he had witnessed, or expressing the results of his private meditations and experiences. Like Horace he largely illustrated his own observations by personal anecdotes and fables. The fragments clearly show how often Horace has imitated him, not only in expression, but in the form of his satires (see for instance i. 5 and ii. 2), in the topics which he treats of, and the class of social vices and the types of character which he satirizes. For students of Latin literature, the chief interest of studying the fragments of Lucilius consists in the light which they throw on the aims and methods of Horace in the composition of his satires, and, though not to the same extent, of his epistles. They are important also as materials for linguistic study; and they have considerable historical value.

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[1] "And so it happens that the whole life of the old man stands clearly before us, as if it were represented on a votive picture."

Editions by F. D. Gerlach (1846), L. Müller (1872), C. Lachmann (1876, posthumous), F. Marx (1905); see also L. Müller, *Leben und Werke des Lucilius* (1876); "Luciliana," by H. A. J. Munro, in the *Journal of Philology*, vii. (1877); Mommsen, *Hist. of Rome*, bk. iv. ch. 13; "Luciliana," by A. E. Housman, in *Classical Quarterly* (April, 1907); C. Cichorius, *Untersuchungen zu Lucilius* (Berlin, 1908). (W. Y. S.; X.)

LUCILIUS JUNIOR, a friend and correspondent of the younger Seneca, probably the author of *Aetna*, a poem on the origin of volcanic activity, variously attributed to Virgil, Cornelius Severus (epic poet of the Augustan age) and Manilius. Its composition has been placed as far back as 44 B.C., on the ground that certain works of art, known to have been removed to Rome about that date, are referred to as being at a distance from the city. But as the author appears to have known and made use of the *Quaestiones Naturales* of Seneca (written A.D. 65), and no mention is made of the great eruption of Vesuvius (A.D. 79), the time of its composition seems to lie between these two dates. In favour of the authorship of Lucilius are the facts that he was a friend of Seneca and acquainted with his writings; that he had for some time held the office of imperial procurator of Sicily, and was thus familiar with the locality; that he was the author of a poem on Sicilian subjects. It is objected that in the 79th letter of Seneca, which is the chief authority on the question, he apparently asks that Lucilius should introduce the hackneyed theme of Aetna merely as an episode in his contemplated poem, not make it the subject of separate treatment. The sources of the Aetna are Posidonius of Apamea, and perhaps the pseudo-Aristotelian *De Mundo*, while there are many reminiscences of Lucretius. It has come down in a very corrupt state, and its difficulties are increased by the unpoetical nature of the subject, the straining after conciseness, and the obtrusive use of metaphor.

Editions by J. Scaliger (1595), F. Jacob (1826), H. A. J. Munro (1867), M. Haupt (in his edition of Virgil, 1873), E. Bährens (in *Poetae latini minores*, ii.), S. Sudhaus (1898), R. Ellis (1901, containing a bibliography of the subject); see also M. Haupt's *Opuscula*, i. 40, ii. 27, 162, iii. 437 (notes, chiefly critical); R. Ellis in *Journal of Philology*, xvi. 292; P. R. Wagler, *De Aetna poemate quaestiones criticae* (1884); B. Kruczkiewicz, *Poema de Aetna Monte* (1883, in which the ancient view of the authorship of Virgil is upheld); L. Alzinger, *Studia in Aetnam collata* (1896); R. Hildebrandt, *Beiträge zur Erklärung des Gedichtes Aetna* (1900); J. Vessereau (text, translation and commentary, 1905); Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans. §§ 307, 308).

LUCINA, goddess of light, a title given to Juno and Diana as presiding over childbirth and bringing children into the light of the world. The full name is *lucina dea*, "the light-bringing goddess" (*lux*, light, hence adj. *lucinus*). It is also given to Hecate (Tibullus 3. 4. 13), as the bringer of terrible dreams, and is used metaphorically as a synonym for child-birth (Virg. *Georg*. iii. 60; Ovid, *Ars. Amat*. iii. 785).

LUCIUS, the name of three popes.

LUCIUS I., pope for eight months (253–254), spent a short period of his pontificate in exile. He is referred to in several letters of Cyprian (see *Epist*. lxviii. 5) as having been in agreement with his predecessor Cornelius in preferring the milder view on the question as to how the lapsed penitent should be treated. He is commemorated on the 4th of March. (L. D.*)

LUCIUS II. (Gherardo Caccianemici dal Orso), pope from the 12th of March 1144 to the 15th of February 1145, a Bolognese, successively canon at his native city, cardinal priest of Sta Croce in Gerusalemme, treasurer of the Roman Church, papal legate in Germany for Honorius II., chancellor and librarian under Innocent II., was the successor of Celestine II. His stormy pontificate was marked by the erection of a revolutionary republic at Rome which sought to deprive the pope of his temporal power, and by the recognition of papal suzerainty over Portugal. He was succeeded by Eugenius III.

His letters are in J. P. Migne, *Patrol. Lat.* vol. 179. A single unreliable writer, Godfrey of Viterbo (in J. M. Watterich, *Pontif. Roman. Vitae*), is authority for the statement that Lucius II. perished in an attempt to storm the Capitol. See Jaffé-Wattenbach, *Regesta pontif. Roman.* (1885–1888); J. Langen, *Geschichte der römischen Kirche von Gregor VII. bis Innocenz III.* (Bonn, 1893); F. Gregorovius, *Rome in the Middle Ages*, vol. 4, trans. by Mrs G. W. Hamilton (London, 1896).

LUCIUS III. (Ubaldo Allucingoli), pope from the 1st of September 1181 to the 25th of November 1185, a native of Lucca and a Cistercian monk, named cardinal-priest of Sta Prassede by Innocent II. and cardinal-bishop of Ostia and Velletri by Adrian IV., succeeded Alexander III. He lived at Rome from November 1181 to March 1182, but dissensions in the city compelled him to pass the remainder of his pontificate in exile, mainly at Velletri, Anagni and Verona. He disputed with the emperor Frederick I. the disposal of the territories of the Countess Matilda. In November 1184 he held a synod at Verona which condemned the Cathari, Paterines, Waldensians and Arnoldists, and anathematized all heretics and their abettors. Lucius died in the midst of preparations for a crusade in answer to appeals of Baldwin IV. of Jerusalem. His successor was Urban III.

His letters are in J. P. Migne, *Patrol. Lat.* vol. 201. Consult J. M. Watterich, *Pontif. Roman. Vitae*, vol. 2 (Leipzig, 1862); and Jaffé-Wattenbach, *Regesta Pontif. Roman.* (1885–1888). See J. Langen, *Geschichte der römischen Kirche von Gregor VII. bis Innocenz III.* (Bonn, 1893); F. Gregorovius, *Rome in the Middle Ages*, vol. 4, trans. by Mrs G. W. Hamilton (London, 1896); P. Scheffer-Boichorst, "Zu den mathildinischen Schenkungen," in *Mittheilungen des österreichen Instituts* (1888). (C. H. HA.)

LUCK, a term for good or bad fortune, the unforeseen or unrecognized causes which bring success or failure in any enterprise, particularly used of the result of chances in games of skill or chance (see PROBABILITY). The word does not occur in English before the 16th century. It was taken from the Low Ger. *luk*, a shortened form of *geluk*, cf. Modern Ger. *Glück*, happiness, good fortune. The *New English Dictionary* considers the word to have been introduced from the Low Countries as a gambling term. The ultimate origin is doubtful; it has been connected with the German *gelingen*, to succeed (cf. *Druck*, pressure, from *dringen*), or with *locken*, to entice.

At Eden Hall in Cumberland, the seat of the Musgrave family, has been long preserved a vessel known as "the luck," supposed to be of Venetian or Byzantine make, and dating from the 10th century. It is a chalice of enamelled glass, and on its safe preservation the fortunes of the Musgrave family are supposed to depend, in accordance with the rhyme:—

"Should this cup either break or fall,
Farewell the luck of Edenhall."

LÜCKE, GOTTFRIED CHRISTIAN FRIEDRICH (1791–1855), German theologian, was born on the 24th of August 1791, at Egeln near Magdeburg, where his father was a merchant. He studied theology at Halle and Göttingen. In 1813 he became *repetent* at Göttingen, and in 1814 he received the degree of doctor in philosophy from Halle; in 1816 he removed to Berlin, where he became licentiate in theology, and qualified as *privatdocent*. He soon became intimate with Schleiermacher and de Wette, and was associated with them in 1819 in the redaction of the *Theologische Zeitschrift*. Meanwhile his lectures and publications (among the latter a *Grundriss der Neutestamentlichen Hermeneutik*, 1816) had brought him into considerable repute, and he was appointed professor extraordinarius in the new university of Bonn in the spring of 1818; in the following autumn he became professor ordinarius. From Bonn, where he had J. C. W. Augusti (1772–1841), J. K. L. Gieseler, and Karl Immanuel Nitzsch for colleagues, he was called in 1827 to Göttingen to succeed K. F. Stäudlin (1761–1826). In that year he helped to found the *Theologische Studien und Kritiken*, the chief organ of the "mediation" theology (*Vermittelungstheologie*). At Göttingen he remained, declining all further calls elsewhere, as to Erlangen, Kiel, Halle, Tübingen, Jena and Leipzig, until his death, which occurred on the 4th of February 1855.

Lücke, who was one of the most learned, many-sided and influential of the so-called "mediation" school of evangelical theologians (*Vermittelungstheologie*), is now chiefly known by his *Kommentar über die Schriften d. Evangelisten Johannes* (4 vols., 1820–1832); it has since passed through two new and improved editions (the last volume of the 3rd edition by E. Bertheau, 1856). He is an intelligent maintainer of the Johannine authorship of the Fourth Gospel; in connexion with this thesis he was one of the first to argue for the early date and non-apostolic authorship of the Apocalypse. His *Einleitung in die Offenbarung Johannis* was published in 1832 (2nd ed., 1848–1852). He also published a *Synopsis Evangeliorum*, conjointly with W. M. L. de Wette (1818, 2nd ed., 1840). See Herzog-Hauck, *Realencyklopädie*.

LUCKENWALDE, a town in the Prussian province of Brandenburg, on the Nuthe, 30 m. S. of Berlin, on the main line to Dresden and Leipzig. Pop. (1905) 22,263. Its cloth and wool manufactories are among the most extensive in Prussia. Among its other industries are cotton printing and dye works, brewing, and the making of metal and bronze goods.

The site of Luckenwalde was occupied in the 12th century by a Cistercian monastery, but the village did not spring up till the reign of Frederick the Great. It was made a town in 1808.

LUCKNOW, a city, district and division of British India. The city was the capital of Oudh from 1775 until it was merged in the United Provinces in 1901. Pop. (1901) 264,049. It lies mainly on the right bank of the winding river Gumti, which is crossed by two railway and three road bridges. It contains the Canning college (1864), with an Oriental department, and La Martinière college, where about 100 boys are educated, the institution being in part supported by an endowment left by General Claude Martin in 1800. There are native manufactures of gold and silver brocade, muslins, embroidery, brass and copper wares, pottery and moulding in clay. There are also important European industrial establishments, such as iron-works and paper-mills. Lucknow is the centre of the Oudh and Rohilkhand railway system, with large workshops. Lines radiate to Cawnpore, Bareilly, Gonda, Fyzabad and Rae Bareli. Lucknow is the headquarters of the 8th division of the northern army. The cantonments are situated 3 m. E. of the city.

Lucknow is chiefly notable in the history of British India as the capital of the nawabs who had dealings with Warren Hastings, and their successors the kings of Oudh, whose deposition by Lord Dalhousie was one of the chief causes of the Mutiny. Amongst the events of the Mutiny the defence of the residency of Lucknow comes only second in historic interest to the massacre at Cawnpore itself. For the two sieges, see INDIAN MUTINY. The name of the residency is now applied not only to the residency itself, but to the whole of the outbuildings and entrenchments in which Sir Henry Lawrence concentrated his small force. These entrenchments covered almost 60 acres of ground, and consisted of a number of detached houses, public edifices, outhouses and casual buildings, netted together, and welded by ditches, parapets, stockades and batteries into one connected whole. On the summit of the plateau stands the residency proper, the official residence of the chief commissioner, a lofty building three storeys high, with a fine portico. Near the residency comes the banqueting hall, and beyond the Baillie Guardgate lie the ruins of the surgeon's house, where Sir Henry Lawrence died of a shell-wound, and where the ladies of the garrison were sheltered in underground rooms. Round the line of the entrenchments are pillars marked with the name of the various "posts" into which the garrison was distributed. The most dangerous of these was the Cawnpore battery post, where the stockade was directly exposed to the enemy's fire. The mutineers had rifles fixed in rests in the house opposite, and swept the road that led through the residency enclosure at this point. Close to the residency is the Lawrence Memorial, an artificial mound 30 ft. high crowned by a marble cross.

Among the other buildings of interest in Lucknow is the Imambara, which is one of the largest rooms in the world (162 ft. by 54), having an arched roof without supports. This room was built by the Nawab Asaf-ud-dowlah in 1784, to afford relief to the famine-stricken people. The many monuments of his reign include his country palace of Bibiapur, outside the city. Among later buildings are the two palaces of Chhattar Manzil, erected for the wives of Ghazi-ud-din Haidar (1814), the remains of the Farhat Baksh, dating from the previous reign, and adjoining the greater Chhattar Manzil, the observatory (now a bank) of Nasir-ud-din Haidar (1827), the imambara or mausoleum and the unfinished great mosque (Jama Masjid) of Mahommed Ali Shah (1837), and the huge debased Kaisar Bagh, the palace of Wajid Ali Shah (1847–1856).

The DISTRICT OF LUCKNOW lies on both sides of the river Gumti, and has an area of 967 sq. m. Its general aspect is that of an open champaign, well studded with villages, finely wooded and in parts most fertile and highly cultivated. In the vicinity of rivers, however, stretch extensive barren sandy tracts (*bhúr*), and there are many wastes of saline efflorescence (*usár*). The country is an almost dead level, the average slope, which is from N.W. to S.E., being less than a foot per mile. The principal rivers are the Gumti and the Sai with their tributaries. The population in 1901 was 793,241, showing an increase of 2·5% in the preceding decade.

The DIVISION OF LUCKNOW contains the western half of the old province of Oudh. It comprises the six districts of Lucknow, Unao, Sitapur, Rae Bareli, Hardoi and Kheri. Its area is 12,051 sq. m. and its population in 1901 was 5,977,086, showing an increase of 2·06% in the decade.

See *Lucknow District Gazetteer* (Allahabad, 1904). For a fuller description of the city see G. W. Forrest, *Cities of India* (1903).

LUÇON, a town of western France, in the department of Vendée, 23 m. S.E. of La Roche-sur-Yon, on the railway from Nantes to Bordeaux, and on the canal of Luçon (9 m. long), which affords communication with the sea in the Bay of Aiguillon. Pop. (1906) 6163. Between Luçon and the sea stretch marshy plains, the bed of the former gulf, partly drained by numerous canals, and in the reclaimed parts yielding excellent pasturage, while in other parts are productive salt-marshes, and ponds for the rearing of mussels and other shell-fish. Luçon is the seat of a bishopric, established in 1317, and held by Richelieu from 1607 to 1624. The cathedral, partly of the 12th-century and partly of later periods, was originally an abbey church. The façade and the clock tower date from about 1700, and the tower is surmounted by a crocketed spire rising 275 ft. above the ground, attributed to the architect François Leduc of Tuscany. The cloisters are of the late 15th century. Adjacent is the bishop's palace, possessing a large theological library and Titian's "Disciples of Emmaus," and there is a fine public garden. A communal college and an ecclesiastical seminary are among the public institutions. During the Vendean wars, Luçon was the scene of several conflicts, notably in 1793.

LUCRE (Lat. *lucrum*, gain; the Indo-European root is seen in Gr. ἀπολαύειν, to enjoy, and in Ger. *Lohn*, wages), a term now only used in the disparaging sense of unworthy profit, or money that is the object of greed, especially in the expression "filthy lucre" (1 Tim. iii. 3). In the adjective "lucrative," profitable, there is, however, no sense of disparagement. In Scots law the term "lucrative succession" (*lucrativa acquisitio*) is used of the taking by an heir, during the lifetime of his ancestor, of a free grant of any part of the heritable property.

LUCRETIA, a Roman lady, wife of Lucius Tarquinius Collatinus, distinguished for her beauty and domestic virtues. Having been outraged by Sextus Tarquinius, one of the sons of Tarquinius Superbus, she informed her father and her husband, and, having exacted an oath of vengeance from them, stabbed herself to death. Lucius Junius Brutus, her husband's cousin, put himself at the head of the people, drove out the Tarquins, and established a republic. The accounts of this tradition in later writers present many points of divergence.

Livy i. 57-59; Dion. Halic. iv. 64-67, 70, 82; Ovid, *Fasti*, ii. 721-852; Dio Cassius, frag. 11 (Bekker); G. Cornewall Lewis, *Credibility of Early Roman History*, i.

LUCRETILIS MONS, a mountain of the Sabine territory, mentioned by Horace (*Od*. i. 17, 1) as visible from his Sabine farm, and probably identical with the "Mons Lucretius" mentioned in the *Liber Pontificalis* (ed. Duchesne, i. 183), which speaks of "possessio in territorio Sabinensi quae cognominatur ad duas casas sub monte Lucretio" in the time of Constantine. The name "ad duas casas" is supposed to survive in the chapel of the Madonna della Casa near Rocca Giovane, and the Mons Lucretilis is generally (and rightly) identified with Monte Gennaro, a limestone peak 4160 ft. high, which forms a prominent feature in the view N.E. of Rome. Excavations on the supposed site of Horace's farm were begun by Professor Pasqui in September 1909. (T. As.)

LUCRETIUS (Titus Lucretius Carus) (*c.* 98–55 B.C.), the great Latin didactic poet. Our sole information concerning his life is found in the brief summary of Jerome, written more than four centuries after the poet's death. Jerome followed, often carelessly, the accounts contained in the lost work of Suetonius *De Viris Illustribus*, written about two centuries after the death of Lucretius; and, although it is likely that Suetonius used the information transmitted by earlier grammarians, there is nothing to guide us to the original sources. According to this account the poet was born in 95 B.C.; he became mad in consequence of the administration of a love-philtre; and after composing several books in his lucid intervals, which were subsequently corrected by Cicero, he died by his own hand in the forty-fourth year of his age. Donatus states in his life of Virgil, a work also based on the lost work of Suetonius, that Lucretius died on the same day on which Virgil assumed the *toga virilis*, that is, in the seventeenth year of Virgil's life, and on the very day on which he was born, and adds that the consuls were the same, that is Cn. Pompeius Magnus and M. Licinius Crassus, consuls in 70 and again in 55. The statements cannot be perfectly reconciled; but we may say with certainty that Lucretius was born between 98 and 95 B.C., and died in 55 or 54. A single mention of his poem, the *De rerum natura* (which from the condition in which it has reached us may be assumed to have been published posthumously) in a letter of Cicero's to his brother Quintus, written early in 54 B.C., confirms the date given by Donatus as that of the poet's death. The statements of Jerome have been questioned or disbelieved on the ground of their intrinsic improbability. They have been regarded as a fiction invented later by the enemies of Epicureanism, with the view of discrediting the most powerful work ever produced by any disciple of that sect. It is more in conformity with ancient credulity than with modern science to attribute a permanent tendency to derangement to the accidental administration of any drug, however potent. A work characterized by such strength, consistency and continuity of thought is not likely to have been composed "in the intervals of madness" as Jerome says. Donatus, in mentioning the poet's death, gives no hint of the act of suicide. The poets of the Augustan age, who were deeply interested both in his philosophy and in his poetry, are entirely silent about the tragical story of his life. Cicero, by his professed antagonism to the doctrines of Epicurus, by his inadequate appreciation of Lucretius himself and by the indifference which he shows to other contemporary poets, seems to have been neither fitted for the task of correcting the unfinished work of a writer whose genius was so distinct from his own, nor likely to have cordially undertaken such a task.

Yet these considerations do not lead to the absolute rejection of the story. The evidence afforded by the poem rather leads to the conclusion that the tradition contains some germ of fact. It is remarkable that in more than one passage of his poem Lucretius writes with extraordinary vividness of the impression produced both by dreams and by waking visions. It is true that the philosophy of Epicurus put great stress on these, as affording the explanation of the origin of supernatural beliefs. But the insistence with which Lucretius returns to the subject, and the horror with which he recalls the effects of such abnormal phenomena, suggest that he himself may have been liable to such hallucinations, which are said to be consistent with perfect sanity, though they may be the precursors either of madness or of a state of despair and melancholy. Other passages, where he describes himself as ever engaged, even in his dreams, on his task of inquiry and composition, produce the impression of an unrelieved strain of mind and feeling, which may have ended in some extreme reaction of spirit, or in some failure of intellectual power, that may have led him to commit suicide. But the strongest confirmation of the tradition is the unfinished condition in which the poem has reached us. The subject appears indeed to have been fully treated in accordance with the plan sketched out in the introduction to the first book. But that book is the only one which is finished in style and in the arrangement of its matter. In all the others, and especially in the last three, the continuity of the argument is frequently broken by passages which must have been inserted after the first draft of the arguments was written out. Thus, for instance, in his account of the transition from savage to civilized life, he assumes at v. 1011 the discovery of the use of skins, fire, &c., and the first beginning of civil society, and proceeds at 1028 to explain the origin of language, and then again returns, from 1090 to 1160, to speculate upon the first use of fire and the earliest stages of political life. These breaks in continuity show what might also be inferred from frequent repetitions of lines which have appeared earlier in the poem, and from the rough workmanship of passages in the later books, that the poem could not have received the final revision of the author. Nor is there any great difficulty in believing that Cicero edited it; the word "emendavit," need not mean more than what we call "preparing for press."

From the absence of any claim on the part of any other district of Italy to the honour of having given birth to Lucretius it is inferred that he was of purely Roman origin. No writer certainly is more purely Roman in personal character and in strength of understanding. His silence on the subject of Roman greatness and glory as contrasted with the prominence of these subjects in the poetry of men of provincial birth such as Ennius, Virgil and Horace, may be explained by the principle that familiarity had made the subject one of less wonder and novelty to him. The Lucretian *gens* to which he belonged was one of the oldest of the great Roman houses, nor do we hear of the name, as we do of other great family names, as being diffused over other parts of Italy, or as designating men of obscure or servile origin. It may well be assumed that Lucretius was a member of the Roman aristocracy, belonging either to a senatorian or to one of the great equestrian families. If the Roman aristocracy of his time had lost much of the virtue and of the governing qualities of their ancestors, they showed in the last years before the establishment of monarchy a taste for intellectual culture which might have made Rome as great in literature as in arms and law. A new taste for philosophy had developed among members of the governing class during the youth of Lucretius, and eminent Greek teachers of the Epicurean sect settled at Rome at the same time, and lived on terms of intimacy with them. The inference that Lucretius belonged to this class is confirmed by the tone in which he addresses Gaius Memmius, a man of an eminent senatorian family, to whom the poem is dedicated. His tone is quite unlike that in which Virgil or even Horace addresses Maecenas. He addresses him as an equal; he expresses sympathy with the prominent part he played in public life, and admiration for his varied accomplishments, but on his own subject claims to speak to him with authority.

Although our conception of the poet's life is necessarily vague and meagre, yet his personal force is so remarkable and so vividly impressed on his poem, that we seem able to form a consistent idea of his qualities and characteristics. We know, for example, that the choice of a contemplative life was not the result of indifference to the fate of the world, or of any natural coldness or even calmness of temperament. In the opening lines of the second and third books we can mark the recoil of a humane and sensitive spirit from the horrors of the reign of terror which he witnessed in his youth, and from the anarchy and confusion which prevailed at Rome during his later years. We may also infer that he had not been through his whole career so much estranged from the social life of his day as he seems to have been in his later years. Passages in his poem attest his familiarity with the pomp and luxury of city life, with the attractions of the public games and with the pageantry of great military spectacles. But much the greater mass of the illustrations of his philosophy indicate that, while engaged on his poem he must have passed much of his time in the open air, exercising at once the keen observation of a naturalist and the contemplative vision of a poet. He seems to have found a pleasure, more congenial to the modern than to the ancient temperament, in ascending mountains or wandering among their solitudes (vi. 469, iv. 575). References to companionship in these wanderings, and the well-known description of the charm of a rustic meal (ii. 29) speak of kindly sociality rather than of any austere separation from his fellows.

Other expressions in his poem (*e.g.* iii. 10, &c.) imply that he was also a student of books. Foremost among these were the writings of Epicurus; but he had also an intimate knowledge of the philosophical poem of Empedocles, and at least an acquaintance with the works of Democritus, Anaxagoras, Heraclitus, Plato and the Stoical writers. Of other Greek prose writers he knew Thucydides and Hippocrates; while of the poets he expresses in more than one passage the highest admiration of Homer, whom he imitated in several places. Next to Homer Euripides is most frequently reproduced by him. But his poetical sympathy was not limited to the poets of Greece. For his own countryman Ennius he expresses an affectionate admiration; and he imitates his language, his rhythm and his manner in many places. The fragments of the old tragedian Pacuvius and of the satirist Lucilius show that Lucretius had made use of their expressions and materials. In his studies he was attracted by the older writers, both Greek and Roman, in whose masculine temperament and understanding he recognized an affinity with his own.

His devotion to Epicurus seems at first sight more difficult to explain than his enthusiasm for Empedocles or Ennius. Probably he found in his calmness of temperament, even in his want of imagination, a sense of rest and of exemption from the disturbing influences of life; while in his physical philosophy he found both an answer to the questions which perplexed him and an inexhaustible stimulus to his intellectual curiosity. The combative energy, the sense of superiority, the spirit of satire characteristic of him as a Roman, unite with his loyalty to Epicurus to render him not only polemical but intolerant and contemptuous in his tone toward the great antagonists of his system, the Stoics, whom, while constantly referring to them, he does not condescend even to name. With his admiration of the genius of others he combines a strong sense of his own power. He is quite conscious of the great importance and of the difficulty of his task; but he feels his own ability to cope with it.

It is more difficult to infer the moral than the intellectual characteristics of a great writer from the personal impress left by him on his work. Yet it is not too much to say that there is no work in any literature that produces a profounder impression of sincerity. No writer shows a juster scorn of all mere rhetoric and exaggeration. No one shows truer courage, not marred by irreverence, in confronting the great problems of human destiny, or greater strength in triumphing over human weakness. No one shows a truer humanity and a more tender sympathy with natural sorrow.

The peculiarity of the poem of Lucretius, that which makes it unique in literature, is that it is a reasoned system of philosophy written in verse. The prosaic title *De Rerum Natura*, a translation of the Gr. περὶ φύσεως, implies the subordination of the artistic to a speculative motive. As in the case of nearly all the great works of Roman literary genius, the form of the poem was borrowed from the Greeks. The rise of speculative philosophy in Greece was coincident with the beginning of prose composition, and many of the earliest philosophers wrote in the prose of the Ionic dialect; others, however, and especially the writers of the Greek colonies in Italy and Sicily, expounded their systems in continuous poems composed in the epic hexameter. Most famous in connexion with this kind of poetry are Xenophanes and Parmenides, the Eleatics and Empedocles of Agrigentum. The last was less important as a philosopher, but greater than the others both as a poet and a physicist. On both of these grounds he had a greater attraction to Lucretius. The fragments of the poem of Empedocles show that the Roman poet regarded that work as his model. In accordance with this model he has given to his own poem the form of a personal address, he has developed his argument systematically, and has applied the sustained impetus of epic poetry to the treatment of some of the driest and abstrusest topics. Many ideas and expressions of the Sicilian have been reproduced by the Roman poet; and the same tone of impassioned solemnity and melancholy seems to have pervaded both works. But Lucretius, if less original as a thinker, was probably a much greater poet than Empedocles. What chiefly distinguishes him from his Greek prototypes is that his purpose is rather ethical than purely speculative; the zeal of a teacher and reformer is more strong in him than even the intellectual passion of a thinker. His speculative ideas, his moral teaching and his poetical power are indeed interdependent on one another, and this interdependence is what mainly constitutes their power and interest. But of the three claims which he makes to immortality, the importance of his subject, his desire to liberate the mind from the bonds of superstition and the charm and lucidity of his poetry—that which he himself regarded as supreme was the second. The main idea of the poem is the irreconcilable opposition between the truth of the laws of nature and the falsehood of the old superstitions. But, further, the happiness and the dignity of life are regarded by him as absolutely dependent on the acceptance of the true and the rejection of the false doctrine. In the Epicurean system of philosophy he believed that he had found the weapons by which this war of liberation could be most effectually waged. Following Epicurus he sets before himself the aim of finally crushing that fear of the gods and that fear of death resulting from it which he regards as the source of all the human ills. Incidentally he desires also to purify the heart from other violent passions which corrupt it and mar its peace. But the source even of these—the passions of ambition and avarice—he finds in the fear of death; and that fear he resolves into the fear of eternal punishment after death.

The selection of his subject and the order in which it is treated are determined by this motive. Although the title of the poem implies that it is a treatise on the "whole nature of things," the aim of Lucretius is to treat only those branches of science which are necessary to clear the mind from the fear of the gods and the terrors of a future state. In the two earliest books, accordingly, he lays down and largely illustrates the first principles of being with the view of showing that the world is not governed by capricious agency, but has come into existence, continues in existence, and will ultimately pass away in accordance with the primary conditions of the elemental atoms which, along with empty space, are the only eternal and immutable substances. These atoms are themselves infinite in number but limited in their varieties, and by their ceaseless movement and combinations during infinite time and through infinite space the whole process of creation is maintained. In the third book he applies the principles of the atomic philosophy to explain the nature of the mind and vital principle, with the view of showing that the soul perishes with the body. In the fourth book he discusses the Epicurean doctrine of the images, which are cast from all bodies, and which act either on the senses or immediately on the mind, in dreams or waking visions, as affording the explanation of the belief in the continued existence of the spirits of the departed. The ~~fifth book~~, which has the most general interest, professes to explain the process by which the earth, the sea, the sky, the sun, moon and stars, were formed, the origin of life, and the gradual advance of man from the most savage to the most civilized condition. All these topics are treated with the view of showing that the world is not itself divine nor directed by divine agency. The ~~sixth book~~ is devoted to the explanation, in accordance with natural causes, of some of the more abnormal phenomena, such as thunderstorms, volcanoes, earthquakes, &c., which are special causes of supernatural terrors.

The consecutive study of the argument produces on most readers a mixed feeling of dissatisfaction and admiration. They are repelled by the dryness of much of the matter, the unsuitableness of many of the topics discussed for poetic treatment, the arbitrary assumption of premises, the entire failure to establish the connexion between the concrete phenomena which the author professes to explain and these assumptions, and the erroneousness of many of the doctrines which are stated with dogmatic confidence. On the other hand, they are constantly impressed by his power of reasoning both deductively and inductively, by the subtlety and fertility of invention with which he applies analogies, by the clearness and keenness of his observation, by the fulness of matter with which his mind is stored, and by the consecutive force, the precision and distinctness of his style, when employed in the processes of scientific exposition. The first two books enable us better than anything else in ancient literature to appreciate the boldness and, on the whole, the reasonableness of the ancient mind in forming hypotheses on great matters that still occupy the investigations of physical science. The third and fourth books give evidence of acuteness in psychological analysis; the fourth and sixth of the most active and varied observation of natural phenomena; the fifth of original insight and strong common sense in conceiving the origin of society and the progressive advance of man to civilization. But the chief value of Lucretius as a thinker lies in his firm grasp of speculative ideas, and in his application of them to the interpretation of human life and nature. All phenomena, moral as well as material, are contemplated by him in their relation to one great organic whole, which he acknowledges under the name of "Natura daedala rerum," and the most beneficent manifestations of which he seems to symbolize and almost to deify in the "Alma Venus," whom, in apparent contradiction to his denial of a divine interference with human affairs, he invokes with prayer in the opening lines of the poem. In this conception of nature are united the conceptions of law and order, of ever-changing life and interdependence, of immensity, individuality, and all-pervading subtlety, under which the universe is apprehended both by his intelligence and his imagination.

Nothing can be more unlike the religious and moral attitude of Lucretius than the old popular conception of him as an atheist and a preacher of the doctrine of pleasure. It is true that he denies the doctrines of a supernatural government of the world and of a future life. But his arguments against the first are really only valid against the limited and unworthy conceptions of divine agency involved in the ancient religions; his denial of the second is prompted by his vital realization of all that is meant by the arbitrary infliction of eternal torment after death. His war with the popular beliefs of his time is waged, not in the interests of licence, but in vindication of the sanctity of human feeling. The cardinal line of the poem,

"Tantum religio potuit suadere malorum,"

is elicited from him as his protest against the sacrifice of Iphigenia by her father. But in his very denial of a cruel, limited and capricious agency of the gods, and in his imaginative recognition of an orderly, all-pervading, all-regulating power, we find at least a nearer approach to the higher conceptions of modern theism than in any of the other imaginative conceptions of ancient poetry and art. But his conception even of the ancient gods and of their indirect influence on human life is more worthy than the popular one. He conceives of them as living a life of eternal peace and exemption from passion, in a world of their own; and the highest ideal of man is, through the exercise of his reason, to realize an image of this life. Although they are conceived of as unconcerned with the interest of our world, yet influences are supposed to emanate from them which the human heart is capable of receiving and assimilating. The effect of unworthy conceptions of the divine nature is that they render a man incapable of visiting the temples of the gods in a calm spirit, or of receiving the emanations that "announce the divine peace" in peaceful tranquillity. The supposed "atheism" of Lucretius proceeds from a more deeply reverential spirit than that of the majority of professed believers in all times.

His moral attitude is also far removed from that of ordinary ancient Epicureanism or of modern materialism. Though he acknowledges pleasure to be the law of life, yet he is far from regarding its attainment as the end of life. What man needs is not enjoyment, but "peace and a pure heart." The victory to be won by man is the triumph over fear, ambition, passion, luxury. With the conquest over these nature herself supplies all that is needed for happiness. Self-control and renunciation are the lessons which he preaches.

It has been doubted whether Cicero,[1] in his short criticism in the letter already referred to, concedes to Lucretius both the gifts of genius and the accomplishment of art or only one of them. Readers of a later time, who could compare his work with the finished works of the Augustan age, would certainly disparage his art rather than his power. But with Cicero it was different. He greatly admired, or professed to admire, the genius of the early Roman poets, while he shows indifference to the poetical genius of his younger contemporaries. Yet he could not have been insensible to the immense superiority in rhythmical smoothness which the hexameter of Lucretius has over that of Ennius and Lucilius. And no reader of Lucretius can doubt that he attached the greatest importance to artistic execution, and that he took a great pleasure, not only in "the long roll of his hexameter," but also in producing the effects of alliteration, assonance, &c., which are so marked a peculiarity in the style of Plautus and the earlier Roman poets. He allows his taste for these tricks of style to degenerate into mannerism. And this is the only drawback to the impression of absolute spontaneity which his style produces. He was unfortunate in living before the natural rudeness of Latin art had been successfully grappled with. His only important precursors in serious poetry were Ennius and Lucilius, and, though he derived from the first of these an impulse to shape the Latin tongue into a fitting vehicle for the expression of elevated emotion and imaginative conception, he could find in neither a guide to follow in the task he set before himself. The difficulty and novelty of his task enhances our sense of his power. His finest passages are thus characterized by a freshness of feeling and enthusiasm of discovery. But the result of these conditions and of his own inadequate conception of the proper limits of his art is that his best poetry is clogged with a great mass of alien matter, which no treatment in the world could have made poetically endurable. (W. Y. S.)

Authorities.—The two most ancient manuscripts of Lucretius, O and Q, are both at Leiden, one being a folio (*oblongus*) and the other a quarto (*quadratus*). Upon these alone the modern texts are founded. The scientific editing of the text began with C. C. Lachmann (1852) whose work still holds the field. The most important commentary is that of H. A. J. Munro (4th ed., 1886) with a prose translation. For the earlier editions it is sufficient to refer to the account in Munro's *Introduction*, vol. i. pp. 3 sqq. Giussani's complete edition (with Italian notes, 1896) and R. Heinze's edition of book iii. (1897) are also of value. So too are A. Brieger's numerous contributions in German periodicals and his text in the Teubner series (2nd ed., 1899).

The philosophy of Lucretius has been much studied in recent times. Amongst special treatises may be mentioned K. H. Usener's *Epicurea* (1887); J. Woltjer's *Lucretii philosophia cum fontibus comparata* (1877); John Masson's *Atomic Theory of Lucretius* (1884) and *Lucretius: Epicurean and Poet* (1909); and several papers and treatises by Brieger and Giussani.

On the characteristics of the poet as a whole, C. Martha's *Le Poème de Lucrèce* (4th ed., Paris, 1885) and W. Y. Sellar in chaps. xi. sqq. of the *Roman Poets of the Republic*, may be consulted. There are useful bibliographies in W. S. Teuffel's *History of Roman Literature* (English trans. by G. C. W. Warr) and Martin v. Schanz's *Geschichte der römischen Litteratur*.

The following translations into English verse are known: T. Creech (1683), J. M. Good (1805), T. Busby (1813), C. F. Johnson (New York, 1872), T. C. Baring (1884). There is also a translation by Cyril Bailey (Oxford, 1910).

LUCRINUS LACUS, or Lucrine Lake, a lake of Campania, Italy, about ½ m. to the N. of Lake Avernus, and only separated from the sea (Gulf of Pozzuoli) by a narrow strip of land, traversed by the coast road, Via Herculanea, which runs on an embankment, the construction of which was traditionally attributed to Heracles in Strabo's time—and the modern railway. Its size has been much reduced by the rise of the crater of the Montenuovo in 1538. Its greatest depth is about 15 ft. In Roman days its fisheries were important and were let out by the state to contractors. Its oyster-beds were, as at the present day, renowned; their foundation is attributed to one Sergius Orata, about 100 B.C. It was also in favour as a resort for pleasure excursions from Baiae (cf. Martial i. 63), and its banks were covered with villas, of which the best known was Cicero's Academia, on the E. bank. The remnants of this villa, with the village of Tripergola, disappeared in 1538.

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[1] *Ad Q. Fratr.* ii. 9 (11), 13. Both sense and words have been much disputed. The general sense is probably that given by the following restoration, "Lucretii poemata, ut scribis, ita sunt multis hominibus ingenii multae etiam (MSS. tamen) artis, sed cum *ad umbilicum* (omitted in MSS.) veneris, virum te putabo, si Sallustii Empedoclea legeris, hominem non putabo." This would concede Lucretius both genius and art, but imply at the same time that he was not easy reading.

See J. Beloch, *Campanien*, ed. 2 (Breslau, 1890), 172.

LUCULLUS, the name of a Roman plebeian family of the Licinian *gens*. By far the most famous of its members was Lucius Licinius Lucullus (*c.* 110–56), surnamed Ponticus from his victories in Asia Minor over Mithradates VI. of Pontus. His father, of the same name, had held an important military command in Sicily, but on his return to Rome he was prosecuted on a charge of bribery and condemned to exile. His mother was Caecilia, of the family of the Metelli, and sister of Quintus Caecilius Metellus Numidicus. Early in life he attached himself to the party of Sulla, and to that party he remained constant. He attracted Sulla's notice in the Social War (90) and in 88, when Sulla was appointed to the command of the war against Mithradates, accompanied him as quaestor to Greece and Asia Minor. While Sulla was besieging Athens, Lucullus raised a fleet and drove Mithradates out of the Mediterranean. He won a brilliant victory off Tenedos, and had he been more of a patriot and less of a party man he might have ended a perilous war. In 84 peace was concluded with Mithradates. Sulla returned to Rome, while Lucullus remained in Asia, and by wise and generous financial reforms laid the foundation of the prosperity of the province. The result of his policy was that he became extremely popular with the provincials, but offended many of the *publicani*, a powerful class which farmed the public revenue. In 80 he returned to Rome as curule aedile, in which capacity he exhibited games of exceptional magnificence. Soon afterwards (77) he was elected praetor, and was next appointed to the province of Africa, where he again won a good name as a just and considerate governor. In 74 he became consul, and went to Asia at the head of about 30,000 foot and 2000 horse, to defend the province of Bithynia against Mithradates, who was besieging his colleague, Marcus Aurelius Cotta, in Chalcedon on the Propontis. Mithradates was forced to retire along the sea-coast till he halted before the strong city of Cyzicus, which he besieged. Lucullus, however, cut off his communications on the land side, and, aided by bad weather, forced him to raise the siege. In the autumn of 73 Lucullus marched to Cabeira or Neocaesarea, where the king had gone into winter quarters with a vague hope that his son-in-law, Tigranes, king of Armenia, and possibly even the Parthians, might come to his aid. Although the forces of Mithradates were far superior in numbers, his troops were no match for the Roman legionaries. A large detachment of his army having been cut up by one of Lucullus's lieutenant-generals, the king decided on instant retreat. The retreat soon became a disorderly flight, Mithradates himself escaping with difficulty into Lesser Armenia.

Thus Pontus, with the exception of some of the maritime cities, such as Sinope, Heraclea and Amisus, became Roman territory. Two years were occupied in the capture of these strongholds, while Lucullus busied himself with a general reform of the administration of the province of Asia. His next step was to demand the surrender of Mithradates and to threaten Tigranes with war in the event of refusal. In the spring of 69, at the head of only two legions, he marched through Sophene, the south-western portion of Armenia, crossed the Tigris, and pushed on to the newly-built royal city, Tigranocerta, situated on one of the affluents of that river. A motley host, made up out of the tribes bordering on the Black Sea and the Caspian, hovered round his small army, but failed to hinder him from laying siege to the town. Lucullus showed consummate military capacity, contriving to maintain the siege and at the same time to give battle to the enemy's vastly superior forces. There might now have been peace but for the interference of Mithradates, who pressed Tigranes to renew the war and to seek the aid and alliance of Parthia. The Parthian king, however, preferred a treaty with Rome to a treaty with Armenia, and desired simply to have the Euphrates recognized as his western boundary. Mithradates next appealed to the national spirit of the peoples of the East generally, and endeavoured to rouse them to a united effort. The position of Lucullus was critical. The home government was for recalling him, and his army was disaffected. Nevertheless, though continually harassed by the enemy, he persisted in marching northwards from Tigranocerta over the high table-land of central Armenia, in the hope of reaching Artaxata on the Araxes. But the open mutiny of his troops compelled him to recross the Tigris into the Mesopotamian valley. Here, on a dark tempestuous night, he surprised and stormed Nisibis, the capital of the Armenian district of Mesopotamia, and in this city, which yielded him a rich booty, he found satisfactory winter quarters. Meantime Mithradates was again in Pontus, and in a disastrous engagement at Ziela the Roman camp was taken and the army slaughtered to a man. Lucullus was obliged to retreat into Asia Minor, leaving Tigranes and Mithradates masters of Pontus and Cappadocia. The work of eight years of war was undone. In 66 Lucullus was superseded by Pompey. He had fairly earned the honour of a triumph, but his powerful enemies at Rome and charges of maladministration, to which his immense wealth gave colour, caused it to be deferred till 63. From this time, with the exception of occasional public appearances, he gave himself up to elegant luxury, with which he combined a sort of dilettante pursuit of philosophy, literature and art. As a general he does not seem to have possessed the entire confidence of his troops, owing probably to his natural hauteur and the strict discipline which he imposed on them. The same causes made him unpopular with the Roman capitalists, whose sole object was the accumulation of enormous fortunes by farming the revenue of the provinces.

Among the Roman nobles who revelled in the newly acquired riches of the East, Lucullus stood pre-eminent. His park and pleasure grounds near Rome, and the costly and laborious works in his parks and villas at Tusculum, near Naples, earned for him from Pompey (it is said) the title of the "Roman Xerxes." On one of his luxurious entertainments he is said to have spent upwards of £2000. He was a liberal patron of Greek philosophers and men of letters, and he collected a valuable library, to which such men had free access. He himself is said to have been a student of Greek literature, and to have written a history of the Marsian war in Greek, inserting solecisms to show that he was a Roman. He was one of the interlocutors in Cicero's *Academica*, the second book (first edition) of which was called *Lucullus*. Sulla also entrusted him with the revision of his *Memoirs*. The introduction of the cherry-tree from Asia into Europe is attributed to him. It appears that he became mentally feeble some years before his death, and was obliged to surrender the management of his affairs to his brother Marcus. The usual funeral panegyric was pronounced on him in the Forum, and the people would have had him buried by the side of Sulla in the Campus Martius, but at his brother's request he was laid in his splendid villa at Tusculum.

See Plutarch's *Lucullus*; Appian's *Mithridatic War*; the epitomes of the lost books of Livy; and many passages in Cicero. Some allusions will also be found in Dio Cassius, Pliny and Athenaeus. For the Mithradatic wars, see bibliography under Mithradates (VI. of Pontus); and generally G. Boissier, *Cicero and his Friends* (Eng. trans. by A. D. Jones, 1897); H. Peter, *Hist. Rom. Reliquiae*, i. p. cclxxxv.; W. Drumann, *Geschichte Roms*, iv. His *Elogium* is given in *C.I.L.* i. 292.

His brother, Marcus Licinius Lucullus, was adopted by Marcus Terentius Varro, and was hence known as Marcus Terentius Varro Lucullus. In 82 B.C. he served under Sulla against Marius. In 79 he was curule aedile with his brother, in 77 praetor, in 73 consul with Gaius Cassius Varus. When praetor he forbade the carrying of arms by slaves, and with his colleague in the consulship passed the *lex Terentia Cassia*, to give authority for purchasing corn with the public money and retailing it at a fixed price at Rome. As proconsul in Macedonia he made war with great cruelty against the Dardani and Bessi, and compelled them to acknowledge the supremacy of Rome.

Having enjoyed a triumph, he was sent out to the East to settle the affairs of the provinces conquered by his brother. He sided with Cicero during the Catilinarian conspiracy, did his utmost to prevent his banishment, and subsequently supported his claim for the restoration of his house. He was one of the better representatives of the optimates, and enjoyed some reputation as an orator.

See Cicero, *De Domo*, 52; *Pro Tullio*, 8; *In Verrem*, iii. 70, v. 21; *Florus*, iii. 4, 7; Ammianus Marcellinus xxvii. 4, 11; Plutarch, *Sulla*, 27; *Lucullus*, 35, 36, 43; Orelli's *Onomasticon Tullianum*.

LUCUS FERONIAE, an ancient shrine in Etruria. It was visited both by Latins and Sabines even in the time of Tullus Hostilius and was plundered by Hannibal in 211 B.C. It was undoubtedly in the territory of Capena (*q.v.*); but in imperial times it became an independent community receiving a colony of Octavian's veterans (*Colonia Iulia felix Lucoferensis*) and possessing an amphitheatre. Its site has been disputed. Some authorities place it on the Colle Civitucola (but see CAPENA), others at the church of S. Abbondio near Rignano, others (and probably rightly) at Nazzano, which was reached by a branch road from the Via Flaminia, where remains of a circular temple have been found.

See E. Bormann in *Corp. Inscr. Lat.* xi. 569 sqq.; H. Nissen, *Italische Landeskunde*, ii. 369 sqq. (T. As.)

LUCY, RICHARD DE (d. 1179), called the "loyal," chief justiciar of England, appears in the latter part of Stephen's reign as sheriff and justiciar of the county of Essex. He became, on the accession of Henry II., chief justiciar conjointly with Robert de Beaumont, earl of Leicester; and after the death of the latter (1168) held the office without a colleague for twelve years. The chief servant and intimate of the king he was among the first of the royal party to incur excommunication in the Becket controversy. In 1173 he played an important part in suppressing the rebellion of the English barons, and commanded the royalists at the battle of Fornham. He resigned the justiciarship in 1179, though pressed by the king to continue in office, and retired to Lesues Abbey in Kent, which he had founded and where he died. Lucy's son, Godfrey de Lucy (d. 1204), was bishop of Winchester from 1189 to his death in September 1204; he took a prominent part in public affairs during the reigns of Henry II., Richard I. and John.

See J. H. Round, *Geoffrey de Mandeville* (1892); Sir J. H. Ramsay, *Angevin Empire* (1903); and W. Stubbs, *Constitutional History*, vol. i.

LUCY, SIR THOMAS (1532–1600), the English Warwickshire squire who is traditionally associated with the youth of William Shakespeare, was born on the 24th of April 1532, the son of William Lucy, and was descended, according to Dugdale, from Thurstane de Cherlecote, whose son Walter received the village of Charlecote from Henry de Montfort about 1190. Walter is said to have married into the Anglo-Norman family of Lucy, and his son adopted the mother's surname. Three of Sir Thomas Lucy's ancestors had been sheriffs of Warwickshire and Leicestershire, and on his father's death in 1552 he inherited Sherborne and Hampton Lucy in addition to Charlecote, which was rebuilt for him by John of Padua, known as John Thorpe, about 1558. By his marriage with Joyce Acton he inherited Sutton Park in Worcestershire, and became in 1586 high sheriff of the county. He was knighted in 1565. He is said to have been under the tutorship of John Foxe, who is supposed to have imbued his pupil with the Puritan principles which he displayed as knight of the shire for Warwick in the parliament of 1571 and as sheriff of the county, but as Mrs Carmichael Stopes points out Foxe only left Oxford in 1545, and in 1547 went up to London, so that the connexion must have been short. He often appeared at Stratford-on-Avon as justice of the peace and as commissioner of musters for the county. As justice of the peace he showed great zeal against the Catholics, and took his share in the arrest of Edward Arden in 1583. In 1585 he introduced into parliament a bill for the better preservation of game and grain, and his reputation as a preserver of game gives some colour to the Shakespearian tradition connected with his name. Nicholas Rowe, writing in 1710, told a story that Lucy prosecuted Shakespeare for deer-stealing from Charlecote Park in 1585, and that Shakespeare aggravated the offence by writing a ballad on his prosecutor. The trouble arising from this incident is said to have driven Shakespeare from Stratford to London. The tale was corroborated by Archdeacon Davies of Sapperton, Gloucestershire, who died in 1708. The story is not necessarily falsified by the fact that there was no deer park at Charlecote at the time, since there was a warren, and the term warren legally covers a preserve for other animals than hares or rabbits, roe-deer among others. Shakespeare is generally supposed to have caricatured the local magnate of Stratford in his portrait of Justice Shallow, who made his first appearance in the second part of *Henry IV.*, and a second in the *Merry Wives of Windsor*. Robert Shallow is a justice of the peace in the county of Gloucester and his ancestors have the dozen white luces in their coats, the arms of the Lucys being three luces, while in Dugdale's *Warwickshire* (ed. 1656) there is drawn a coat-of-arms in which these are repeated in each of the four quarters, making twelve in all. There are many considerations which make it unlikely that Shallow represents Lucy, the chief being the noteworthy difference in their circumstances. Lucy died at Charlecote on the 7th of July 1600. His grandson, Sir Thomas Lucy (1585–1640), was a friend of Lord Herbert of Cherbury, and was eulogized by John Davies of Hereford in 1610. The Charlecote estates eventually passed to the Rev. John Hammond through his marriage with Alice Lucy, and in 1789 he adopted the name of Lucy.

For a detailed account of Sir Thomas Lucy, with his son and grandson of the same name, see Mrs C. Carmichael Stopes, *Shakespeare's Warwickshire Contemporaries* (2nd ed., 1907). Cf. also an article by Mrs Stopes in the *Fortnightly Review* (Feb. 1903), entitled "Sir Thomas Lucy not the Original of Justice Shallow," and J. O. Halliwell-Phillipps, *Observations on the Charlecote Traditions* (Brighton, 1887).

LUDDITES, the name given to organized bands of English rioters for the destruction of machinery, who made their first appearance in Nottingham and the neighbouring districts towards the end of 1811. The origin of the name is given in Pellew's *Life of Lord Sidmouth* (iii. 80). In 1779 there lived in a village in Leicestershire a person of weak intellect, called Ned Ludd, who was the butt of the boys of the village. On one occasion Ludd pursued one of his tormentors into a house where were two of the frames used in stocking manufacture, and, not being able to catch the boy, vented his anger on the frames. Afterwards, whenever any frames were broken, it became a common saying that Ludd had done it. The riots arose out of the severe distress caused by the war with France. The leader of the riotous bands took the name of "General Ludd." The riots were specially directed against machinery because of the widespread prejudice that its use produced a scarcity in the demand for labour. Apart from this prejudice, it was inevitable that the economic and social revolution implied in the change from manual labour to work by machinery should give rise to great misery. The riots began with the destruction of stocking and lace frames, and, continuing through the winter and the following spring, spread into Yorkshire, Lancashire, Derbyshire and Leicestershire. They were met by severe repressive legislation, introduced by Lord Liverpool's government, a notable feature in the opposition to which was Lord Byron's speech in the House of Lords. In 1816 the rioting was resumed, caused by the depression which followed the peace of 1815 and aggravated by one of the worst of recorded harvests. In that year, although the centre of the rioting was again in Nottingham, it extended over almost the whole kingdom. The rioters were also thoroughly organized. While part of the band destroyed the machinery, sentinels were posted to give warning of the approach of the military. Vigorous repressive measures, and, especially, reviving prosperity, brought the movement to an end.

See G. Pellew, *Life and Correspondence of H. Addington, 1st Viscount Sidmouth* (London, 1847); Spencer Walpole, *History of England*, vol. i. (London, 1890); and the *Annual Register* for 1811, 1812 and 1816.

LÜDENSCHEID, a town in the Prussian province of Westphalia, 19 m. by rail S.S.E. of Hagen. Pop. (1905) 28,921. It is the seat of various hardware manufactures, among them metal-plated and tin-plated goods, buckles, fancy nails and brooches, and has iron-foundries and machine shops. From the counts of Altena Lüdenscheid passed to the counts of the Mark, with which district it was ceded to Brandenburg early in the 17th century.

LUDHIANA, a town and district of British India, in the Jullundur division of the Punjab. The town is 8 m. from the present left bank of the Sutlej, 228 m. by rail N.W. of Delhi. Pop. (1901) 48,649. It is an important centre of trade in grain, and has manufactures of shawls, &c., by Kashmiri weavers, and of scarves, turbans, furniture and carriages. There is an American Presbyterian mission, which maintains a medical school for Christian women, founded in 1894.

The District of Ludhiana lies south of the river Sutlej, and north of the native states of Patiala, Jind, Nabha and Maler Kotla. Area 1455 sq. m. The district consists for the most part of a broad plain, without hills or rivers, stretching northward from the native borders to the ancient bed of the Sutlej. The soil is a rich clay, broken by large patches of shifting sand. On the eastern edge, towards Umballa, the clay is covered by a bed of rich mould, suitable for the cultivation of cotton and sugar-cane. Towards the west the sand occurs in union with the superficial clay, and forms a light friable soil, on which cereals form the most profitable crop. Even here, however, the earth is so retentive of moisture that good harvests are reaped from fields which appear mere stretches of dry and sandy waste. These southern uplands descend to the valley of the Sutlej by an abrupt terrace, which marks the former bed of the river. The principal stream has shifted to the opposite side of the valley, leaving an alluvial strip, 10 m. in width, between its ancient and its modern bed. The Sutlej itself is here only navigable for boats of small burden. A branch of the Sirhind canal irrigates a large part of the western area. The population in 1901 was 673,097. The principal crops are wheat, millets, pulse, maize and sugar-cane. The district is crossed by the main line of the North-Western railway from Delhi to Lahore, with two branches.

During the Mussulman epoch, the history of the district is bound up with that of the Rais of Raikot, a family of converted Rajputs, who received the country as a fief under the Sayyid dynasty, about 1445. The town of Ludhiana was founded in 1480 by two of the Lodi race (then ruling at Delhi), from whom it derives its name, and was built in great part from the prehistoric bricks of Sunet. The Lodis continued in possession until 1620, when it again fell into the hands of the Rais of Raikot. Throughout the palmy days of the Mogul empire the Raikot family held sway, but the Sikhs took advantage of the troubled period which accompanied the Mogul decadence to establish their supremacy south of the Sutlej. Several of their chieftains made encroachments on the domains of the Rais, who were only able to hold their own by the aid of George Thomas, the famous adventurer of Hariana. In 1806 Ranjit Singh crossed the Sutlej and reduced the obstinate Mahommedan family, and distributed their territory amongst his co-religionists. Since the British occupation of the Punjab, Ludhiana has grown in wealth and population.

See *Ludhiana District Gazetteer* (Lahore, 1907).

LUDINGTON, a city and the county-seat of Mason county, Michigan, U.S.A., on Lake Michigan, at the mouth of the Marquette river, about 85 m. N.W. of Grand Rapids. Pop. (1900) 7166 (2259 foreign-born); (1904, state census) 7259; (1910) 9132. It is served by the Père Marquette, and the Ludington and Northern railways, and by steamboat lines to Chicago, Milwaukee and other lake ports. To Manitowoc, Milwaukee, Kewanee and Two Rivers, Wisconsin, on the W. shore of Lake Michigan, cars, especially those of the Père Marquette railway, are ferried from here. Ludington was formerly well known as a lumber centre, but this industry has greatly declined. There are various manufactures, and the city has a large grain trade. On the site of the city Père Marquette died and was buried, but his body was removed within a year to Point St Ignace. Ludington was settled about 1859, and was chartered as a city in 1873. It was originally named Père Marquette, but was renamed in 1871 in honour of James Ludington, a local lumberman.

LUDLOW, EDMUND (*c.* 1617–1692), English parliamentarian, son of Sir Henry Ludlow of Maiden Bradley, Wiltshire, whose family had been established in that county since the 15th century, was born in 1617 or 1618. He went to Trinity College, Oxford, and was admitted to the Inner Temple in 1638. When the Great Rebellion broke out, he engaged as a volunteer in the life guard of Lord Essex. His first essay in arms was at Worcester, his next at Edgehill. He was made governor of Wardour Castle in 1643, but had to surrender after a tenacious defence on the 18th of March 1644. On being exchanged soon afterwards, he engaged as major of Sir A. Hesilrige's regiment of horse. He was present at the second battle of Newbury, October 1644, at the siege of Basing House in November, and took part in an expedition to relieve Taunton in December. In January his regiment was surprised by Sir M. Langdale, Ludlow himself escaping with difficulty. In 1646 he was elected M.P. for Wilts in the room of his father and attached himself to the republican party. He opposed the negotiations with the king, and was one of the chief promoters of Pride's Purge in 1648. He was one of the king's judges, and signed the warrant for his execution. In February he was elected a member of the council of state. In January 1651 Ludlow was sent into Ireland as lieutenant-general of horse, holding also a civil commission. Here he spared neither health nor money in the public service. Ireton, the deputy of Ireland, died on the 26th of November 1651; Ludlow then held the chief command, and had practically completed the conquest of the island when he resigned his authority to Fleetwood in October 1652. Though disapproving Cromwell's action in dissolving the Long Parliament, he maintained his employment, but when Cromwell was declared Protector he declined to acknowledge his authority. On returning to England in October 1655 he was arrested, and on refusing to submit to the government was allowed to retire to Essex. After Oliver Cromwell's death Ludlow was returned for Hindon in Richard's parliament of 1659, but opposed the continuance of the protectorate. He sat in the restored Rump, and was a member of its council of state and of the committee of safety after its second expulsion, and a commissioner for the nomination of officers in the army. In July he was sent to Ireland as commander-in-chief. Returning in October 1659, he endeavoured to support the failing republican cause by reconciling the army to the parliament. In December he returned hastily to Ireland to suppress a movement in favour of the Long Parliament, but on arrival found himself almost without supporters. He came back to England in January 1660, and was met by an impeachment presented against him to the restored parliament. His influence and authority had now disappeared, and all chance of regaining them vanished with Lambert's failure. He took his seat in the Convention parliament as member for Hindon, but his election was annulled on the 18th of May. Ludlow was not excepted from the Act of Indemnity, but was included among the fifty-two for whom punishment less than capital was reserved. Accordingly, on the proclamation of the king ordering the regicides to come in, Ludlow emerged from his concealment, and on the 20th of June surrendered to the Speaker; but finding that his life was not assured, he succeeded in escaping to Dieppe, travelled to Geneva and Lausanne, and thence to Vevey, then under the protection of the canton of Bern. There he remained, and in spite of plots to assassinate him he was unmolested by the government of that canton, which had also extended its protection to other regicides. He steadily refused during thirty years of exile to have anything to do with the desperate enterprises of republican plotters. But in 1689 he returned to England, hoping to be employed in Irish affairs. He was however remembered only as a regicide, and an address from the House of Commons was presented to William III. by Sir Edward Seymour, requesting the king to issue a proclamation for his arrest. Ludlow escaped again, and returned to Vevey, where he died in 1692. A monument raised to his memory by his widow is in the church of

St Martin. Over the door of the house in which he lived was placed the inscription "Omne solum forti patria, quia Patris." Ludlow married Elizabeth, daughter of William Thomas, of Wenvoe, Glamorganshire, but left no issue.

His *Memoirs*, extending to the year 1672, were published in 1698–1699 at Vevey and have been often reprinted; a new edition, with notes and illustrative material and introductory memoir, was issued by C. H. Firth in 1894. They are strongly partisan, but the picture of the times is lifelike and realistic. Ludlow also published "a letter from Sir Hardress Waller . . . to Lieutenant-General Ludlow with his answer" (1660), in defence of his conduct in Ireland. See C. H. Firth's article in *Dict. Nat. Biog.*; Guizot's *Monk's Contemporaries*; A. Stein's *Briefe Englischer Flüchtlinge in der Schweiz*.

LUDLOW, a market town and municipal borough in the Ludlow parliamentary division of Shropshire, England, on the Hereford-Shrewsbury joint line of the Great Western and London & North Western railways, 162 m. W.N.W. from London. Pop. (1901) 4552. It is beautifully situated at the junction of the rivers Teme and Corve, upon and about a wooded eminence crowned by a massive ruined castle. Parts of this castle date from the 11th century, but there are many additions such as the late Norman circular chapel, the Decorated state rooms, and details in Perpendicular and Tudor styles. The parish church of St Lawrence is a cruciform Perpendicular building, with a lofty central tower, and a noteworthy east window, its 15th-century glass showing the martyrdom of St Lawrence. There are many fine half-timbered houses of the 17th century, and one of seven old town-gates remains. The grammar school, founded in the reign of John, was incorporated by Edward I. The principal public buildings are the guildhall, town-hall and market-house, and public rooms, which include a museum of natural history. Tanning and flour-milling are carried on. The town is governed by a mayor, 4 aldermen and 12 councillors. Area 416 acres.

The country neighbouring Ludlow is richly wooded and hilly, while the scenery of the Teme is exquisite. Westward, Vinnal Hill reaches 1235 ft., eastward lies Titterstone Clee (1749 ft.). Richard's Castle, 3 m. S. on the borders of Herefordshire, dates from the reign of Edward the Confessor, but little more than its great artificial mound remains. At Bromfield, 3 m. above Ludlow on the Teme, the church and some remains of domestic buildings belonged to a Benedictine monastery of the 12th century.

Ludlow is supposed to have existed under the name of Dinan in the time of the Britons. Eyton in his history of Shropshire identifies it with one of the "Ludes" mentioned in the Domesday Survey, which was held by Roger de Lacy of Osbern FitzRichard and supposes that Roger built the castle soon after 1086, while a chronicle of the FitzWarren family attributes the castle to Roger earl of Shrewsbury. The manor afterwards belonged to the Lacys, and in the beginning of the 14th century passed by marriage to Roger de Mortimer and through him to Edward IV. Ludlow was a borough by prescription in the 13th century, but the burgesses owe most of their privileges to their allegiance to the house of York. Richard, duke of York, in 1450 confirmed their government by 12 burgesses and 24 assistants, and Edward IV. on his accession incorporated them under the title of bailiffs and burgesses, granted them the town at a fee-farm of £24, 3s. 4d., a merchant gild and freedom from toll. Several confirmations of this charter were granted; the last, dated 1665, continued in force (with a short interval in the reign of James II.) until the Municipal Corporations Act of 1835. By the charter of Edward IV. Ludlow returned 2 members to parliament, but in 1867 the number was reduced to one, and in 1885 the town was disfranchised. The market rights are claimed by the corporation under the charters of Edward IV. (1461) and Edward VI. (1552). The court of the Marches was established at Ludlow in the reign of Henry VII., and continued to be held here until it was abolished in the reign of William III. Ludlow castle was granted by Edward IV. to his two sons, and by Henry VII. to Prince Arthur, who died here in 1502. In 1634 Milton's *Comus* was performed in the castle under its original style of "A Masque presented at Ludlow Castle," before the earl of Bridgewater, Lord President of Wales. The castle was garrisoned in 1642 by Prince Rupert, who went there after the battle of Naseby, but in 1646 it surrendered to Parliament and was afterwards dismantled.

See *Victoria County History*, Shropshire; Thomas Wright, *The History of Ludlow and its Neighbourhood* (1826).

LUDLOW GROUP, or LUDLOVIAN, in geology, the uppermost subdivision of the Silurian rocks in Great Britain. This group contains the following formations in descending order:—Tilestones, Downton Castle sandstones (90 ft.), Ledbury shales (270 ft.), Upper Ludlow rocks (140 ft.), Aymestry limestone (up to 40 ft.), Lower Ludlow rocks (350 to 780 ft.). The Ludlow group is essentially shaly in character, except towards the top, where the beds become more sandy and pass gradually into the base of the Old Red Sandstone. The Aymestry limestone, which is irregular in thickness, is sometimes absent, and where the underlying Wenlock limestones are absent the shales of the Ludlow group graduate downwards into the Wenlock shales. The group is typically developed between Ludlow and Aymestry, and it occurs also in the detached Silurian areas between Dudley and the mouth of the Severn.

The *Lower Ludlow rocks* are mainly grey, greenish and brown mudstones and sandy and calcareous shales. They contain an abundance of fossils. The series has been zoned by means of the graptolites by E. M. R. Wood; the following in ascending order, are the zonal forms: *Monograptus vulgaris*, *M. Nilssoni*, *M. scanicus*, *M. tumescens* and *M. leintwardinensis*. *Cyathaspis ludensis*, the earliest British vertebrate fossil, was found in these rocks at Leintwardine in Shropshire, a noted fossil locality. Trilobites are numerous (*Phacops caudatus*, *Lichas anglicus*, *Homolonotus delphinocephalus*, *Calymene Blumenbachii*); brachiopods (*Leptaena rhomboidalis*, *Rhynchonella Wilsoni*, *Atrypa reticularis*), pelecypods (*Cardiola interrupta*, *Ctenodonta sulcata*) and gasteropods and cephalopods (many species of *Orthoceras* and also *Gomphoceras*, *Trochoceras*) are well represented. Other fossils are *Ceratiocaris*, *Pterygotus*, *Protaster*, *Palaeocoma* and *Palaeodiscus*.

The *Upper Ludlow rocks* are mainly soft mudstones and shales with some harder sandy beds capable of being worked as building-stones. These sandy beds are often found covered with ripple-marks and annelid tracks; one of the uppermost sandy layers is known as the "Fucoid bed" from the abundance of the seaweed-like impressions it bears. At the top of this sub-group, near Ludlow, a brown layer occurs, from a quarter of an inch to 4 in. in thickness, full of the fragmentary remains of fish associated with those of *Pterygotus* and mollusca. This layer, known as the "Ludlow Bone bed," has been traced over a very large area (see BONE BED). The common fossils include plants (*Actinophyllum*, *Chondrites*), ostracods, phyllocarids, eurypterids, trilobites (less common than in the older groups), numerous brachiopods (*Lingula minima*, *Chonetes striatella*), gasteropods, pelecypods and cephalopods (*Orthoceras bullatum*). Fish include *Cephalaspis*, *Cyathaspis*, *Auchenaspis*. The Tilestones, Downton Castle Sandstone and Ledbury shales are occasionally grouped together under the term *Downtonian*. They are in reality passage beds between the Silurian and Old Red Sandstone, and were originally placed in the latter system by Sir R. I. Murchison. They are mostly grey, yellow or red micaceous, shaly sandstones. *Lingula cornea*, *Platyschisma helicites* and numerous phyllocarids and ostracods occur among the fossils.

In Denbighshire and Merionethshire the upper portion of the Denbighshire Grits belongs to this horizon: viz. those from below upwards, the Nantglyn Flags, the Upper Grit beds, the *Monograptus leintwardinensis* beds and the Dinas Bran beds. In the Silurian area of the Lake district the Coldwell beds, forming the upper part of the Coniston Flags, are the equivalents of the Lower Ludlow; they are succeeded by the Coniston Grits (4000 ft.), the Bannisdale Slates (5200 ft.) and the Kirkby Moor Flags (2000 ft.).

In the Silurian areas of southern Scotland, the Ludlow rocks are represented in the Kirkcudbright Shore and Riccarton district by the Raeberry Castle beds and Balmae Grits (500-750 ft.). In the northern belt—Lanarkshire and the Pentland Hills—the lower portion (or Ludlovian) consists of mudstones, flaggy shales and greywackes; but the upper (or Downtonian) part is made up principally of thick red and yellow sandstones and conglomerates with green mudstones. The Ludlow rocks of Ireland include the "Salrock beds" of County Galway and the "Croagmarhin beds" of Dingle promontory.

See SILURIAN, and, for recent papers, the *Q. J. Geol. Soc.* (London) and *Geological Literature* (Geol. Soc., London) annual.

LUDOLF (or LEUTHOLF), **HIOB** (1624–1704), German orientalist, was born at Erfurt on the 15th of June 1624. After studying philology at the Erfurt academy and at Leiden, he travelled in order to increase his linguistic knowledge. While in Italy he became acquainted with one Gregorius, an Abyssinian scholar, and acquired from him an intimate knowledge of the Ethiopian language. In 1652 he entered the service of the duke of Saxe-Gotha, in which he continued until 1678, when he retired to Frankfort-on-Main. In 1683 he visited England to promote a cherished scheme for establishing trade with Abyssinia, but his efforts were unsuccessful, chiefly through the bigotry of the authorities of the Abyssinian Church. Returning to Frankfort in 1684, he gave himself wholly to literary work, which he continued almost to his death on the 8th of April 1704. In 1690 he was appointed president of the *collegium imperiale historicum*.

The works of Ludolf, who is said to have been acquainted with twenty-five languages, include *Sciagraphia historiae aethiopicae* (Jena, 1676); and the *Historia aethiopica* (Frankfort, 1681), which has been translated into English, French and Dutch, and which was supplemented by a *Commentarius* (1691) and by *Appendices* (1693–1694). Among his other works are: *Grammatica linguae amharicae* (Frankfort, 1698); *Lexicon amharico-latinum* (Frankfort, 1698); *Lexicon aethiopico-latinum* (Frankfort, 1699); and *Grammatica aethiopica* (London, 1661, and Frankfort, 1702). In his *Grammatik der äthiopischen Sprache* (1857) August Dillmann throws doubt on the story of Ludolf's intimacy with Gregorius.

See C. Juncker, *Commentarius de vita et scriptis Jobi Ludolfi* (Frankfort, 1710); L. Diestel, *Geschichte des alten Testaments in der christlichen Kirche* (Jena, 1868); and J. Flemming, "Hiob Ludolf," in the *Beiträge zur Assyriologie* (Leipzig, 1890–1891).

LUDWIG, KARL FRIEDRICH WILHELM (1816–1895), German physiologist, was born at Witzenhausen, near Cassel, on the 29th of December 1816. He studied medicine at Erlangen and Marburg, taking his doctor's degree at Marburg in 1839. He made Marburg his home for the next ten years, studying and teaching anatomy and physiology, first as prosector to F. L. Fick (1841), then as *privat-docent* (1842), and finally as extraordinary professor (1846). In 1849 he was chosen professor of anatomy and physiology at Zürich, and six years afterwards he went to Vienna as professor in the Josephinum (school for military surgeons). In 1865 he was appointed to the newly created chair of physiology at Leipzig, and continued there until his death on the 23rd of April 1895. Ludwig's name is prominent in the history of physiology, and he had a large share in bringing about the change in the method of that science which took place about the middle of the 19th century. With his friends H. von Helmholtz, E. W. Brücke and E. Du Bois-Reymond, whom he met for the first time in Berlin in 1847, he rejected the assumption that the phenomena of living animals depend on special biological laws and vital forces different from those which operate in the domain of inorganic nature; and he sought to explain them by reference to the same laws as are applicable in the case of physical and chemical phenomena. This point of view was expressed in his celebrated *Text-book of Human Physiology* (1852–1856), but it is as evident in his earliest paper (1842) on the process of urinary secretion as in all his subsequent work. Ludwig exercised enormous influence on the progress of physiology, not only by the discoveries he made, but also by the new methods and apparatus he introduced to its service. Thus in regard to secretion, he showed that secretory glands, such as the submaxillary, are more than mere filters, and that their secretory action is attended by chemical and thermal changes both in themselves and in the blood passing through them. He demonstrated the existence of a new class of secretory nerves that control this action, and by showing that if the nerves are appropriately stimulated the salivary glands continue to secrete, even though the animal be decapitated, he initiated the method of experimenting with excised organs. He devised the kymograph as a means of obtaining a written record of the variations in the pressure of the blood in the blood-vessels; and this apparatus not only conducted him to many important conclusions respecting the mechanics of the circulation, but afforded the first instance of the use of the graphic method in physiological inquiries. For the purpose of his researches on the gases in the blood, he designed the mercurial blood-pump which in various modifications has come into extensive use, and by its aid he made many investigations on the gases of the lymph, the gaseous interchanges in living muscle, the significance of oxidized material in the blood, &c. There is indeed scarcely any branch of physiology, except the physiology of the senses, to which he did not make important contributions. He was also a great power as a teacher and the founder of a school. Under him the Physiological Institute at Leipzig became an organized centre of physiological research, whence issued a steady stream of original work; and though the papers containing the results usually bore the name of his pupils only, every investigation was inspired by him and carried out under his personal direction. Thus his pupils gained a practical acquaintance with his methods and ways of thought, and, coming from all parts of Europe, they returned to their own countries to spread and extend his doctrines. Possessed himself of extraordinary manipulative skill, he abhorred rough and clumsy work, and he insisted that experiments on animals should be planned and prepared with the utmost care, not only to avoid the infliction of pain (which was also guarded against by the use of an anaesthetic), but to ensure that the deductions drawn from them should have their full scientific value.

LUDWIG, OTTO (1813–1865), German dramatist, novelist and critic, was born at Eisfeld in Thuringia, on the 11th of February 1813. His father, who was syndic of Eisfeld, died when the boy was twelve years old, and he was brought up amidst uncongenial conditions. He had devoted his leisure to poetry and music, which unfitted him for the mercantile career planned for him. The attention of the duke of Meiningen was directed to one of his musical compositions, an opera, *Die Köhlerin*, and Ludwig was enabled in 1839 to continue his musical studies under Mendelssohn in Leipzig. But ill-health and constitutional shyness caused him to give up a musical career, and he turned exclusively to literary studies, and wrote several stories and dramas. Of the latter, *Der Erbförster* (1850) attracted immediate attention as a masterly psychological study. It was followed by *Die Makkabäer* (1852), in which the realistic method of *Der Erbförster* was transferred to an historical *milieu*, which allowed more brilliant colouring and a freer play of the imagination. With these tragedies, to which may be added *Die Rechte des Herzens* and *Das Fräulein von Scuderi*, the comedy *Hans Frey*, and an unfinished tragedy on the subject of Agnes Bernauer, Ludwig ranks immediately after Hebbel as Germany's most notable dramatic poet at the middle of the 19th century. Meanwhile he had married and settled permanently in Dresden, where he turned his attention to fiction. He published a series of admirable stories of Thuringian life, characterized by the same attention to minute detail and careful psychological analysis as his dramas. The best of these are *Die Heiterethei und ihr Widerspiel* (1851), and Ludwig's masterpiece, the powerful novel, *Zwischen Himmel und Erde* (1855). In his *Shakespeare-Studien* (not published until 1891) Ludwig showed himself a discriminating critic, with a fine insight into the hidden springs of the creative imagination. So great, however, was his enthusiasm for Shakespeare, that he was led to depreciate Schiller in a way which found little favour among his countrymen. He died at Dresden on the 25th of February 1865.

Ludwig's *Gesammelte Schriften* were published by A. Stern and E. Schmidt in 6 vols. (1891–1892); also by A. Bartels (6 vols., 1900). See A. Stern, *Otto Ludwig, ein Dichterleben* (1891; 2nd ed., 1906), and A. Sauer, *Otto Ludwig* (1893).

LUDWIGSBURG, a town in the kingdom of Württemberg, 9 m. to the N. of Stuttgart by rail and 1½ m. from the river Neckar. Pop. (1905) 23,093. It was founded and laid out at the beginning of the 18th century by the duke of Württemberg, Eberhard Louis, and was enlarged and improved by Duke Charles Eugene. Constructed as the adjunct of a palace the town bears the impress of its origin, with its straight streets and spacious squares. It is now mainly important as the chief military depot in Württemberg. The royal palace, one of the finest in Germany, stands in a beautiful park and contains a portrait gallery and the burial vault of the rulers of Württemberg. The industries include the manufacture of organs and pianos, of cotton, woollen and linen goods, of chemicals, iron and wire goods, and brewing and brick-making. In the vicinity is the beautiful royal residence of Monrepos, which is connected with the park of Ludwigsburg by a fine avenue of lime trees. From 1758 to

1824 the town was famous for the production of a special kind of porcelain.

See Belschner, *Ludwigsburg in zwei Jahrhunderten* (Ludwigsburg, 1904).

LUDWIGSHAFEN, a town of Germany, in the Bavarian Palatinate, on the left bank of the Rhine, immediately opposite to Mannheim, with which it is connected by a steam ferry and a railway bridge. Pop. (1885) 21,042, (1900) 61,905, (1905) 72,168. It has an increasing trade in iron, timber, coal and agricultural products, a trade which is fostered by a harbour opened in 1897; and also large factories for making aniline dyes and soda. Other industries are the manufacture of cellulose, artificial manure, flour and malt; and there are saw-mills, iron foundries and breweries in the town. The place, which was founded in 1843 by Louis I., king of Bavaria, was only made a town in 1859.

See J. Esselborn, *Geschichte der Stadt Ludwigshafen* (Ludwigshafen, 1888).

LUDWIGSLUST, a town of Germany, in the grand-duchy of Mecklenburg-Schwerin, 22 m. by rail S. by E. of Schwerin. Pop. (1905) 6728. The castle was built by the duke of Mecklenburg-Schwerin, Frederick II., in 1772–1776. There is also another ducal residence a fine park and a monument of the grand duke, Frederick Francis I. (d. 1837). The town has a church constructed on the model of a Greek temple. It has manufactures of chemicals and other small industries. Ludwigslust was founded by the duke Frederick, being named after this duke's father, Christian Louis II. It became a town in 1876.

LUG, a verb meaning to pull a heavy object, to drag, now mainly used colloquially. It is probably Scandinavian in origin; the Swedish *lugg*, forelock, lock of hair, gives *lugga*, to pull, tug; and "lug" in some north-eastern English dialects is still chiefly used in the sense of pulling a person's hair. "Luggage," passengers' baggage, means by origin that which has to be "lugged" about. The Scandinavian word may be also the source of "lug," in the sense of "ear," in Scotland the regular dialectical word, and in English commonly applied to the ear-shaped handles of metal or earthenware pots, pitchers, &c. If so the word means something that can be pulled or tugged. This is also possibly the origin of the "lug" or "lug-sail," a four-sided sail attached to a yard which is hung obliquely to the mast, whence probably the name "lugger" of a sailing-vessel with two or three masts and fore and aft lug-sails. The word may, however, be connected with the Dutch *logger*, a fishing-boat using drag-nets. "Lug" is also the name of a marine worm, *Arenicola marina*, used as bait.

LUGANO (Ger. *Lauis*), the most populous and most thriving town in the Swiss canton of Ticino or Tessin, situated (906 ft.) on the northern shore of the lake of Lugano. Pop. (1900) 9394, almost all Italian-speaking and Romanists. To the S. it is dominated by the Monte Salvatore (3004 ft.) and on the S.E. (across the lake) by the Monte Generoso (5591 ft.)—a magnificent view point. Both mountains are accessible by railways. By rail Lugano is 124 m. from Lucerne and 51½ m. from Milan. Situated on the main St Gotthard railway line, Lugano is now easily reached, so that it is much frequented by visitors (largely German) in spring and in autumn. Though politically Swiss since 1512, Lugano is thoroughly Italian in appearance and character. Of recent years many improvements have been made in the town, which has two important suburbs—Paradiso to the south and Cassarate to the east. The railway station (1109 ft.) is above the town, and is connected with the fine quays by a funicular railway. On the main quay is a statue of William Tell by the sculptor Vincenzo Vela (1820–1891), a native of the town, while other works by him are in the gardens of private villas in the neighbourhood. The principal church, San Lorenzo, in part dates back earlier than the 15th century, while its richly sculptured façade bears the figures 1517. This church is now the cathedral church of the bishop of Lugano, a see erected in 1888, with jurisdiction over the Italian parts of Switzerland. The church of Santa Maria degli Angioli, built about 1499, and till 1848 occupied by Franciscans, contains several very fine frescoes (particularly a Crucifixion) painted 1529–1530 by Bernardino Luini. A gallery containing modern pictures has been built on the site of the old palace of the bishops of Como. During the struggle of 1848–1866 to expel the Austrians from Lombardy, Lugano served as headquarters for Mazzini and his followers. Books and tracts intended for distribution in Italy were produced there and at Capolago (9 m. distant, at the S.E. end of the lake), and the efforts of the Austrian police to prevent their circulation were completely powerless. (W. A. B. C.)

LUGANO, LAKE OF (also called CERESIO), one of the smaller lakes in Lombardy, N. Italy, lying between Lago Maggiore (W.) and the Lake of Como (E). It is of very irregular shape, the great promontory of Monte Salvatore (3004 ft.) nearly cutting off the western arm from the main lake. The whole lake has an area of 19½ sq. m., its greatest length is about 22 m., its greatest width 2 m., and its greatest depth 945 ft., while its surface is 899 ft. above sea-level. Between Melide (S. of the town of Lugano) and Maroggia (on the east shore) the lake is so shallow that a great stone dam has been built across for the St Gotthard railway line and the carriage road. The chief town is Lugano (at its northern end), which by the St Gotthard line is 19 m. from Bellinzona and 9 m. from Capolago, the station at the south-eastern extremity of the lake, which is but 8 m. by rail from Como. At the south-western extremity a railway leads S.W. from Porto Ceresio to Varese (9 m.). Porlezza, at the east end of the lake, is 8 m. by rail from Menaggio on the Lake of Como, while Ponte Tresa, at the west end of the lake, is about the same distance by a steam tramway from Luino on Lago Maggiore. Of the total area of the lake, about 7½ sq. m. are in the Swiss Canton of Ticino (Tessin), formed in 1803 out of the conquests made by the Swiss from the Milanese in 1512. The remainder of the area is in Italy. The lake lies among the outer spurs of the Alps that divide the Ticino (Tessin) basin from that of the Adda, where the calcareous strata have been disturbed by the intrusion of porphyry and other igneous rocks. It is not connected with any considerable valley, but is fed by numerous torrents issuing from short glens in the surrounding mountains, while it is drained by the Tresa, an unimportant stream flowing into Lago Maggiore. The first steamer was placed on the lake in 1856. (W. A. B. C.)

LUGANSK (also LUGAÑ and LUGANSKIY ZAVŌD), a town of southern Russia, in the government of Ekaterinoslav. Pop. (1900) 34,175. It has a technical railway school and a meteorological observatory, stands on the small river Lugan, 10 m. from its confluence with the northern Donets, in the Lugan mining district, 213 m. E. of the city of Ekaterinoslav, and has prospered greatly since 1890. This district, which comprises the coal-mines of Lisichansk and the anthracite mines of Gorodishche, occupies about 110,000 acres on the banks of the Donets river. Although it is mentioned in the 16th century, and coal was discovered there at the time of Peter the Great, it was not until 1795 that an Englishman, Gascoyne or Gaskoin, established its first iron-works for supplying the Black Sea fleet and the southern fortresses with guns and shot. This proved a failure, owing to the great distance from the sea; but during the Crimean War the iron-works of Lugan again produced shot, shell and gun-carriages. Since 1864 agricultural implements, steam-engines, and machinery for beetroot sugar-works, distilleries, &c., have been the chief manufactures. There is an active trade in cattle, tallow, wools, skins, linseed, wine, corn and manufactured wares.

LUGARD, SIR FREDERICK JOHN DEALTRY (1858–), British soldier, African explorer and administrator, son of the Rev. F. G. Lugard, was born on the 22nd of January 1858. He entered the army in 1878, joining the Norfolk regiment. He served in the Afghan War of 1879–80, in the Sudan campaign of 1884–85, and in Burma in 1886–87. In May 1888, while on temporary half-pay, he took command of an expedition organized by the British settlers in Nyasaland against the Arab slave traders on Lake Nyasa, and was severely wounded. He left Nyasaland in April 1889, and in the same year was engaged by the Imperial

British East Africa Company. In their service he explored the Sabaki river and the neighbouring region, and elaborated a scheme for the emancipation of the slaves held by the Arabs in the Zanzibar mainland. In 1890 he was sent by the company to Uganda, where he secured British predominance and put an end to the civil disturbances, though not without severe fighting, chiefly notable for an unprovoked attack by the "French" on the "British" faction. While administering Uganda he journeyed round Ruwenzori to Albert Edward Nyanza, mapping a large area of the country. He also visited Albert Nyanza, and brought away some thousands of Sudanese who had been left there by Emin Pasha and H. M. Stanley. In 1892 Lugard returned to England, where he successfully opposed the abandonment of Uganda by Great Britain, a step then contemplated by the fourth Gladstone administration. In 1894 Lugard was despatched by the Royal Niger Company to Borgu, where, distancing his French and German rivals in a country up to then unvisited by any Europeans, he secured treaties with the kings and chiefs acknowledging the sovereignty of the British company. In 1896–1897 he took charge of an expedition to Lake Ngami on behalf of the British West Charterland Company. From Ngami he was recalled by the British government and sent to West Africa, where he was commissioned to raise a native force to protect British interests in the hinterland of Lagos and Nigeria against French aggression. In August 1897 he raised the West African Frontier Force, and commanded it until the end of December 1899. The differences with France were then composed, and, the Royal Niger Company having surrendered its charter, Lugard was chosen as high commissioner of Northern Nigeria. The part of Northern Nigeria under effective control was small, and Lugard's task in organizing this vast territory was rendered more difficult by the refusal of the sultan of Sokoto and many other Fula princes to fulfil their treaty obligations. In 1903 a successful campaign against the emir of Kano and the sultan of Sokoto rendered the extension of British control over the whole protectorate possible, and when in September 1906 he resigned his commissionership, the whole country was being peacefully administered under the supervision of British residents (see NIGERIA). In April 1907 he was appointed governor of Hong-Kong. Lugard was created a C.B. in 1895 and a K.C.M.G. in 1901. He became a colonel in 1905, and held the local rank of brigadier-general. He married in 1902 Flora Louise Shaw (daughter of Major-General George Shaw, C.B., R.A.), who for some years had been a distinguished writer on colonial subjects for *The Times*. Sir Frederick (then Captain) Lugard published in 1893 *The Rise of our East African Empire* (partly auto-biographical), and was the author of various valuable reports on Northern Nigeria issued by the Colonial Office. Throughout his African administrations Lugard sought strenuously to secure the amelioration of the condition of the native races, among other means by the exclusion, wherever possible, of alcoholic liquors, and by the suppression of slave raiding and slavery.

LUGO, a maritime province of north-western Spain, formed in 1833 of districts taken from the old province of Galicia, and bounded N. by the Atlantic, E. by Oviedo and Leon, S. by Orense, and W. by Pontevedra and Corunna. Pop. (1900) 465,386; area, 3814 sq. m. The coast, which extends for about 40 m. from the estuary of Rivadéo to Cape de Vares, is extremely rugged and inaccessible, and few of the inlets, except those of Rivadéo and Vivero, admit large vessels. The province, especially in the north and east, is mountainous, being traversed by the Cantabrian chain and its offshoots; the sierra which separates it from Leon attains in places a height of 6000 ft. A large part of the area is drained by the Miño. This river, formed by the meeting of many smaller streams in the northern half of the province, follows a southerly direction until joined by the Sil, which for a considerable distance forms the southern boundary. Of the rivers flowing north into the Atlantic, the most important are the Navia, which has its lower course through Oviedo; the Eo, for some distance the boundary between the two provinces; the Masma, the Oro and the Landrove.

Some of the valleys of Lugo are fertile, and yield not only corn but fruit and wine. The principal agricultural wealth, however, is on the Miño and Sil, where rye, maize, wheat, flax, hemp and a little silk are produced. Agriculture is in a very backward condition, mainly owing to the extreme division of land that prevails throughout Galicia. The exportation of cattle to Great Britain, formerly a flourishing trade, was ruined by American and Australian competition. Iron is found at Caurel and Incio, arsenic at Castroverde and Cervantes, argentiferous lead at Riotorto; but, although small quantities of iron and arsenic are exported from Rivadéo, frequent strikes and lack of transport greatly impeded the development of mining in the earlier years of the 20th century. There are also quarries of granite, marble and various kinds of slate and building-stone. The only important manufacturing industries are those connected with leather, preserves, coarse woollen and linen stuffs, timber and osier work. About 250 coasting vessels are registered at the ports, and about as many boats constitute the fishing fleet, which brings in lampreys, soles, tunny and sardines, the last two being salted and tinned for export. The means of communication are insufficient, though there are over 100 m. of first-class roads, and the railways from Madrid and northern Portugal to Corunna run through the province.

Lugo the capital (pop. 1900, 26,959) and the important towns of Chantada (15,003), Fonsagrada (17,302), Mondoñedo (10,590), Monforte (12,912), Pantou (12,988), Villalba (13,572) and Vivero (12,843) are described in separate articles. The province contained in 1900 twenty-six towns of more than 7000 inhabitants, the largest being Sarria (11,998) and Saviñao (11,182). For a general description of the people and the history of this region see GALICIA.

LUGO, capital of the above Spanish province, is situated on the left bank of the river Miño and on the railway from Corunna to Madrid. Pop. (1900) 26,959. Lugo is an episcopal see, and was formerly the capital of Galicia. Suburbs have grown up round the original town, the form of which, nearly quadrangular, is defined by a massive Roman wall 30 to 40 ft. high and 20 ft. thick, with projecting semicircular towers which numbered 85 as late as 1809, when parts of the fortifications were destroyed by the French. The wall now serves as a promenade. The Gothic cathedral, on the south side of the town, dates from the 12th century, but was modernized in the 18th, and possesses no special architectural merit. The conventual church of Santo Domingo dates from the 14th century. The principal industries are tanning, and the manufacture of linen and woollen cloth. About 1 m. S., on the left bank of the Miño, are the famous hot sulphur baths of Lugo.

Lugo (*Lucus Augusti*) was a flourishing city under Roman rule (*c.* 19 B.C.–A.D. 409) and was made by Augustus the seat of a *conventus juridicus* (assize). Its sulphur baths were even then well known. It was sacked by barbarian invaders in the 5th century, and suffered greatly in the Moorish wars of the 8th century. The bishopric dates from a very early period, and it it said to have acquired metropolitan rank in the middle of the 6th century; it is now in the archiepiscopal province of Santiago de Compostela.

LUGOS, the capital of the county of Krassó-Szörény, Hungary, 225 m. S.E. of Budapest by rail. Pop. (1900) 16,126. It is situated on both banks of the river Temes, which divides the town in two quarters, the Rumanian on the right and the German on the left bank. It is the seat of a Greek-United (Rumanian) bishop. Lugos carries on an active trade in wine, and has several important fairs, while the surrounding country, which is mountainous and well-wooded, produces large quantities of grapes and plums. Lugos was once a strongly fortified place and of greater relative importance than at present. It was the last seat of the Hungarian revolutionary government (August 1849), and the last resort of Kossuth and several other leaders of the national cause, previous to their escape to Turkey.

LUGUDUNUM, or LUGDUNUM, an old Celtic place-name (fort or hill of the god Lugos or Lug) used by the Romans for several towns in ancient Gaul. The most important was the town at the confluence of the Saône and Rhone now called Lyons (*q.v.*). This place had in Roman times two elements. One was a Roman *colonia* (municipality of Roman citizens, self-governing) situated on the hill near the present Fourvières (*Forum vetus*). The other, territorially distinct from it for reasons of statecraft, was the Temple of Roma and Augustus, to which the inhabitants of the 64 Gallic cantons in the three Roman provinces of Aquitania, Lugudunensis and Belgica—the so-called Tres Galliae—sent delegates every summer to hold games and otherwise celebrate the worship of the emperor which was supposed to knit the provincials to Rome. The two elements together composed the most important town of western Europe in Roman times. Lugudunum controlled the trade of its two rivers, and that which passed from northern Gaul to the Mediterranean or vice versa; it had a mint; it was the capital of all northern Gaul, despite its position in the south, and its wealth was such that, when Rome was burnt in Nero's reign, its inhabitants subscribed largely to the relief of the Eternal City. (F. J. H.)

LUINI, BERNARDINO (?1465-?1540), the most celebrated master of the Lombard school of painting founded upon the style of Leonardo da Vinci, was born at Luino, a village on Lago Maggiore. He wrote his name as "Bernardin Lovino," but the spelling "Luini" is now generally adopted. Few facts are known regarding his life, and until a comparatively recent date many even of his works had, in the lapse of years and laxity of attribution, got assigned to Leonardo da Vinci. It appears that Luini studied painting at Vercelli under Giovenone, or perhaps under Stephano Scotto. He reached Milan either after the departure of Da Vinci in 1500, or shortly before that event; it is thus uncertain whether or not the two artists had any personal acquaintance, but Luini was at any rate in the painting-school established in Milan by the great Florentine. In the later works of Luini a certain influence from the style of Raphael is superadded to that, far more prominent and fundamental, from the style of Leonardo; but there is nothing to show that he ever visited Rome. His two sons are the only pupils who have with confidence been assigned to him; and even this can scarcely be true of the younger, who was born in 1530, when Bernardino was well advanced in years. Guadenzio Ferrari has also been termed his disciple. One of the sons, Evangelista, has left little which can now be identified; the other, Aurelio, was accomplished in perspective and landscape work. There was likewise a brother of Bernardino, named Ambrogio, a competent painter. Bernardino, who hardly ever left Lombardy, had some merit as a poet, and is said to have composed a treatise on painting. The precise date of his death is unknown; he may perhaps have survived till about 1540. A serene, contented and happy mind, naturally expressing itself in forms of grace and beauty, seems stamped upon all the works of Luini. The same character is traceable in his portrait, painted in an upper group in his fresco of "Christ crowned with Thorns" in the Ambrosian library in Milan —a venerable bearded personage. The only anecdote which has been preserved of him tells a similar tale. It is said that for the single figures of saints in the church at Saronno he received a sum equal to 22 francs per day, along with wine, bread and lodging; and he was so well satisfied with this remuneration that, in completing the commission, he painted a Nativity for nothing.

A dignified suavity is the most marked characteristic of Luini's works. They are constantly beautiful, with a beauty which depends at least as much upon the loving self-withdrawn expression as upon the mere refinement and attractiveness of form. This quality of expression appears in all Luini's productions, whether secular or sacred, and imbues the latter with a peculiarly religious grace—not ecclesiastical unction, but the devoutness of the heart. His heads, while extremely like those painted by Leonardo, have less subtlety and involution and less variety of expression, but fully as much amenity. He began indeed with a somewhat dry style, as in the "Pietà" in the church of the Passione; but this soon developed into the quality which distinguishes all his most renowned works; although his execution, especially as regards modelling, was never absolutely equal to that of Leonardo. Luini's paintings do not exhibit an impetuous style of execution, and certainly not a negligent one; yet it appears that he was in fact a very rapid worker, as his picture of the "Crowning with Thorns," painted for the College del S. Sepolcro, and containing a large number of figures, is recorded to have occupied him only thirty-eight days, to which an assistant added eleven. His method was simple and expeditious, the shadows being painted with the pure colour laid on thick, while the lights are of the same colour thinly used, and mixed with a little white. The frescoes exhibit more freedom of hand than the oil pictures; and they are on the whole less like the work of Da Vinci, having at an early date a certain resemblance to the style of Mantegna, as later on to that of Raphael. Luini's colouring is mostly rich, and his light and shade forcible.

Among his principal works the following are to be mentioned. At Saronno are frescoes painted towards 1525, representing the life of the Madonna—her "Marriage," the "Presentation of the Infant Saviour in the Temple," the "Adoration of the Magi" and other incidents. His own portrait appears in the subject of the youthful "Jesus with the Doctors in the Temple." This series—in which some comparatively archaic details occur, such as gilded nimbuses—was partly repeated from one which Luini had executed towards 1520 in S. Croce. In the Brera Gallery, Milan, are frescoes from the suppressed church of La Pace and the Convent della Pelucca—the former treating subjects from the life of the Virgin, the latter, of a classic kind, more decorative in manner. The subject of girls playing at the game of "hot-cockles," and that of three angels depositing St Catherine in her sepulchre, are particularly memorable, each of them a work of perfect charm and grace in its way. In the Casa Silva, Milan, are frescoes from Ovid's *Metamorphoses*. The Monastero Maggiore of Milan (or church of S. Maurizio) is a noble treasure-house of Luini's art—including a large Crucifixion, with about one hundred and forty figures; "Christ bound to the Column," between figures of Saints Catherine and Stephen, and the founder of the chapel kneeling before Catherine; the martyrdom of this saint; the "Entombment of Christ," and a large number of other subjects. In the Ambrosian library is the fresco (already mentioned), covering one entire wall of the Sala della S. Corona, of "Christ crowned with Thorns," with two executioners, and on each side six members of a confraternity; in the same building the "Infant Baptist playing with a Lamb"; in the Brera, the "Virgin Enthroned, with Saints" (dated 1521); in the Louvre, the "Daughter of Herodias receiving the Head of the Baptist"; in the Esterhazy Gallery, Vienna, the "Virgin between Saints Catherine and Barbara"; in the National Gallery, London, "Christ disputing with the Doctors" (or rather, perhaps, the Pharisees). Many or most of these gallery pictures used to pass for the handiwork of Da Vinci. The same is the case with the highly celebrated "Vanity and Modesty" in the Sciarra Palace, Rome, which also may nevertheless in all probability be assigned to Luini. Another singularly beautiful picture by him is in the Royal Palace in Milan—a large composition of "Women Bathing." That Luini was also pre-eminent as a decorative artist is shown by his works in the Certosa of Pavia.

A good account of Luini by Dr G. C. Williamson was published in 1900. (W. M. R.)

LUKE, the traditional author of the third Gospel and of the Book of Acts, and the most literary among the writers of the New Testament. He alone, too, was of non-Jewish origin (Col. iv. 11, 14), a fact of great interest in relation to his writings. His name, a more familiar form of Lucanus (cf. Silas for Silvanus, Acts xvii. 4, 1 Thess. i. 1, and see *Encycl. Bibl.* s.v., for instances of Λουκᾶς on Egyptian inscriptions), taken together with his profession of physician (Col. iv. 14), suggests that he was son of a Greek freedman possibly connected with Lucania in south Italy; and as Julius Caesar gave Roman citizenship to all physicians in Rome (Sueton. *Jul.* 42), Luke may even have inherited this status from his father. But in any case such a man would have the attitude to things Roman which appears in the works attributed to Luke. He was a fellow-worker of Paul's when in Rome (Philemon 24), where he seems to have remained in constant attendance on his leader, as physician as well as attached friend (Col. iv. 14; 2 Tim. iv. 11). That Luke, before he became a Christian, was an adherent of the synagogue— not a full proselyte, but one of those "worshippers" of God to whom Acts makes frequent reference—is fairly certain from the familiarity with the Septuagint indicated in Acts, as well as from its sympathy with the Hellenistic type of piety as distinct from specific Paulinism, of which there is but little trace.

The earliest extra-biblical reference to him is perhaps in the Muratonian Canon, which implies that his name already stood in MSS. of both Gospel (probably so even in Marcion's day) and Acts, and says that Paul took him for his companion *quasi ut juris studiosum* ("as being a student of law"). Here *juris* is almost certainly corrupt; and whether we take the sense to have been "as being devoted to travel" (*ut juris=itineris*) or "as skilled in disease" (*νόσου* passing into *νόμου* in the Greek original), it is probably a mere inference from biblical data. Beyond references in Irenaeus, Clement of Alexandria (cf. HEBREWS) and Tertullian, which add nothing to our knowledge, we have the belief to which Origen (*Hom.* i. *in Lucam*) witnesses as existing in his day, that Luke was the "brother" of 2 Cor. viii. 18, "whose praise in the Gospel" (as preached) was "throughout all the churches." Though the basis of the identification be a mistake, yet that this "brother," "who was also appointed by the churches (note the generality of this) to travel with us in the matter of the charity," was none other than Paul's constant companion Luke is quite likely; *e.g.* he seems to have been almost the only non-Macedonian (as demanded by 2 Cor. ix. 2-4) of Paul's circle available[1] at the time (see Acts xx. 4). Our next witness, a prologue to the Lucan writings (originally in Greek, now known only in Latin, see *Nov. Test. Latine* (Oxford), I. iii., II. i.), perhaps preserves a genuine tradition in stating that Luke died in Bithynia at the age of seventy-four. It is hard to see why this should be fiction, which usually took the form of martyrdom, as in a later tradition touching his end. The same prologue, and indeed all early tradition, connects him originally with Antioch (see Euseb. *Hist. Eccl.* iii. 4, 6, possibly after Julius Africanus in the first half of the 3rd century).

That he was actually a native of Antioch is as doubtful as the statement that he was a Syrian by race (Prologue). But internal evidence bears out the view that he practised his profession in Antioch, where (or in Tarsus) he probably first met Paul. Whether any of his information in Acts as to the Gospel in Antioch (xi. 19 ff., xiii. 1 ff., xiv. 26-xv. 35) was due to an Antiochene document used by him (cf. A. Harnack, *The Acts of the Apostles*, 245 ff.) or not, this knowledge in any case suggests Luke's connexion with that church. He shows, too, local knowledge on points unlikely to have stood in any such source (*e.g.* it was in Antioch that the name "Christians" was first coined, xi. 26), which points to his share in early Church life there. The Bezan reading in Acts xi. 27, "when *we* were assembled," may imply memory of this.

But while Luke probably met Paul in Antioch, and thence started with him on his second great missionary enterprise (xv. 36 ff.), partly at least as his medical attendant (cf. Gal. iv. 13), it is possible that he had also some special connexion with the north-eastern part of the Aegean. Sir W. M. Ramsay and others fancy that Luke's original home was Philippi, and that in fact he may have been the "certain Macedonian" seen in vision by Paul at Troas, inviting help for his countrymen (xvi. 9 f.). But this is as precarious as the view that, because "we" ceases at Philippi in xvi. 17, and then re-emerges in xx. 6, Luke must have resided there during all the interval. The use and disuse of the first person plural, identifying Paul and his party, has probably a more subtle and psychological[2] meaning (see ACTS). The local connexion in question may have been subsequent to that with Antioch, dating from his work with Paul in the province of Asia, and being resumed after Paul's martyrdom. This accords at once with Harnack's argument that Luke wrote Acts in Asia[3] (*Luke the Physician*, p. 149 ff.), and with the early tradition, above cited, that he died in Bithynia at the age of seventy-four, without ever having married (this touch may be due to an ascetic feeling current already in the 2nd century).

The later traditions about Luke's life are based on fanciful inference or misunderstanding, *e.g.* that he was one of the Seventy (Adamantius *Dial. de recta fide*, 4th century), or the story (in Theodorus Lector, 6th century) that he painted a portrait of the Virgin Mother. But a good deal can still be gathered by sympathetic study of his writings as to the manner of man he was. It was a beautiful soul from which came "the most beautiful book" ever written, as Renan styled his Gospel. The selection of stories which he gives us—especially in the section mainly peculiar to himself (ix. 51-xviii. 14)—reflects his own character as well as that of the source he mainly follows. His was indeed a *religio medici* in its pity for frail and suffering humanity, and in its sympathy with the triumph of the Divine "healing art" upon the bodies and souls of men (cf. Harnack, *The Acts, Excursus*, iii.). His was also a humane[4] spirit, a spirit so tender that it saw further than almost any save the Master himself into the soul of womanhood. In this, as in his joyousness, united with a feeling for the poor and suffering, he was an early Francis of Assisi. Luke, "the physician, the beloved physician," that was Paul's characterization of him; and it is the impression which his writings have left on humanity. How great his contribution to Christianity has been, in virtue of what he alone preserved of the historical Jesus and of the embodiment of his Gospel in his earliest followers, who can measure? Harnack even maintains (*The Acts*, p. 301) that his story of the Apostolic age was the indispensable condition for the incorporation of the Pauline epistles in the Church's canon of New Testament scriptures. Certainly his conception of the Gospel, viz. a Christian Hellenistic universalism (with some slight infusion of Pauline thought) passed through a Graeco-Roman mind, proved more easy of assimilation, and so more directly influential for the ancient Church, than Paul's own distinctive teaching (*ib.* 281 ff.; cf. *Luke the Physician*, pp. 139-145).

LITERATURE.—Introductions to commentaries like A. Plummer's on Luke's Gospel in the "Intern. Crit." series, R. B. Rackham's *Acts of the Apostles* ("Oxford Comm."); the article "Luke" in Hastings's *Dict. of the Bible* and *Dict. of Christ and the Gospels*, the *Encycl. Biblica* and Hauck's *Realencyklopädie*, vol. xi.; Sir W. M. Ramsay's *Paul the Traveller* and *Pauline and other Studies*, and A. Harnack's *Lukas der Arzt* (1906, Eng. trans. 1907) and *Die Apostelgeschichte* (1908, Eng. trans. 1909). For the Luke of legend, see authorities quoted under MARK. (J. V. B.)

LUKE, GOSPEL OF ST, the third of the four canonical Gospels of the Christian Church.

1. *Authorship and Date.*—The earliest indication which we possess of the belief that the author was Luke, the companion of the Apostle Paul (Col. iv. 14; Philem. 24; 2 Tim. iv. 11), is found in Justin Martyr, who, in his *Dialogue with Trypho* (c. 103), when making a statement found only in our Luke, instead of referring for it simply to the "Apostolic Memoirs," his usual formula, says that it is contained in the memoirs composed by "the Apostles and *those that followed them*." But the first distinct mention of Luke as the author of the Gospel is that by Irenaeus in his famous passage about the Four Gospels (*Adv. Haer.* III. i. 2, *c.* A.D. 180).

This tradition is important in spite of the fact that it first comes clearly before us in a writer belonging to the latter part of the 2nd century, because the prominence and fame of Luke were not such as would of themselves have led to his being singled out to have a Gospel attributed to him. The question of the authorship cannot, however, be decided without considering the internal evidence, the interpretation of which in the case of the Third Gospel and the Acts (the other writing attributed to Luke) is a matter of peculiar interest. It is generally admitted that the same person is the author of both works in their present form. This is intimated at the beginning of the second of them (Acts i. 1); and both are marked, broadly speaking throughout, though in some parts much more strongly than in others, by stylistic characteristics which we may conveniently call "Lucan" without making a premature assumption as to the authorship. The writer is more versed than any other New Testament writer except the author of the Epistle to the Hebrews, and very much more than most of them, in the literary Greek of the period of the rise of Christianity; and he has, also, like other writers, his favourite words, turns of expression and thoughts. The variations in the degree to which these appear in different passages are in the main to be accounted for by his having before him in many cases documents or oral reports, which he reproduces with only slight alterations in the language, while at other times he is writing freely.

We have next to observe that there are four sections in Acts (xvi. 9-17, xx. 4-16, xxi. 1-17, xxvii. 1-xxviii. 16) in which the first person plural is used. Now it is again generally admitted that in these sections we have the genuine account of one who was a member of Paul's company, who may well have been Luke. But it has been and is still held by many critics that the author of Acts is a different person, and that as in the Third Gospel he has used documents for the Life of Christ, and perhaps also in the earlier half of the Acts for the history of the beginnings of the Christian Church, so in the "we" sections, and possibly in some other portions of this narrative of Paul's missionary life, he has used a kind of travel-diary by one who accompanied the Apostle on some of his journeys. That neither this, nor any other, companion of Paul can have been the author of the whole work is supposed to follow both from its theological temper and from discrepancies between its statements and those of the Pauline Epistles on matters of fact.

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[1] Tychicus may be the other "brother," in viii. 22.

[2] So also A. Hilgenfeld, *Zeit. f. theol. Wissenschaft* (1907), p. 214, argues that "we" marks the author's wish to give his narrative more vividness at great turning-points of the story—the passage from Asia to Europe, and again the real beginning of the solemn progress of Paul towards the crisis in Jerusalem, as yet later towards Rome, xxvii. 1 ff.

[3] Note that Luke is at pains to explain why Paul passed by Asia and Bithynia in the first instance (xvi. 6 f.).

[4] Compare what A. W. Verrall has said of the poet Statius and "the gentle doctrine of humanity" on Hellenic soil, as embodied in his description of The Altar of Mercy at Athens (*Oxford and Cambridge Review*, i. 101 ff.).

A careful examination, however, of the "we" sections shows that words and expressions characteristic of the author of the third Gospel and the Acts are found in them to an extent which is very remarkable, and that in many instances they belong to the very texture of the passages. This linguistic evidence, which is of quite unusual force, has never yet been fairly faced by those who deny Luke's authorship of Acts. Moreover, the difficulties in the way of supposing that the author of Acts could at an earlier period of his life have been a companion of St Paul do not seem to be so serious as some critics think. Indeed it is easier to explain some of the differences between the Acts and St Paul's Epistles on this assumption than on that of authorship by a writer who would have felt more dependent upon the information which might be gathered from those Epistles, and who would have been more likely to have had a collection of them at hand, if his work was composed *c.* A.D. 100, as is commonly assumed by critics who reject the authorship by Luke.

There is then strong reason for believing the tradition that Luke, the companion of the Apostle Paul, was the author of our third Gospel and the Acts. Another argument in support of this belief, upon which much reliance has been placed, is found in the descriptions of diseases, and the words common in Greek medical writers, contained in these two works. These, it is said, point to the author's having been a physician, as Luke (Col. iv. 14) was (see esp. Hobart, *The Medical Language of St Luke*, 1882). The instances alleged are, many of them at least, not very distinctive. Yet they have some value as confirming the conclusion based on a comparison of the "we" sections of the Acts, with the remainder of the two books.

If we may assume that the writer who uses the first person plural in Acts xvi. 10 sqq. was the author of the two works, they can hardly have been composed later than A.D. 96; he would then have been about 65 years old, even if he was a very young man when he first joined the Apostle. An earlier date than A.D. 96 cannot be assigned if it is held that his writings show acquaintance with the *Antiquities of the Jewish People* by Josephus. The grounds for supposing this appear, however, to be wholly insufficient (see article on Acts by Bishop Lightfoot in 2nd ed. of Smith's *Dict. of Bible*, p. 39) and it is not easy to see why he should have deferred writing so long. On the other hand, a comparison of Luke xxi. 20-24 with Mark xiii. 14 seq. seems to show that in using his document Luke here mingled with the prophecy the interpretation which events had suggested and that the siege of Jerusalem in A.D. 70 and dispersion of its inhabitants had already taken place some little time before. *Circa* A.D. 80 may with probability be given as the time of the composition of his Gospel.

2. *Contents, Sources and Arrangement.*—In the preface to his Gospel, i. 1-4, Luke alludes to other Gospel-records which preceded his own. He does not say whether he made any use of them, but he seems to imply that his own was more complete. And this was true in regard to the two which, from a comparison of his Gospel with the other two Synoptics, we know that he did use. These we may call his Marcan and his Logian document. Luke also claims that he has written "in order." The instances in which he has departed from the Marcan order, and the manner in which he has introduced his additional matter into the Marcan outline, do not suggest the idea that he had any independent knowledge of an exact kind of the chronological sequence of events. By the phrase "in order" he may himself have intended chiefly to contrast the orderliness and consecutiveness of his account with the necessarily fragmentary character of the catechetical instruction which Theophilus had received. He may, also, have had in view the fact that he has prefixed a narrative of the birth and infancy of Jesus and of John and so begun the history at what he considered to be its true point of departure; to this he plainly alludes when he says that he has "traced the course of all things accurately from the first." He may, also, in part be thinking of those indications which he—and he alone among the evangelists—has given of the points in the course of secular history at which Jesus was born and the Baptist began to preach (ii. 1-3, iii. 1, 2), though it may be doubted whether these are in all respects accurate.

Chap. i. 5-ii. 52. *The Birth and Infancy of John and of Jesus.*—This portion of the Gospel differs in style and character from all the remainder. Its source may be an Aramaic or a Hebrew document. Some critics, however, hold that it is wholly Luke's own composition, and that the Hebraic style—in which he was able to write in consequence of his familiarity with the LXX.—has been adopted by him as suitable to the subject in hand. Perhaps an intermediate view may be the most probable one; he may have obtained part of his materials, especially the hymns, from some source, and have skilfully worked these into his narrative.

Chap. iii. 1-iv. 13. *From the Commencement of the Preaching of the Baptist to the End of the Temptation in the Wilderness.*—The accounts of the Baptist's preaching and of the temptation are taken from the Logian document. The genealogy of Jesus here given is peculiar to this Gospel.

Chap. iv. 14-vi. 16 *From the Commencement of the Ministry of Jesus in Galilee to the Appointment of the Twelve.*—In the main Luke here follows his Marcan document. He has, however, independent narratives of the visit of Jesus to Nazareth (iv. 16-30) and the call of the first disciples (v. 1-11). The former, which in Mark is placed some way on in the Galilean ministry (vi. 1-6*a*), is given by Luke at the very beginning of it, perhaps because of the previous connexion of Jesus with Nazareth. But that it is not in its right position here, before any mention of the work in Capernaum, appears from verse 23. Luke has also slightly altered the position of the call of the first disciples in the sequence of events.

Chap. vi. 17-viii. 3.—This is an insertion into the Marcan outline of matter chiefly taken from the Logian document (the Address, Luke vi. 20-49, corresponds with portions of the Sermon on the Mount in Matt. v.-vii.; the healing of the centurion's servant, Luke vii. 1-10 = Matt. viii. 5-13; the message of the Baptist and the discourse for which it gave occasion, Luke vii. 18-35 = Matt. xi. 2-19). He includes besides, a few pieces peculiar to this Gospel which Luke had probably himself collected.

Chap. viii. 4-ix. 50. *From the Adoption of Parabolic Teaching to the End of the Ministry in Galilee.*—He begins again to follow his Marcan document for what he gives. Many sections, however, contained in the corresponding part of Mark have no parallel in Luke, while the parallel to one of them is placed later and differs considerably in form. Possibly this fact points to his Marcan document having been briefer than our Mark, and to its having afterwards received interpolations (see MARK, GOSPEL OF ST).

Chap. ix. 51-xviii. 14. *Incidents and Teaching connected with Journey towards Jerusalem.*—This is another insertion into the Marcan outline, much longer than the previous one, and consisting partly of matter taken from the Logian document (warnings to men who offer to become disciples, Luke ix. 57-60 = Matt. viii. 19-22; a mission-charge, Luke x. 2-16 = Matt. ix. 37 and x. 7-16, 40; thanksgiving that the Father reveals to the simple that which is hidden from the wise, Luke x. 21-24 = Matt. xi. 25-27 and xiii. 16, 17, &c., &c.) and partly of sections peculiar to Luke, about which the same remark may be made as before.

Chap. xviii. 15-xxii. 13. *From the Bringing of young Children to Jesus to the Preparation for the Passover.*—Luke again takes up his Marcan document, nearly at the point at which he left it, and follows it in the main, though he adds the story of Zacchaeus and the parable of the Minae (the Ten Pieces of Money), and omits the withering of the fig-tree and some matter at the end of the discourse on the Last Things, which are given in Mark.

Chap. xxii. 14 to end. *The Last Supper, Passion and Resurrection.*—Though in this portion of his Gospel signs of use of Mark are not wanting, he also has much that is peculiar to himself. It is supposed by some that he here made use of another document. It seems more likely that he had a good many distinct oral traditions for this part of the history and that he used them freely, sometimes substituting them for passages of the Marcan document, sometimes altering the latter in accordance therewith.

3. *Doctrinal, Ethical and Literary Characteristics.*—The thought of divine forgiveness, as set forth in the teaching of Jesus and manifested in His own attitude towards, and power over, the hearts of the outcasts among the people, is peculiarly prominent in this Gospel. This feature of Christ's ministry appears only in one passage of Mark; some other illustrations of it are mentioned in Matthew, but in Luke there are several more which are peculiar to himself (see the three individual cases vii. 36 sqq.; xix. 1 sqq., xxiii. 40 sqq.; also the description at xv. 1, and the three parables that follow). These were "lost sheep of the house of Israel"; but Christ's freedom from Jewish exclusiveness is also brought out (1) as regards Samaritans, by the rebuke

administered to the disciples at ix. 52 sqq., the parable in x. 30 sqq., and the incident at xvii. 15-19; whereas they are not mentioned in Mark, and in Matthew only in the saying (x. 5) in which the Twelve are forbidden to enter any village of theirs; (2) as regards Gentiles, by the words of Jesus at iv. 25-27, not to mention sayings which have parallels in the other Gospels. The promises of Old Testament prophets that the Gentiles would share in the blessing of the coming of Christ are also recalled, ii. 32-iii. 6. Once more the word εὐαγγελίζεσθαι ("to proclaim good tidings") is a favourite one with Luke. These are all traits which we should expect to find in one who was a companion of Paul and a Gentile (Col. iv. 11, 14).

With the breadth and depth of the Saviour's sympathy, which are so fully exhibited in this Gospel, we may connect the clearness with which His true humanity is here portrayed. An incident of His boyhood is related in which His sense of vocation is revealed, and this is followed by the years of quiet growth that succeeded (ii. 41-52). Further, during the years of His public ministry more glimpses of His inner life are given us than in either Matthew or Mark. His being engaged in prayer is mentioned several times where there is no parallel in those Gospels (iii. 21, v. 16, vi. 12, ix. 18, 28, 29, xi. 1). Again, besides narrating the Temptation in the Wilderness and the Agony in the Garden, this evangelist gives a saying which implies that Jesus had undergone many temptations, or rather a life of temptation (xxii. 28). Once more he records a saying that shows Christ's sense of the intense painfulness of the work He was sent into the world to do, arising from the divisions which it caused (xii. 49 sqq.).

Among practical duties, the stress laid on that of almsgiving is remarkable (see especially xi. 41, xii. 33, xvi. 9 sqq., which are peculiar to this Gospel). In the second of these passages the disciples are exhorted to choose a life of voluntary poverty; the nearest parallel is the ideal set before the rich young man at Mark x. 21 = Matt. xix. 21 = Luke xviii. 22. In the Beatitudes in Luke vi. 20, 21 a condition of physical want is contemplated, not, as in Matt. v. 3, 6, poverty of spirit and spiritual hunger, while woes are denounced against the rich and the full (vi. 24, 25). The folly of absorption in the amassing and enjoyment of wealth is also shown (xii. 15 sqq. and xvi. 19 sqq.). But it would be an exaggeration to say, as some have done, that the poor are represented as being the heirs of a blessed hereafter, simply on the ground that they are now poor. In the Beatitudes Christ's own disciples are addressed, who were blessed *though* poor, whereas the rich as a class were opposed or indifferent to the kingdom of God. Again, the contrast between Lazarus and Dives in the future state pictures vividly the reversals that are in store; but it is unreasonable to take it as implying that every poor man, whatever his moral character, will be blessed.

But while there is in Luke's Gospel this strain of asceticism—as to many in modern times it will appear to be—the prevailing spirit is gentle and tender, and there is in it a note of spiritual gladness, which is begun by the song and the messages of angels and the hymns and rejoicing of holy men and women, accompanying the birth of the Christ (chaps. i. and ii., *passim*), and prolonged by the expressions of joy, the ascriptions of thanksgiving and praise, called forth by the words and works of Christ and the wonders of the cross and resurrection, which are peculiarly frequent and full (iv. 15, v. 25, 26, vii. 16, x. 17, xiii. 13, 17, xvii. 15-18, xviii. 43, xix. 6, 37, 38, xxiii. 47, xxiv. 41, 52, 53. Cf. also xv. 5, 7, 10, 32).

The peculiar charm which this Gospel has been generally felt to possess is largely due to the spiritual and ethical traits which have been noted. But from a purely literary point of view, also, it is distinguished by great excellences. The evangelist's phraseology is indeed affected to some extent by the rhetorical style of the period when he wrote. Nevertheless his mode of narration is simple and direct. And the many fascinating character-sketches, which he has added to the portrait gallery of Scripture, are drawn clearly and without signs of effort. In some cases he has skilfully suggested parallelisms and contrasts. The chief instance is his careful interweaving of the accounts of the births and early years of John the Baptist and of Jesus. Later examples are the two sisters, Martha and Mary (x. 38-42), and the penitent and the impenitent thief (xxiii. 39-48). That he was a man of great versatility appears in the Acts from the speeches introduced on various occasions, if (as is probable) they were in part, at least, his own composition. In the Gospel he had no opportunity for showing his power in a manner strictly analogous. But if the hymns in the two introductory chapters owe even their Greek form in any measure to him, he was a poet of no mean order. His style varies greatly; at times, as in i. 1-4, it is Hellenistic; at others, as in i. 5 to end of ii., it is strongly Hebraic. Such differences are largely due, no doubt, to the degree in which he was in various parts independent of, or dependent upon, sources. But he would seem in some degree to have adapted his manner of writing to the subject-matter in hand. And at all events it is worthy of note that we pass without any sense of jar from passages in one style to those in another.

See Godet, *Commentaire sur l'évangile de S. Luc* (Eng. trans., 1875); Plummer's *Comm. on St Luke* (in international Series, 4th ed., 1906); W. Ramsay, *Was Christ born in Bethlehem?* (3rd ed., 1905); A. Harnack, *Lukas der Arzt* (1906); B. Weiss, *Die Quellen des Lukas-evangeliums* (1907); also books on the Four Gospels, or the Synoptic Gospels, mentioned at end of article GOSPEL. (V. H. S.)

LULEÅ, a seaport of Sweden, capital of the district (*län*) of Norrbotten, on the peninsula of Sandö, at the mouth of the Lule river and the north-west corner of the Gulf of Bothnia. Pop. (1900) 9484. It is connected at Boden (22 m. N.) with the main line of railway from Stockholm to Gellivara and Narvik on Ofoten Fjord in Norway. By this line Luleå is 723 m. N.N.E. of Stockholm. It is the shipping place for the iron ore mined at Gellivara, 127 m. N. by W., and there are smelting works at Karlsvik in the vicinity. Timber is also exported, being floated in large quantities down the Lule. As a rule the port is closed by ice from November to the end of May. The town was almost entirely burnt down in 1887, and its buildings are new—the church (1888–1893), the Norrbotten Museum and a technical school being the most important. Luleå as founded by Gustavus Adolphus was 7 m. higher up the river, but was moved to the present site in 1649.

LULL (or LULLY), **RAIMON**, or RAYMOND (*c.* 1235–1315), Catalan author, mystic and missionary, was born at Palma (Majorca). Inheriting the estate conferred upon his father for services rendered during the victorious expedition (1229) against the Balearic Islands, Lull was married at an early age to Blanca Picany, and, according to his own account, led a dissipated life till 1266 when, on five different occasions, he beheld the vision of Christ crucified. After his conversion, he resolved to devote himself to evangelical work among the heathen, to write an exposure of infidel errors, and to promote the teaching of foreign tongues in seminaries. He dedicated nine years to the study of Arabic, and in 1275 showed such signs of mental exaltation that, at the request of his wife and family, an official was appointed to administer his estate. He withdrew to Randa, there wrote his *Ars major* and *Ars generalis*, visited Montpellier, and persuaded the king of Majorca to build a Franciscan monastery at Miramar. There for ten years he acted as professor of Arabic and philosophy, and composed many controversial treatises. After a fruitless visit to Rome in 1285–1286, he journeyed to Paris, residing in that city from 1287 to 1289, and expounding his bewildering theories to auditors who regarded him as half insane. In 1289 he went to Montpellier, wrote his *Ars veritatis inventiva*, and removed to Genoa where he translated this treatise into Arabic. In 1291, after many timorous doubts and hesitations for which he bitterly blamed himself, Lull sailed for Tunis where he publicly preached Christianity for a year; he was finally imprisoned and expelled. In January 1293 he reached Naples where tradition alleges that he studied alchemy; there appears to be no foundation for this story, and the treatises on alchemy which bear his name are all apocryphal.[1] His efforts to interest Clement V. and Boniface

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[1] The alchemical works ascribed to Lull, such as *Testamentum*, *Codicillus seu Testamentum* and *Experimenta*, are of early although uncertain date. De Luanco ascribes some of them to a Raimundo

VIII. in his favourite project of establishing missionary colleges were unavailing; but a visit to Paris in 1298 was attended with a certain measure of success. He was, however, disappointed in his main object, and in 1300 he sailed to Cyprus to seek support for his plan of teaching Oriental languages in universities and monasteries. He was rebuffed once more, but continued his campaign with undiminished energy. Between 1302 and 1305 he wrote treatises at Genoa, lectured at Paris, visited Lyons in the vain hope of enlisting the sympathies of Pope Clement V., crossed over to Bougie in Africa, preached the gospel, and was imprisoned there for six months. On being released he lectured with increasing effect at Paris, attended the General Council at Vienne in 1311, and there witnessed the nominal adoption of his cherished proposals. Though close on eighty years of age, Lull's ardour was unabated. He carried on his propaganda at Majorca, Paris, Montpellier and Messina, and in 1314 crossed over once more to Bougie. Here he resumed his crusade against Mahommedanism, raised the fanatical spirit of the inhabitants, was stoned outside the city walls and died of his wounds on the 29th of June 1315. There can be no reasonable doubt that these events actually occurred, but the scene is laid by one biographer at Tunis instead of Bougie.

The circumstances of Lull's death caused him to be regarded as a martyr, local patriotism helped to magnify his merits, and his fantastic doctrines found many enthusiastic partisans. The *doctor illuminatus* was venerated throughout Catalonia and afterwards throughout Spain, as a saint, a thinker and a poet; but his doctrines were disapproved by the powerful Dominican order, and in 1376 they were formally condemned in a papal bull issued at the instance of the inquisitor, Nicolas Emeric. The authenticity of this document was warmly disputed by Lull's followers, and the bull was annulled by Martin V. in 1417. The controversy was renewed in 1503 and again in 1578: but the general support of the Jesuits and the staunch fidelity of the Majorcans saved Lull from condemnation. His philosophical treatises abound with incoherent formulae to which, according to their inventor, every demonstration in every science may be reduced, and posterity has ratified Bacon's disdainful verdict on Lull's pretensions as a thinker; still the fact that he broke away from the scholastic system has recommended him to the historians of philosophy, and the subtle ingenuity of his dialectic has compelled the admiration of men so far apart in opinion as Giordano Bruno and Leibniz.

The speculations of Lull are now obsolete outside Majorca where his philosophy still flourishes, but his more purely literary writings are extremely curious and interesting. In *Blanquerna* (1283), a novel which describes a new Utopia, Lull renews the Platonic tradition and anticipates the methods of Sir Thomas More, Campanella and Harrington, and in the *Libre de Maravelles* (1286) he adopts the Oriental apologue from *Kalilah and Dimnah*. And as a poet Lull takes a prominent position in the history of Catalan literature; such pieces as *El Desconort* (1295) and *Lo Cant de Ramon* (1299) combine in a rare degree simple beauty of expression with sublimity of thought and impassioned sincerity.

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(J. F.-K.)

LULLABY, a cradle-song, a song sung to children to "lull" them to sleep; the melody being styled in Fr. *berceuse* and in Ger. *Wiegenlied*. "Lull," cf. Swed. *lulla*, Du. *lullen*, &c., is of echoic or onomatopoeic origin, cf. Lat. *lallare*, to chatter.

LULLY, JEAN-BAPTISTE (*c.* 1633–1687), Italian composer, was born in Florence. Through the duc de Guise he entered the services of Madame de Montpensier as scullery-boy, and with the help of this lady his musical talents were cultivated. A scurrilous poem on his patroness resulted in his dismissal. He then studied the theory of music under Métra and entered the orchestra of the French court, being subsequently appointed director of music to Louis XIV, and director of the Paris opera. The influence of his music produced a radical revolution in the style of the dances of the court itself. Instead of the slow and stately movements which had prevailed until then, he introduced lively ballets of rapid rhythm. In December 1661 he was naturalized as a Frenchman, his original name being Giovanni Battista Lulli. In 1662 he was appointed music master to the royal family. In 1681 he was made a court secretary to the king and ennobled. While directing a *Te Deum* on the 8th of January 1687 with a rather long baton he injured his foot so seriously that a cancerous growth resulted which caused his death on the 22nd of March. Having found a congenial poet in Quinault, Lully composed twenty operas, which met with a most enthusiastic reception. Indeed he has good claim to be considered the founder of French opera, forsaking the Italian method of separate recitative and aria for a dramatic consolidation of the two and a quickened action of the story such as was more congenial to the taste of the French public. He effected important improvements in the composition of the orchestra, into which he introduced several new instruments. Lully enjoyed the friendship of Molière, for some of whose best plays he composed illustrative music. His *Miserere*, written for the funeral of the minister Sequier, is a work of genius; and very remarkable are also his minor sacred compositions. On his death-bed he wrote *Bisogna morire, peccatore*.

LUMBAGO, a term in medicine applied to a painful ailment affecting the muscles of the lower part of the back, generally regarded as of rheumatic origin. An attack of lumbago may occur alone, or be associated with rheumatism in other parts of the body. It usually comes on by a seizure, often sudden, of pain in one or both sides of the small of the back, of a severe cutting or stabbing character, greatly aggravated on movement of the body, especially in attempting to rise from the recumbent posture and also in the acts of drawing a deep breath, coughing or sneezing. So intense is the suffering that it is apt to suggest the existence of inflammation in some of the neighbouring internal organs, such as the kidneys, bowels, &c., but the absence of the symptoms specially characteristic of these latter complaints, or of any great constitutional disturbance beyond the pain, renders the diagnosis a matter of no great difficulty. Lumbago seems to be brought on by exposure to cold and damp, and by the other exciting causes of rheumatism. Sometimes it follows a strain of the muscles of the loins. The attack is in general of short duration, but occasionally it continues for a long time, as a feeling of soreness and stiffness on movement. The treatment includes that for rheumatic affections in general (see RHEUMATISM) and the application of local remedies to allay the pain.

LUMBER, a word now meaning (1) useless discarded furniture or other rubbish, particularly if of a bulky or heavy character; (2) timber, when roughly sawn or cut into logs or beams (see TIMBER); (3) as a verb, to make a loud rumbling noise, to move in a clumsy heavy way, also to burden with useless material, to encumber. "Lumber" and "lumber-house" were formerly used for a pawnbroker's shop, being in this sense a variant of "Lombard," a name familiar throughout Europe for a banker, money-changer or pawnbroker. This has frequently been taken to be the origin of the word in sense (1), the reference being to the store of unredeemed and unsaleable articles accumulating in pawnbrokers' shops. Skeat adopts this in preference to the connexion with "lumber" in sense (3), but thinks that the word may have been influenced by both sources (*Etym. Dict.*, 1910). This word is probably of Scandinavian origin, and is cognate with a Swedish dialect word *lomra*, meaning "to roar," a frequentative of *ljumma*, "to make a noise." The English word may be of native origin and merely onomatopoeic. The *New English Dictionary*, though admitting the probability of the association with "Lombard," prefers the second proposed derivation. The application of the word to timber is of American origin; the *New English Dictionary* quotes from *Suffolk* (Mass.) *Deeds* of 1662—"Freighted in Boston, with beames . . . boards . . . and other lumber."

LUMBINI, the name of the garden or grove in which Gotama, the Buddha, was born. It is first mentioned in a very ancient Pali ballad preserved in the *Sutta Nipāta* (verse 583). This

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de Tárraga (*c.* 1370), a converted Jew who studied the occult. Others are ascribed by Morhof to a Raymundus Lullius Neophytus, who lived about 1440. See ALCHEMY, and also J. Ferguson, *Bibliotheca chemica* (1906).

is the *Song of Nalaka* (the Buddhist Simeon), and the words put in the mouth of the angels who announce the birth to him are: "The Wisdom-child, that jewel so precious, that cannot be matched, has been born at Lumbinī, in the Sākiya land, for weal and for joy in the world of men." The commentaries on the *Jātakas* (i. 52, 54), and on a parallel passage in the *Majjhima* (*J.R.A.S.*, 1895, p. 767), tell us that the mother of the future Buddha was on her way from Kapilavastu (Kapilavatthu), the capital of the Sākiyas, to her mother's home at Devadaha, the capital of the adjoining tribe, the Koliyas, to be confined there. Her pains came upon her on the way, and she turned aside into this grove, which lay not far from Devadaha, and gave birth there to her son. All later Buddhist accounts, whether Pali or Sanskrit, repeat the same story.

A collection of legends about Asoka, included in the *Divyāvadāna*, a work composed probably in the 1st or 2nd century A.D., tells us (pp. 389, 390) how Asoka, the Buddhist emperor, visited the traditional site of this grove, under the guidance of Upagupta. This must have been about 248 B.C. Upagupta (Tissa: see PALI) himself also mentions the site in his *Kathā Vatthu* (p. 559). The Chinese pilgrims, Fa Hien and Hsuan Tsang, visiting India in the 5th and 7th centuries A.D., were shown the site; and the latter (ed. Watters, ii. 15-19) mentions that he saw there an Asoka pillar, with a horse on the top, which had been split, when Hsuan Tsang saw it, by lightning. This pillar was rediscovered under the following circumstances.

The existence, a few miles beyond the Nepalese frontier, of an inscribed pillar had been known for some years when, in 1895, the discovery of another inscribed pillar at Niglīva, near by, led to the belief that this other, hitherto neglected, one must also be an Asoka pillar, and very probably the one mentioned by Hsuan Tsang. At the request of the Indian government the Nepalese government had the pillar, which was half buried, excavated for examination; and Dr Führer, then in the employ of the Archaeological Survey, arrived soon afterwards at the spot.

The stone was split into two portions, apparently by lightning, and was inscribed with Pali characters as used in the time of Asoka. Squeezes of the inscription were sent to Europe, where various scholars discussed the meaning, which is as follows: "His Majesty, Piyadassi, came here in the 21st year of his reign and paid reverence. And on the ground that the Buddha, the Sākiya sage, was born here, he (the king) had a flawless stone cut, and put up a pillar. And further, since the Exalted One was born in it, he reduced taxation in the village of Lumbinī, and established the dues at one-eighth part (of the crop)."

The inscription, having been buried for so many centuries beneath the soil, is in perfect preservation. The letters, about an inch in height, have been clearly and deeply cut in the stone. No one of them is doubtful. But two words are new, and scholars are not agreed in their interpretation of them. These are the adjective *vigaḍabhī* applied to the stone, and rendered in our translation "flawless"; and secondly, the last word, rendered in our translation "one-eighth part (of the crop)." Fortunately these words are of minor importance for the historical value of this priceless document. The date, the twenty-first year after the formal coronation of Asoka, would be 248 B.C. The name Piyadassi is the official epithet always used by Asoka in his inscriptions when speaking of himself. The inscription confirms in every respect the Buddhist story, and makes it certain that, at the time when it was put up, the tradition now handed down in the books was current at the spot. Any further inference that the birth really took place there is matter of probability on which opinions will differ.

The grove is situate about 3 m. north of Bhagwanpur, the chief town of a district of the same name in the extreme south of Nepal, just over the frontier dividing Nepal from the district of Basti in British territory. It is now called Rummin-dei, *i.e.* the shrine of the goddess of Rummin, a name no doubt derived from the ancient name Lumbinī. There is a small shrine at the spot, containing a bas-relief representing the birth of the Buddha. But the Buddha is now forgotten there, and the bas-relief is reverenced only for the figure of the mother, who has been turned into a tutelary deity of the place. Except so far as the excavation of the pillar is concerned the site has not been explored, and four small stupas there (already noticed by Hsuan Tsang) have not been opened.

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LUMP-SUCKER, or LUMP-FISH (*Cyclopterus lumpus*), a marine fish, which with another British genus (*Liparis*) and a few other genera forms a small family (Cyclopteridae). Like many littoral fishes of other families, the lump-suckers have the ventral fins united into a circular concave disk, which, acting as a sucker, enables them to attach themselves firmly to rocks or stones. The body (properly so called) is short and thick, with a thick and scaleless skin, covered with rough tubercles, the larger of which are arranged in four series along each side of the body. The first dorsal fin is almost entirely concealed by the skin, appearing merely as a lump on the back. The lump-sucker inhabits the coasts of both sides of the North Atlantic; it is not rare on the British coasts, but becomes more common farther north. It is so sluggish in its habits that individuals have been caught with sea-weed growing on their backs. In the spring the fish approaches the shores to spawn, clearing out a hollow on a stony bottom in which it deposits an immense quantity of pink-coloured ova. Fishermen assert that the male watches the spawn until the young are hatched, a statement which receives confirmation from the fact that the allied gobies, or at least some of them, take similar care of their progeny. The vernacular name, "cock and hen paddle," given to the lump-fish on some parts of the coast, is probably expressive of the difference between the two sexes in their outward appearance, the male being only half or one-third the size of the female, and assuming during the spawning season a bright blue coloration, with red on the lower parts. This fish is generally not esteemed as food, but Franz Faber (*Fische Islands*, p. 53) states that the Icelanders consider the flesh of the male as a delicacy.[1] The bones are so soft, and contain so little inorganic matter, that the old ichthyologists placed the lump-sucker among the cartilaginous fishes.

LUMSDEN, SIR HARRY BURNETT (1821–1896), Anglo-Indian soldier, son of Colonel Thomas Lumsden, C.B., was born on the 12th of November 1821. He joined the 59th Bengal Native Infantry in 1838, was present at the forcing of the Khyber Pass in 1842, and went through the first and second Sikh wars, being wounded at Sobraon. Having become assistant to Sir Henry Lawrence at Lahore in 1846, he was appointed in 1847 to raise the Corps of Guides. The object of this corps, composed of horse and foot, was to provide trustworthy men to act as guides to troops in the field, and also to collect intelligence beyond as well as within the North-West frontier of India. The regiment was located at Mardan on the Peshawar border, and has become one of the most famous in the Indian army. For the equipment of this corps, Lumsden originated the *khaki* uniform. In 1857 he was sent on a mission to Kandahar with his younger brother, Sir Peter Lumsden, in connexion with the subsidy paid by the Indian government to the amir, and was in Afghanistan throughout the Mutiny. He took part in the Waziri Expedition of 1860, was in command of the Hyderabad Contingent from 1862, and left India in 1869. He became lieutenant-general in 1875, and died on the 12th of August 1896.

See Sir Peter Lumsden and George Elsmie, *Lumsden of the Guides* (1899).

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[1] The "cock-padle" was formerly esteemed also in Scotland, and figures in the *Antiquary*, chap. xi.

LUNA, ÁLVARO DE (d. 1453), Constable of Castile, Grand Master of Santiago, and favourite of King John II. of Castile, was the natural son of Álvaro de Luna, a Castilian noble. He was introduced to the court as a page by his uncle Pedro de Luna, archbishop of Toledo, in 1410. Álvaro soon secured a commanding influence over John II., then a mere boy. During the regency of the king's uncle Ferdinand, which ended in 1412, he was not allowed to be more than a servant. When, however, Ferdinand was elected king of Aragon, and the regency remained in the hands of the king's mother, Constance, daughter of John of Gaunt, a foolish and dissolute woman, Álvaro became a very important person. The young king regarded him with an affection which the superstition of the time attributed to witchcraft. As the king was surrounded by greedy and unscrupulous nobles, among whom his cousins, the sons of Ferdinand, commonly known as the Infantes (princes) of Aragon, were perhaps the worst, his reliance on a favourite who had every motive to be loyal to him is quite intelligible. Álvaro too was a master of all the accomplishments the king admired—a fine horseman, a skilful lance and a writer of court verse. Until he lost the king's protection he was the central figure of the Castilian history of the time. It was a period of constant conflict conducted by shifting coalitions of the nobles, who under pretence of freeing the king from the undue influence of his favourite were intent on making a puppet of him for their own ends. The part which Álvaro de Luna played has been diversely judged. To Mariana he appears as a mere self-seeking favourite. To others he has seemed to be a loyal servant of the king who endeavoured to enforce the authority of the crown, which in Castile was the only alternative to anarchy. He fought for his own hand, but his supremacy was certainly better than the rule of gangs of plundering nobles. His story is in the main one of expulsions from the court by victorious factions, and of his return when his conquerors fell out among themselves. Thus in 1427 he was solemnly expelled by a coalition of the nobles, only to be recalled in the following year. In 1431 he endeavoured to employ the restless nobles in a war for the conquest of Granada. Some successes were gained, but a consistent policy was impossible with a rebellious aristocracy and a king of indolent character. In 1445 the faction of the nobles allied with Álvaro's main enemies, the Infantes de Aragon, were beaten at Olmedo, and the favourite, who had been constable of Castile and count of Santestéban since 1423, became Grand Master of the military order of Santiago by election of the Knights. His power appeared to be thoroughly established. It was, however, based on the personal affection of the king. The king's second wife, Isabella of Portugal, was offended at the immense influence of the constable, and urged her husband to free himself from slavery to his favourite. In 1453 the king succumbed, Álvaro was arrested, tried and condemned by a process which was a mere parody of justice, and executed at Valladolid on the 2nd of June 1453.

The *Chronicle of Álvaro de Luna* (Madrid, 1784), written by some loyal follower who survived him, is a panegyric and largely a romance. The other contemporary authority—the *Chronicle of John II.*—is much less favourable to the constable. Don Jose Quintana has summarized the two chronicles in his life of Luna in the *Vidas de Españoles célebres*; *Biblioteca de Autores Españoles* (Madrid, 1846–1880), vol. xix.

LUNA (mod. *Luni*), an ancient city of Etruria, Italy, 4½ m. S.E. of the modern Sarzana. It was the frontier town of Etruria, on the left bank of the river, Macra, the boundary in imperial times between Etruria and Liguria. When the Romans first appeared in these parts, however, the Ligurians were in possession of the territory as far as Pisa. It derived its importance mainly from its harbour, which was the gulf now known as the Gulf of Spezia, and not merely the estuary of the Macra as some authors have supposed. The town was apparently not established until 177 B.C., when a colony was founded here, though the harbour is mentioned by Ennius, who sailed hence for Sardinia in 205 B.C. under Manlius Torquatus. An inscription of 155 B.C., found in the forum of Luna in 1857, was dedicated to M. Claudius Marcellus in honour of his triumph over the Ligurians and Apuani. It lost much of its importance under the Empire, though traversed by the coast road (Via Aurelia), and it was renowned for the marble from the neighbouring mountains of Carrara, which bore the name of Luna marble. Pliny speaks of the quarries as only recently discovered in his day. Good wine was also produced. There are some remains of the Roman period on the site, and a theatre and an amphitheatre may be distinguished. No Etruscan remains have come to light. O. Cuntz's investigations (*Jahreshefte des Österr. Arch. Instituts*, 1904, 46) seem to lead to the conclusion that an ancient road crossed the Apennines from it, following the line of the modern road (more or less that of the modern railway from Sarzana to Parma), and dividing near Pontremoli, one branch going to Borgotaro, Veleia and Placentia, and the other over the Cisa pass to Forum Novum (Fornovo) and Parma. The town was destroyed by the Arabs in 1016, and the episcopal see transferred to Sarzana in 1204.

See G. Dennis, *Cities and Cemeteries of Etruria* (London, 1883), ii. 63. (T. As.)

LUNATION, the period of return of the moon (*luna*) to the same position relative to the sun; for example, from full moon to full moon. Its duration is 29·5305884 days.

LUNAVADA, a native state in India, in the Gujarat division of Bombay. Area, 388 sq. m.; pop. (1901) 63,967, showing a decrease of 28% in the decade, due to famine. The chief, whose title is maharana, is a Rajput of high lineage. Estimated revenue, £12,000; tribute, £1000. The capital is Lunavada town, said to have been founded in 1434; pop. (1901) 10,277.

LUNCHEON, in present usage the name given to a meal between breakfast and tea or dinner. When dinner was taken at an early hour, or when it is still the principal midday meal, luncheon was and is still a light repast. The derivation of the word has been obscured, chiefly owing to the attempted connexion with "nuncheon," with which the word has nothing to do etymologically. "Luncheon" is an extended form of "lunch" (another form of "lump," as "bunch" is of "bump"). Lunch and luncheon in the earliest meanings found are applied to a thick piece of bread, bacon, meat, &c.

The word "nuncheon," or "nunchion," with which "luncheon" has been frequently connected, appears as early as the 14th century in the form *noneschenche*. This meant a refreshment or distribution, properly of drink, but also accompanied with some small quantity of meat, taken in the early afternoon. The word means literally "noon-drink," from none or noon, *i.e. nona hora*, the ninth hour, originally 3 o'clock P.M., but later "midday"—the church office of "nones," and also the second meal of the day, having been shifted back—and *schenchen*, to pour out; cf. German *schenken*, which means to retail drink and to give, present. *Schenche* is the same as "shank," the shin-bone, and the sense development appears to be shin-bone, pipe, hence tap for drawing liquor. See also Skeat, *Etymological Dict. of English Language* (1910), s.v. "nunchion."

LUND, TROELS FREDERIK (1840–), Danish historian, was born in Copenhagen on the 5th of September 1840. He entered the university of Copenhagen in 1858. About the age of thirty he took a post which brought before his notice the treasures of the archives of Denmark. His first important work, *Historiske Skitser*, did not appear until 1876, but after that time his activity was stupendous. In 1879 was published the first volume of his *Danmarks og Norges Historie i Slutningen af det xvi. Aarhundrede*, a history of daily life in Denmark and Norway at the close of the 16th century. Troels Lund was the pioneer of the remarkable generation of young historians who came forward in northern Europe about 1880, and he remained the most original and conspicuous of them. Saying very little about kings, armies and governments, he concentrates his attention on the life, death, employments, pleasures and prejudices of the ordinary men and women of the age with which he deals, using to illustrate his theme a vast body of documents previously neglected by the official historian. Lund was appointed historiographer-royal to the king of Denmark and comptroller of the Order of the Dannebrog. There was probably no living man to whom the destruction of the archives, when Christiansborg Castle was accidentally burned in 1884, was so acute a matter of distress. But his favourite and peculiar province, the MSS. of the 16th century, was happily not involved in that calamity.

LUND, a city of Sweden, the seat of a bishop, in the district (*län*) of Malmöhus, 10 m. N.E. of Malmö by rail. Pop. (1900) 16,621. A university was founded here in 1668 by Charles XI., with faculties of law, medicine, theology and philosophy. The number of students ranges from 600 to 800, and there are about 50 professors. Its library of books and MSS. is entitled to receive a copy of every work printed in Sweden. Important buildings include the university hall (1882), the academic union of the students (1851) containing an art museum; the astronomical observatory, built in 1866, though observations have been carried on since 1760; the botanical museum, and ethnographical and industrial art collections, illustrating life in southern Sweden from early times. Each student belongs to one of twelve nations (*landskap*), which mainly comprises students from a particular part of the country. The Romanesque cathedral was founded about the middle of the 10th century. The crypt under the raised transept and choir is one of the largest in the world, and the church is one of the finest in Scandinavia. A statue of the poet Esaias Tegner stands in the Tegners Plads, and the house in which he lived from 1813 to 1826 is indicated by an inscribed stone slab. The chief industries are sugar-refining, iron and brick works, and the manufacture of furniture and gloves.

Lund (*Londinum Gothorum*), the "Lunda at Eyrarsund" of Egil's Saga, was of importance in Egil's time (*c.* 920). It appears that, if not actually a seaport, it was at least nearer the Sound than now. In the middle of the 11th century it was made a bishopric, and in 1103 the seat of an archbishop who received primatial rank over all Scandinavia in 1163, but in 1536 Lund was reduced to a bishopric. Close to the town, at the hill of Sliparabacke, the Danish kings used to receive the homage of the princes of Skare, and a monument records a victory of Charles XI. over the Danes (1676), which extinguished the Danish claim to suzerainty over this district.

LUNDY, BENJAMIN (1789–1839), American philanthropist, prominent in the anti-slavery conflict, was born of Quaker parentage, at Hardwick, Warren county, New Jersey, on the 4th of January 1789. As a boy he worked on his father's farm, attending school for only brief periods, and in 1808–1812 he lived at Wheeling, Virginia (now W. Va.), where he served an apprenticeship to a saddler, and where—Wheeling being an important headquarters of the inter-State slave trade—he first became deeply impressed with the iniquity of the institution of slavery, and determined to devote his life to the cause of abolition. In 1815, while living at Saint Clairsville, Ohio, he organized an anti-slavery association, known as the "Union Humane Society," which within a few months had a membership of more than five hundred men. For a short time he assisted Charles Osborne in editing the *Philanthropist*; in 1819 he went to St Louis, Missouri, and there in 1819–1820 took an active part in the slavery controversy; and in 1821 he founded at Mount Pleasant, Ohio, an anti-slavery paper, the *Genius of Universal Emancipation*. This periodical, first a monthly and later a weekly, was published successively in Ohio, Tennessee, Maryland, the District of Columbia and Pennsylvania, though it appeared irregularly, and at times, when Lundy was away on lecturing tours, was issued from any office that was accessible to him. From September 1829 until March 1830 Lundy was assisted in the editorship of the paper by William Lloyd Garrison (*q.v.*). Besides travelling through many states of the United States to deliver anti-slavery lectures, Lundy visited Haiti twice—in 1825 and 1829, the Wilberforce colony of freedmen and refugee slaves in Canada in 1830–1831, and in 1832 and again in 1833 Texas, all these visits being made, in part, to find a suitable place outside the United States to which emancipated slaves might be sent. Between 1820 and 1830, according to a statement made by Lundy himself, he travelled "more than 5000 m. on foot and 20,000 in other ways, visited nineteen states of the Union, and held more than 200 public meetings." He was bitterly denounced by slaveholders and also by such non-slaveholders as disapproved of all anti-slavery agitation, and in January 1827 he was assaulted and seriously injured by a slave-trader, Austin Woolfolk, whom he had severely criticized in his paper. In 1836–1838 Lundy edited in Philadelphia a new anti-slavery weekly, *The National Enquirer*, which he had founded, and which under the editorship of John G. Whittier, Lundy's successor, became *The Pennsylvania Freeman*. In 1838 Lundy removed to Lowell, La Salle county, Illinois, where he printed several copies of the *Genius of Universal Emancipation*. There, on the 22nd of August 1839, he died. Lundy is said to have been the first to deliver anti-slavery lectures in the United States.

See *The Life, Travels and Opinions of Benjamin Lundy* (Philadelphia, 1847), compiled (by Thomas Earle) "under the direction and on behalf of his children."

LUNDY, ROBERT (fl. 1689), governor of Londonderry. Nothing is known of Lundy's parentage or early life; but he had seen service in the foreign wars before 1688, when he was at Dublin with the rank of lieutenant-colonel in the regiment of Lord Mountjoy. When the apprentices of Derry closed the gates in the face of the earl of Antrim, who was approaching the city at the head of an Irish Catholic force in the interests of James II., the viceroy Tyrconnel despatched Mountjoy to pacify the Protestants. Mountjoy and his regiment were well received in the north, and the citizens of Derry permitted him to leave within their walls a small Protestant garrison under the command of Lundy, who assumed the title of governor. Popular feeling in Derry ran so strongly in favour of the prince of Orange that Lundy quickly declared himself an adherent of William; and he obtained from him a commission confirming his appointment as governor. Whether Lundy was a deliberate traitor to the cause he had embraced with explicit asseveration of fidelity in a signed document, or whether, as Macaulay suggests, he was only a cowardly poltroon, cannot certainly be known. What is certain is that from the moment Londonderry was menaced by the troops of King James, Lundy used all his endeavours to paralyse the defence of the city. In April 1689 he was in command of a force of Protestants who encountered some troops under Richard Hamilton at Strabane, when, instead of holding his ground, he told his men that all was lost and ordered them to shift for themselves; he himself was the first to take flight back to Derry. King James, then at Omagh on his way to the north, similarly turned in flight towards Dublin on hearing of the skirmish, but returned next day on receiving the true account of the occurrence. On the 14th of April English ships appeared in the Foyle with reinforcements for Lundy under Colonel Cunningham. Lundy dissuaded Cunningham from landing his regiments, representing that a defence of Londonderry was hopeless; and that he himself intended to withdraw secretly from the city. At the same time he sent to the enemy's headquarters a promise to surrender the city at the first summons. As soon as this became known to the citizens Lundy's life was in danger, and he was vehemently accused of treachery. When the enemy appeared before the walls Lundy gave orders that there should be no firing. But all authority had passed out of his hands. The people flew to arms under the direction of Major Henry Baker and Captain Adam Murray, who organized the famous defence in conjunction with the Rev. George Walker (*q.v.*). Lundy, to avoid popular vengeance, hid himself until nightfall, when by the connivance of Walker and Murray he made his escape in disguise. He was apprehended in Scotland and sent to the Tower of London. He was excluded from the Act of Indemnity in 1690, but his subsequent fate is unknown.

See Lord Macaulay, *History of England*, vol. iii. (Albany edition of complete works, London, 1898); Rev. George Walker, *A True Account of the Siege of Londonderry* (London, 1689); J. Mackenzie, *Narrative of the Siege of Londonderry* (London, 1690); John Hempton, *The Siege and History of Londonderry* (Londonderry, 1861); Rev. John Graham, *A History of the Siege of Derry and Defence of Enniskillen, 1688–9* (Dublin, 1829). (R. J. M.)

LUNDY, an English island at the entrance of the Bristol Channel, 12 m. N.W. by N. of the nearest point on the mainland, namely Hartland Point on the Devonshire coast. The nearest ports are Clovelly and Bideford. The extreme length of the island is 3 m. from N. to S., the mean breadth about half a mile, but at the south the breadth is nearly 1 m. The area is about 1150 acres. The component rock is a hard granite, except at the south, where slate occurs. This granite was used in the construction of the Victoria Embankment, London. An extreme elevation of about 450 ft. is found in the southern half of the island; the northern sloping gently to the sea, but the greater part of the coast is cliff-bound and very beautiful. The landing, at the south-east, is sheltered by the small Rat Island, where the once common black rat survives. There are a few prehistoric remains on Lundy, and the foundations of an ancient chapel of St Helen. There are also ruins, and the still inhabited keep, of Marisco Castle, occupying a strong precipitous site on the south-east, held in the reign of Henry II. by Sir Jordan de Marisco. The Mariscos, in their inaccessible retreat, lived lawlessly until in 1242 Sir William Marisco was hanged for instigating an attempt on the life of Henry III. In 1625 the island was reported to be captured by Turkish pirates, and in 1633 by Spaniards. Later it became an object of attack and a hiding place for French privateers. The island, which is reckoned as extra-parochial, has some cultivable land and heath pasture, and had a population in 1901 of 94.

LÜNEBURG, a town of Germany, in the Prussian province of Hanover, situated near the foot of a small hill named the Kalkberg, on the navigable Ilmenau, 14 m. above its confluence with the Elbe and 30 m. by rail S.E. of Hamburg by the main line to Hanover. Pop. (1905) 26,751. Numerous handsome medieval buildings testify to its former prosperity as a prominent member of the Hanseatic league, and its many quaint houses with high gables and overhanging eaves have gained for it the appellation "the Nüremberg of the North." Portions of the old walls survive, but the greater part of the former circumvallation has been converted into promenades and gardens, outside which a modern town has sprung up. The finest of its squares are the market-place and the so-called Sand. The churches of St John, with five aisles and a spire 375 ft. in height; of St Michael, containing the tombs of the former princes of Lüneburg, and of St Nicolas, with a huge nave and a lofty spire, are fine Gothic edifices of the 14th and 15th centuries. The old town-hall in the market square is a huge pile, dating originally from the 13th century, but with numerous additions. It has an arcade with frescoes, restored by modern Munich artists, and contains a magnificent hall—the Fürstensaal—richly decorated with wood-carving and stained-glass windows. Galvanoplastic casts of the famous Lüneburg silver plate, consisting of 36 pieces which were acquired in 1874 by the Prussian government for £33,000 and are now housed in the art museum in Berlin, are exhibited here. Among other public edifices are the old palace; the convent of St Michael (now converted into a school and law court), and the Kaufhaus (merchants' hall). There are a museum, a library of 36,000 volumes, classical and commercial schools, and a teachers' seminary. Lüneburg owes its importance chiefly to the gypsum and lime quarries of the Kalkberg, which afford the materials for its cement works, and to the productive salt-spring at its base which has been known and used since the 10th century. Hence the ancient saying which, grouping with these the commercial facilities afforded by the bridge over the Ilmenau, ascribes the prosperity of Lüneburg to its *mons, fons, pons*. Other industries are the making of chemicals, ironware, soda and haircloth. There is a considerable trade in French wines, for which Lüneburg has for centuries been one of the chief emporia in north Germany, and also in grain and wool. Celebrated are its lampreys, *Lüneburger Bricken*.

Lüneburg existed in the days of Charlemagne, but it did not gain importance until after the erection of a convent and a castle on the Kalkberg in the 10th century. After the destruction of Bardowiek, then the chief commercial centre of North Germany, by Henry the Lion, duke of Saxony, in 1189, Lüneburg inherited much of its trade and subsequently became one of the principal towns of the Hanseatic league. Having belonged to the extensive duchy of Saxony it was the capital of the duchy of Brunswick-Lüneburg from 1235 to 1369; later it belonged to one or other of the branches of the family of Brunswick, being involved in the quarrels, and giving its name to cadet lines, of this house. From the junior line of Brunswick-Lüneburg the reigning family of Great Britain is descended. The reformed doctrines were introduced into the town in 1530 and it suffered heavily during the Thirty Years' War. It reached the height of its prosperity in the 15th century, and in the 17th century it was the depot for much of the merchandise exported from Saxony and Bavaria to the mouth of the Elbe; then after a period of decay the 19th century witnessed a revival of its prosperity. In 1813 the German war of liberation was begun by an engagement with the French near Lüneburg.

See W. F. Volger, *Urkundenbuch der Stadt Lüneburg* (3 vols., Lüneburg, 1872–1877); E. Bodemann, *Die älteren Zunfturkunden der Stadt Lüneburg* (Hanover, 1883); O. Jürgens, *Geschichte der Stadt Lüneburg* (Lüneburg, 1891); *Des Propstes Jakob Schomaker Lüneburger Chronik*, edited by T. Meyer (Hanover, 1904); A. Wrede, *Die Einführung der Reformation in Lüneburg* (Göttingen, 1887), and W. Reinecke, *Lüneburgs ältestes Stadtbuch und Verfasstungsregister* (Hanover, 1903). For the history of the principality see von Leuthe, *Archiv für Geschichte und Verfassung des Fürstentums Lüneburg* (Celle, 1854–1863).

LÜNEBURGER HEIDE, a district of Germany, in the Prussian province of Hanover, lying between the Aller and the Elbe and intersected by the railways Harburg-Hanover and Bremen-Stendal. Its main character is that of a broad saddle-back, running for 55 m. from S.E. to N.W. of a mean elevation of about 250 ft. and attaining its greatest height in the Wilseder Berg (550 ft.) at its northern end. The soil is quartz sand and is chiefly covered with heather and brushwood. In the north, and in the deep valleys through which the streams descend to the plain, there are extensive forests of oak, birch and beech, and in the south, of fir and larch. Though the climate is raw and good soil rare, the heath is not unfertile. Its main products are sheep—the celebrated Heidschnucken breed,—potatoes, bilberries, cranberries and honey. The district is also remarkable for the numerous Hun barrows found scattered throughout its whole extent.

See Rabe, *Die Lüneburger Heide und die Bewirthschaftung der Heidhöfe* (Jena, 1900); Kniep, *Führer durch die Lüneburger Heide* (Hanover, 1900); Linde, *Die Lüneburger Heide* (Lüneburg, 1905), and Kück, *Das alte Bauernleben der Lüneburger Heide* (Leipzig, 1906).

LUNETTE (French diminutive of *lune*, moon), a crescent-shaped, semi-circular object. The term is particularly applied in architecture to a circular opening at the intersection of vaulting by a smaller vault, as in a ceiling for the entrance of light or in the lower stories of towers for the passage of bells. It is also used of a panel space of semi-circular shape, filled by a fresco or other decorative treatment. In fortification a "lunette" was originally an earthwork of half-moon shape; later it became a redan with short flanks, in trace somewhat resembling a bastion standing by itself without curtains on either side. The gorge was generally open.

LUNÉVILLE, an industrial and garrison town of north-eastern France, capital of an arrondissement in the department of Meurthe-et-Moselle, 21 m. E.S.E. of Nancy on the railway to Strassburg. Pop. (1906) town, 19,199; commune, 24,266 (including troops). The town stands on the right bank of the Meurthe between that river and its affluent the Vezouze, a little above their confluence. Its château, designed early in the 18th century by the royal architect Germain Boffrand, was the favourite residence of Duke Leopold of Lorraine, where he gathered round him an academy composed of eminent men of the district. It is now a cavalry barracks, and the gardens form a public promenade. Lunéville is an important cavalry station with a large riding school. The church of St Jacques with its two domed towers dates from 1730–1745. There are statues of General Count Antoine de Lasalle, and of the Conventional Abbé Henri Grégoire. The town is the seat of a sub-prefect, and has a tribunal of first instance and a communal college. It carries on cotton-spinning and the manufacture of railway material, motor vehicles, porcelain, toys, hosiery, embroidery, straw-hats and gloves. Trade is in grain, wine, tobacco, hops and other agricultural produce.

The name of Lunéville (*Lunae villa*) is perhaps derived from an ancient cult of Diana, the moon goddess, a sacred fountain and medals with the effigy of this goddess having been found at Leormont, some 2 m. E. of the town. Lunéville belonged to Austrasia, and after various changes fell, in 1344, to the house of Lorraine. A walled town in the middle ages, it suffered in the Thirty Years' War and in the campaigns of Louis XIV. from war, plague and famine. The town flourished again under Dukes Leopold and Stanislas, on the death of the latter of whom, which took place at Lunéville, Lorraine was united to France (1766). The treaty of Lunéville between France and Austria (1801) confirmed the former power in the possession of the left bank of the Rhine.

LUNG, in anatomy, the name of each of the pair of organs of respiration in man and other air-breathing animals, the corresponding organs in fishes being the *branchiae* or gills (see RESPIRATORY SYSTEM). The word in Old English was *lungen*; it appears in many Teutonic languages, cf. Ger. *Lunge*, Du. *long*, Swed. *lunga*; the Teutonic root from which these are derived meant "light," and the lungs were so-called from their lightness. The word "lights" was formerly used as synonymous with "lungs," but is now confined to the lungs of sheep, pigs or cattle; it is etymologically connected with "lung," the pre-Teutonic root being seen in Sansk. *laghu*, Gr. ἐλαφρός.

SURGERY OF THE LUNG AND PLEURA.—When a person meets with a severe injury to the chest, as from a wheel passing over him, the ribs may be broken and driven into the lung. Air then entering into the pleural space, the lung collapses, and breathing becomes so difficult that death may ensue from asphyxia. Short of this, however, there is a cough with the spitting of frothy, blood-stained mucus or of bright red blood. All that can be done is to place the person on his back, slightly propped up by pillows, and to combat syncope by subcutaneous injections of ether and strychnia.

Empyema means the presence of an abscess between the lung and the chest wall, *i.e.* in the pleural space; it is the result of a septic inflammation of the pleura by the micro-organisms of pneumonia or of typhoid fever, or by some other germs. As the abscess increases in size, the lung is pushed towards the spine, and that side of the chest gives a dull note on percussion. If much fluid collects the heart may be pushed out of its place, and, the lung-space being taken up, respiration is embarrassed. Having made sure of the presence of an abscess by exploring with syringe and hollow needle, the surgeon opens and drains it. The drainage is made more effectual by removing an inch or so of one of the ribs, for, unless this is done, there is a risk of the rubber drainage tube being compressed as the ribs come closer together again.

The lung itself has sometimes to be operated on, as when it is the seat of an hydatid cyst, or when it contains an abscess cavity which cannot otherwise be drained, or when it becomes necessary to remove a foreign body the exact situation of which has been revealed by the X-rays. Portions of some of the ribs having been resected, the pleural cavity is opened, and if the lung has not already become glued to the chest-wall by inflammatory adhesions, it is stitched up to the chest-wall, and in a few days, when adhesions have taken place, an incision is safely made into the lung-tissue. See also RESPIRATORY SYSTEM. (E. O.*)

LUNG, one of the four symbolical creatures of Chinese legend. It is a dragon with a scaly snake-like body, long claws, horns, a bristly face, and its back-bone armed with spikes. Originally three-clawed, it has become, as the official dragon of the present dynasty, a five-clawed beast. The form is embroidered on the state robes of the emperor of China, and it is traditionally connected with the dynasty's history and fortunes.

LUNGCHOW, a town in the province of Kwangsi, China, in 22° 21′ N., 106° 45′ E., near the Tongking frontier, and at the junction of the Sung-chi and Kao-ping rivers. Pop. (estimate) 22,000. The town is prettily situated in a circular valley. From a military point of view it is considered important, and considerable bodies of troops are stationed here. It was selected as the seat of frontier trade by the French convention of 1886, and was opened in 1889. In 1898 the total value of its trade amounted to only £20,000, but in 1904 the figures increased to £56,692.

LUNGE, GEORG (1839–), German chemist, was born at Breslau on the 15th of September 1839. He studied at Heidelberg (under R. W. Bunsen) and Breslau, graduating at the latter university in 1859. Turning his attention to technical chemistry, he became chemist at several works both in Germany and England, and in 1876 he was appointed professor of technical chemistry at Zurich polytechnic. Lunge's original contributions cover a very wide field, dealing both with technical processes and analysis. In addition, he was a voluminous writer, enriching scientific literature with many standard works. His treatises *Coal Tar and Ammonia* (5th ed. 1909; 1st ed. 1867), *Destillation des Steinkohlentheers*) and *Sulphuric Acid and Alkali* (1st ed. 1878, 4th ed. 1909), established his position as the highest authority on these subjects, while the *Chemische-technische Untersuchungs-Methoden* (1899–1900; Eng. trans.), to which he contributed, testified to his researches in technical analysis. His jubilee was celebrated at Zurich on the 15th of September 1909.

LUPERCALIA, a very ancient, possibly pre-Roman, pastoral festival in honour of Lupercus. Its rites were under the superintendence of a corporation of priests called Luperci,[1] whose institution is attributed either to the Arcadian Evander, or to Romulus and Remus. In front of the Porta Romana, on the western side of the Palatine hill, close to the Ficus Ruminalis and the Casa Romuli, was the cave of Lupercus; in it, according to the legend, the she-wolf had suckled the twins, and the bronze wolf, which is still preserved in the Capitol, was placed in it in 296 B.C. But the festival itself, which was held on February 15th, contains no reference to the Romulus legend, which is probably later in origin, though earlier than the grecizing Evander legend. The festival began with the sacrifice by the Luperci (or the flamen dialis) of goats and a dog; after which two of the Luperci were led to the altar, their foreheads were touched with a bloody knife, and the blood wiped off with wool dipped in milk; then the ritual required that the two young men should laugh. The smearing of the forehead with blood probably refers to human sacrifice originally practised at the festival. The sacrificial feast followed, after which the Luperci cut thongs from the skins of the victims and ran in two bands round the walls of the old Palatine city, the line of which was marked with stones, striking the people who crowded near. A blow from the thong prevented sterility in women. These thongs were called *februa*, the festival Februatio, and the day *dies februatus* (*februare* = to purify); hence the name of the month February, the last of the old Roman year. The object of the festival was, by expiation and purification, to secure the fruitfulness of the land, the increase of the flocks and the prosperity of the whole people. The Lupercal (cave of Lupercus), which had fallen into a state of decay, was rebuilt by Augustus; the celebration of the festival had been maintained, as we know from the famous occurrence of it in 44 B.C. It survived until A.D. 494, when it was changed by Gelasius into the feast of the Purification. Lupercus, in whose honour the festival was held, is identified with Faunus or Inuus, Evander (Εὔανδρος), in the Greek legend being a translation of Faunus (the "kindly"). The Luperci were divided into two *collegia*, called Quinctiliani (or Quinctiales) and Fabiani, from the gens Quinctilia (or Quinctia)[2] and Fabia; at the head of each of these colleges was a magister. In 44 B.C. a third college, Luperci Julii, was instituted in honour of Julius Caesar, the first magister of which was Mark Antony. In imperial times the members were usually of equestrian standing.

See Marquardt, *Römische Staatsverwaltung*, iii. (1885) p. 438; W. Warde Fowler, *Roman Festivals* (1899), p. 390 foll., and article in Smith's *Dictionary of Greek and Roman Antiquities* (3rd ed. 1891).

LUPINE (*Lupinus*), in botany, a genus of about 100 species of annual and perennial herbaceous plants of the tribe *Genisteae*, of the order Leguminosae. Species with digitate leaves range along the west side of America from British Columbia to northern Chile, while a few occur in the Mediterranean regions. A few others with entire leaves are found in Brazil and eastern North America. The leaves are remarkable for "sleeping" in three different ways. From being in the form of a horizontal star by day, the leaflets either fall and form a hollow cone with their bases upwards (*L. pilosus*), or rise and the cone is inverted (*L. luteus*), or else the shorter leaflets fall and the longer rise, and so together form a vertical star as in many species; the object in every case being to protect the surfaces of the leaflets from radiation and consequent wetting with dew (Darwin, *Movements of Plants*, p. 340). The flowers are of the usual "papilionaceous" or pea-like form, blue, white, purple or yellow, in long terminal spikes. The stamens are monadelphous and bear dimorphic anthers. The species of which earliest mention is made is probably *L. Termis*, which was cultivated by the ancient Egyptians. It is wild in some parts of the Mediterranean area and is extensively cultivated in Egypt. Its seeds are eaten by the poor after being steeped in water to remove their bitterness; the stems furnish fuel and charcoal for gunpowder. The lupine of the ancient Greeks and Romans was probably *L. albus*, which is still extensively cultivated in Italy, Sicily and other Mediterranean countries for forage, for ploughing in to enrich the land, and for its round flat seeds, which form an article of food. Yellow lupine (*L. luteus*) and blue lupine (*L. angustifolius*) are also cultivated on the European continent as farm crops for green manuring.

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[1] Many derivations are suggested, but it seems most probable that Luperci simply means "wolves" (the last part of the word exhibiting a similar formation to *nov-erca*), the name having its origin in the primitive worship of the wolf as a wolf-god.

[2] Mommsen considers the Quinctia to be the older gens, and the Quinctilia a later introduction from Alba.

Lupines are easily cultivated in moderately good garden soil; they include annuals which are among the most ornamental and most easily grown of summer flowering plants (sow in open borders in April and May), and perennials, which are grown from seed or propagated by dividing strong plants in March and April. Many of the forms in cultivation are hybrid. One of the best known of the perennial species is *L. polyphyllus*, a western North American species. It grows from 3 to 6 ft. high, and has numerous varieties, including a charming white-flowered one. The tree lupine (*L. arboreus*) is a Californian bush, 2 to 4 ft. high, with fragrant yellow flowers. It is only hardy in the most favoured parts of the kingdom.

LUPUS, PUBLIUS RUTILIUS, Roman rhetorician, flourished during the reign of Tiberius. He was the author of a treatise on the figures of speech (Σχήματα λέξεως), abridged from a similar work by the rhetorician Gorgias (of Athens, not the well-known sophist of Leontini), the tutor of Cicero's son. In its present form it is incomplete, as is clearly shown by the express testimony of Quintilian (*Instit.* ix. 2, 103, 106) that Lupus also dealt with figures of sense, rhetorical figures (Σχήματα διανοίας). The work is valuable chiefly as containing a number of examples, well translated into Latin, from the lost works of Greek rhetoricians. The author has been identified with the Lupus mentioned in the Ovidian catalogue of poets (*Ex Ponto*, iv. 16), and was perhaps the son of the Publius Rutilius Lupus, who was a strong supporter of Pompey.

Editions by D. Ruhnken (1768), F. Jacob (1837), C. Halm in *Rhetores latini minores* (1863); see also monographs by G. Dzialas (1860 and 1869), C. Schmidt (1865), J. Draheim (1874), Thilo Krieg (1896).

LUPUS (Lat. *lupus*, wolf), a disease characterized by the formation in the skin or mucous membrane of small tubercles or nodules consisting of cell growth which has an inclination to retrograde change, leading to ulceration and destruction of the tissues, and, if it heals, to the subsequent formation of permanent white scars. *Lupus vulgaris* is most commonly seen in early life, and occurs chiefly on the face, about the nose, cheeks or ears. But it may also affect the body or limbs. It first shows itself as small, slightly prominent, nodules covered with thin crusts or scabs. These may be absorbed and removed at one point whilst spreading at another. Their disappearance is followed by a permanent white cicatrix. The disease may be superficial, in which case both the ulceration and the resulting scar are slight (*lupus non-exedens*); or the ulcerative process may be deep and extensive, destroying a large portion of the nose or cheek, and leaving much disfigurement (*lupus exedens*). A milder form, *lupus erythematosus*, occurs on the nose and adjacent portions of the cheeks in the form of red patches covered with thin scales, underneath which are seen the widened openings of the sebaceous ducts. With a longitudinal patch on the nose and spreading symmetrical patches on each cheek the appearance is usually that of a large butterfly. It is slow in disappearing, but does not leave a scar. Lupus is more frequently seen in women than in men; it is connected with a tuberculous constitution. In the superficial variety the application of soothing ointments when there is much redness, and linear incisions, or scrapings with a sharp spoon, to destroy the increased blood supply, are often serviceable. In the ordinary form the local treatment is to remove the new tissue growth by solid points of caustic thrust into the tubercles to break them up, or by scraping with a sharp spoon. The light-treatment has been successfully applied in recent years. As medicines, cod-liver oil, iron and arsenic are useful. (E. O.*)

LUQMĀN, or LOKMAN, the name of two, if not of three (cf. note to Terminal Essay in Sir Rd. Burton's translation of the *Arabian Nights*), persons famous in Arabian tradition. The one was of the family of 'Ād, and is said to have built the great dike of Mārib and to have received the gift of life as long as that of seven vultures, each of which lived eighty years. The name of the seventh vulture—Lubad—occurs in proverbial literature. The name of the second Luqmān, called "Luqmān the Sage," occurs in the Koran (31, 11). Two accounts of him are current in Arabian literature. According to Mas'ūdī (i. 110) he was a Nubian freedman who lived in the time of David in the district of Elah and Midian. According to some commentators on the Koran (*e.g.*, Baidāwī) he was the son of Bā'ūrā, one of the sons of Job's sister or maternal aunt. Derenbourg in his *Fables de Loqmân le sage* (1850) identifies Bā'ūrā with Beor, and believes the name *Luqmān* to be a translation of *Balaam*. The grave of Luqmān was shown on the east coast of the lake of Tiberias, also in Yemen (cf. Yāqūt, vol. iii. p. 512).

The so-called *Fables of Luqmān* are known to have existed in the 13th century, but are not mentioned by any Arabian writer. They were edited by Erpenius (Leiden, 1615) and have been reprinted many times. For the relation of these to similar literature in other lands, see J. Jacobs's edition of Caxton's *Fables of Aesop*, vol. i. (London, 1889). The name of Luqmān also occurs in many old verses, anecdotes and proverbs; cf. G. Freytag's *Arabum Proverbia* (Bonn, 1838–1843) and such Arabian writers as Tabarī, Mas'ūdi, Damiri and the *Kitāb al-Mu'ammarīn* (ed. by I. Goldziher, Leiden, 1899). (G. W. T.)

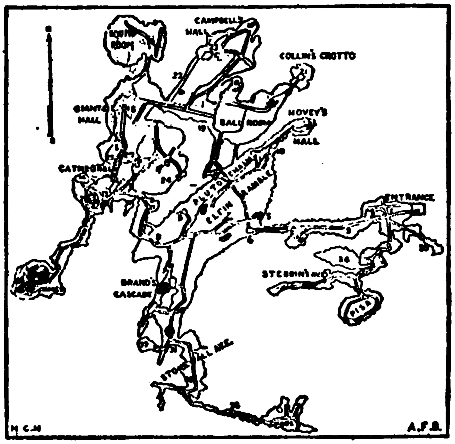
LURAY CAVERN, a large cave in Page county, Virginia, U.S.A., 39° 35′ N. and 78° 17′ W., near the village of Luray, on the Norfork & Western railway. The valley, here 10 m. wide, extends from the Blue Ridge to the Massanutton Mountain. The ridges lie in vast folds and wrinkles; and elevations in the valley are often found to be pierced by erosion. Cave Hill, 300 ft. above the water-level, had long been an object of local interest on account of its pits and oval-hollows or sink-holes, through one of which, on the 13th of August 1878, Andrew J. Campbell and others entered, thus discovering the cavern now described.

The Luray cavern does not date beyond the Tertiary period, though carved from the Silurian limestone. At some period, long subsequent to its original excavation, and after many large stalactites had grown, it was completely filled with glacial mud charged with acid, whereby the dripstone was eroded into singularly grotesque shapes. After the mud had been mostly removed by flowing water, these eroded forms remained amid the new growths. To this contrast may be ascribed some of the most striking scenes in the cave. The many and extraordinary monuments of aqueous energy include massive columns wrenched from their place in the ceiling and prostrate on the floor; the Hollow Column, 40 ft. high and 30 ft. in diameter, standing erect, but pierced by a tubular passage from top to bottom; the Leaning Column nearly as large, undermined and tilting like the campanile of Pisa; the Organ, a cluster of stalactites in the chamber known as the Cathedral; besides a vast bed of disintegrated carbonates left by the whirling flood in its retreat through the great space called the Elfin Ramble.

The stalactitic display exceeds that of any other cavern known. The old material is yellow, brown or red; and its wavy surface often shows layers like the gnarled grain of costly woods. The new stalactites growing from the old, and made of hard carbonates that had already once been used, are usually white as snow, though often pink, blue or amber-coloured. The Empress Column is a stalagmite 35 ft. high, rose-coloured, and elaborately draped. The double column, named from Professors Henry and Baird, is made of two fluted pillars side by side, the one 25 and the other 60 ft. high, a mass of snowy alabaster. Several stalactites in the Giant Hall exceed 50 ft. in length. The smaller pendants are innumerable; in the canopy above the Imperial Spring it is estimated that 40,000 are visible at once.

The "cascades" are wonderful formations like foaming cataracts caught in mid-air and transformed into milk-white or amber alabaster. The Chalcedony Cascade displays a variety of colours. Brand's Cascade, the finest of all, is 40 ft. high and 30 ft. wide, and is unsullied and wax-like white, each ripple and braided rill seeming to have been polished.

The Swords of the Titans are monstrous blades, eight in number, 50 ft. long, 3 to 8 ft. wide, hollow, 1 to 2 ft. thick, but drawn down to an extremely thin edge, and filling the cavern with tones like tolling bells when struck heavily by the hand. Their origin and also that of certain so-called scarfs and blankets is from carbonates deposited by water trickling down a sloping and corrugated surface. Sixteen of these alabaster scarfs hang side by side in Hovey's Balcony, three white and fine as crape shawls, thirteen striated like agate with every shade of brown, and all perfectly translucent. Down the edge of each a tiny rill glistens like silver, and this is the ever-plying shuttle that weaves the fairy fabric.



Luray Cavern. Scale 500 ft. to the inch.

1. The Vestibule.
2. Washington's Pillar.
3. Flower Garden.
4. Amphitheatre.
5. Natural Bridge.
6. Fish Market.
7. Crystal Spring.
8. Proserpine's Pillar.
9. The Spectral Column.
10. Hovey's Balcony.
11. Oberon's Grot.
12. Titania's Veil.
13. Saracen's Tent.
14. The Organ.
15. Tower of Babel.
16. Empress Column.
17. Hollow Column.
18. Henry-Baird Column.
19. Chalcedony Cascade.
20. Coral Spring.
21. The Dragon.
22. Bootjack Alley.
23. Scaly Column.
24. Lost Blanket.
25. Helen's Scarf.
26. Chapman's Lake.
27. Broaddus Lake.
28. Castles on the Rhine.
29. Imperial Spring.
30. The Skeleton.
31. The Twin Lakes.
32. The Engine Room.
33. Miller's Room.
34. Hawes Cabinet.
35. Specimen Avenue.
36. Proposed Exit.

Streams and true springs are absent, but there are hundreds of basins, varying from 1 to 50 ft. in diameter, and from 6 in. to 15 ft. in depth. The water in them is exquisitely pure, except as it is impregnated by the carbonate of lime, which often forms concretions, called according to their size, pearls, eggs and snowballs. A large one is known as the cannon ball. On fracture these spherical growths are found to be radiated in structure.

Calcite crystals, drusy, feathery or fern-like, line the sides and bottom of every water-filled cavity, and indeed constitute the substance of which they are made. Variations of level at different periods are marked by rings, ridges and ruffled margins. These are strongly marked about Broaddus Lake and the curved ramparts of the Castles on the Rhine. Here also are polished stalagmites, a rich buff slashed with white, and others, like huge mushrooms, with a velvety coat of red, purple or olive-tinted crystals. In some of the smaller basins it sometimes happens that, when the excess of carbonate acid escapes rapidly, there is formed, besides the crystal bed below, a film above, shot like a sheet of ice across the surface. One pool 12 ft. wide is thus covered so as to show but a third of its surface. The quantity of water in the cavern varies greatly at different seasons. Hence some stalactites have their tips under water long enough to allow tassels of crystals to grow on them, which, in a drier season, are again coated over with stalactitic matter; and thus singular distortions are occasioned. Contiguous stalactites are often inwrapped thus till they assume an almost globular form, through which by making a section the primary tubes appear. Twig-like projections, to which the term *helictite* has been applied by the present writer, are met with in certain portions of the cave, and are interesting by their strange and uncouth contortions. Their presence is due to lateral outgrowths of crystals shooting from the side of a growing stalactite, or to deflections caused by currents of air, or to the existence of a diminutive fungus peculiar to the locality and designated from its habitat *Mucor stalactitis*. The Toy-Shop is an amusing collection of these freaks of nature.

The dimensions of the various chambers included in Luray Cavern cannot easily be stated, on account of the great irregularity of their outlines. Their size may be seen from the diagram. But it should be understood that there are several tiers of galleries, and the vertical depth from the highest to the lowest is 260 ft. The large tract of land owned by the Luray Caverns Corporations covers all possible modes of entrance.

The waters of this cavern appear to be entirely destitute of life; and the existing fauna comprises only a few bats, rats, mice, spiders, flies and small centipedes. When the cave was first entered, the floor was covered with thousands of tracks of raccoons, wolves and bears—most of them probably made long ago, as impressions made in the tenacious clay that composes most of the cavern floor would remain unchanged for centuries. Layers of excrementitious matter appear, and also many small bones, along with a few large ones, all of existing species. The traces of human occupation are pieces of charcoal, flints, moccasin tracks and a single skeleton embedded in stalagmite in one of the chasms, estimated, from the present rate of stalagmitic growth, to have lain where found for not more than five hundred years.

The temperature is uniformly 54° Fahr., coinciding with that of Mammoth Cave, Kentucky. The air is very pure, and the avenues are not uncomfortably damp. The portions open to the public are now lighted by electric lamps. The registered number of visitors in 1906 was 18,000. A unique and highly successful experiment merits mention, by which the cool pure air of Luray Cavern is forced through all the rooms of the Limair sanatorium erected in 1901, by Mr T. C. Northcott, president of the Luray Caverns Corporation, on the summit of Cave Hill. Tests made for several successive years by means of culture media and sterile plates, demonstrated the perfect bacteriologic purity of the air, first drawn into the caverns through myriads of rocky crevices that served as natural filters, then further cleansed by floating over the transparent springs and pools, and finally supplied to the inmates of the sanatorium.

For a full description see an article by Dr G. L. Hunner, of Johns Hopkins University, in the *Popular Science Monthly* for April 1904.
(H. C. H.)

LURCH, a word with several meanings, the etymological relationships of which are obscure. The chief uses which survive are—(1) in the phrase "to leave in the lurch," to abandon some one, to leave him in a position of great difficulty; (2) a stagger, sudden leaning over, originally a nautical expression of a sudden "list" made by a ship; (3) the name of a dog, the "lurcher" used by poachers, properly a cross between a sheep-dog or collie and a greyhound. In (1) "lurch" is the name of a game, of which nothing is known (it is supposed to have resembled backgammon), and also of a state of the score in various games, in which the loser either scores nothing or is beaten by very heavy points. In this sense the term is practically obsolete.

It was taken from Fr. *lourche*, connected with many German forms, now only dialectical such as *Lortsch*, *Lurtsch*, *Lorz*, *Lurz*, all for some kind of game, but also meaning left-hand, wrong, which the *New English Dictionary* thinks is the origin of the word, it being first used as a term in gambling. In (2) "lurch" occurs first in the form "lee-lurches," sudden rolls a ship takes to leeward in a heavy sea, which may be a corruption of "lee-latch," defined in Smyth's *Sailor's Word Book* as dropping to leeward of the course. In (3) "lurch" is probably another form of "lurk," to lie in wait for, watch stealthily, hence to pilfer, steal.

LURGAN, a market-town of Co. Armagh, Ireland, well situated on high ground overlooking Lough Neagh a few miles to the north; 20 m. S.W. of Belfast by the Great Northern railway. Pop. (1901) 11,782. The parish church of Shankill (this parish including Lurgan) has a finely proportioned tower. Contiguous to the town is Lurgan Castle, a fine modern Elizabethan structure, the seat of Lord Lurgan. Lurgan is famed for its diapers, and the linen trade is of the first importance, but there are also tobacco factories and coach factories. It is governed by an urban district council. Lurgan was founded by William Brownlow, to whom a grant of the town was made by James I. In 1619 it consisted of forty-two houses, all inhabited by English settlers. It was burned by the insurgents in 1641, and again by the troops of James II. After its restoration in 1690 a patent for a market and fair was obtained.

LURIA, ISAAC BEN SOLOMON (1534–1572), Jewish mystic, was born in Jerusalem. From his German descent he was surnamed *Ashkenazi* (the German), and we find that epithet applied to him in a recently discovered document of date 1559. In that year Isaac Luria was living in Cairo and trading as a spice merchant with his headquarters in Alexandria. He had come to Egypt as a boy after his father's death, and was brought up by his wealthy maternal uncle Mordecai Francis. The boy, according to the legends which soon grew round his life, was a "wonder-child," and early displayed marvellous capacity. He married as a lad of fifteen, his bride being his cousin. For some time he continued his studies; later on when engaged in business there was no break in this respect. Two years after his marriage he became possessed of a copy of the Kabbalistic "Bible"—the *Zohar* of Moses de Leon (*q.v.*). In order to meditate on the mystic lore he withdrew to a hut by the Nile, returning home for the Sabbath. Luria afterwards gave to the Sabbath a mystic beauty such as it had never before possessed. Thus passed several years; he was still young, but his new mode of life produced its effects on a man of his imagination and saintly piety. He became a visionary. Elijah, who had been his godfather in his babyhood, now paid him frequent visits, initiating him into sublime truths. By night Luria's soul ascended to heaven and conversed with celestial teachers who had once been men of renown on earth.

In 1566 at earliest Luria removed to Safed. This Palestinian town was in the 16th century the headquarters of the Kabbala. A large circle of Talmudists lived there; at their head Joseph Qaro, then over eighty years of age. Qaro's son married Luria's daughter, and Qaro rejoiced at the connexion, for he had a high opinion of Luria's learning. Mysticism is often the expression of a revolt against authority, but in Luria's case mysticism was not divorced from respect for tradition. After his arrival at Safed Luria lived at most six years, and died in 1572. But these years were momentous for Judaism. He established an extraordinary reputation; his personality had a winning attractiveness; and he founded a school of mystics who powerfully affected Judaism after the master's death. The Holy Spirit, we are told, rested on him, drawn to him by the usual means of the mystics—self-flogging, ablutions and penance. He had wonderful gifts of insight, and spoke to the birds. Miracles abounded. More soberly true is the statement that he went on long walks with enthusiastic disciples, whom he taught without books. Luria himself wrote no mystical works; what we know of his doctrines and habits comes chiefly from his Boswell, Ḥayim Vital.

There was little of originality in Luria's doctrines; the theory of emanations, the double belief in the process of the Divine Essence as it were self-concentrating (*Zimzum*) and on the other hand as expanding throughout creation; the philosophical "sceptism" which regards God as unknowable but capable of direct intuition by feeling—these were all common elements of mystical thought. Luria was an inspirer of saintly conduct rather than an innovator in theories. Not beliefs, he said, but believers need rebirth. As he rose in the morning he prayed: "O God, grant that throughout this coming day I may be able to love my neighbour as myself." Never would he retire to rest until he had fulfilled his definite engagements to those who had served him. Luria and his school altered the very look of the Jewish Prayer Book. Prayer was his main prop. By it men became controllers of the earthly world and reached God. He or his school introduced innumerable ritual customs, some of them beautiful enough. On Sabbath he dressed in white, wearing a four-fold garment to typify the four letters of the Divine Name. The Sabbath was to him an actual cult. It was a day of the most holy joy. Resuming the Talmudic idea of an Over-soul present in every Israelite on the Sabbath, Luria and his school made play with this Over-soul, fed it with spiritual and material dainties and evolved an intricate maze of mystic ceremonial, still observed by countless masses. Another strong point with Luria was penance. The confessions of sin which he introduced descend to minute ritual details and rise to the most exalted aspects of social and spiritual life. He deprecated general confessions and demanded that the individual must lay bare the recesses of his heart. Ḥayim Vital reports that on his death-bed Luria said to his disciples: "Be at peace with one another: bear with one another: and so be worthy of my coming again to reveal to you what no mortal ear has heard before." His mystic ceremonial became a guide to religious practice, and though with this there came in much meaningless and even bewildering formalism, yet the example of his life and character was a lasting inspiration to saintliness.

See S. Schecher, *Studies in Judaism*, second series, pp. 251 seq.; *Jewish Encyclopedia*, viii. 210; E. Worman in *Revue des Études Juives*, lvii. 281. (I. A.)

LURISTAN, in the wider sense (as its name implies) the "Land of the Lurs," namely that part of western Persia which is bounded by Turkish territory on the west and extends for about 400 m. N.W.-S.E. from Kermanshah to Fars with a breadth of 100 to 140 m. It is chiefly mountainous, being intersected by numerous ranges running N.W.-S.E. The central range has many summits which are almost within the line of perpetual snow, rising to 13,000 ft. and more, and in it are the sources of Persia's most important rivers, as the Zayendeh-rud, Jarahi, Karun, Diz, Abi, Kerkheh. Between the higher ranges are many fertile plains and low hilly districts, well watered but comparatively little cultivated in consequence of intertribal feuds. The Lurs are thought to be aboriginal Persians with a mixture of Semitic blood. Their language is a dialect of Persian and does not differ materially from Kurdish. Outwardly they are Mussulmans of the Shiah branch, but most of them show little veneration for either Prophet or Koran, and the religion of some of them seems to be a mixture of Ali-Illahism involving a belief in successive incarnations combined with mysterious, ancient, heathen rites. The northern part of Luristan, which was formerly known as Lurikuchik (little Luristan), is inhabited by the Feili Lurs and these are divided into the Pishkuh (cis-montane) Lurs in the east and Pushtkuh (ultra-montane) Lurs in the west adjoining Turkish territory. They number about 350,000. Little Luristan was governed by a race of independent princes of the Khurshidi dynasty, and called atabegs, from 1155 to the beginning of the 17th century when the last atabeg, Shah Verdi Khan, was removed by Shah Abbas I. and the government of the province given to Husain Khan, the chief of a rival tribe, with the title of vali in exchange for that of atabeg. The descendants of Husain Khan have retained the title but now govern only the Pushtkuh Lurs, to whom only the denomination of Feili is at present applied. The southern part of Luristan was formerly known as Lur i Buzurg (great Luristan) and is composed of the Bakhtiari division of the Arabistan province and the districts of the Mamasennis and Kuhgilus which belong to Fars. The Bakhtiaris number about 200,000, the others 40,000. Great Luristan was an independent state under the Fazlevieh atabegs from 1160 until 1424, and its capital was Idaj, now represented by mounds and ruins at Malamir 60 m. S.E. of Shushter.

LUSATIA (Ger. *Lausitz*), a name applied to two neighbouring districts in Germany, Upper and Lower Lusatia, belonging now mainly to Prussia, but partly to Saxony. The name is taken from the Lusitzi, a Slav tribe, who inhabited Lower Lusatia in the 9th and 10th centuries.

In the earliest times Lower Lusatia reached from the Black Elster to the Spree; its inhabitants, the Lusitzi, were conquered by the German king, Henry the Fowler, and by the margrave Gero in the 10th century. Their land was formed into a separate march, which for about three centuries was sometimes attached to, and sometimes independent of, the margraviate of Meissen, its rulers being occasionally called margraves of Lusatia. In 1303 it was purchased by the margrave of Brandenburg, and after other changes it fell in 1368 into the hands of the king of Bohemia, the emperor Charles IV., who already possessed Upper Lusatia. During the Hussite wars its people remained loyal to the Roman Catholic Church. In 1469 they recognized Matthias Corvinus, king of Hungary, as their sovereign, but in 1490 they came again under the rule of the Bohemian king.

The district now known as Upper Lusatia was occupied by a Slav tribe, the Milzeni, who like the Lusitzi, were subdued by Henry the Fowler early in the 10th century. For about three centuries it was called Baudissin (Bautzen), from the name of its principal fortress. In the 11th and 12th centuries it was connected at different periods with Meissen, Poland and Bohemia. Towards 1160 the emperor Frederick I. granted it to Ladislas, king of Bohemia, and under this ruler and his immediate successors it was largely colonized by German immigrants. In 1253 it passed to the margrave of Brandenburg, and about the same time it was divided into an eastern and a western part, Baudissin proper and Görlitz. In 1319 the former was restored to Bohemia, which also recovered Görlitz in 1329. During the 14th century the nobles and the townsmen began to take part in the government, and about this time Upper Lusatia was known as the district of the six towns (*Sechsstädtelandes*), these being Bautzen, Görlitz, Zittau, Löbau, Lauban and Kamenz. From 1377 to 1396 Görlitz was a separate duchy ruled by John, a son of the emperor Charles IV., and, like Lower Lusatia, Upper Lusatia owned the authority of Matthias Corvinus from 1469 to 1490, both districts passing a little later with the kingdoms of Hungary and Bohemia to the German king, Ferdinand I. The "six towns" were severely punished for their share in the war of the league of Schmalkalden, and about this time the reformed teaching made very rapid progress in Lusatia, the majority of the inhabitants becoming Protestants. The name of Lusatia hitherto confined to Lower Lusatia, was soon applied to both districts, the adjectives Upper and Lower being used to distinguish them. In 1620, early in the Thirty Years' War, the two Lusatias were conquered by the elector of Saxony, John George I., who was allowed to keep them as the price of his assistance to the emperor Ferdinand I. In 1635 by the treaty of Prague they were definitely transferred from Bohemia to Saxony, although the emperor as king of Bohemia retained a certain supremacy for the purpose of guarding the rights and privileges of the Roman Catholics. They suffered much during the wars of the 18th century. By the peace of Vienna (1815) the whole of Lower Lusatia and part of Upper Lusatia were transferred from Saxony to Prussia.

The area of the part of Upper Lusatia retained by Saxony was slightly increased in 1845; it is now about 960 sq. m. In 1900 Lower Lusatia contained 461,973 inhabitants, of whom 34,837 were Wends; the portion of Upper Lusatia belonging to Prussia had 305,080 inhabitants, of whom 24,361 were Wends. There were 405,173 inhabitants, including 28,234 Wends, in Saxon Upper Lusatia. Laws relating to this district, after passing through the Saxon parliament must be submitted to the Lusatian diet at Bautzen. The chief towns of Upper Lusatia are Bautzen, Zittau, Löbau, Kamenz, Görlitz, Rothenburg, Hoyerswerda and Lauban; in Lower Lusatia they are Guben, Kottbus, Forst, Lubben and Spremberg. The principal rivers are the Spree with its tributaries, the Black Elster and the Neisse. Upper Lusatia is generally mountainous and picturesque, Lower Lusatia is flat and sandy. The chief industries are linen weaving, cloth making and coal mining.

For the history of Lusatia see the collections, *Scriptores rerum Lusaticarum antiqui et recentiores*, edited by C. G. Hoffmann (4 vols., Leipzig and Bautzen, 1719); and *Scriptores rerum Lusaticarum* (4 vols., Görlitz, 1839–1870). See also W. Lippert, *Wettiner und Wittelsbacher sowie die Niederlausitz im 14 Jahrhundert* (Dresden, 1894); T. Scheltz, *Gesamtgeschichte der Ober- und Niederlausitz*, Band i. (Halle, 1847), Band ii. (Görlitz, 1882); J. G. Worbs, *Urkundenbuch zur Geschichte des Markgraftums Niederlausitz* (Lübben, 1897); and J. A. E. Kohler, *Die Geschichte der Oberlausitz* (Görlitz, 1867).

LUSHAI HILLS, a mountainous district of Eastern Bengal and Assam, south of Cachar, on the border between Assam and Burma. Area, 7227 sq. m., pop. (1901) 82,434. The hills are for the most part covered with dense bamboo jungle and rank undergrowth; but in the eastern portion, owing probably to a smaller rainfall, open grass-covered slopes are found, with groves of oak and pine interspersed with rhododendrons. These hills are inhabited by the Lushais and cognate tribes, but the population is extremely scanty. From the earliest known times the original inhabitants were Kukis, and the Lushais were not heard of until 1840, when they invaded the district from the north. Their first attack upon British territory took place in November, 1849, and after that date they proved one of the most troublesome tribes on the north-east frontier of India; but operations in 1890 resulted in the complete pacification of the northern Lushai villages, and in 1892 the eastern Lushais were reduced to order. The management of the South Lushai hill country was transferred from Bengal to Assam in 1898. To obtain more efficient control over the country the district has been divided into eighteen circles, each in charge of an interpreter, through whom all orders are transmitted to the chiefs. The Welsh Presbyterian Mission began work at Aijal in 1897, and the people have shown unexpected readiness to accept education. According to the census of 1901 the total number of Lushais in Assam was 63,452.

See Colonel T. H. Lewin, *Wild Races of N.B. India* (1870); *Lushai Hills Gazetteer* (Calcutta, 1906).

LUSIGNAN, the name of a family which sprang from Poitou[1] and distinguished itself by its connexion with the kingdom of Jerusalem, and still more by its long tenure of the kingdom of Cyprus (1192–1475). A Hugh de Lusignan appears in the ill-fated crusade of 1100–1101; another Hugh, the Brown, came as a pilgrim to the Holy Land in 1164, and was taken prisoner by Nureddin. In the last quarter of the 12th century the two brothers Amalric and Guy, sons of Hugh the Brown, played a considerable part in the history of the Latin East. About 1180 Amalric was constable of the kingdom of Jerusalem; and he is said to have brought his handsome brother Guy to the notice of Sibylla, the widowed heiress of the kingdom. Guy and Sibylla were married in 1180; and Guy thus became heir presumptive of the kingdom, if the young Baldwin V., Sibylla's son by her first marriage to William of Montferrat, should die without issue. He acted as regent in 1183, but he showed some incapacity in the struggle with Saladin, and was deprived of all right of succession. In 1186, however, on the death of Baldwin V., he succeeded in obtaining the crown, in spite of the opposition of Raymund of Tripoli. Next year he suffered a crushing defeat at the battle of Hittin, and was taken prisoner by Saladin. Released on parole in 1188, he at once broke his parole, and began the siege of Acre. Difficulties, however, had arisen with Conrad of Montferrat; and when Guy lost his wife Sibylla in 1190, and Conrad married Isabella, her sister, now heiress of the kingdom, these difficulties culminated in Conrad's laying claim to the crown. Guy found his cause espoused in 1191 by the overlord of his house, Richard I. of England; but Conrad's superior ability, and the support of the French crusaders, ultimately carried the day, and in 1192 Richard himself abandoned the pretensions of Guy, and recognized Conrad as king. Though Conrad was almost immediately assassinated, the crown did not return to Guy, but went to Henry of Champagne, who married the widowed Isabella. Guy found some satisfaction for his loss in buying from the Templars the island of Cyprus, and there he reigned for the last two years of his life (1192–1194). He is judged harshly by contemporary writers, as *simplex* and *insufficiens*; but Dodu (in his *Histoire des institutions du royaume de Jérusalem*) suggests that Guy was depreciated because the kingdom had been lost in his reign, in much the same way as Godfrey of Bouillon was exalted because Jerusalem had just been won at his accession. Guy was a brave if not a particularly able knight; and his instant attack on Acre after his release by Saladin shows that he had the *sentiment de ses devoirs*.

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[1] A branch of the line continued in Poitou during the 13th century, and ruled in LaMarche till 1303. Hugh de la Marche, whose betrothed wife, Isabella of Angoulême, King John of England seized (thus bringing upon himself the loss of the greater part of his French possessions), was a nephew of Guy of Lusignan. He ultimately married Isabella, after the death of John, and had by her a number of sons, half-brothers of Henry III. of England, who came over to England, amongst other foreign favourites, during his reign.

He was succeeded in Cyprus by his brother Amalric, who acquired the title of king of Cyprus from the emperor Henry VI., and became king of Jerusalem in 1197 by his marriage to Isabella, after the death of Henry of Champagne (see AMALRIC II.). Amalric was the founder of a dynasty of kings of Cyprus, which lasted till 1475, while after 1269 his descendants regularly enjoyed the title of kings of Jerusalem. The scions of the house of Lusignan proved themselves the most sincere of crusaders. They possessed in Cyprus a kingdom, in which they had vindicated for themselves a stronger hold over their feudatories than the kings of Jerusalem had ever enjoyed, and in which trading centres like Famagusta flourished vigorously; and they used the resources of their kingdom, in conjunction with the Hospitallers of Rhodes, to check the progress of the Mahommedans.

Among the most famous members of the house who ruled in Cyprus three may be mentioned. The first is Hugh III. (the Great), who was king from 1267 to 1285: to him, apparently, St Thomas dedicated his *De Regimine Principum*; and it is in his reign that the kingdom of Jerusalem becomes permanently connected with that of Cyprus. The second is Hugh IV. (1324–1359), to whom Boccaccio dedicated one of his works, and who set on foot an alliance with the pope, Venice and the Hospitallers, which resulted in the capture of Smyrna (1344). The last is Peter I., Hugh's second son and successor, who reigned from 1359 to 1369, when he was assassinated as the result of a conspiracy of the barons. Peter and his chancellor de Mezières represent the last flicker of the crusading spirit (see CRUSADES).

Before the extinction of the line in 1475, it had succeeded in putting a branch on the throne of Armenia. Five short-lived kings of the house ruled in Armenia after 1342, "Latin exiles," as Stubbs says, "in the midst of several strange populations all alike hostile." The kingdom of Armenia fell before the sultan of Egypt, who took prisoner its last king Leo V. in 1375, though the kings of Cyprus afterwards continued to bear the title; the kingdom of Cyprus itself continued to exist under the house of Lusignan for 100 years longer. The mother of the last king, James III. (who died when he was two years old), was a Venetian lady, Catarina Cornaro. She had been made a daughter of the republic at the time of her marriage to the king of Cyprus; and on the death of her child the republic first acted as guardian for its daughter, and then, in 1489, obtained from her the cession of the island.

See J. M. J. L. de Mas-Latrie, *Histoire de l'île de Chypre sous les princes de la maison de Lusignan* (Paris, 1852–1853); W. Stubbs, *Lectures on Medieval and Modern History* (3rd ed., Oxford, 1900).

LUSSIN, a small island in the Adriatic Sea, in the Gulf of Quarnero, forming together with the adjacent islands of Veglia and Cherso an administrative district in the Austrian crownland of Istria. Pop. (1900) 11,615. The island is 24 m. in length, is of an average breadth of 1·64 m., being little more than 300 yds. wide at its narrowest point, and has an area of 29 sq. m. The chief town and principal harbour is Lussinpiccolo (pop. 7207), which is the most important trading centre in the Quarnero group. The town has become a favourite winter resort, its climate resembling that of Nice. To the south-east of it is Lussingrande (pop. 2349), with an old Venetian palace and a shipbuilding wharf. The island was first peopled at the end of the 14th century. Its inhabitants are renowned seamen.

LUSTRATION, a term that includes all the methods of purification and expiation among the Greeks and Romans. Among the Greeks there are two ideas clearly distinguishable—that human nature must purify itself (κάθαρσις) from guilt before it is fit to enter into communion with God or even to associate with men, and that guilt must be expiated voluntarily (ἱλασμός) by certain processes which God has revealed, in order to avoid the punishment that must otherwise overtake it. It is not possible to make such a distinction among the Latin terms *lustratio*, *piacula*, *piamenta*, *caerimoniae*, and even among the Greeks it is not consistently observed. Guilt and impurity arose in various ways; among the Greeks, besides the general idea that man is always in need of purification, the species of guilt most insisted on by religion are incurred by murder, by touching a dead body, by sexual intercourse, and by seeing a prodigy or sign of the divine will. The last three spring from the idea that man had been without preparation and improperly brought into communication with God, and was therefore guilty. The first, which involves a really moral idea of guilt, is far more important than the others in Hellenic religion. Among the Romans we hear more of the last species of impurity; in general the idea takes the form that after some great disaster the people become convinced that guilt has been incurred and must be expiated. The methods of purification consist in ceremonies performed with water, fire, air or earth, or with a branch of a sacred tree, especially of the laurel, and also in sacrifice and other ceremonial. Before entering a temple the worshipper dipped his hand in the vase of holy water (περιρραντήριον, *aqua lustralis*) which stood at the door; before a sacrifice bathing was common; salt-water was more efficacious than fresh, and the celebrants of the Eleusinian mysteries bathed in the sea (ἅλαδε, μύσται); the water was more efficacious if a firebrand from the altar were plunged in it. The torch, fire and sulphur (τὸ θεῖον) were also powerful purifying agents. Purification by air was most frequent in the Dionysiac mysteries; puppets suspended and swinging in the air (*oscilla*) formed one way of using the lustrative power of the air. Rubbing with sand and salt was another method. The sacrifice chiefly used for purification by the Greeks was a pig; among the Romans it was always, except in the Lupercalia, a pig, a sheep and a bull (*suovetaurilia*). In Athens a purificatory sacrifice and prayer was held before every meeting of the ecclesia; the Maimacteria,[1] in honour of Zeus Maimactes (the god of wrath), was an annual festival of purification, and at the Thargelia two men (or a woman and a man) were sacrificed on the seashore, their bodies burned and the ashes thrown into the sea, to avert the wrath of Apollo. On extraordinary occasions lustrations were performed for a whole city. So Athens was purified by Epimenides after the Cylonian massacre, and Delos in the Peloponnesian War (426 B.C.) to stop the plague and appease the wrath of Apollo. In Rome, besides such annual ceremonies as the *Ambarvalia*, *Lupercalia*, *Cerialia*, *Paganalia*, &c., there was a lustration of the fleet before it sailed, and of the army before it marched. Part of the ceremonial always consisted in leading or carrying the victims round the impure persons or things. After any disaster the *lustratio classium* or *exercitus* was often again performed, so as to make certain that the gods got all their due. The *Amburbium*, a solemn procession of the people round the boundaries of Rome, was a similar ceremonial performed for the whole city on occasions of great danger or calamity; the *Ambilustrium* (so called from the sacrificial victims being carried round the people assembled on the Campus Martius) was the purificatory ceremony which took place after the regular quinquennial census (*lustrum*) of the Roman people.

See C. F. Hermann, *Griechische Altertümer*, ii.; G. F. Schömann, *ib.* ii.; P. Stengel, *Die griechischen Kultusaltertümer* (1898); Marquardt, *Römische Staatsverwaltung*, iii. p. 200 (1885); P. E. von Lasaulx, *Die Sühnopfer der Griechen und Römer* (1841); J. Donaldson, "On the Expiatory and Substitutionary Sacrifices of the Greeks," in *Transactions of the Royal Society of Edinburgh*, xxvii., 1876; and the articles by A. Bouché-Leclercq in Daremberg and Saglio, *Dictionnaire des antiquités*, and by W. Warde Fowler in Smith's *Dictionary of Greek and Roman Antiquities* (3rd ed., 1891).

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[1] Maimacteria does not actually occur in ancient authorities as the name of a festival.

LUTE (Arabic *al'ūd*, "the wood"; Fr. *luth*; Ital. *liuto*; Span. *laud*; Ger. *Laute*; Dut. *luit*), an ancient stringed musical instrument, derived in form as well as name from the Arabs. The complete family consisted of the pandura, tanbur or mandoline as treble, the lute as alto or tenor, the barbiton or theorbo as bass, and the chitarrone as double bass. The Arab instrument, with convex sound-body, pointing to the resonance board or membrane having been originally placed upon a gourd, was strung with silk and played with a plectrum of shell or quill. It was adopted by the Arabs from Persia. Instruments with vaulted backs are all undoubtedly of Eastern origin; the distinct type, resembling the longitudinal section of a pear, is more specially traced in ancient India, Persia and the countries influenced by their civilization. This type of instrument includes many families which became known during the middle ages of western Europe, being introduced into southern Europe and Spain by the Moors, into southern Russia by the Persians of the Sassanian period, into Greece from the confines of the Byzantine Empire. As long as the strings were plucked by fingers or plectrum the large pear-shaped instrument may be identified as the archetype of the lute. When the bow, obtained from Persia, was applied to the instrument by the Arabs, a fresh family was formed, which was afterwards known in Europe as rebab and later rebec. The largest member of the ancient lute family—the bass lute or theorbo—has been identified with the barbiton.

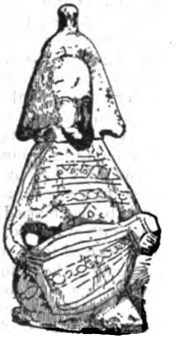
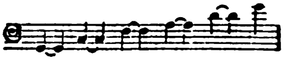
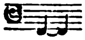


FIG. 1.—Post-Mycenaean terra-cotta figure, with ancient lute (1000 B.C.) from the cemetery at Goshen.

Until recently the existence of these ancient stringed instruments was presumed on the evidence of the early medieval European instruments and of the meagre writings extant, such as those of Fārābi.[1] But a chain of plastic evidence can now be offered, beginning with the Greek post-Mycenaean age (*c.* 1000 B.C.). A statuette of a female musician playing upon a large lute with only an embryonic neck, on which nevertheless the left hand is stopping strings, was unearthed in Egypt in a tomb of the XXth Dynasty in the cemetery of Goshen by the members of the British School of Archaeology in Egypt,[2] under the direction of Professor Flinders Petrie, to whose courtesy we owe the photograph (fig. 1) here reproduced. It is difficult to form a conclusive opinion as to the number of strings the artist intended to represent, owing to the decorative figures following the direction of the strings, but, judging from the position of the right hand plucking a string, there may have been seven. Among a number of terra-cotta figures of musicians, brought to light during the excavations in a Tell at Suza and dating from the 8th century B.C.,[3] although there is no instrument that might be identified with the alto lute, the treble lute or tanbur is represented with a long, curved neck and a head bent back to increase the tension, and there is also an instrument having a smaller and more elongated body than the lute. On one of the friezes from Afghanistan presented to the British Museum by Major-General Cunningham, which formed the risers of steps leading to the tope at Jumal Garhi, dating from the 1st century A.D. are represented scenes of music and dancing. Here the archetype of the lute appears several times; it had four strings, and the head was bent back at right angles to the neck. In the 6th century A.D. illustrations of this early lute are no longer rare, more especially on Persian silver-work of the Sassanian period[4] and in the paintings of the Buddhist cave-temples of Ajanta.[5] Several representations of the barbiton are extant from the classical Roman period.

The modern Egyptian *'ūd* is the direct descendant of the Arabic lute, and, according to Lane, is strung with seven pairs of catgut strings played by a plectrum. A specimen in the Victoria and Albert Museum, given by the khedive, has four pairs only, which appears to have been the old stringing of the instrument. When frets (cross-lines dividing the neck or finger-board to show the fingering) are employed they are of catgut disposed according to the Arabic scale of seventeen intervals in the octave, consisting of twelve limmas, an interval rather less than our equal semitone, and five commas, which are very small but quite recognizable differences of pitch.

The lute family is separated from the guitars, also of Eastern origin, by the formation of the sound body, which is in all lutes pear-shaped, without the sides or ribs necessary to the structure of the flat-backed guitar and cither. Observing this distinction, we include with the lute the little Neapolitan mandoline of 2 ft. long and the large double-necked Roman chitarrone, not infrequently 6 ft. long. Mandolines are partly strung with wire, and are played with a plectrum, indispensable for metal or short strings. Perhaps the earliest lutes were so played, but the large lutes and theorbos strung with catgut have been invariably touched by the fingers only, the length permitting this more sympathetic means of producing the tone.

Praetorius,[6] writing when the lute was in universal favour, mentions seven varieties distinguished by size and tuning. The smallest would be larger than a mandoline, and the melody string, the "chanterelle," often a single string, lower in pitch. Praetorius calls this an octave lute, with the chanterelle C or D. The two discant lutes have respectively B and A, the alto G, the tenor E, the bass D, and the great octave bass G, an octave below the alto lute which may be taken as the model lute cultivated by the amateurs of the time. The bass lutes were theorbos, that is, double-necked lutes, as described below. The accordance of an alto lute was  founded upon that of the original eight-stringed European lute, to which the highest and lowest notes had, in course of time, been added. A later addition was the  also on the finger-board, and bass strings, double or single, known as diapasons, which, descending to the deep C of the violoncello, were not stopped with the fingers. The diapasons were tuned as the key of the piece of music required. Fig. 2 represents an Italian instrument made by one of the most celebrated lute makers, Venere of Padua, in 1600; it is 3 ft. 6 in. high, and has six pairs of unisons and eight single diapasons. The finger-board, divided into approximately equal half tones by the frets, as a rule eight in number, was often further divided on the higher notes, for ten, eleven, or, as in the woodcut, even twelve, semitones. The head, bearing the tuning pegs, was placed at an obtuse or a right angle to the neck, to increase the bearing of the strings upon the nut, and be convenient for sudden requirements of tuning during performance, the trouble of keeping a lute in tune being proverbial.

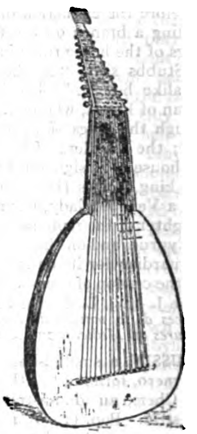


FIG. 2.—Lute, by Venere of Padua.

The lute was in general use during the 16th and 17th centuries. In the 18th it declined; still J. S. Bach wrote a "partita" for it. The latest date we have met with of an engraved publication for the lute is 1760.

The large double-necked lute, with two sets of tuning pegs, the lower for the finger-board, the higher for the diapason strings, was known as the theorbo; also, and especially in England, as the arch-lute; and, in a special form, the neck being then very long, as the chitarrone. Theorbo and chitarrone appear together at the close of the 16th century, and their introduction was synchronous with the rise of accompanied monody in music, that is, of the oratorio and the opera. Peri, Caccini and Monteverde used theorbos to accompany their newly-devised recitative, the invention of which in Florence, from the impulse of the Renaissance, is well known. The height of a theorbo varied from 3 ft. 6 in. to 5 ft., the Paduan being always the largest, excepting the Roman 6-ft. long chitarrone. These large lutes had very deep notes, and doubtless great liberties were allowed in tuning, but the strings on the finger-board followed the lute accordance already given, or another quoted by Baron (*Untersuchung des Instruments der Lauten*, Nuremberg, 1727) as the old theorbo or "violway" (see Mace, *Musick's Monument*, London, 1676):—

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[1] See Latin translation by J. G. L. Kosegarten, *Alii Ispahenensis Liber . . . Arabice editur adjectaque translatione adnotationibusque illustratus* (Greifswald, 1840).

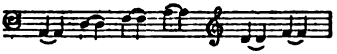
[2] See *Hyksos and Israelite Cities*, by W. M. Flinders Petrie and J. Garrow Duncan, 1906 (double volume), Brit. Sch. of Arch.

[3] J. de Morgan, *Délégation en Perse* (Paris, 1900), vol. i. pl. viii. Nos. 8, 7 and 9.

[4] See "The Treasures of the Oxus," catalogue of the Franks Bequest to the British Museum by Ormonde M. Dalton (London, 1905), pl. xxvi. No. 190; see also J. R. Aspelin, "Les antiquités du nord," No. 608; also for further references, Kathleen Schlesinger, "Precursors of the Violin Family," pt. ii. of *The Instruments of the Orchestra*, pp. 407-408, and appendix B, pp. 492-493; and *Gazette archéologique* (Paris, 1886), vol. xi. pl. x. and p. 70.

[5] By John Griffiths (London, 1896), vol. ii. pl. 105, cave I. 10, e.

[6] *Syntagm. Music.* pt. ii., "Organographie" (Wolfenbüttel, 1618), pp. 30 and 58-61.



We find again both these accordances varied and transposed a tone higher, perhaps with thinner strings, or to accommodate local differences of pitch. Praetorius recommends the chanterelles of theorbos being tuned an octave lower on account of the great strain. By such a change, another authority, the Englishman Thomas Mace, says, the life and spruceness of airy lessons were quite lost. The theorbo or archlute had at last to give way to the violoncello and double bass, which are still used to accompany the "recitativo secco" in oratorios and operas. Handel wrote a part for a theorbo in *Esther* (1720); after that date it appears no more in orchestral scores, but remained in private use until nearly the end of the century.

The lute and the organ share the distinction of being the first instruments for which the oldest instrumental compositions we possess were written. For the lute, however, they were not written in our present notation, but in tablature, "lyrawise," a system by which as many lines were drawn horizontally as there were pairs of strings on the finger-board, the frets, distributed at intervals of a semitone, being distinguished by the letters of the alphabet, repeated from A, representing the open string, for each line. This was the English and French manner; the Italian was by numbers instead of letters. The signs of time were placed over the stave, and were not repeated unless the mensural values changed. (A. J. H.; K. S.)

LUTHARDT, CHRISTOPH ERNST (1823–1902), German Lutheran theologian, was born at Maroldsweisach, Bavaria, on the 22nd of March 1823. He studied theology at Erlangen and Berlin, and in 1856 became professor ordinarius of systematic theology and New Testament exegesis at Leipzig. In 1865 he was made a counsellor to the consistory, in 1871 canon of Meissen cathedral, and in 1887 a privy councillor to the church. He died at Leipzig on the 21st of September 1902. A strictly orthodox theologian, and a clear writer, though not a very profound scholar, Luthardt became widely appreciated as the author of apologetic lectures. These were collected under the title *Apologie des Christentums* (vol. i., 1864, 14th ed. 1896; vol. ii. 7th ed., 1901; vol. iii. 7th ed., 1898; vol. iv. 2nd ed., 1880), a work of which the first three volumes have been translated into English. In 1868 he founded and edited the *Allgemeine evang.-lutherische Kirchenzeitung*, with its supplement the *Theologisches Litteraturblatt*, and in 1880 became editor of the *Zeitschrift für kirchl. Wissenschaft und kirchl. Leben*.

His other works include *Das Johanneische Evangelium . . . erklärt* (1852–1853; 2nd ed. in 2 vols., 1875–1876), *Offenbarung Johannis erklärt* (1861), *Lehre von den letzten Dingen* (1861; 3rd ed. 1885); *Kompendium der Dogmatik* (1865; 9th ed., 1893), *Geschichte der christlichen Ethik* (2 vols., 1888–1893), *Gnade und Wahrheit* (1874), *Das Wort des Lebens* (1877) and *Gnade und Frieden* (1880). His autobiography was published with the title *Erinnerungen aus vergangenen Tagen* (1889; 2nd ed., 1891).

LUTHER, MARTIN (1483–1546), the great German religious reformer, was born at Eisleben on the 10th of November 1483. His father, Hans Luther (Lyder, Luder, Ludher), a peasant from the township of Möhra in Thuringia, after his marriage with Margarethe Ziegler, had settled in Mansfeld, attracted by the prospects of work in the mines there. The counts of Mansfeld, who, many years before, had started the mining industry, made a practice of building and letting out for hire small furnaces for smelting the ore. Hans Luther soon leased one, then three. In 1491 he became one of the four elected members of the village council (*vier Herren von der Gemeinde*); and we are told that the counts of Mansfeld held him in esteem. The boy grew up amid the poor, coarse surroundings of the German peasant life, imbibing its simple beliefs. He was taught that the Emperor protected the poor people against the Turk, that the Church was the "Pope's House," wherein the Bishop of Rome had all the rights of the house-father. He shared the common superstitions of the time and some of them never left him.

Young Martin went to the village school at Mansfeld; to a school at Magdeburg kept by the Brethren of the Common Lot; then to the well-known St George's school at Eisenach. At Magdeburg and Eisenach Luther was "a poor student," *i.e.* a boy who was received into a hospice where he lived rent-free, attended school without paying fees, and had the privilege of begging for his bread at the house-doors of the town; in return for which he sang as a chorister in the church to which the school was attached. Luther was never a "wandering student"; his parents were too careful of their child to permit him to lead the life of wandering licence which marked these pests of medieval German scholastic life. At Eisenach he attracted the notice of the wife of a wealthy merchant of Eisenach, whom his biographers usually identify as Frau Cotta.

After three happy years at Eisenach, Luther entered the university of Erfurt (1501), then the most famous in Germany. Hans Luther had been prospering, and was more than ever resolved to make his son a lawyer. Young Luther entered his name on the matriculation book in letters which can still be read "Martinus Ludher ex Mansfelt," a free student, no longer embarrassed by great poverty. In Luther's time Erfurt was the intellectual centre of Germany and its students were exposed to a variety of influences which could not fail to stimulate young men of mental ability.

Its theology was, of course, scholastic, but of what was then called the modern type, the Scotist; its philosophy was the nominalist system of William of Occam, whose great disciple, Gabriel Biel (d. 1495), had been one of its most famous professors; Nicholas de Lyra's (d. 1340) system of biblical interpretation had been long taught there by a succession of able teachers; Humanism had won an early entrance to the university; the anti-clerical teaching of John of Wessel, who had himself taught at Erfurt for fifteen years (1445–1460), had left its mark on the place and was not forgotten. Hussite propagandists, even in Luther's time, secretly visited the town and whispered among the students their anti-clerical Christian socialism. Papal legates to Germany seldom failed to visit the university and by their magnificence bore witness to the majesty of the Roman church.

A study of the scholastic philosophy was then the preliminary training for a course of law, and Luther worked so hard at the prescribed studies that he had little leisure, he said, for classical learning. He attended none of the Humanist lectures, but he read a good many of the Latin authors and also learned a little Greek. He never was a member of the Humanist circle; he was too much in earnest about religious questions and of too practical a turn of mind. The young Humanists would have gladly welcomed him into their select band. They dubbed him the "philosopher," the "musician," recalled in after days his fine social disposition, his skill in playing the lute, and his ready power in debate. He took the various degrees in an unusually brief time. He was bachelor in 1502 and master in 1505. His father, proud of his son's steady application and success, sent him the costly present of a *Corpus Juris*. He may have begun to study law. Suddenly he plunged into the Erfurt Convent of the Augustinian Eremites and after due noviciate became a monk.

The action was so unexpected that his contemporaries felt bound to give all manner of explanations which have been woven into accounts which are legendary. Nothing is known about the cause of the sudden plunge but what Luther has himself revealed. He has told us that he entered the monastery because he doubted of himself, and that his action was sudden because he knew that his father would have disapproved of his intention.

The word "doubt" has made historians think of intellectual difficulties—of the "theological scepticism" taught by Occam and Biel, of the disintegrating criticism of Humanism. But there is no trace of any theological difficulties in Luther's mind in the struggles which sent him into the convent and distracted him there. He was driven to do what he did by the pressure of a practical religious need, the desire to save his soul. The fires of hell and the shades of purgatory, which are the constant background of Dante's "Paradiso," were present to Luther from childhood.

Luther was the greatest religious genius which the 16th century produced, and the roots of the movement in which he was the central figure must be sought for in the popular religious life of the last decades of the 15th and opening decades of the 16th centuries—a field which has been neglected by almost all his biographers. When it is explored traces of at least five different types of religious sentiment can be discovered. Pious parents, whether among the burghers or peasants, seem to have taught their children a simple evangelical faith. Martin Luther and thousands of children like him were trained at home to know the creed, the ten commandments, the Lord's prayer, and such simple hymns as *Ein Kindelein so lobelich*, *Nun bitten wir den Heiligen Geist* and *Crist ist erstanden*; and they were taught to believe that God for Christ's sake freely pardons sin. They learned that simple faith which Luther afterwards expounded in his *Small Catechism* and called the *Kinderlehre*. When lads trained like himself entered school and college they came in contact with that religious revival which characterized the last half of the 15th century. Fear seemed to brood over the peoples of Western Europe. The plague devastated the badly drained towns, new diseases spread death, the fear of the Turks was permanent. All this went to feed revival, which, founded on fear, refused to see in Jesus Christ anything but a stern judge, and made the Virgin Mother and Anna the "grandmother" the intercessors; which found consolation in pilgrimages from shrine to shrine; which believed in crude miracles, and in the thought that God could be best served within convent walls. Luther's mind was caught in this current of feeling. He records how it was burnt into him by pictures which filled his boyish imagination. Jesus in the painted window of Mansfeld church, stern of face, sword in hand, sitting on a rainbow, coming to judge; an altarpiece at Magdeburg, in which a ship with its crew was sailing on to heaven, carrying no layman on board; the deeds of St Elizabeth emblazoned on the window of St George's parish church at Eisenach; the living pictures of a young nobleman who had turned monk to save his soul, of a monk, the holiest man Luther had ever known, who was aged far beyond his years by his maceration; and many others of the same kind.

Alongside this we can trace the growth of another religious movement of a different kind. We can see a sturdy commonsense religion taking possession of multitudes in Germany, which insisted that laymen might rule in many departments supposed to belong exclusively to the clergy. The *jus episcopale* which Luther afterwards claimed for the secular authorities had been practically exercised in Saxony and Brandenburg; cities and districts had framed police regulations which set aside ecclesiastical decrees about holidays and begging; the supervision of charity was passing from the hands of the church into those of laymen; and religious confraternities which did not take their guidance from the clergy were increasing. Lastly, the medieval Brethren were engaged in printing and distributing tracts, mystical, anti-clerical, sometimes socialist. All these influences abounded as Luther was growing to manhood and laid their marks upon him. It was the momentary power of the second which drove him into the convent, and he selected the monastic order which represented all that was best in the revival of the latter half of the 15th century—the Augustinian Eremites.

In the convent Luther set himself to find salvation. The last word of that Scotist theology which ruled at the close of the middle ages was that man must work out his own salvation, and Luther tried to do so in the most approved later medieval fashion by the strictest asceticism. He fasted and scourged himself; he practised all the ordinary forms of maceration and invented new ones, all to no purpose. His theological studies, part of the convent education, told him that pardon could be had through the Sacrament of Penance, and that the first part of the sacrament was sorrow for sin. The older theology declared that such sorrow must be based on love to God. Had he this love? God always appeared to him as an implacable judge, threatening punishment for breaking a law which it was impossible to keep. He confessed to himself that he often hated this arbitrary Will which Scotist theology called God. The later theology, taught in the convent by John of Palz and John Nathin, said that sorrow might be based on a meaner motive provided the Sacrament of Penance was continually resorted to. Luther wearied his superiors with his attendance at the confessional. He was looked upon as a young saint, and his reputation extended throughout the convents of his order. The young saint felt himself to be no nearer the pardon of God; he thought that he was "gallows-ripe." At last his superiors seemed to discover his real difficulties. Partly by their help, partly by study of the scriptures, he came to understand that God's pardon was to be won by trusting to His promises. Thus after two years of indescribable mental conflicts Luther found peace. The struggle marked him for life. His victory gave him a sense of freedom, and the feeling that life was given by God to be enjoyed. In all external things he remained unchanged. He was a faithful son of the medieval church, with its doctrines, ceremonies and usages.

Soon after he had attained inward peace, Luther was ordained. He continued his studies in theology, devoting himself to the more "experimental" portions of Augustine, Bernard and Gerson. He showed himself a good man of business and was advanced in his order. In 1508 he was sent with some other monks to Wittenberg to assist the small university which had been opened there in 1502 by Frederick the Wise, elector of Saxony. It was there that Luther began to preach, first in a small chapel to the monks of his order; later taking the place of one of the town's clergy who was in ill-health. From Wittenberg he was sent by the chiefs of the German Augustinian Eremites to Rome on a mission concerning the organization of the order. He went up with the feelings of the medieval pilgrim rather than with the intoxication of the ardent Humanist. On his return (1512) he was sent by Staupitz, his vicar-general, to Erfurt to take the necessary steps for higher graduation in theology, in order to succeed Staupitz himself as professor of theology in Wittenberg. He graduated as Doctor of the Holy Scripture, took the Wittenberg doctor's oath to defend the evangelical truth vigorously (*viriliter*), became a member of the Wittenberg Senate, and three weeks later succeeded Staupitz as professor of theology.

From the first Luther's lectures in theology differed from those ordinarily given at the time. He had no opinions on theological subjects at variance with the theology taught at Erfurt and elsewhere. No one attributed any heretical views to the young Wittenberg professor. He differed from others because he looked at theology in a more practical way. He thought it ought to be made useful to guide men to the grace of God and to tell them how to persevere in a life of joyous obedience to God and His commandments. His teaching was "experimental" from the beginning. Besides he believed that he had been specially set apart to lecture on the Holy Scriptures, and he began by commenting on the Psalms and on the Epistles of St Paul. He never knew much Hebrew and was not specially strong in Greek; so he used the Vulgate in his prelections. He had a huge widely printed volume on his desk, and wrote the notes for his lectures on the margins and between the lines. Some of the pages survive. They contain in the germ the leading thoughts of what became Lutheran theology. At first he expressed himself in the phrases common to scholastic theology, when these were found to be inadequate in words borrowed from the mystical writers of the 14th and 15th centuries, and then in new phrases more appropriate to the circle of fresh thoughts. Those new thoughts at first simply pushed aside the ordinary theology taught in the schools without staying to criticize it. Gradually, however, Luther began to find that there was some real opposition between what he was teaching and the theology he had been taught in the Erfurt convent. It appeared characteristically enough on the practical and not on the speculative side of theology in a sermon on *Indulgences* preached in July 1516.

Once begun the breach widened, until Luther could contrast "our theology" with what was taught at Erfurt, and by September he began to write against the scholastic theology, to declare that it was Pelagian at heart, that it repudiated the Augustinian doctrines of grace, and neglected to teach the supreme value of that faith "which throws itself upon God."

These lectures and the teaching they contained soon made a great impression. Students began to flock to the small obscure university of Wittenberg, and the elector grew proud of the teacher who was making his university famous. It was at this interesting stage of his own religious career that he felt himself compelled to stand forth in opposition to what he believed to be a great religious scandal, and almost unconsciously to become a Reformer.

Luther began his work as a Reformer by proposing to discuss the true meaning of Indulgences. The occasion was an Indulgence proclaimed by Pope Leo X., farmed by the archbishop of Mainz, and preached by John Tetzel, a Dominican monk and a famed seller of Indulgences. Many of the German princes had no great love for Indulgence sellers, and Frederick of Saxony had prohibited Tetzel from entering his territories. But it was easy to reach most parts of Electoral Saxony without actually crossing the frontiers. The Red Cross of the Indulgence seller had been set up at Zerbst and at Jüterbogk, and people had gone from Wittenberg to buy the *Papal Tickets*. Luther believed that the sales were injurious to the morals of the townsmen; he had heard reports of Tetzel's sermons; he had become wrathful on reading the letter of recommendation of the archbishop; and friends had urged him to interfere. He protested with a characteristic combination of caution and courage. The church of All Saints (the castle church) was closely connected with the university of Wittenberg. Its doors were commonly used for university proclamations. The Elector Frederick was a great collector of relics and had stored them in his church. He had procured an Indulgence for all who attended its services on All Saints' Day, and crowds commonly gathered. Luther nailed ninety-five *theses* on the church door on that day, the 1st of November 1517, when the crowd could see and read them.

The proceeding was strictly academic. The matter discussed, to judge by the writings of theologians, was somewhat obscure; and Luther offered his *theses* as an attempt to make it clearer. No one was supposed to be committed to every opinion he advanced in such a way. But the *theses* posted somehow touched heart and conscience in a way unusual in the common subjects of academic disputation. Every one wanted to read them. The University Press could not supply copies fast enough. They were translated into German, and were known throughout Germany in less than a fortnight. Within a month they had been heard of all over western and southern Europe. Luther himself was staggered at the way they were received. He said he had never meant to determine, but to debate.

The *theses* were singularly unlike what might have been expected from a professor of theology. They made no attempt at theological definition, no pretence at logical arrangement; they were anything but a brief programme of reformation. They were simply ninety-five sledge-hammer blows directed against the most flagrant ecclesiastical abuse of the age. They were addressed to the "common" man and appealed to his common sense of spiritual things.

The practice of offering, selling and buying Indulgences (see INDULGENCE) was everywhere common in the beginning of the 16th century. The beginnings go back more than a thousand years before the time of Luther. In the earliest church life, when Christians fell into sin, they were required to make public confession before the congregation, to declare their sorrow, and to vow to perform certain acts which were regarded as evidence of the sincerity of their repentance. When the custom of public confession before the congregation had changed to private confession to the clergy, it became the confessor's duty to impose these satisfactions. It was thought only right that there should be some uniformity in dealing with repentant sinners, and books appeared giving lists of sins and what were supposed to be suitable satisfactions. When the sins confessed were very heinous the satisfactions were correspondingly severe and sometimes lasted over many years. About the 7th century arose a custom of commuting or relaxing these imposed satisfactions. A penance of several years fasting might be commuted into saying so many prayers, or giving an arranged amount in alms, or even into a money-fine. In the last case the analogy of the Wergeld of the German tribal codes was commonly followed. The usage generally took the form that any one who visited a church, to which the Indulgence had been attached, on a day named, and gave a contribution to its funds, had his penance shortened by one-seventh, one-third or one-half, as might be arranged. This was the origin of Indulgences properly so-called. They were always mitigations of satisfactions or penances which had been imposed by the church as outward signs of inward sorrow, tests of fitness for pardon, and the needful precedents of absolution. Luther uttered no protest against Indulgences of this kind. He held that what the church had imposed the church could remit.

This old and simple conception of Indulgences had been greatly altered since the beginning of the 13th century. The institution of penance had been raised to the dignity of a sacrament, and this had changed both the place and the character of satisfactions. Under the older conception the order had been Sorrow (*Contritio*), Confession, Satisfaction (or due manifestation of sorrow in ways prescribed) and Absolution. Under the newer theory the order was Sorrow, Confession, Absolution, Satisfaction, and both satisfaction and sorrow took new meanings. It was held that Absolution removed guilt and freed from eternal punishment, but that something had to be done to free the penitent from temporal punishment whether in this life or in purgatory. Satisfactions took the new meaning of the temporal punishments due in this life and the substitute for the pains of purgatory. The new thought of a treasury of merits (*thesaurus meritorum*) introduced further changes. It was held that the good deeds over and above what were needed for their own salvation by the living or by the saints in heaven, together with the inexhaustible merits of Christ, were all deposited in a treasury out of which they could be taken by the pope and given by him to the faithful. They could be added to the satisfactions actually done by penitents. Thus Satisfactions became not merely signs of sorrow but actual merits, which freed men from the need to undergo the temporal pains here and in purgatory which their sins had rendered them liable to. By an Indulgence merits could be transferred from the storehouse to those who required them. The change made in the character of Sorrow made Indulgences all the more necessary for the indifferent penitent. On the older theory Sorrow (*Contritio*) had for its one basis love to God; but on the newer theory the starting-point might be a less worthy king of sorrow (*Attritio*) which it was held would be changed into the more worthy kind in the Sacrament of Penance. The conclusion was naturally drawn that a process of penitence which began with sorrow of the more unworthy kind needed a larger amount of Satisfactions or penance than what began with Contrition. Hence for the indifferent Christian, *Attrition*, *Confession* and *Indulgence* became the three heads in the scheme of the church of the later middle ages for his salvation. The one thing which satisfied his conscience was the burdensome thing he had to do, and that was to procure an Indulgence—a matter made increasingly easy for him as time went on.

This doctrine of *Attrition* had not the undivided support of the theologians of the later medieval church; but it was taught by the Scotists and was naturally a favourite theme with the sellers of Indulgences. Nor were all theologians at one upon the whole theory of Indulgences. The majority of the best theologians held that Indulgences had nothing to do with the pardoning of guilt, but only with freeing from temporal penalties in this life or in purgatory. But the common people did not discriminate, and believed that when they bought an Indulgence they were purchasing pardon from sin; and Luther placed himself in the position of the ordinary Christian uninstructed in the niceties of theological distinctions.

His *Ninety-five Theses* made six different assertions about Indulgences and their efficacy:—

i. An Indulgence is and can only be the remission of a merely ecclesiastical penalty; the church can remit what the church has imposed; it cannot remit what God has imposed.

ii. An Indulgence can never remit guilt; the pope himself cannot do such a thing; God has kept that in His own hand.

iii. It cannot remit the divine punishment for sin; that also is in the hands of God alone.

iv. It can have no efficacy for souls in Purgatory; penalties imposed by the church can only refer to the living; death dissolves them; what the pope can do for souls in Purgatory is by prayer, not by jurisdiction or the power of the keys.

v. The Christian who has true repentance has already received pardon from God altogether apart from an Indulgence, and does not need one; Christ demands this true repentance from every one.

vi. The Treasury of Merits has never been properly defined; it is hard to say what it is, and it is not properly understood by the people; it cannot be the merits of Christ and of His saints, because these act of themselves and quite apart from the intervention of the pope; it can mean nothing more than that the pope, having the power of the keys, can remit ecclesiastical penalties imposed by the church; the true Treasure-house of merits is the Holy Ghost of the grace and glory of God.

The unexpected effect of the *Theses* was that the sale of Indulgences began to decline rapidly, and the archbishop of Mainz, disappointed in his hopes of revenue, sent a copy to Rome. The pope thinking that the whole dispute was a monkish quarrel, contented himself with asking the general of the Augustinian Eremites to keep his monks quiet. This was not easy. Tetzel, in conjunction with a friend, Conrad Wimpina, had published a set of counter-theses. John Mayr of Eck, a noted controversialist and professor of theology in the university of Ingolstadt, scented the Hussite heresy in the *Theses*, and denounced them in a tract entitled *Obelisks*. Luther at once answered in his *Asterisks*. A controversy raged in Germany. Meanwhile, at Rome, Silvester Mazzolini of Prierio, a Dominican monk and Inquisitor, had been studying the *Theses*, was profoundly dissatisfied with them, and wrote a *Dialogue about the Power of the Pope, against the presumptuous conclusions of Martin Luther*. This book reached Germany about the middle of January 1518, and increased the tumult.

Luther's friends had been provokingly silent about the *Theses*; but in April 1518, at the annual chapter of the Augustinian Eremites held at Heidelberg, Luther heard his positions temperately discussed, and found somewhat to his astonishment that his views were not acceptable to all his fellow monks. On his return to Wittenberg he began an answer to his opponents. He carefully considered his positions, found them unassailable, and published his *Resolutions*, the most carefully written of all his works. The book practically discarded all the ideas and practices concerning Indulgences which had come into the medieval church since the beginning of the 13th century, and all the ingenious explanations of the scholastic theologians from Bonaventura and Thomas Aquinas downwards. The effect of the controversy was a great decrease in the sale of Indulgences in Germany, and the Papal Curia saw with alarm a prolific source of revenue decaying. It was felt that Luther must be silenced. He was accordingly summoned to Rome. To obey would have meant death; to refuse in his own name would have been contumacy. But the peremptory summons could be construed as an attack on the university of Wittenberg, and both the elector of Saxony and the emperor Maximilian so regarded it. The result was that Pope Leo cancelled the summons, and it was arranged that Luther should appear before the papal Legate to the German Diet, Thomas de Vio, Cardinal Cajedtan, at Augsburg. The interview was not very successful. At its conclusion Luther wrote two appeals—one from the pope ill-informed to the pope well-informed, and the other to a General Council. True to his habit of taking the German people into his confidence, he wrote an account of his interview with the Legate, and published it under the title of the *Acta Augustana*.

The publication greatly increased the sympathy of almost all classes in Germany for Luther. They saw in him a pious man, an esteemed professor, who had done nothing but propose a discussion on the notoriously intricate subject of Indulgences, peremptorily ordered to recant and to remain silent. The elector Frederick shared the common feelings and resolved to defend the man who had made his university so famous. His action compelled the Roman Curia to pause. Germany was on the eve, it was believed, of an election of a king of the Romans; it was possible that an imperial election was not far distant; Frederick was too important a personage to offend. So the condemnation by the Cardinal-Legate was withdrawn for the time, and the pope resolved to deal with the matter otherwise. He selected one of his chamberlains, Charles von Miltitz, the elector's private agent at Rome, and commissioned him to deal with the matter as he best could. Miltitz received the "golden rose" to give to Frederick, and was furnished with several letters in all of which the pope spoke of Luther as a "child of the devil." His holiness had probably forgotten the fact when he addressed Luther some months later as "his dear son."

When Miltitz arrived in Germany he discovered that the movement was much more important than the Roman Curia had imagined. He had not to deal with the opposition of a recalcitrant monk, but with the awakening of a nation. He resolved to meet with Tetzel and with Luther privately before he produced his credentials. Tetzel he could not see; the man was afraid to leave his convent; but he had lengthy interviews with Luther in the house of Spalatin the chaplain and private secretary of the elector Frederick. There he disowned the sermons of the pardon-sellers, let it be seen that he did not approve of the action of the Legate, and so prevailed with Luther that the latter promised to write a submissive letter to the pope, to exhort people to reverence the Roman See, to say that Indulgences were useful to remit canonical penances, and to promise to write no more on the matter unless he happened to be attacked. Luther did all this. A reconciliation might have taken place had the Roman Curia supported Miltitz. But the Curia did not support Miltitz, and placed more faith in Eck, who was eager to extinguish Luther in a public discussion.

Luther had been spending the time between his interview with the Legate at Augsburg (Oct. 1518) and the Leipzig Disputation (June 1519) in severe and disquieting studies. He had found that all his opponents had pursued one line of argument: the power to issue an Indulgence is simply one case of the universal papal jurisdiction; Indulgences are what the pope proclaims them to be, and to attack them is to attack the power of the pope; the pope represents the Roman church, which is actually the universal church, and to oppose the pope is to defy the whole church of Christ; whoever attacks such a long-established system as that of Indulgences is a heretic. Such was the argument. Luther felt himself confronted with the pope's absolute supremacy in all ecclesiastical matters. It was a plea whose full force he felt. The papal supremacy was one of his oldest inherited beliefs. He re-examined his convictions about justifying faith and whether they did lead to his declarations about Indulgences. He could come to no other conclusion. It then became necessary to examine the papal claims. He set himself to study the Decretals, and to his amazement and indignation he found that they were full of frauds. It is hard to say whether the discovery brought him more joy or more grief. His letters show him half-exultant and half-terrified. While he was in this state of mind he received Eck's challenge to dispute with him at Leipzig on the papal supremacy.

This Leipzig Disputation was perhaps the most important point in Luther's career. He met Eck in June 1519. It soon appeared that the intention of that practised debater was to force Luther into some admission which would justify opponents in accusing him of holding the opinions of Huss, who had been condemned by the great German Council of Constance. In this he was eminently successful. Eck left Leipzig triumphant, and Luther returned to Wittenberg much depressed. As usual he wrote out and published an account of the Disputation, which was an appeal to his fellow Germans. The result surpassed his expectations. The Disputation made him see that his protest against the abuses of Indulgences was no criticism of an excrescence on the medieval ecclesiastical system, but an attack on its centre of existence. He saw that he stood for the spiritual priesthood of all believers and that medievalism in religion meant that man cannot approach God without a priestly mediator. The people also saw his position and rallied round him; and the Humanists discerned in him a champion against the old intolerance against which they had been revolting in vain. Luther's depression fled. Sermons, pamphlets, letters from his tireless pen flooded the land, and Luther began to be the leader of a German revolt against Rome.

The year 1520 saw the publication of his three most important works, all written at a time when he was fully convinced that he had broken for ever with Rome. They were, *On the Liberty of a Christian Man*, *An Address to the Nobility of the German Nation*, and *On the Babylonian Captivity of the Church of God*—the three primary treatises, as they have been called.

Meanwhile at Rome the pope had entrusted Eck and Prierias with the preparation of a bull (*Exurge Domine*) against Luther—a bull which followed the line of Eck's charges at Leipzig. The reformer had been expecting it ever since the Disputation at Leipzig, and had resolved to answer it by one striking act which would impress the imagination of every man. He posted up a notice inviting the Wittenberg students to witness the burning of the bull (10th of December 1520). Rome had shot its last ecclesiastical bolt. Nothing remained but an appeal to the secular power, and this was at once prepared.

The emperor Maximilian had died suddenly (12th January 1519), and for long Germany was disturbed with intrigues about the succession—the papal policy being specially tortuous. The widely expressed desire for a German emperor secured the unanimous election of Charles, the grandson of Maximilian and the king of Spain. Never were a people more mistaken and disappointed. The veins of Charles were full of German blood, but he was his mother's son. It was the Spaniard, not the German, who faced Luther at Worms.

Charles was crowned at Aachen, 23rd of October 1520, and opened his first German diet at Worms, 22nd of January 1521. The pope had selected two envoys to wait on the young emperor, one of them, Jerome Aleander, being specially appointed to secure the outlawry of Luther. The agenda of the diet contained many things seriously affecting all Germany, but the one problem which every one was thinking about was how Luther would be dealt with. The Electoral College was divided. The archbishop of Cologne, the elector of Brandenburg and his brother the archbishop of Mainz were for instant outlawry, while the elector of Saxony, who was resolved to protect Luther, had great influence with the archbishop of Trier and the Count Palatine of the Rhine.

Aleander had no difficulty in persuading Charles, while both were still in the Netherlands, to put Luther under the ban within his hereditary dominions, and the papal nuncio expected that the decree would be extended to the whole German empire. But Charles at first refused to deal summarily with Luther so far as Germany was concerned. The emperor even wrote to the elector of Saxony, asking him to bring Luther with him to the diet for examination. Gradually he came to think that Luther might be condemned without appearing. The members of the diet were slow to come to any conclusion. At last they made up their minds, and presented a memorial to the emperor (19th of February 1521) in which they reminded him that no imperial edict could be published against Luther without their sanction, and proposed that he should be invited to Worms under a safe-conduct and be there examined. They also suggested that Luther should be heard upon the papal claims, and ended by asking the emperor to deliver Germany from the papal tyranny. The emperor agreed to summon Luther under a safe-conduct, and that he should be heard; but he refused to mix his case with that of grievances against Rome. He had no sooner made the promise than he seems to have repented it. He saw no need for Luther's appearance. He tried to get him condemned unheard. An edict against Luther had been drafted (15th of February) which the diet refused to sanction. A few days later a second edict was drafted which ordered the burning of Luther's books. The diet again objected. Finally four days after the safe-conduct had been despatched the emperor revised this second edict, limited it to the seizure of Luther's books, and published it on his own authority without consulting the diet (10th March). After Luther had begun his journey, this edict was posted up along his route in order to intimidate him; other means were taken to make him turn aside from Worms; but he was resolved to go there and nothing daunted him. He reached the town (16th April) and was met by encouraging crowds. He was summoned to appear before the diet on the 17th and measures were taken to prevent him doing more than answering definite questions put to him. He was asked whether certain books had been written by him and whether he was prepared to maintain or to abjure what he had written. He asked time to prepare an answer to the second question. The diet was anxious to hear Luther, if the emperor was not, and his request was granted. He thus defeated the plot to keep him silent. On the 18th he made his second appearance and delivered the speech, which electrified his audience. At the close he was threatened by Spaniards in the diet. The Germans ringed him round, and, with their hands raised high in the fashion of a landsknecht who had struck a successful blow, passed out into the street and escorted him to his lodgings. Next day (April 19th) the emperor proposed to place Luther under the ban of the empire and read to the assembly a brief statement of his own views. The diet objected, and asked for a conference between Luther and some selected members. Conferences were held, but came to nothing. No compromise was possible between the declaration that man's conscience could only be bound by the Word of God and the emperor's belief in the infallibility of a general council. The commission had to report that its efforts had failed. Luther was ordered to leave Worms and to return to Wittenberg. His safe-conduct was to expire twenty-one days after the 16th of April. Then he was liable to be seized and put to death as a pestilent heretic. There only remained to draft and publish the edict containing the ban. Days passed and it did not appear. Suddenly the startling news reached Worms that Luther had disappeared, no one knew where. It was reported that his body had been found in a silver-mine pierced with a dagger. The news flew over Germany and beyond it that he had been slain by papal emissaries. At Worms the indignation of the populace was intense. The public buildings were placarded during the night with an intimation that four hundred knights had sworn not to leave Luther unavenged, and the ominous words *Bundschuh*, *Bundschuh*, *Bundschuh* (the watchword of peasant revolts) were written at the foot. The combination suggested an alliance between the lesser knights and the peasants, dreaded by all the ruling classes. The true story of Luther's disappearance was not known until long afterwards. After the failure of the conference the elector of Saxony had commissioned two of the councillors to convey Luther to a place of safety without telling him where it was. Many weeks elapsed before Frederick himself learned that Luther was safe in his own castle of the Wartburg. The disappearance did not mean that Luther had ceased to be a leader of men; but it marked the beginning of an organized national opposition to Rome.

It was not till the 25th of May that the edict against Luther was presented to a small number of members of the diet, after the elector of Saxony and many important members had left Worms. It threatened all Luther's sympathisers with extermination, and practically proclaimed an Albigensian war in Germany. But few public documents prepared with so much care have proved so futile. The latter half of 1521 saw the silent spread of Lutheran opinions all over Germany. This was not unaccompanied with dangers. Every movement for reform carries within it the seeds of revolution, and Luther's was no exception to the rule.

The revolution began in Wittenberg during Luther's seclusion in the Wartburg. Andrew Boden of Carlstadt, a colleague of Luther's in the university of Wittenberg, was strongly impressed with the contradiction which he believed to exist between evangelical teaching and the usages of medieval ecclesiastical life. He denounced monastic vows, a distinctive dress for the clergy, the thought of a propitiatory mass, and the presence of images and pictures in the churches. Zwilling, a young Augustinian Eremite, added his fiery denunciations. His preaching stirred the commonalty. Turbulent crowds invaded two of the churches and rioted inside. The excitement of the people was increased by the arrival of three men known in history as the *Zwickau prophets*. Melanchthon felt himself powerless to restrain the tumult. The magistrates of the town were won over and issued an ordinance which attempted to express in legislation the new evangelical ideas. Duke George of Saxony, a resolute opponent of the Reformation, threatened to make the diet interfere. Luther became alarmed, and, not without a private hint from the elector of Saxony,[1] left his retreat and appeared among his townsmen. His presence and exertions restored order, and the conservative reformation resumed its quiet course. From this time onwards to the outbreak of the Peasants' War (1525) Luther was the real leader of the German nation, and everything seemed to promise a gradual reformation without tumult.

The Peasants' War ended this anticipation. From one point of view this insurrection was simply the last, the most widespreading and the most disastrous of these revolts, which had been almost chronic in Germany during the later decades of the 15th and earlier years of the 16th century and which had been almost continuous between 1503 and 1517. All the social and economic causes which produced them were increasingly active in 1524 and 1525. But it is undoubted that the religious revolt intensified the rebellion of the lower classes. Luther's voice awoke echoes he never dreamt of. The times were ripe for revolution, and the message which spoke of a religious democracy could not fail to suggest the social democracy also. In his appeal to the *Nobility of the German Nation* he had stated with severe precision the causes of social discontent. Himself a peasant's son and acquainted with the grievances under which the peasant lived, he had at various times formulated most of the demands which afterwards figured conspicuously in the Twelve Articles. The insurgents had good cause to regard him as a sympathiser. But Luther, rightly or wrongly, believed that of the two ways in which wrongs can be set right—the way of war and the path of peace—the latter is the only sure road in the long run. He did his best therefore to prevent the rising and risked his life among the infuriated peasants as readily as when he stood before the emperor and the diet. When the rebellion was at its height and Thomas Münzer had sent forth fiery proclamations urging the peasantry "not to let the blood cool on their swords," Luther issued the pamphlet, which casts a stain on his whole life, in which he hounds on the ruling classes to suppress the insurgents with all violence. In the end the rebellion, formidable as it seemed for a few months, was crushed, and a heavier yoke was laid on the shoulders of the unfortunate peasants.

This year, 1525, saw the parting of the ways in the movement for reform. It ceased to be national and became ecclesiastical. It divided into three separate parts. One, guided by Luther himself, ended, after a long struggle with pope and emperor, in the establishment of evangelical churches under the rule of the secular authorities of the territories which adopted the Lutheran Reformation. Another, remaining true to the principles, doctrines, usages and hierarchy of the medieval church, dreamt only of a purification of moral life, and saw its end realised in the reforms of the council of Trent. The third, gathering together the more revolutionary impulses, expanded into that complex movement called Anabaptism—which spread over western Europe from England to Poland and from Scandinavia to northern Italy, and endured a long and sanguinary persecution at the hands of the civil authorities in most European countries. Its strength and popularity, especially among the artizan classes, have been very much underrated by most historians.

During the storm of the Peasants' War (13th of June 1525) Luther married Catherine von Bora, the daughter of a noble but impoverished family belonging to Meissen. She had been a Cistercian nun in the convent of Nimtzch near Grimma—a convent reserved for ladies of noble birth. Luther's writings, circulating through Saxony, had penetrated the convent walls and had convinced most of the inmates of the unlawfulness of monastic vows. Catherine and eight companions resolved to escape. Their relatives refused to aid them, and they applied to Luther. He entrusted the business to Leonhard Koppe of Torgau, and the rescue was safely carried out (4th of April 1523). The rescued nuns found places of refuge in the families of Wittenberg burghers. The elector John of Saxony (who had succeeded his brother Frederick) gave Luther the house which had served as the Augustinian Convent. The family gathered in this three-storeyed building, with its back windows looking over the Elbe and its front door opening on a great garden, was latterly Luther and his wife, their three sons and two daughters, Magdelena von Bora, Catherine's aunt, two orphan nieces and a grandniece. At the beginning of his married life Luther must have been in straitened circumstances. He married a portionless nun. On to 1532 his salary was two hundred gulden annually (about £160 in present money); after 1532 the stipend was increased to £240 with various payments in kind—corn, wood, malt, wine, &c.—which meant a great deal more. The town added occasional gifts to enable Luther to entertain the great personages who came to consult him frequently. Princes made him presents in money. This enabled Luther to purchase from his wife's brother the small estate of Zulsdorf. Catherine, too, was an excellent house-wife. She made the long-neglected garden profitable; kept pigs and poultry; rented other gardens; stocked a fishpond; farmed in a small way; and had her house full of boarders. Luther had a high opinion of her intelligence; she took rank among those consulted on all important occasions; in one letter to her, seldom quoted, he gives the fairest statement he ever made about the views of Zwingli on the Sacrament of the Supper.

The diet of Speyer (1526) saw Germany divided into a Protestant and a Romanist party. After much debate a compromise was arrived at, which foreshadowed the religious peace of Augsburg of 1555. It was resolved that the Word of God should be preached without disturbance, that indemnity should be given for past offences against the edict of Worms, and that meanwhile each state should live religiously as it hoped to answer for its conduct to God and the emperor. The Lutherans interpreted this to mean the right to frame ecclesiastical regulations for various principalities and to make changes in public worship. Luther busied himself in simplifying the service, in giving advice, anxiously sought for, about the best modes of organising ecclesiastical affairs. In the diet held at Speyer in 1529 a compact Roman Catholic majority faced a weak Lutheran minority. The emperor declared through his commissioners that he abolished "by his imperial and absolute authority" the clause in the ordinance of 1526 on which the Lutherans had relied when they began to organize their territorial churches. The majority of the diet supported the emperor in this, and further proceeded to decree that no ecclesiastical body was to be deprived of its revenues or authority. This meant that throughout all Germany medieval ecclesiastical rule was to be upheld, and that none of the revenues of the medieval church could be appropriated for Protestant uses. On this a portion of the Protestant minority drafted a legal protest, in which the signers declared that they meant to abide by the decision of the diet of 1526 and refused to be bound by that of 1529. From this protest came the name *Protestant*.

A minority in such a case could only maintain their protest if they were prepared to defend each other by force in case of an attack. Three days after the protest had been read, many of the protesting cities and states concluded "a secret and particular treaty," and Philip of Hesse, the ablest statesman among the Protesters, saw the need for a general union of all evangelical Christians in the empire. The difficulties in the way were great. The Saxons and the Swiss, Luther and Zwingli, were in fierce controversy about the true doctrine of the sacrament of the Supper. Luther was a patriotic German who was for ever bewailing the disintegration of the Fatherland; Zwingli was full of plans for confederations of Swiss cantons with South German cities, which could not fail to weaken the empire. Luther had but little trust in the "common man"; Zwingli was a thorough democrat. When Luther thought of the Swiss reformer he muttered as Archbishop Parker did of John Knox—"God keep us from such visitations as Knox hath attempted in Scotland; the people to be orderers of things." Above all Luther had good grounds for believing that at the conference at Memmingen friends of Zwingli had helped to organize a Peasants' War and to link the social revolution to the religious awakening. All these suspicions were in Luther's mind when he consented very half-heartedly to meet Zwingli at a conference to be held in Philip of Hesse's castle at Marburg. The debate proceeded as such debates usually do. Zwingli attacked the weakest part of Luther's theory—the *ubiquity* of the body of Christ; and Luther attacked Zwingli's exegesis of the words of the institution. Neither sought to bring out their points of agreement. Yet the conference did good; it showed that the Protestants were agreed on all doctrinal points but one. If union was for the present impossible, there were hopes for it in the future.

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[1] Enders, *Dr Martin Luther's Briefwechsel*, iii. 292-295; von Bezold, *Zeitschrift für Kirchengeschichte* xx. 186 sqq.; Barge, *Andreas Bodenstein von Karlstadt*, i. 432 sqq.

In 1530 the emperor Charles, resolved to crush the Reformation, himself presided at the diet. The Protestant divisions were manifest. Three separate confessions were presented to the emperor—one from Zwingli, one by the theologians of the four cities of Strassbourg, Constance, Lindau and Memmingen (*Confessio Tetrapolitana*), and the *Augsburg Confession*, the future symbol of the Lutheran church. The third was the most important, and the emperor seriously set himself to see whether it might not be made the basis of a compromise. He found that reconciliation was hopeless. Thereupon the diet resolved that the edict of Worms was to be enforced against Luther and his partizans; that the ecclesiastical jurisdictions were to be preserved; and that all the church property taken possession of by the Lutheran princes was to be restored; and that in all cases of dispute the last court of appeal was to be the Imperial Court of Appeals. The last provision meant that the growing Protestantism was to be fought by harrassing litigation—*nicht fechten sondern rechten* was the phrase.

Luther was not present at the diet nor at the negotiations. He was still an outlaw according to imperial ideas. Melanchthon took his place as leader.

The decision of the diet compelled the Protestant princes to face the new and alarming situation. They met in conference in mid-winter at the little town of Schmalkald, and laid the foundations of what became the powerful Schmalkald League, which effectually protected the Protestants of Germany until it was broken up by the intrigues of the imperial party. From the time of the formation of this league, Luther retired gradually from the forefront of a reformation movement which had become largely political, and busied himself with reforms in public worship and suggestions for an organization of the polity of the Evangelical church. In this work his natural conservatism is apparent, and he contented himself with such changes as would make room for the action of evangelical principles. He disclaimed the right of suggesting a common order of worship or a uniform ecclesiastical polity; and Lutheran ritual and polity, while presenting common features, did not follow one common use. It may be said generally that while Luther insisted on a service in the vernacular, including the singing of German hymns, he considered it best to retain most of the ceremonies, the vestments and the uses of lights on the altar, which had existed in the unreformed church, while he was careful to explain that their retention might be dispensed with if thought necessary. To the popular mind the great distinction between the Lutheran and the medieval church service, besides the use of the vernacular and the supreme place assigned to preaching, was that the people partook of the cup in the sacrament of the Lord's Supper; and the Lutheran service became popularly distinguished from the Reformed because it retained, while the Reformed did away with, most of the medieval ceremonies and vestments (see LUTHERANS). The variations in the details of the polity of the Lutheran churches were very numerous, but they all preserved the same distinctive principles. Two conceptions lay at the basis—the thought of the spiritual priesthood of all believers and the belief that the state was a divine ordinance, that the magistracy might represent the whole body of believers and that discipline and administration might be exercised through courts constituted somewhat like the consistorial courts of the medieval bishops, their members being appointed by the magistracy.

The last years of Luther's life were spent in incessant labour disturbed by almost continuous ill-health. He was occupied in trying to unite firmly together the whole evangelical movement; he laboured to give his countrymen a good system of schools; he was on the watch to defeat any attempt of the Roman Curia to regain its hold over Germany; and he was the confidential adviser of a large number of the evangelical princes. Luther's intimacy with his own elector, first John, then John Frederick, helped to give him the place accorded to him by the princes. The chiefs of the Houses of Anhalt and Lüneburg, Duke Henry of Saxony, Joachim II. of Brandenburg, Albert of Brandenburg and the counts of Mansfeld, were among Luther's most devoted supporters and most frequently sought his advice. Princely correspondence was not always pleasant. It took its most disagreeable form when Philip of Hesse besieged Luther with requests to give his sanction to taking a second wife while his first was still alive. Luther's weakness brought the second great blot on his career. The document sanctioning the bigamy of the landgrave was signed by Martin Bucer, Luther and Melanchthon, and is a humiliating paper. It may be thus summarized. According to the original commandment of God, marriage is between one man and one woman, and this original precept has been confirmed by our Lord; but sin brought it about that first Lamech, then the heathen, and then Abraham, took more than one wife, and this was permitted under the law. We are now living under the Gospel, which does not give prescribed rules for the external life and has not expressly prohibited bigamy. The law of the land expresses the original commandment of God, and the plain duty of the pastorate is to denounce bigamy. Nevertheless, the pastorate, in single cases of the direst need and to prevent worse, may sanction bigamy in a purely exceptional way. Such a bigamous marriage is a true marriage in the sight of God (the necessity being proved), but it is not a true marriage in the eye of public law and custom. Such a marriage and the dispensation for it ought to be kept secret; if it is made known, the dispensation becomes *eo ipso* invalid and the marriage is mere concubinage. The principle which underlies this extraordinary paper is probably the conception that the Protestant church has the same dispensing power which the medieval church claimed, but that it was to be exercised altogether apart from fees of any kind.

In his later years Luther became more tolerant on the sacramental question which divided him from the South German cities, although he never departed from his strong opposition to the supposed views of Zwingli himself. He consented to a conference, which, as he was too ill to leave home, met at Wittenberg (May–June 1536). After prolonged discussion the differences were narrowed to one point—the presence of the body of Christ *extended in space* in the sacrament of the Supper. It was agreed in the *Wittenberg Concord* to leave this an open question. Thus North and South Germany were united. It is possible that had Luther lived longer his followers might have been united with the Swiss. He repeatedly expressed an admiration for Calvin's writings on the subject of the sacrament; and Melanchthon believed that if the Swiss accepted Calvin's theory of the Supper, the Wittenberg Concord could be extended to include them. But the *Consensus Tigurinus*, which dates the adhesion of the Swiss to the views of Calvin, was not signed until 1549, when Luther was already dead.

Year by year Luther had been growing weaker, his attacks of illness more frequent and his bodily pains more continuous.

Despite the entreaties of wife and elector he resolved to do what he could to end some trifling dispute about inheritance which threatened the peace of the House of Mansfeld. He left Wittenberg in bitterly cold weather on the 23rd of January 1546, and the journey was tedious and hazardous. He was accepted as arbiter and his decision brought an end to the strife. He preached in Eisleben (February 14) with all his old fervour; but suddenly said quietly: "This and much more is to be said about the Gospel; but I am too weak and we will close here." These were his last words in the pulpit. On the 16th and 17th the deeds of reconciliation were signed and Luther's work was done. The end came swiftly. He was very ill on the evening of the 17th; he died on the early morning of the 18th of February 1546 in his sixty-third year.

The elector of Saxony and Luther's family resolved that he must be buried at Wittenberg, and on the 20th the funeral procession began its long march. The counts of Mansfeld, the magistrates of the city and all the burghers of Eisleben accompanied the coffin to the gates of their town. A company of fifty light-armed troops commanded by the young counts of Mansfeld headed the procession and went with it all the way to Wittenberg. The following was temporarily swelled as it passed through villages and towns. Delegates from the elector of Saxony met it as it crossed the boundaries of the principality. Luther was laid to rest in the Castle church on whose door he had nailed the *theses* which had kindled the great conflagration.

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(*b*) For special incidents: The *Theses* and their publication: W. Köhler, *Luthers 95 Theses sammt seinen Resolutionen, den Gegenschriften von Wimpina-Tetzel, Eck and Prierias, und den Antworten Luthers darauf* (Leipzig, 1903); Emil Reich, *Select Documents illustrating Medieval and Modern History* (London, 1905); The Leipzig Disputation: Seidemann, *Die Leipziger Disputation im Jahre 1519* (Dresden, 1843); Luther before the Diet of Worms: *Deutsche Reichstagsakten unter Kaiser Karl V.* (Gotha, 1893–1901), ii , The Marburg Colloquy; Schirrmacher, *Briefe und Acten zu der Geschichte des Religionsgespräches zu Marburg, 1529, und des Reichstages zu Augsburg 1530* (Gotha, 1876); Hospinian, *Historia Sacramentaria*, ii. 123*b*-126*b*; Ehrard, *Das Dogma vom heiligen Abendmahl und seine Geschichte*, ii. (Frankfurt a M., 1846); The Augsburg Confession. Schaff, *The Creeds of the Evangelical Protestant Churches* (London, 1877), *History of the Creeds of Christendom* (London, 1877).

(T. M. L.)

LUTHERANS, the general title given to those Christians who have adopted the principles of Martin Luther in his opposition to the Roman Church, to the followers of Calvin, and to the sectaries of the times of the Reformation. Their distinctive name is the *Evangelical*, as opposed to the *Reformed* church. Their dogmatic symbols are usually said to include nine separate creeds which together form the *Book of Concord* (*Liber Concordiae*). Three belong to the Early Christian church—the *Apostles' Creed*, the *Nicene Creed* (in its Western form, *i.e.* with the *filioque*), and the so-called *Athanasian Creed*; six come from the 16th century—the *Augsburg Confession*, the *Apology for the Augsburg Confession*, the *Schmalkald Articles*, Luther's two *Catechisms*, and the *Form of Concord*. But only the three early creeds and the Augsburg Confession are recognized by all Lutherans. Luther's Catechisms, especially the shorter of the two, have been almost universally accepted, but the Form of Concord was and is expressly rejected by many Lutheran churches. The Augsburg Confession and Luther's Short Catechism may therefore be said to contain the distinctive principles which all Lutherans are bound to maintain, but, as the principal controversies of the Lutheran church all arose after the publication of the Augsburg Confession and among those who had accepted it, it does not contain all that is distinctively Lutheran. Its universal acceptance is perhaps due to the fact that it exists in two forms (the *variata* and the *invariata*) which vary slightly in the way in which they state the doctrine of the sacrament of the Supper. The *variata* edition was signed by Calvin, in the meaning, he said, of its author Melanchthon.

After Luther's death the more rigid Lutherans declared it to be their duty to preserve the *status religionis in Germania per Lutherum instauratus*, and to watch over the *depositum Jesu Christi* which he had committed to their charge. As Luther was a much greater preacher than a systematic thinker, it was not easy to say exactly what this deposit was, and controversies resulted among the Lutheran theologians of the 16th century. The Antinomian controversy was the earliest (1537–1560). It arose from differences about the precise meaning of the word "law" in Luther's distinction between law and gospel. Luther limited the meaning of the word to mean a definite command accompanied by threats, which counts on terror to produce obedience. He declared that Christ was not under the dominion of the law in this sense of the word, and that believers enter the Christian life only when they transcend a rule of life which counts on selfish motives for obedience. But law may mean ethical rule, and the Antinomians so understood it, and interpreted Luther's declaration to mean that believers are not under the dominion of the moral law. The controversy disturbed the Lutheran church for more than twenty years.

The Arminian controversy in the Reformed church, the Jansenist controversy in the Roman Catholic church, had their parallel in three separate disputes among the Lutherans lasting from 1550 to 1580. (1) George Major, discussing the relation of good works to conversion, declared that such works were both useful and necessary to holiness. He was attacked by Flacius and Amsdorf, and after a long controversy, full of ambiguities and lacking in the exhibition of guiding principles, he was condemned because his statement savoured of Pelagianism. (2) The same problem took a new form in the Synergist controversy, which discussed the first impulse in conversion. One party taught that while the first impulse must come from the Holy Spirit the work might be compared to reviving a man *apparently* dead. It was answered that the sinner was *really* dead, and that the work of the Spirit was to give an actually new life. The latter assertion was generally approved of. (3) Then a fresh controversy was started by the assertion that sin was part of the substance of man in his fallen condition. It was answered that sin had not totally destroyed man's ethical nature, and that grace changed what was morally insensitive into what was morally sensitive, so that there could be a co-operation between God's grace and man's will.

The controversy raised by Andrew Osiander was more important. He felt that Luther had omitted to make adequate answer to an important practical question, how Christ's death on the cross could be brought into such actual connexion with every individual believer as to be the ground of his actual justification. The medieval church had spanned the centuries by supposing that Christ's death was continuous down through the age in the sacrifice of the Mass; Protestant theology had nothing equivalent. He proposed to supply the lack by the theory that justification is a real work done in the individual by the same Christ who died so many centuries ago. Redemption, he said, was the result of the historical work of Christ; but justification was the work of the living risen Christ, dwelling within the believer and daily influencing him. Osiander's theory did not win much support, but it was the starting-point of two separate doctrines. In the Lutheran church, Striegel taught that the principal effect of Christ's work on the cross was to change the attitude of God towards the whole human race, and that, in consequence, when men come into being and have faith, they can take advantage of the change of attitude effected by the past historical work of Christ. The Reformed church, on the other hand, constructed their special doctrine of the limited reference in the atonement.

The other controversies concerned mainly the doctrine of the sacrament of the Supper, and Luther's theory of Consubstantiation. This required a doctrine of *Ubiquity*, or the omnipresence of the body of Christ extended in space, and therefore of its presence in the communion elements. Calvin had taught that the true way to regard substance was to think of its power (*vis*), and that the presence of a substance was the immediate application of its power. The presence of the body of Christ in the sacramental elements did not need a presence extended in space. Melanchthon and many Lutherans accepted the theory of Calvin, and alleged that Luther before his death had approved of it. Whereupon the more rigid Lutherans accused their brethren of Crypto-Calvinism, and began controversies which dealt with that charge and with a defence of the idea of ubiquity.

The university of Jena, led by Matthias Flacius, was the headquarters of the stricter Lutherans, while Wittenberg and Leipzig were the centres of the Philippists or followers of Melanchthon. Conferences only increased the differences. The Lutheran church seemed in danger of falling to pieces. This alarmed both parties. New conferences were held and various articles of agreement were proposed, the most notable being the *Torgau Book* (1576). In the end, the greater proportion adopted the *Book of Concord* (1577), drafted chiefly by Jacob Andreae of Tübingen, Martin Chemnitz of Brunswick and Nicolas Selnecker of Leipzig. Its recognition was mainly due to the efforts of Augustus, elector of Saxony. This *Book of Concord* was accepted by the Lutheran churches of Sweden and of Hungary in 1593 and 1597; but it was rejected by the Lutheran churches of Denmark, of Hesse, of Anhalt, of Pomerania and of several of the imperial cities. It was at first adopted and then rejected by Brunswick, the Palatinate and Brandenburg. The churches within Germany which refused the *Book of Concord* became for the most part Calvinistic or Reformed. They published, as was the fashion among the Reformed churches, separate creeds for themselves, but almost all accepted the *Heidelberg Catechism*. These differences in the German Protestant churches of the second half of the 16th century are reflected in the great American Lutheran church. The church exists in three separate organizations. The General Synod of the Evangelical Church of the United States, organized in 1820, has no other creed than the *Augsburg Confession*, so liberally interpreted as not to exclude Calvinists. The Synodical Conference of North America, organized in 1872, compels its pastors to subscribe to the whole of the nine creeds contained in the Book of Concord. The General Council, a secession from the General Synod, was organized in 1867, and accepts the "unaltered" (*invariata*) *Augsburg Confession* in its original sense, and the other Lutheran symbols as explanatory of the Augsburg Confession.

The divided state of German Protestantism, resulting from these theological differences, contributed in no small degree to the disasters of the Thirty Years' War, and various attempts were made to unite the two confessions. Conferences were held at Leipzig (1631), Thorn (1645), Cassel (1661); but without success. At length the union of the two churches was effected by the force of the civil authorities in Prussia (1817), in Nassau (1817), in Hesse (1823), in Anhalt-Dessau (1827) and elsewhere. These unions for the most part aimed, not at incorporating the two churches in doctrine and in worship, but at bringing churches or congregations professing different confessions under one government and discipline. They permitted each congregation to use at pleasure the *Augsburg Confession* or the *Heidelberg Catechism*. The enforced union in Prussia was combined with the publication of a new liturgy intended for common use. This led to secessions from the state church. These seceders were at first treated with great harshness, but have won their way to toleration, and form the Lutheran Free churches of Germany.

The most important of these latter is the Evangelical Lutheran church of Prussia, sometimes called the Old Lutherans. It came into being in 1817 and gradually gained the position of a tolerated nonconformist church (1845 being the date of its complete recognition by the state). At the 1905 census it numbered 51,600 members under 75 pastors. Its affairs are managed by an *Oberkirchencollegium*, with four ordained and two lay members. The Evangelical Lutheran Immanuel Synod came into being in 1864, and has a membership of 5300 with 13 ordained pastors. Its headquarters is Liegnitz. The Independent Evangelical Lutheran church in the lands of Hesse arose partly on account of the slumbering opposition to the union of 1823 and more particularly in consequence of an attempt made at a stricter union in 1874. It has a membership of about 1800. The *renitente* church of Lower Hesse has a membership of 2400. The Evangelical Lutheran Free Church of Hanover has a membership of 3050 under 10 ordained pastors. The Hermannsburg Free Church has a membership of about 2000 under 2 pastors. The Evangelical Lutheran Community in Baden has a membership of about 1100 with 2 ordained pastors. The Evangelical Lutheran Free Church of Saxony has a membership of about 3780 with 15 ordained pastors. These free churches exist separate from the State Evangelical United Church (*Evangelische unirte Landskirche*).

The general system of ecclesiastical government which prevails among all Lutheran churches is called the *consistorial*. It admits of great variety of detail under certain common features of organization. It arose partly from the makeshift policy of the times of the Reformation, and partly from Luther's strong belief that the *jus episcopale* belonged in the last resort to the civil authorities. It may be most generally described by saying that the idea was taken from the consistorial courts through which the medieval bishops managed the affairs of their dioceses. Instead of the appointments to the membership of the consistories being made by the bishops, they were made by the supreme civil authority, whatever that might be. Richter, in his *Evangelische Kirchenordnungen des 16ten Jahrhunderts* (2 vols., 1846), has collected more than one hundred and eight separate ecclesiastical constitutions, and his collection is confessedly imperfect. The publication of a complete collection by Emil Sehling was begun in 1902.

The liturgies of the Lutheran churches exhibit the same diversities in details as appear in their constitutions. It may be said in general that while Luther insisted that public worship ought to be conducted in a language understood by the people, and that all ideas and actions which were superstitious and obscured the primary truth of the priesthood of all believers should be expurged, he wished to retain as much as possible of the public service of the medieval church. The external features of the medieval churches were retained; but the minor altars, the *tabernacula* to contain the Host, and the light permanently burning before the altar, were done away with. The ecclesiastical year with its fasts and festivals was retained in large measure. In 1526 Luther published the *German Mass and order of Divine Service*, which, without being slavishly copied, served as a model for Lutheran communities. It retained the altar, vestments and lights, but explained that they were not essential and might be dispensed with. The peril attending the misuse of pictures in churches was recognized, but it was believed to be more than counterbalanced by the instruction given through them when their presence was not abused. In short Luther contented himself with setting forth general principles of divine service, leaving them to be applied as his followers thought best. The consequence was that there is no uniform Lutheran liturgy. In his celebrated *Codex Liturgicus Ecclesiae Lutheranae in epitomen redactus* (Leipzig, 1848), Daniel has used 98 different liturgies and given specimens to show the differences which they exhibit.

The divergences in ritual and organization, the principle underlying all the various ecclesiastical unions, viz. to combine two different confessions under one common government, and, resulting from it, the possibility of changing from one confession to another; have all combined to free the state churches from any rigid interpretation of their theological formulas. A liberal and a conservative theology (rationalist and orthodox) exist side by side within the churches, and while the latter clings to the theology of the 16th century, the former ventures to raise doubts about the truth of such a common and simple standard as the Apostles' Creed. The extreme divergence in doctrinal position is fostered by the fact that the theology taught in the universities is in a great measure divorced from the practical religious life of the people, and the theological opinions uttered in the theological literature of the country cannot be held to express the thoughts of the members of the churches. In each state the sovereign is still held to be the *summus episcopus*. He appoints a minister of public worship, and through him nominates the members of the governing body, the *Oberkirchenrath* or *Consistorium* or *Directorium*. This council deals with the property, patronage and all other ecclesiastical matters. But each parish elects its own council for parochial affairs, which has a legal status and deals with such matters as the ecclesiastical assessments. Delegates from these parish councils form the *Landessynode*. In cases that call for consultation together, the *Consistorium* and the Synod appoint committees to confer. In Alsace-Lorraine about half of those entitled to vote appear at the polls; but in other districts of Germany very little interest is shown in the elections to the parish councils.

The income of the state churches is derived from four sources. The state makes an annual provision for the stipends of the clergy, for the maintenance of fabrics and for other ecclesiastical needs. The endowments for church purposes, of which there are many, and which are destined to the support of foreign missions, clerical pensions, supply of books to the clergy, &c. are administered by the supreme council. The voluntary contributions of the people are all absorbed in the common income of the national churches and are administered by the supreme council. Each parish is legally entitled to levy ecclesiastical assessments for defined purposes.

Appointments to benefices are in the hands of the state (sometimes with consent of parishes), of private patrons and of local parish councils. The number of these benefices is always increasing; and in 1897 they amounted to 16,400, or 300 more than in 1890. The state appoints to 56%, private and municipal patrons to 34%, and congregations to 10% of the whole. Customs vary in different states; thus in Schleswig-Holstein the state nominates but the parish elects; in Alsace-Lorraine the directorium or supreme consistory appoints, but the appointment must be confirmed by the viceroy; in Baden the state offers the parish a selection from six names and then appoints the one chosen.

The Lutheran state churches of Denmark, Sweden and Norway have retained the episcopate. In all of them the king is recognized to be the *summus episcopus* or supreme authority in all ecclesiastical matters, but in Norway and Sweden his power is somewhat limited by that of parliament. The king exercises his ecclesiastical authority through a minister who superintends religion and education. The position and functions of the bishops vary in the different countries. In all the rite of ordination is in their hands. In Denmark they are the inspectors of the clergy and of the schools. In Sweden they preside over local consistories composed of clerical and lay members. The episcopate in all three countries accommodates itself to something like the Lutheran consistorial system of ecclesiastical government.

The two leading religions within Germany are the Evangelical (Lutheran) and the Roman Catholic, including respectively 58 and 39% of the population. The proportions are continually varying, owing to the new migratory habits of almost every class of the population. Generally speaking, the Roman Catholics are on the increase in Prussia, Bavaria, Saxony and Württemburg; and the Evangelicals in the other districts of Germany, especially in the large cities. There is a growing tendency to mixed marriages, which are an important factor in religious changes.

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LUTHER LEAGUE, a religious association for young people in the United States of America. It began with a local society founded by delegates of six Lutheran church societies in New York City in 1888. The first national convention was held at Pittsburg, Pennsylvania, on the 30th and 31st of October 1895. The basis of the league is the Augsburg Confession. Its membership is open to "any society of whatever name connected with a Lutheran congregation or a Lutheran institution of learning." According to the constitution its objects are "to encourage the formation of the young people's societies in all Lutheran congregations in America, to urge their affiliation with their respective state or territorial leagues, and with this league to stimulate the various young people's societies to greater Christian activity and to foster the spirit of loyalty to the church." The league publishes a monthly paper, *The Luther League Review*, in Washington. According to its official report it had 70,000 members in 1906, which had increased to more than 100,000 in 1910.

LUTON, a market town and municipal borough in the southern or Luton parliamentary division of Bedfordshire, England, 30 m. N.W. by N. of London by the Midland railway, served also by a branch of the Great Northern. Pop. (1901) 36,404. It lies in a narrow valley on the south flank of the Chiltern Hills, on the upper part of the river Lea. The church of St Mary is mainly Decorated, but has portions of Early English and Perpendicular work. It has brasses and monuments of interest and a late Decorated baptistery of stone, an ornate roofed structure, octagonal in form. The font within it is Early English. Luton is the principal seat in England of the straw-plait manufacture, and large quantities of hats and other straw goods have been exported, though in recent years the industry has suffered from increased foreign competition. The industry originated with the colony of straw-plaiters transplanted by James I. from Scotland, whither they had been brought from Lorraine by Queen Mary. The town has also foundries, motor car works and other manufactures. The borough is under a mayor, 6 aldermen and 18 councillors. Area, 3133 acres.

LUTSK (Polish, *Luck*), a town of southern Russia, in the government of Volhynia, on the Styr, 51 m. by rail N.W. of Kovel. Pop. (1900) 17,701. It is supposed to have been founded in the 7th century; in the 11th century it was known as Luchesk, and was the chief town of an independent principality. In the 15th century it was the seat of a bishop and became wealthy, but during the wars between Russia and Poland in the second half of the 16th century, and especially after the extermination of its 40,000 inhabitants, it lost its importance. In 1791 it was taken by Russia. Its inhabitants, many of them Jews, live mainly by shipping goods on the Styr. Among its buildings is a 16th-century castle. Lutsk is the seat of a Roman Catholic bishop.

LUTTERWORTH, a market town in the Harborough parliamentary division of Leicestershire, England, 90 m. N.N.W. from London by the Great Central railway. Pop. (1901) 1734. It lies in a pleasant undulating country on the small river Swift, an affluent of the Avon. The church of St Mary is a fine building, mainly Decorated and Perpendicular, wherein are preserved relics of John Wycliffe, who was rector here from 1374 until his death in 1384. The exhumation and burning of his body in 1428, when the ashes were cast into the Swift, gave rise to the saying that their distribution by the river to the ocean resembled that of Wycliffe's doctrines over the world. Wycliffe is further commemorated by a modern obelisk in the town. Trade is principally agricultural.

LUTTRELL, HENRY (*c.* 1765–1851), English wit and writer of society verse, was the illegitimate son of Henry Lawes Luttrell, 2nd earl of Carhampton (1743–1821), a grandson of Colonel Henry Luttrell (*c.* 1655–1717), who served James II. in Ireland in 1689 and 1690, and afterwards deserted him, being murdered in Dublin in November 1717. Colonel Luttrell's son Simon (1713–1787) was created earl of Carhampton in 1785, and the latter's son was Henry Lawes Luttrell. Before succeeding to the peerage, the 2nd earl, then Colonel Luttrell, had won notoriety by opposing John Wilkes at the Middlesex election of 1769. He was beaten at the poll, but the House of Commons declared that he and not Wilkes had been elected. In 1796 he was made commander of the forces in Ireland and in 1798 he became a general. Being an Irish peer, Carhampton was able to sit in the English parliament until his death in April 1821. The earldom became extinct on the death of his brother John, the 3rd earl, in 1829.

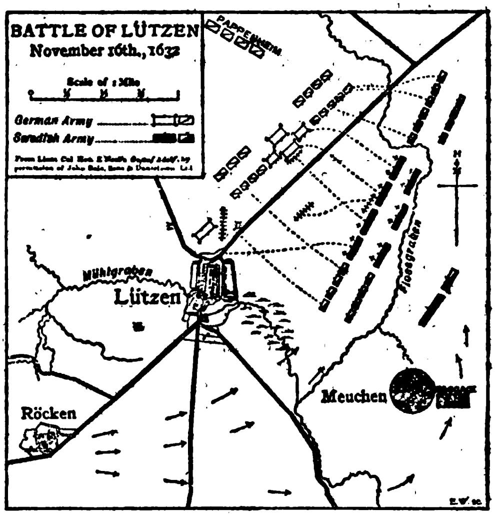
Henry Luttrell secured a seat in the Irish parliament in 1798 and a post in the Irish government, which he commuted for a pension. Introduced into London society by the duchess of Devonshire, his wit made him popular. Soon he began to write verse, in which the foibles of fashionable people were outlined. In 1820 he published his *Advice to Julia*, of which a second edition, altered and amplified, appeared in 1823 as *Letters to Julia in Rhyme*. This poem, suggested by the ode to Lydia in the first book of Horace's *Odes*, was his most important work. His more serious literary contemporaries nicknamed it "Letters of a Dandy to a Dolly." In 1827 in *Crockford House* he wrote a satire on the high play then in vogue. Byron characterized him as "the best sayer of good things, and the most epigrammatic conversationist I ever met"; Sir Walter Scott wrote of him as "the great London wit;" and Lady Blessington described him as the one talker "who always makes me think." Luttrell died in London on the 19th of December 1851.

LÜTTRINGHAUSEN, a town of Germany, in the Prussian Rhine province, 6 m. S.E. of Elberfeld by rail. Pop. (1905) 11,829. It is the seat of various iron and other metal industries, and has cloth and calico mills.

LÜTZEN, a town in Prussian Saxony, in the circle of Merseburg (pop. in 1905, 3981), chiefly famous as the scene of a great battle fought on the 6/16th of November 1632 between the Swedes, under King Gustavus Adolphus, and the Imperialists, under Wallenstein. On the 5/15th November, Gustavus, with some 20,000 men, advanced from Naumburg on the Saale to meet a contingent of his German allies at Grimma, S.E. of Leipzig, but becoming aware of the presence of Wallenstein's army near Lützen, and that it had been weakened by a large detachment sent away under Pappenheim towards Halle, he turned towards Lützen. Wallenstein's posts at Weissenfels and Rippach prevented him from fighting his main battle the same evening, and the Swedes went into camp near Rippach, a little more than an hour's march from Lützen.

Wallenstein made ready to give battle on the following day and recalled Pappenheim. The latter had taken a small castle, the reduction of which was one of the objects of his expedition, but his men had dispersed to plunder and could not be rallied before the following morning. Gustavus had now to choose between proceeding to Grimma and fighting Wallenstein on the chance that Pappenheim had not rejoined. He chose the latter. In the mist of the early morning Wallenstein's army was formed in line of battle along the Leipzig road with its right on Lützen. Its left was not carried out as far as the Flossgraben in order to leave room on that flank for Pappenheim. His infantry was arranged in five huge oblongs, four of which (in lozenge formation) formed the centre and one the right wing at Lützen. These "battalias" had their angles strengthened in the old-fashioned way that had prevailed since Marignan, with small outstanding bodies of musketeers, so that they resembled rectangular forts with bastions. On either side of this centre was the cavalry in two long lines, while in front of the centre and close to the right at Lützen were the two batteries of heavy artillery. Lützen was set on fire as a precaution. Skirmishers lined the bank and the ditch of the Leipzig road. The total strength of the Imperial army was about 12,000 foot and 8000 horse.

Gustavus's hopes of an early decision were frustrated by the fog, which delayed the approach and deployment of the Swedes. It was 8 A.M. before all was ready. The royal army was in two lines. The infantry in the centre was arrayed in the small and handy battalions then peculiar to Gustavus's army, the horse on either wing extended from opposite Lützen to some distance beyond Wallenstein's left, which Pappenheim was to extend on his arrival. By the accident of the terrain, or perhaps, following the experience of Breitenfeld (*q.v.*), by design, the right of the Swedes was somewhat nearer to the enemy than the left. In front, near the centre, were the heavy guns and each infantry battalion had its own light artillery. The force of infantry and cavalry on either side was about equal, the Swedes had perhaps rather less cavalry and rather more infantry, but their artillery was superior to Wallenstein's. Not until 11 was it possible to open fire, for want of a visible target, but about noon, after a preliminary cannonade, Gustavus gave the word to advance.



The king himself commanded the right wing, which had to wait until small bodies of infantry detached for the purpose had driven in the Imperialist skirmish line, and had then to cross a ditch leading the horses. They were not charged by the Imperialists at this moment, for Pappenheim had not yet arrived, and the usual cavalry tactics of the day were founded on the pistol and not on the sword and the charging horse. Gaining at last room to form, the Swedes charged and routed the first line of the Imperial cavalry but were stopped by the heavy squadrons of cuirassiers in second line, and at that moment Gustavus galloped away to the centre where events had taken a serious turn. The Swedish centre (infantry) had forced their way across the Leipzig road and engaged Wallenstein's living forts at close quarters. The "Blue" brigade—Gustavus's infantry wore distinctive colours—overran the battery of heavy guns, and the "Swedish"[1] and "Yellow" brigades engaged the left face of the Imperialist lozenge with success. But a gap opened between the right of the infantry and the left of the cavalry and Wallenstein's second line squadrons pressed into it. It was this which brought Gustavus from the extreme right, and he was killed here in leading a counter charge.

On the extreme left, meanwhile, the "Green" brigade had come to close quarters with Wallenstein's infantry and guns about Lützen, and the heavy artillery had gone forward to close range between the "Green" and the "Yellow" infantry. But the news of Gustavus's death spread and the fire of the assault died out. Wallenstein advanced in his turn, recaptured his guns and drove the Swedes over the road.

But the fiery Duke Bernhard of Saxe-Weimar took up the command and ordered a fresh advance. He was too good a soldier to waste his reserves and only brought up a few units of the second line to help the disordered brigades of the first. Again the Imperialists were driven in and their guns recaptured, this time all along the line. About three in the afternoon the Swedes were slowly bearing back Wallenstein's stubborn infantry when Pappenheim appeared. The famous cavalry leader had brought on his mounted men ahead of the infantry and asking, "Where is the king of Sweden?" charged at once in the direction of the enemy's right. Wallenstein thus gained time to re-establish his order, and once more the now exhausted brigades of the Swedish first line were driven over the road. But Pappenheim fell in the moment of victory and his death disheartened the Imperialists almost as much as the fall of Gustavus had disheartened the Swedes. For the last time Bernhard, wounded as he was, forced the Swedish army to the attack. The three infantry brigades of his second line had not been engaged,[2] and as usual the last closed reserve, resolutely handled, carried the day. Wallenstein's army gave way at all points and the Swedes slept on the battlefield. The infantry of Pappenheim's corps did not appear on the field until the battle was over. Of the losses on either side no accurate statement can be given, but the Swedish "Green" and "Yellow" brigades are said to have lost five-sixths of their numbers. Near the spot where Gustavus fell a granite boulder was placed in position on the day after the battle. A canopy of cast-iron was erected over this "Schwedenstein" in 1832, and close by, a chapel, built by Oskar Ekman, a citizen of Gothenburg (d. 1907), was dedicated on the 6th of November 1907.

Lützen is famous also as the scene of a victory of Napoleon over the Russians and Prussians on the 2nd of May 1813 (see NAPOLEONIC CAMPAIGNS). This battle is often called Gross Görschen.

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LÜTZOW, ADOLF, FREIHERR VON (1782–1834), Prussian lieutenant-general, entered the army in 1795, and eleven years later as a lieutenant took part in the disastrous battle of Auerstädt. He achieved distinction in the siege of Colberg, as the leader of a squadron of Schill's volunteers. In 1808, as a major, he retired from the Prussian army, indignant at the humiliating treaty of Tilsit. He took part in the heroic venture of his old chief Schill in 1809; wounded at Dodendorf and left behind, he thereby escaped the fate of his comrades. In 1811 he was restored to the Prussian army as major, and at the outbreak of the "war of liberation" received permission from Scharnhorst to organize a "free corps" consisting of infantry, cavalry and Tirolese marksmen, for operating in the French rear and rallying the smaller governments into the ranks of the allies. This corps played a marked part in the campaign of 1813. But Lützow was unable to coerce the minor states, and the wanderings of the corps had little military influence. At Kitzen (near Leipzig) the whole corps, warned too late of the armistice of Poischwitz, was caught on the French side of the line of demarcation and, as a fighting force, annihilated. Lützow himself, wounded, cut his way out with the survivors, and immediately began reorganizing and recruiting. In the second part of the campaign the corps served in more regular warfare under Wallmoden. Lützow and his men distinguished themselves at Gadebusch (where Körner fell) and Göhrde (where Lützow himself, for the second time, received a severe wound at the head of the cavalry). Sent next against Denmark, and later employed at the siege of Jülich, Lützow in 1814 fell into the hands of the French. After the peace of 1814 the corps was dissolved, the infantry becoming the 25th Regiment, the cavalry the 6th Ulans. At Ligny he led the 6th Ulans to the charge, but they were broken by the French cavalry, and he finally remained in the hands of the enemy, escaping, however, on the day of Waterloo. Made colonel in this year, his subsequent promotions were: major-general 1822, and lieutenant-general (on retirement) 1830. He died in 1834. One of the last acts of his life for which Lützow is remembered is his challenge (which was ignored) to Blücher, who had been ridden down in the rout of the 6th Ulans at Ligny, and had made, in his official report, comments thereon, which their colonel considered disparaging.

See Koberstein in *Preussisches Jahrbuch*, vol. xxiii (Berlin, 1868), and *Preussisches Bilderbuch* (Leipzig, 1889); K. von Lützow, *Adolf Lützows Freikorps* (Berlin, 1884); Fr. von Jagwitz, *Geschichte des Lützow'schen Freikorps* (Berlin, 1892); and the histories of the campaigns of 1813 and 1815.

LUXEMBURG, FRANÇOIS HENRI DE MONTMORENCY-BOUTEVILLE, DUKE OF (1628–1695), marshal of France, the comrade and successor of the great Condé, was born at Paris on the 8th of January 1628. His father, the comte de Montmorency-Bouteville, had been executed six months before his birth for killing the marquis de Beuvron in a duel, but his aunt, Charlotte de Montmorency, princess of Condé, took charge of him and educated him with her son, the duc d'Enghien. The young Montmorency (or Bouteville as he was then called) attached himself to his cousin, and shared his successes and reverses throughout the troubles of the Fronde. He returned to France in 1659 and was pardoned, and Condé, then much attached to the duchesse de Châtillon, Montmorency's sister, contrived the marriage of his adherent and cousin to the greatest heiress in France, Madeleine de Luxemburg-Piney, princesse de Tingry and heiress of the Luxemburg dukedom (1661), after which he was created duc de Luxembourg and peer of France. At the opening of the War of Devolution (1667–68), Condé, and consequently Luxemburg, had no command, but during the second campaign he served as Condé's lieutenant-general in the conquest of Franche Comté. During the four years of peace which followed Luxemburg cultivated the favour of Louvois, and in 1672 held a high command against the Dutch. He defeated the prince of Orange at Woerden and ravaged Holland, and in 1673 made his famous retreat from Utrecht to Maestricht with only 20,000 men in face of 70,000, an exploit which placed him in the first rank of generals. In 1674 he was made captain of the gardes du corps; and in 1675 marshal of France. In 1676 he was placed at the head of the army of the Rhine, but failed to keep the duke of Lorraine out of Philipsburg; in 1677 he stormed Valenciennes; and in 1678 he defeated the prince of Orange, who attacked him at St Denis after the signature of the peace of Nijmwegen. His reputation was now high, and it is reputed that he quarrelled with Louvois, who managed to involve him in the "affair of the poisons" (see LA VOISIN, CATHERINE) and get him sent to the Bastille. Rousset in his *Histoire de Louvois* has shown that this quarrel is probably apocryphal. There is no doubt that Luxemburg spent some months of 1680 in the Bastille, but on his release took up his post at court as *capitaine des gardes*. When the war of 1690 broke out, the king and Louvois recognized that Luxemburg was the only general fit to cope with the prince of Orange, and he was put in command of the army of Flanders. On the 1st of July 1690 he won a great victory over the prince of Waldeck at Fleurus. In the following year he commanded the army which covered the king's siege of Mons and defeated William III.

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[1] So called as being the only brigade containing no foreign elements in the army.

[2] They had, however, found detachments to reinforce the first line.

of England at Leuze on September 18, 1691. Again in the next campaign he covered the king's siege of Namur, and defeated William at Steenkirk (*q.v.*) on June 5, 1692; and on July 29, 1693, he won his greatest victory over his old adversary at Neerwinden, after which he was called *le tapissier de Nôtre Dame* from the number of captured colours that he sent to the cathedral. He was received with enthusiasm at Paris by all but the king, who looked coldly on a relative and adherent of the Condés. St Simon describes in the first volume of his *Memoirs* how, instead of ranking as eighteenth peer of France according to his patent of 1661, he claimed through his wife to be duc de Piney of an old creation of 1571, which would place him second on the roll. The affair is described with St Simon's usual interest in the peerage, and was chiefly checked through his assiduity. In the campaign of 1694, Luxemburg did little in Flanders, except that he conducted a famous march from Vignamont to Tournay in face of the enemy. On his return to Versailles for the winter he fell ill, and died on January 4, 1695. In his last moments he was attended by the famous Jesuit priest Bourdaloue, who said on his death, "I have not lived his life, but I would wish to die his death." Luxemburg's morals were bad even in those times, and he had shown little sign of religious conviction. But as a general he was Condé's grandest pupil. Though slothful like Condé in the management of a campaign, at the moment of battle he seemed seized with happy inspirations, against which no ardour of William's and no steadiness of Dutch or English soldiers could stand. His death and Catinat's disgrace close the second period of the military history of the reign of Louis XIV., and Catinat and Luxemburg, though inferior to Condé and Turenne, were far superior to Tallard and Villeroi. He was distinguished for a pungent wit. One of his retorts referred to his deformity. "I never can beat that cursed humpback," William was reputed to have said of him. "How does he know I have a hump?" retorted Luxemburg, "he has never seen my back." He left four sons, the youngest of whom was a marshal of France as Maréchal de Montmorency.

See, besides the various memoirs and histories of the time, Beaurain's *Histoire militaire du duc de Luxembourg* (Hague and Paris, 1756); *Mémoires pour servir a l'histoire du maréchal duc de Luxembourg* (Hague and Paris, 1758); Courcelles, *Dictionnaire des généraux français* (Paris, 1823), vol. viii. There are some interesting facts in Desormeaux's *Histoire de la maison de Montmorency* (1764), vols. iv. and v. Camille Rousset's *Louvois* and the recent biography of Luxemburg by Count de Ségur (1907) should also be studied.

LUXEMBURG, a district in the European low countries, of which the eastern part forms the grand-duchy of Luxemburg, and the western is the Belgian province of that name (for map, see BELGIUM). The name is derived from the chief town.

Under the Romans the district was included in the province of *Belgica prima*, afterwards forming part of the Frankish kingdom of Austrasia and of the empire of Charlemagne. About 1060 it came under the rule of Conrad (d. 1086), who took the title of count of Luxemburg. His descendants ruled the county, first in the male and then in the female line, until the death of the emperor Sigismund in 1437. Through the marriage of Sigismund's daughter, Elizabeth, with the German king, Albert II., Luxemburg, which had been made a duchy in 1354, passed to the house of Habsburg, but was seized in 1443 by Philip III. the Good, duke of Burgundy, who based his claim upon a bargain concluded with Sigismund's niece Elizabeth (d. 1451). Regained by the Habsburgs in 1477 when Mary, daughter and heiress of duke Charles the Bold, married the German king Maximilian I., the duchy passed to Philip II. of Spain in 1555, though subject to the laws of the empire, of which it still formed part. After a section had been ceded to France in 1659, the remainder was given to the emperor Charles VI. by the treaty of Utrecht in 1713. It was conquered by France in 1795, and retained by that power until the end of the Napoleonic wars. The congress of Vienna (1814–1815) erected Luxemburg into a grand-duchy, added part of the duchy of Bouillon to it, and assigned it to William I., king of the Netherlands, in return for the German territories of the house of Orange-Nassau, which Napoleon had confiscated in 1806, and which were given by the congress to the king of Prussia. In 1830 when the Belgian provinces separated from Holland, an effort was made to include Luxemburg in the new kingdom of the Belgians; but in November 1831 the powers decided that part of the grand-duchy should be retained by the king of Holland, who refused to accept this arrangement. Consequently the whole of Luxemburg remained in the possession of the Belgians until 1838, when the treaty of the 19th of April, concluded at the conference of London, enforced the partition of 1831.

The grand-duchy of Luxemburg, the portion under the rule of William I. retaining the name, was ruled by the kings of Holland until the death of William III. in 1890. William's daughter, Wilhelmina, succeeded to the throne of Holland, but under the Salic law[1] the grand-duchy passed to his kinsman, Adolphus, duke of Nassau, who died in 1905, and was succeeded by his son William (b. 1852).

By modifications of the treaty of Vienna the garrisoning of the fortress of Luxemburg had passed into Prussian hands, an arrangement which lasted until 1867. In the previous year the German Confederation, to which the grand-duchy of Luxemburg had belonged since 1815, had been dissolved; but the Prussians maintained their garrison in Luxemburg, which was not included in the new North German Confederation, while King William III. proposed to sell his rights over the grand-duchy to France. The Prussians were irritated by this proposal, but war was averted, and the question was referred to a conference of the powers in London. The treaty of London, signed on the 11th of May 1867, decided that the Prussian garrison must be withdrawn and the fortress dismantled, which was done in 1872. At the same time the great powers guaranteed the neutrality of the grand-duchy, and although a member of the German *Zollverein*, Luxemburg now forms a sovereign and independent state.

The GRAND-DUCHY lies S.E. of Belgium. Its area is 999 sq. m., with a population (1905) of 246,455. The people are nearly all Catholics. The country is rich in iron ore. The hills in the south of the duchy are a continuation of the Lorraine plateau, and the northern districts are crossed in all directions by outrunners from the Ardennes. The streams mostly join the Moselle, which forms the boundary between Luxemburg and the Rhine province for about 20 m. The Sure or Sauer, the most important stream in the duchy, rises at Vaux-les-Rosières in Belgian Luxemburg, crosses the duchy, and forms the eastern boundary from the confluence of the Our till it joins the Moselle after a course of 50 m., during which it receives the Wiltz, Attert, Alzette, White and Black Ernz, &c. The soil of Luxemburg is generally good; the southern districts are on the whole the most fertile as well as the most populous. Building materials of all sorts are obtained throughout the duchy. Besides the iron furnaces, situated in the south near the Lorraine plateau, there are tanneries, weaving and glove-making factories, paper-mills for all sorts of paper, breweries and distilleries, and sugar refineries. A German patois mixed with French words is spoken throughout the country; but French, which is employed by the commercial community, is also the common speech on the French and Belgian frontiers. Though liberty of worship prevails, Roman Catholicism is almost the sole form. The government is in the hands of the grand-duke, who sanctions and promulgates the laws. There is a council (*staatsrat*) of 15 members. There is a chamber of deputies with 48 members elected by the cantons (12 in number) for six years, half the body being elected every three years. No law can be passed without the consent of the chamber. Bills are introduced by the grand-duke, but the house has also the right of initiative. A single battalion (150) of volunteers composes the grand-ducal army. The gendarmerie consists of about 150 men. There are cantonal courts and two district courts, one at Luxemburg, the other at Diekirch, and a high court at Luxemburg. The bishopric of Luxemburg holds its authority directly from the Holy See. From 13,000,000 to 17,000,000 francs is the annual amount of the state budget, and the debt, consisting of loans contracted principally for the construction of railways, of which there are about 350 m., is 12,000,000 francs.

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[1] It should be noticed, however, that the Salic law is subordinate to the Nassau family law, which provides for the succession in the case of the *complete extinction* of males. Thus Article xlii. of the Nassau Pact of the 30th of June 1783 provides "that in the event of the extinction of males, the rights of succession pass to the daughter or nearest heiress of the last male."

Among towns next to the capital, Luxemburg, are Echternach and Diekirch, both worthy of note for their blast furnaces. Grevenmacher is the centre of a great wine district.

The PROVINCE OF LUXEMBURG is the largest and least populous of the nine provinces of Belgium. Its capital is Arlon, which lies near the borders of the grand-duchy. A considerable part of the province is forested and the state requires systematic replanting. Marble, granite and slate quarries are worked in different districts. Successful attempts have been made to introduce fruit cultivation. The province is well watered by the Ourthe, the Semois and the Sûre. The general elevation of the country is about 500 ft., but the hills and plateaus which form the prominent feature in the scenery of Luxemburg range from 1200 to 1500 ft. The highest point of the province is the Baraque de Fraiture (1980 ft.), N.E. of La Roche. The woods are well stocked with red and roe deer, wild boar, hares, rabbits, pheasants, woodcock and snipe. The area of the province is 1725 sq. m. The population was 225,963 in 1904.

The HOUSE OF LUXEMBURG was descended from Count Conrad (d. 1086), and its fortunes were advanced through the election of Count Henry IV. as German king in 1308 and his coronation as emperor under the title of Henry VII. Henry's son was John, king of Bohemia, who fell on the field of Crécy, and John's eldest son was the emperor Charles IV., while another famous member of the family was Baldwin, archbishop of Treves (1285–1354), who took an active part in imperial affairs. Two of the sons of Charles IV., Wenceslaus and Sigismund, succeeded in turn to the imperial throne, and one of his nephews, Jobst, margrave of Moravia, was chosen German king in opposition to Sigismund in 1410. The French branch of the Luxemburg family was descended from Waleran (d. 1288), lord of Ligny and Roussy, a younger son of Count Henry II. Waleran's great-grandson was Guy (d. 1371), who married Matilda, sister and heiress of Guy V., count of Saint-Pol (d. 1360), and was created count of Ligny in 1367. Guy's son, Waleran (d. 1417), who became constable of France in 1412, had been carried as a prisoner to England, and had married Matilda, daughter of Thomas Holland, earl of Kent (d. 1360) and half-sister of King Richard II. To avenge Richard's death he made a raid on the Isle of Wight, and then took part in the civil wars in France. He left no sons, and was succeeded by his nephew, Peter, count of Brienne (d. 1433), who, like his brother Louis (d. 1443), cardinal archbishop of Rouen and chancellor of France, was found on the side of the English in their struggle against France. Another of Peter's brothers, John (d. 1440), a stout supporter of England, was made governor of Paris by Henry V. He sold Joan of Arc to the English. Peter's son and successor, Louis, fought at first for England, but about 1440 he entered the service of France and obtained the office of constable. King Louis XI. accused him of treachery, and he took refuge with Charles the Bold, duke of Burgundy; but the duke handed him over to the king and he was beheaded in 1475. The elder branch of his descendants became extinct in the male line in 1482, and was merged through the female line in the house of Bourbon-Vendôme. Louis's third son, Anthony (d. 1510), founded the family of Luxemburg-Brienne, the senior branch of which became extinct in 1608. A junior branch, however, was the family of the duke of Luxemburg-Piney, whose last representative, Margaret-Charlotte (d. 1680), married firstly Léon d'Albert de Luynes (d. 1630) and secondly Charles Henry de Clermont-Tonnerre (d. 1674). Her daughter by her second husband, Madeleine Charlotte, married Francis Henry de Montmorenci (d. 1695) and de Luynes, and, subsequently, members of the family of Montmorenci claimed the title of duke of Luxemburg. The Luxembourg palace in Paris owes its name to the fact that it was built on a site belonging to the duke of Luxemburg-Piney.

See N. van Werveke, *Beiträge zur Geschichte des Luxemburger Landes* (Luxemburg, 1886–1887); J. Schötter, *Geschichte des Luxemburger Landes* (Luxemburg, 1882); and N. Vigner, *Histoire de la maison de Luxembourg* (Paris, 1619).

LUXEMBURG, or LÜTZELBURG (*i.e.* the little fortress or town), the capital of the grand-duchy of the same name (see above), situated on the Alzette, a tributary of the Sûre. Pop. (1905) 20,984. The situation is romantic, steep cliffs overhanging the winding river, and the principal portion of the town with the palace and public buildings covering a central plateau. The more densely populated parishes of Clausen, Pfaffenthal and Grund lie in the valley. As a fortress Luxemburg was considered the strongest in Europe after Gibraltar, which it was supposed to resemble because many of its casemates were cut into the rock. It was dismantled in 1867. Two colossal viaducts carry the railway and the approach from the railway station to the town. Since the place ceased to be a fortress the population has more than doubled, and the Alzette is lined with tanneries, breweries and distilleries. The Hôtel de Ville dates from 1844 and contains a collection of antiquities. The church of Notre Dame was built in 1613, and that of St Michael, with parts dating from 1320, contains the tomb of blind John of Luxemburg, king of Bohemia, slain at Crécy. There are two annual fête days, one in honour of Our Lady of Luxemburg, patroness of the city, held on the Sunday before Ascension Day, and the other the annual fair or *Schobermesse* (tent fair), instituted in 1340 and held each year on the 24th of August.

LUXEUIL-LES-BAINS, a town of eastern France, in the department of Haute-Saône, 18 m. N.E. of Vesoul. Pop. (1906) 5195. It is situated in a region of forests on the right bank of the Breuchin. It has an abbey-church dating from the 13th and 14th centuries, containing a curious 17th-century organ loft in the form of an immense bracket supported by a colossal figure of Hercules. The abbot's palace (16th and 18th centuries) serves as presbytery and town hall. A cloister of the 15th century and other buildings of the 17th century also remain. There are several mansions and houses dating from various periods from the 14th to the 16th century. The Maison Carrée, once the town hall, an interesting specimen of 15th-century architecture, was built by Perrin Jouffroy, father of Cardinal Jouffroy. The cardinal, who was born at Luxeuil in 1412, built the house with a graceful balcony and turret which faces the Maison Carrée. The Maison de la Baille and the Maison François I. are of the Renaissance period. The fine modern Grammont Hospital is in the style of Louis XIII. Luxeuil is renowned for its mineral springs, of which there are seventeen, two being ferruginous, and the rest charged with chloride of sodium; their temperatures range from 70° to 158° F. The water is employed for drinking and for baths. The bathing establishment contains a museum of Gallo-Roman antiquities and there are also remains of Roman baths and aqueducts to be seen in or near it. Luxeuil has a communal college. Copper-founding, the spinning and weaving of cotton, lace-making, dyeing and the distilling of kirsch are carried on.

Luxeuil was the Roman *Lixovium* and contained many fine buildings at the time of its destruction by the Huns under Attila in 451. In 590 St Columban here founded a monastery, afterwards one of the most famous in Franche Comté. In the 8th century it was destroyed by the Saracens; afterwards rebuilt, monastery and town were devastated by the Normans in the 9th century and pillaged on several occasions afterwards. The abbey schools were celebrated in the middle ages and the abbots had great influence; but their power was curtailed by the emperor Charles V. and the abbey was suppressed at the Revolution.

See H. Beaumont, *Étude hist. sur l'abbaye de Luxeuil, 590–1790* (Lux. 1895); Grandmongin and A. Garnier, *Hist. de la ville et des thermes de Luxeuil* (Paris, 1866), with 16 plates.

LUXOR, more properly El-Aksur, "The Castles" (plur. of kasr), a town of Upper Egypt, on the east bank of the Nile 450 m. above Cairo by river and 418 by rail. Pop. (1907 census) 12,644. It is the centre for visitors to the ruins of and about Thebes, and is frequented by travellers and invalids in the winter season, several fine hotels having been built for their accommodation. There are Anglican and Roman Catholic churches, and a hospital for natives, opened in 1891. The district is the seat of an extensive manufacture of forged antiques.

The temple of Luxor is one of the greatest of the monuments of Thebes (*q.v.*). It stands near the river bank on the S.W. side of the town and measures nearly 300 yds. from back to front. There may have been an earlier temple here, but the present structure, dedicated to the Theban triad of Ammon, Mut and

Khons, was erected by Amenophis III. The great colonnade, which is its most striking feature, was apparently intended for the nave of a hypostyle hall like that of Karnak, but had to be hastily finished without the aisles. After the heresy of Amenophis IV. (Akhenaton), the decoration of this incomplete work was taken in hand by Tutenkhamun and Haremhib. The axis of the temple ran from S.W. to N.E.; a long paved road bordered by recumbent rams led from the façade to the temples of Karnak (*q.v.*) in a somewhat more easterly direction, and Rameses II. adopted the line of this avenue in adding an extensive court to the work of Amenophis, producing a curious change of axis. He embellished the walls and pylons of his court with scenes from his victories over Hittites and Syrians, and placed a number of colossal statues within it. In front of the pylon Rameses set up colossi and a pair of obelisks (one of which was taken to Paris in 1831 and re-erected in the Place de la Concorde). A few scenes and inscriptions were added by later kings, but the above is practically the history of the temple until Alexander the Great rebuilt the sanctuary itself. The chief religious festival of Thebes was that of "Southern Opi," the ancient name of Luxor. The sacred barks of the divinities preserved in the sanctuary of Karnak were then conveyed in procession by water to Luxor and back again; a representation of the festal scenes is given on the walls of the great colonnade. The Christians built churches within the temple. The greater part of the old village of Luxor lay inside the courts: it was known also as Abu 'l Haggag from a Moslem saint of the 7th century, whose tomb-mosque, mentioned by Ibn Batuta, stands on a high heap of débris in the court of Rameses. This is the last of the buildings and rubbish which encumbered the temple before the expropriation and clearances by the Service des Antiquités began in 1885. The principal street of Luxor follows the line of the ancient avenue.

See G. Daressy, *Notice explicative des ruines du temple de Louxor* (Cairo, 1893); Baedeker's *Egypt*. (F. Ll. G.)

LUXORIUS, Roman writer of epigrams, lived in Africa during the reigns of the Vandal kings Thrasamund, Hilderic and Gelimer (A.D. 496–534). He speaks of his poor circumstances, but from the superscription *clarissimus* and *spectabilis* in one MS., he seems to have held a high official position. About a hundred epigrams by him in various metres (the elegiac predominating) have been preserved. They are after the manner of Martial, and many of them are coarse. They deal chiefly with the games of the circus and works of art, and the language shows the author to have been well acquainted with the legends and antiquities of the classical period of Rome.

Luxorius also wrote on grammatical subjects (see R. Ellis in *Journal of Philology*, viii., 1879). The epigrams are contained in the *Anthologia Latina*, edited by F. Bücheler and A. Riese (1894).

LUYNES, a territorial name belonging to a noble French house. The family of Albert, which sprang from Thomas Alberti (d. 1455), seigneur de Boussargues, *bailli* of Viviers and Valence, and *viguier* of Bagnols and Pont St Esprit in Languedoc, acquired the estate of Luynes (dep. of Indre-et-Loire) in the 16th century. Honoré d'Albert (d. 1592), seigneur de Luynes, was in the service of the three last Valois kings and of Henry IV., and became colonel of the French bands, commissary of artillery in Languedoc and governor of Beaucaire. He had three sons: Charles (1578–1621), first duke of Luynes, and favourite of Louis XIII.; Honoré (1581–1649), seigneur de Cadenet, who married Charlotte Eugénie d'Ailly, countess of Chaulnes, in 1619, and was created duke of Chaulnes in 1621; and Léon, seigneur de Brantes, who became duke of Luxemburg-Piney by his marriage in 1620 with Margaret Charlotte of Luxemburg.

By her marriage with Claude of Lorraine, duke of Chevreuse, Marie de Rohan, the widow of the first duke of Luynes, acquired in 1655 the duchy of Chevreuse, which she gave in 1663 to Louis Charles d'Albert, her son by her first husband; and from that time the title of duke of Chevreuse and duke of Luynes was borne by the eldest sons of the family of Luynes, which also inherited the title of duke of Chaulnes on the extinction of the descendants of Honoré d'Albert in 1698. The branch of the dukes of Luxemburg-Piney became extinct in 1697.

Charles (1578–1621), the first duke of Luynes, was brought up at court and attended the dauphin, who later became Louis XIII. The king shared his fondness for hunting and rapidly advanced him in favour. In 1615 he was appointed commander of the Louvre and counsellor, and the following year grand falconer of France. He used his influence over the king in the court intrigues against the queen-mother Marie de Medici and her favourite Concini. It was Luynes who, with Vitry, captain of the guard, arranged the plot that ended in Concini's assassination (1617) and secured all the latter's possessions in Italy and France. In the same year he was appointed captain of the Bastille and lieutenant-general of Normandy, and married Marie de Rohan, daughter of the duke of Montbazon. He employed extreme measures against the pamphleteers of the time, but sought peace in Italy and with the Protestants. In 1619 he negotiated the treaty of Angoulême by which Marie de Medici was accorded complete liberty. He was made governor of Picardy in 1619; suppressed an uprising of nobles in 1620; and in 1621, with slight military ability or achievement, was appointed constable of France. His rapid rise to power made him a host of enemies, who looked upon him as but a second Concini. In order to justify his newly-won laurels, Luynes undertook an expedition against the Protestants, but died of a fever in the midst of the campaign, at Longueville in Guienne, on the 15th of December 1621.

His brother Honoré (1581–1649), first duke of Chaulnes, was governor of Picardy and marshal of France (1619), and defended his province successfully in 1625 and 1635. Louis Auguste d'Albert d'Ailly (1676–1744), duke of Chaulnes, also became marshal of France (1741). Louis Joseph d'Albert de Luynes (1670–1750), prince of Grimberghen, was in the service of the emperor Charles VII., and became field-marshal and ambassador in France.

Several members of the family of Albert were distinguished in letters and science. Louis Charles d'Albert (1620–1690), duke of Luynes, son of the constable, was an ascetic writer and friend of the Jansenists; Paul d'Albert de Luynes (1703–1788), cardinal and archbishop of Sens, an astronomer; Michel Ferdinand d'Albert d'Ailly (1714–1769), duke of Chaulnes, a writer on mathematical instruments, and his son Marie Joseph Louis (1741–1793), a chemist; and Honoré Théodore Paul Joseph (1802–1867), duke of Luynes, a writer on archaeology.

For the first duke see *Recueil des pièces les plus curieuses qui ont esté faites pendant le règne du connestable M. de Luynes* (2nd ed., 1624); Le Vassor, *Histoire de Louis XIII.* (Paris, 1757); Griffet, *Histoire du règne de Louis XIII., roi de France et de Navarre* (Paris, 1758); V. Cousin, "Le Duc et connétable de Luynes," in *Journal des savants* (1861–1863); B. Zeller, *Études critiques sur le règne de Louis XIII.: le connétable de Luynes, Montauban et la Valteline* (Paris, 1879); E. Pavie, *La Guerre entre Louis XIII. et Marie de Médicis* (Paris, 1899); Lavisse, *Histoire de France*, vi.^{2}, 141-216 (Paris, 1905).

LUZÁN CLARAMUNT DE SUELVES Y GURREA, IGNACIO (1702–1754), Spanish critic and poet, was born at Saragossa on the 28th of March 1702. His youth was passed under the care of his uncle, and, after studying at Milan, he graduated in philosophy at the university of Catania. In 1723 he took minor orders, but abandoned his intention of entering the church and took up his residence at Naples, where he read assiduously. Business took him to Spain in 1733, and he became known in Madrid as a scholar with a tendency towards innovations in literature. *La Poética, ó Reglas de la poesia en general y de sus principales especies* (1737) proved that this impression was correct. He at once took rank as the leader of the literary reformers, and his courteous determination earned him the respect of his opponents. In 1747 he was appointed secretary to the Spanish embassy in Paris and, on returning to Madrid in 1750, was elected to the "Academia Poética del Buen Gusto," where, on account of his travels, he was known by the sobriquet of *El Peregrino*. He became master of the mint and treasurer of the royal library. He died at Madrid, after a short illness, on the 19th of May 1754. Luzán was not the pioneer of Franco-Italian theories in Spain, but he was their most powerful exponent, and his *Poëtica* is an admirable example of destructive criticism. The defects of Lope de Vega and Calderón are indicated with vigilant severity, but on the constructive side Luzán is notably weak, for he merely proposes to substitute one exhausted convention for another. The doctrine of the dramatic unities had not the saving virtues which he ascribed to it, and, though he succeeded in banishing the older dramatists from the boards, he and his school failed to produce a single piece of more than mediocre merit. His theories, derived chiefly from Muratori, were ineffective in practice; but their ingenuity cannot be denied, and they acted as a stimulus to the partisans of the national tradition.

LUZ-SAINT-SAUVEUR, a town of south-western France in the department of Hautes-Pyrénées, 21 m. S. of Lourdes by rail. Pop. (1906) 1069. Luz is beautifully situated at a height of 2240 ft. on the Bastan. It has a remarkable church, built by the Templars in the 12th and 13th centuries and fortified later. The crenelated ramparts with which it is surrounded, and the tower to the north of the apse resembling a keep, give it the aspect of a fortress; other interesting features are the Romanesque north door and a chapel of the 16th century. The village of St Sauveur lies a little above Luz on the left bank of the gorge of the Gave de Pau, which is crossed higher up by the imposing Pont Napoléon (1860). It is a pleasant summer resort, and is visited for its warm sulphurous springs. Discovered in the 16th century, the waters came into vogue after 1820, in which year they were visited by the duchesses of Angoulême and Berry. There is much picturesque mountain scenery in the vicinity; 12 m. to the south is the village of Gavarnie, above which is the magnificent rock amphitheatre or *cirque* of Gavarnie, with its cascade, one of the highest in Europe.

LUZZATTI, LUIGI (1841-), Italian economist and financier, was born of Jewish parents at Venice on the 11th of March 1841. After completing his studies in law at the university of Padua, he attracted the attention of the Austrian police by his lectures on political economy, and was obliged to emigrate. In 1863 he obtained a professorship at the Milan Technical Institute; in 1867 he was appointed professor of constitutional law at Padua, whence he was transferred to the university of Rome. Gifted with eloquence and energy, he popularized in Italy the economic ideas of Schultze-Delitzsch, worked for the establishment of a commercial college at Venice, and contributed to the spread of people's banks on a basis of limited liability throughout the country. In 1869 he was appointed by Minghetti under secretary of state to the ministry of agriculture and commerce, in which capacity he abolished government control over commercial companies and promoted a state inquiry into the conditions of industry. Though theoretically a free trader, he was largely instrumental in creating the Italian protective system. In 1877 he participated in the commercial negotiations with France, in 1878 compiled the Italian customs tariff, and subsequently took a leading part in the negotiations of all the commercial treaties between Italy and other countries. Appointed minister of the treasury in the first Di Rudini cabinet of 1891, he imprudently abolished the system of frequent clearings of bank-notes between the state banks, a measure which facilitated the duplication of part of the paper currency and hastened the bank crisis of 1893. In 1896 he entered the second Di Rudini cabinet as minister of the treasury, and by timely legislation helped to save the bank of Naples from failure. After his fall from office in June 1898, his principal achievement was the negotiation of the Franco-Italian commercial treaty, though, as deputy, journalist and professor, he continued to take an active part in all political and economic manifestations. He was again minister of the treasury from November 1903 to March 1905 in Giolitti's second administration, and for the third time from February to May 1906, under Sonnino's premiership. During the latter term of office he achieved the conversion of the Italian 5% debt (reduced to 4% by the tax) to 3¾% to be eventually lowered to 3½%, an operation which other ministers had attempted without success; although the actual conversion was not completed until after the fall of the cabinet of which he formed part the merit is entirely his. In 1907 he was president of the co-operative congress at Cremona.

See L. Carpi's *Risorgimento Italiano*, vol. ii. (Milan, 1886), which contains a biographical sketch of Luzzatti.

LUZZATTO, MOSES HAYIM (1707-1747), Hebrew dramatist and mystic, was born in Padua 1707, and died at Acre 1747. He was influenced by Isaac Luria (*q.v.*) on the mystical side, and on the poetical side by Italian drama of the school of Guarini (*q.v.*). He attacked Leon of Modena's anti-Kabbalistic treatises, and as a result of his conflict with the Venetian Rabbinate left Italy for Amsterdam, where, like Spinoza, he maintained himself by grinding lenses. Here, in 1740, he wrote his popular religious manual the *Path of the Upright* (*Messilath Yesharim*) and other ethical works. He visited London, but finally settled in Palestine, where he died. Luzzatto's most lasting work is in the realm of Hebrew drama. His best-known compositions are: the *Tower of Victory* (*Migdal 'Oz*) and *Glory to the Upright* (*Layesharim Tehillah*). Both of these dramas, which were not printed at the time but were widely circulated in manuscript, are of the type which preceded the Shakespearean age—they are allegorical and all the characters are types. The beautiful Hebrew style created a new school of Hebrew poetry, and the Hebrew renaissance which resulted from the career of Moses Mendelssohn owed much to Luzzatto.

See Grätz, *History of the Jews*, v. ch. vii.; I. Abrahams, *Jewish Life in the Middle Ages*, pp. 190, 268; N. Slouschz, *The Renascence of Hebrew Literature*, ch. i. (I. A.)

LUZZATTO, SAMUEL DAVID (1800-1865), Jewish scholar, was born at Trieste in 1800, and died at Padua in 1865. He was the most distinguished of the Italian Jewish scholars of the 19th century. The first Jew to suggest emendations to the text of the Hebrew Bible, he edited Isaiah (1856-1867), and wrote a commentary on the Pentateuch (1871). His grammatical works were mostly written in Italian. He also contributed to the history of the Synagogue liturgy, and enjoys with Geiger (*q.v.*) and Zunz (*q.v.*) the honour of reviving interest in the medieval Hebrew hymnology and secular verse.

See Grätz, *History of the Jews* (Eng. trans.), v. 622 seq.; N. Slouschz, *The Renascence of Hebrew Literature*, pp. 84-92; the *Jewish Encyclopedia*, viii. 225-226, with list of works. (I. A.)

LYALL, SIR ALFRED COMYN (1835-), Anglo-Indian civil servant and man of letters, son of the Rev. Alfred Lyall, was born in 1835, and educated at Eton and Haileybury. He entered the Bengal civil service in 1855, saw service during the Mutiny in the Bulandshahr district, at Meerut, and with the Khaki Risala of volunteers. He was commissioner in Berar (1867), secretary to the government of India in the Home and Foreign departments, lieutenant-governor of the North-western Provinces (1882-1887), and member of the Council of India (1888-1903). Among his writings, his *Verses Written in India* (1889) attained considerable popularity, and in his *Asiatic Studies* (1882 and 1899) he displays a deep insight into Indian life and character. He wrote the *Life* of Lord Dufferin (1905), and made numerous contributions to periodical literature.

LYALL, EDNA, the pen-name of Ada Ellen Bayly (1857-1903), English novelist. She was born at Brighton in 1857, the daughter of a barrister. Her parents died while she was a child, and she was brought up at Caterham, Surrey. At Eastbourne, where most of her life was spent, she was well known for her philanthropic activity. She died on the 8th of February 1903. Edna Lyall's vogue as a novelist was the result of a combination of the story-teller's gift with a sincere ethical and religious spirit of Christian tolerance, which at the time was new to many readers. Though her *Won by Waiting* (1879) had some success, it was with *Donovan* (1882) and *We Two* (1884), in which the persecuted atheist was inevitably identified with Charles Bradlaugh, that she became widely popular. Other novels were *In the Golden Days* (1885), a story of the Great Rebellion; *Knight Errant* (1887); *Autobiography of a Slander* (1887); *A Hardy Norseman* (1889); *Derrick Vaughan, The Story of a Novelist* (1889); *To Right the Wrong* (1892); *Doreen* (1894), a statement of the case for Irish Home Rule; *The Autobiography of a Truth* (1896), the proceeds of which were devoted to the

Armenian Relief Fund; *In Spite of All* (1901), which had originally been produced by Mr Ben Greet as a play; and *The Bruges Letters* (1902), a book for children.

A *Life* by J. N. Escreet appeared in 1904, and a shorter account of her by the Rev. G. A. Payne was printed at Manchester in 1903.

LYALLPUR, a district of India, in the Multan division of the Punjab. It was constituted in 1904 to comprise the "Chenab Colony," being the waste portion of the former Jhang district that is now irrigated by the Lower Chenab canal. Area, 3075 sq. m.; pop. (1906) 654,666. It is traversed by a section of the North-western railway. The headquarters are at Lyallpur town (pop. in 1906, 13,483), named after Sir James Lyall, a lieutenant-governor. It contains several factories for ginning and pressing cotton.

See *Chenab Colony Gazetteer* (Lahore, 1904).

LYCAEUS (Mons Lycaeus, *Λύχαιον ὄρος*: mod. *Diaphorti*), a mountain in Arcadia, sacred to Zeus Lycaeus, who was said to have been born and brought up on it, and the home of Pelasgus and his son Lycaon, who is said to have founded the ritual of Zeus practised on its summit. This seems to have involved a human sacrifice, and a feast in which the man who received the portion of a human victim was changed to a wolf, as Lycaon had been after sacrificing a child. The altar of Zeus consists of a great mound of ashes with a retaining wall. It was said that no shadows fell within the precincts; and that any who entered it died within the year.

LYCANTHROPY (Gr. λύκος, wolf, ἄνθρωπος, man), a name employed (1) in folk-lore for the liability or power of a human being to undergo transformation into an animal; (2) in pathology for a form of insanity in which the patient believes that he is transformed into an animal and behaves accordingly.

I. Although the term lycanthropy properly speaking refers to metamorphosis into a wolf (see WERWOLF), it is in practice used of transformation into any animal. The Greeks also spoke of kynanthropy (κύων, dog); in India and the Asiatic islands the tiger is the commonest form, in North Europe the bear, in Japan the fox, in Africa the leopard or hyena, sometimes also the lion, in South America the jaguar; but though there is a tendency for the most important carnivorous animal of the area to take the first place in stories and beliefs as to transformation, the less important beasts of prey and even harmless animals like the deer also figure among the wer-animals.

Lycanthropy is often confused with transmigration; but the essential feature of the wer-animal is that it is the alternative form or the double of a living human being, while the soul-animal is the vehicle, temporary or permanent, of the spirit of a dead human being. The vampire is sometimes regarded as an example of lycanthropy; but it is in human form, sometimes only a head, sometimes a whole body, sometimes that of a living person, at others of a dead man who issues nightly from the grave to prey upon the living.

Even if the denotation of lycanthropy be limited to the animal-metamorphosis of living human beings, the beliefs classed together under this head are far from uniform, and the term is somewhat capriciously applied. The transformation may be voluntary or involuntary, temporary or permanent; the wer-animal may be the man himself metamorphosed, it may be his double whose activity leaves the real man to all appearance unchanged, it may be his soul, which goes forth seeking whom it may devour and leaving its body in a state of trance; or it may be no more than the messenger of the human being, a real animal or a familiar spirit, whose intimate connexion with its owner is shown by the fact that any injury to it is believed, by a phenomenon known as repercussion, to cause a corresponding injury to the human being.

The phenomenon of repercussion, the power of animal metamorphosis, or of sending out a familiar, real or spiritual, as a messenger, and the supernormal powers conferred by association with such a familiar, are also attributed to the magician, male and female, all the world over; and witch superstitions are closely parallel to, if not identical with, lycanthropic beliefs, the occasional involuntary character of lycanthropy being almost the sole distinguishing feature. In another direction the phenomenon of repercussion is asserted to manifest itself in connexion with the bush-soul of the West African and the *nagual* of Central America; but though there is no line of demarcation to be drawn on logical grounds, the assumed power of the magician and the intimate association of the bush-soul or the *nagual* with a human being are not termed lycanthropy. Nevertheless it will be well to touch on both these beliefs here.

In North and Central America, and to some extent in West Africa, Australia and other parts of the world, every male acquires at puberty a tutelary spirit (see DEMONOLOGY); in some tribes of Indians the youth kills the animal of which he dreams in his initiation fast; its claw, skin or feathers are put into a little bag and become his "medicine" and must be carefully retained, for a "medicine" once lost can never be replaced. In West Africa this relation is said to be entered into by means of the blood bond, and it is so close that the death of the animal causes the man to die and vice versa. Elsewhere the possession of a tutelary spirit in animal form is the privilege of the magician. In Alaska the candidate for magical powers has to leave the abodes of men; the chief of the gods sends an otter to meet him, which he kills by saying "O" four times; he then cuts out its tongue and thereby secures the powers which he seeks. The Malays believe that the office of *pawang* (priest) is only hereditary if the soul of the dead priest, in the form of a tiger, passes into the body of his son. While the familiar is often regarded as the alternative form of the magician, the *nagual* or bush-soul is commonly regarded as wholly distinct from the human being. Transitional beliefs, however, are found, especially in Africa, in which the power of transformation is attributed to the whole of the population of certain areas. The people of Banana are said to change themselves by magical means, composed of human embryos and other ingredients, but in their leopard form they may do no hurt to mankind under pain of retaining for ever the beast shape. In other cases the change is supposed to be made for the purposes of evil magic and human victims are not prohibited. We can, therefore, draw no line of demarcation, and this makes it probable that lycanthropy is connected with nagualism and the belief in familiar spirits, rather than with metempsychosis, as Dr Tylor argues, or with totemism, as suggested by J. F. M'Lennan. A further link is supplied by the Zulu belief that the magician's familiar is really a transformed human being; when he finds a dead body on which he can work his spells without fear of discovery, the wizard breathes a sort of life into it, which enables it to move and speak, it being thought that some dead wizard has taken possession of it. He then burns a hole in the head and through the aperture extracts the tongue. Further spells have the effect of changing the revivified body into the form of some animal, hyena, owl or wild cat, the latter being most in favour. This creature then becomes the wizard's servant and obeys him in all things; its chief use is, however, to inflict sickness and death upon persons who are disliked by its master.

Lycanthropy in Europe.—The wolf is the commonest form of the wer-animal (see WERWOLF), though in the north the bear disputes its pre-eminence. In ancient Greece the dog was also associated with the belief. Marcellus of Sida, who wrote under the Antonines, gives an account of a disease which befell people in February; but a pathological state seems to be meant.

Lycanthropy in Africa.—In Abyssinia the power of transformation is attributed to the Boudas, and at the same time we have records of pathological lycanthropy (see below). Blacksmiths are credited with magical powers in many parts of the world, and it is significant that the Boudas are workers in iron and clay; in the *Life of N. Pearce* (i. 287) a European observer tells a story of a supposed transformation which took place in his presence and almost before his eyes; but it does not appear how far hallucination rather than coincidence must be invoked to explain the experience.

The Wer-tiger of the East Indies.—The Poso-Alfures of central Celebes believe that man has three souls, the *inosa*, the *angga* and the *tanoana*. The *inosa* is the vital principle; it can be detected in the veins and arteries; it is given to man by one of the great natural phenomena, more especially the wind. The *angga* is the intellectual part of man; its seat is unknown; after death it goes to the under-world, and, unlike the *inosa*, which is believed to be dissolved into its original elements, takes possession of an immaterial body. The *tanoana* is the divine in man and after death returns to its lord, Poewempala boeroe. It goes forth during sleep, and all that it sees it whispers into the sleeper's ear and then he dreams. According to another account, the *tanoana* is the substance by which man lives, thinks and acts; the *tanoana* of man, plants and animals is of the same nature. A man's *tanoana* can be strengthened by those of others; when the *tanoana* is long away or destroyed the man dies. The *tanoana* seems to be the soul of which lycanthropic feats are asserted.

Among the Toradjas of central Celebes it is believed that a man's "inside" can take the form of a cat, wild pig, ape, deer or other animal, and afterwards resume human form; it is termed *lamboyo*. The exact relation of the *lamboyo* to the *tanoana* does not seem to be settled; it will be seen below that the view seems to vary. According to some the power of transformation is a gift of the gods, but others hold that werwolfism is contagious and may be acquired by eating food left by a werwolf or even by leaning one's head against the same pillar. The Todjoers hold that any one who touches blood becomes a werwolf. In accordance with this view is the belief that werwolfism can be cured; the breast and stomach of the werman must be rubbed and pinched, just as when any other witch object has to be extracted. The patient drinks medicine, and the contagion leaves the body in the form of snakes and worms. There are certain marks by which a werman can be recognized. His eyes are unsteady and sometimes green with dark shadows underneath. He does not sleep soundly and fireflies come out of his mouth. His lips remain red in spite of betel chewing, and he has a long tongue. The Todjoers add that his hair stands on end.

Some of the forms of the *lamboyo* are distinguishable from ordinary animals by the fact that they run about among the houses; the wer-buffalo has only one horn, and the wer-pig transforms itself into an ants' nest, such as hangs from trees. Some say that the werman does not really take the form of an animal himself, but, like the sorcerer, only sends out a messenger. The *lamboyo* attacks by preference solitary individuals, for he does not like to be observed. The victim feels sleepy and loses consciousness; the *lamboyo* then assumes human form (his body being, however, still at home) and cuts up his victim, scattering the fragments all about. He then takes the liver and eats it, puts the body together again, licks it with his long tongue and joins it together. When the victim comes to himself again he has no idea that anything unusual has happened to him. He goes home, but soon begins to feel unwell. In a few days he dies, but before his death he is able sometimes to name the werman to whom he has fallen a victim.

From this account it might be inferred that the *lamboyo* was identical with the *tanoana*; the absence of the *lamboyo* seems to entail a condition of unconsciousness, and it can assume human form. In other cases, however, the *lamboyo* seems to be analogous to the familiar of the sorcerer. The Toradjas tell a story of how a man once came to a house and asked the woman to give him a rendezvous; it was night and she was asleep; the question was put three times before the answer was given "in the tobacco plantation." The husband was awake, and next day followed his wife, who was irresistibly drawn thither. The werman came to meet her in human form, although his body was engaged in building a new house, and caused the woman to faint by stamping three times on the ground. Thereupon the husband attacked the werman with a piece of wood, and the latter to escape transformed himself into a leaf; this the husband put into a piece of bamboo and fastened the ends so that he could not escape. He then went back to the village and put the bamboo in the fire. The werman said "Don't," and as soon as it was burnt he fell dead.

In another case a woman died, and, as her death was believed to be due to the malevolence of a werwolf, her husband watched by her body. For, like Indian witches, the werwolf, for some reason, wishes to revive his victim and comes in human form to carry off the coffin. As soon as the woman was brought to life the husband attacked the werwolf, who transformed himself into a piece of wood and was burnt. The woman remained alive, but her murderer died the same night.

According to a third form of the belief, the body of the werman is itself transformed. One evening a man left the hut in which a party were preparing to pass the night; one of his companions heard a deer and fired into the darkness. Soon after the man came back and said he had been shot. Although no marks were to be seen he died a few days later.

In Central Java we meet with another kind of wer-tiger. The power of transformation is regarded as due to inheritance, to the use of spells, to fasting and will-power, to the use of charms, &c. Save when it is hungry or has just cause for revenge it is not hostile to man; in fact, it is said to take its animal form only at night and to guard the plantations from wild pigs, exactly as the *balams* (magicians) of Yucatan were said to guard the corn fields in animal form. Variants of this belief assert that the werman does not recognize his friends unless they call him by name, or that he goes out as a mendicant and transforms himself to take vengeance on those who refuse him alms. Somewhat similar is the belief of the Khonds; for them the tiger is friendly; he reserves his wrath for their enemies, and a man is said to take the form of a tiger in order to wreak a just vengeance.

Lycanthropy in South America.—According to K. F. P. v. Martius the *kanaima* is a human being who employs poison to carry out his function of blood avenger; other authorities represent the *kanaima* as a jaguar, which is either an avenger of blood or the familiar of a cannibalistic sorcerer. The Europeans of Brazil hold that the seventh child of the same sex in unbroken succession becomes a wer-man or woman, and takes the form of a horse, goat, jaguar or pig.

II. As a pathological state lycanthropy may be described as a kind of hysteria, and may perhaps be brought into connexion with the form of it known as *latah*. It is characterized by the patient's belief that he has been metamorphosed into an animal, and is often accompanied by a craving for strange articles of food, including the flesh of living beings or of corpses. In the lower stages of culture the state of the patient is commonly explained as due to possession, but where he leaves the neighbourhood of man real metamorphosis may be asserted, as in ordinary lycanthropic beliefs. Marcellus of Sida says that in Greece the patients frequented the tombs at night; they were recognizable by their yellow complexion, hollow eyes and dry tongue. The Garrows of India are said to tear their hair when they are seized with the complaint, which is put down to the use of a drug applied to the forehead; this recalls the stories of the witch's salve in Europe. In Abyssinia the patient is usually a woman; two forms are distinguished, caused by the hyena and the leopard respectively. A kind of trance ushers in the fit; the fingers are clenched, the eyes glazed and the nostrils distended; the patient, when she comes to herself, laughs hideously and runs on all fours. The exorcist is a blacksmith; as a rule, he applies onion or garlic to her nose and proceeds to question the evil spirit.

BIBLIOGRAPHY.—For the anthropological side of the subject see bibliography to WERWOLF; also *Tijdskrift voor indische Taal, Land en Volkenkunde*, xxviii. 338, xli. 548, 568; *Med. Zendelingsgenootschap*, xxxix. 3, 16; O. Stoll, *Suggestion*, p. 418; W. H. Brett, *Indians of British Guiana*. For the pathological side, see Hack Tuke, *Dict. of Psychological Medicine*, s.v. "Lycanthropy"; *Dict. des sciences médicales*; Waldmeier, *Autobiography*, p. 64; A. J. Hayes, *Source of Blue Nile*, p. 286 seq.; *Abh. phil.-hist. Klasse kgl. sächsische Gesellschaft der Wiss.* 17, No. 3. (N. W. T.)

LYCAON, in Greek mythology, son of Pelasgus, the mythical first king of Arcadia. He, or his fifty impious sons, entertained Zeus and set before him a dish of human flesh; the god pushed away the dish in disgust and either killed the king and his sons by lightning or turned them into wolves (Apollodorus iii. 8; Ovid, *Metam.* i. 198). Some say that Lycaon slew and dished up his own son Nyctimus (Clem. Alex. *Protrept.* ii. 36; Nonnus, *Dionys.* xviii. 20; Arnobius iv. 24). The deluge was said to have been sent by Zeus in the time of Deucalion in consequence of the sons' impiety. Pausanias (viii. 2) says that Lycaon sacrificed a child to Zeus on the altar on mount Lycaeus, and immediately after the sacrifice was turned into a wolf. This gave rise to the story that a man was turned into a wolf at each annual sacrifice to Zeus Lycaeus, but recovered his human form if he abstained from human flesh for ten years. The oldest city, the oldest cultus (that of Zeus Lycaeus), and the first civilization of Arcadia are attributed to Lycaon. His story has been variously interpreted. According to Weizsäcker, he was an old Pelasgian or pre-Hellenic god, to whom human sacrifice was offered, bearing a non-Hellenic name similar to λύκος, whence the story originated of his metamorphosis into a wolf. His cult was driven out by that of the Hellenic Zeus, and Lycaon himself was afterwards represented as an evil spirit, who had insulted the new deity by setting human flesh before him. Robertson Smith considers the sacrifices offered to the wolf-Zeus in Arcadia to have been originally cannibal feasts of a wolf-tribe, who recognized the wolf as their totem. Usener and others identify Lycaon with Zeus Lycaeus, the god of light, who slays his son Nyctimus (the dark) or is succeeded by him, in allusion to the perpetual succession of night and day. According to Ed. Meyer, the belief that Zeus Lycaeus accepted human sacrifice in the form of a wolf was the origin of the myth that Lycaon, the founder of his cult, became a wolf, *i.e.* participated in the nature of the god by the act of sacrifice, as did all who afterwards duly performed it. W. Mannhardt sees in the ceremony an allusion to certain agricultural rites, the object of which was to prevent the failure of the crops and to avert pestilence (or to protect them and the flocks against the ravages of wolves). Others (*e.g.* V. Bérard) take Zeus Lycaeus for a Semitic Baal, whose worship was imported into Arcadia by the Phoenicians; Immerwahr identifies him with Zeus Phyxios, the god of the exile who flees on account of his having shed blood. Another explanation is that the place of the sacred wolf once worshipped in Arcadia was taken in cult by Zeus Lycaeus, and in popular tradition by Lycaon, the ancestor of the Arcadians, who was supposed to have been punished for his insulting treatment of Zeus. It is possible that the whole may be merely a reminiscence of a superstition similar to the familiar werwolf stories.

See articles by P. Weizsäcker in Roscher's *Lexikon* and by G. Fougères (*s.v.* "Lykaia") in Daremberg and Saglio's *Dictionnaire des antiquités*; W. Immerwahr, *Die Kulte und Mythen Arkadiens*, I. (1891), p. 14; L. R. Farnell, *Cults of the Greek States*, i. (1896), p. 40; A. Lang, *Myth, Ritual and Religion* (1899); C. Pascal, *Studii di antichità e mitologia* (1896), who sees in Lycaon a god of death honoured by human sacrifice; Ed. Meyer, *Forschungen zur alten Geschichte*, i. (1892), p. 60; W. Mannhardt, *Wald- und Feldkulte*, ii. (1905); G. Fougères, *Mantinée et l'Arcadie orientale* (1898), p. 202; V. Bérard, *De l'origine des cultes arcadiens* (1894); H. D. Müller, *Mythologie der griechischen Stämme*, ii. (1861), p. 78; H. Usener, *Rheinisches Museum*, liii. (1898), p. 375; G. Görres, *Berliner Studien für classische Philologie*, x. 1 (1889), who regards the Lycaea as a funeral festival connected with the changes of vegetation; Vollgraf, *De Ovidii mythopoeia*; a concise statement of the various forms of the legend in O. Gruppe, *Griechische Mythologie*, ii. p. 920, n. 4; see also LYCANTHROPY; D. Bassi, "Apollo Liceo," in *Rivista di storia antica*, i. (1895); and Frazer's *Pausanias*, iv. p. 189.

(J. H. F.)

LYCAONIA, in ancient geography, a large region in the interior of Asia Minor, north of Mount Taurus. It was bounded on the E. by Cappadocia, on the N. by Galatia, on the W. by Phrygia and Pisidia, while to the S. it extended to the chain of Mount Taurus, where it bordered on the country popularly called in earlier times Cilicia Tracheia and in the Byzantine period Isauria; but its boundaries varied greatly at different times. The name is not found in Herodotus, but Lycaonia is mentioned by Xenophon as traversed by Cyrus the younger on his march through Asia. That author describes Iconium as the last city of Phrygia; and in Acts xiv. 5 St Paul, after leaving Iconium, crossed the frontier and came to Lystra in Lycaonia. Ptolemy, on the other hand, includes Lycaonia as a part of the province of Cappadocia, with which it was associated by the Romans for administrative purposes; but the two countries are clearly distinguished both by Strabo and Xenophon and by authorities generally.

Lycaonia is described by Strabo as a cold region of elevated plains, affording pasture to wild asses and to sheep; and at the present day sheep abound, but asses are practically unknown. Amyntas, king of Galatia, to whom the district was for a time subject, maintained there not less than three hundred flocks. It forms part of the interior tableland of Asia Minor, and has an elevation of more than 3000 ft. It suffers from want of water, aggravated in some parts by abundance of salt in the soil, so that the northern portion, extending from near Iconium to the salt lake of Tatta and the frontiers of Galatia, is almost wholly barren, only small patches being cultivated near Iconium and the large villages. The soil, where water is supplied, is productive. In ancient times great attention was paid to storing and distributing the water, so that much land now barren was formerly cultivated and supported a large number of cities.

The plain is interrupted by some minor groups of mountains, of volcanic character, of which the Kara Dagh in the south, a few miles north of Karaman, rises above 7000 ft., while the Karadja Dagh, north-east of it, though of inferior elevation, presents a striking range of volcanic cones. The mountains in the north-west, near Iconium and Laodicea, are the termination of the Sultan Dagh range, which traverses a large part of Phrygia.

The Lycaonians appear to have been in early times to a great extent independent of the Persian empire, and were like their neighbours the Isaurians a wild and lawless race of freebooters; but their country was traversed by one of the great natural lines of high road through Asia Minor, from Sardis and Ephesus to the Cilician gates, and a few considerable towns grew up along or near this line. The most important was Iconium, in the most fertile spot in the country, of which it was always regarded by the Romans as the capital, although ethnologically it was Phrygian. It is still called Konia, and it was the capital of the Seljuk Turkish empire for several centuries. A little farther north, immediately on the frontier of Phrygia, stood Laodicea (Ladik), called Combusta, to distinguish it from the Phrygian city of that name; and in the south, near the foot of Mount Taurus, was Laranda, now called Karaman, which has given name to the province of Karamania. Derbe and Lystra, which appear from the Acts of the Apostles to have been considerable towns, were between Iconium and Laranda. There were many other towns, which became bishoprics in Byzantine times. Lycaonia was Christianized very early; and its ecclesiastical system was more completely organized in its final form during the 4th century than that of any other region of Asia Minor.

After the defeat of Antiochus the Great, Lycaonia was given by the Romans to Eumenes II., king of Pergamos. About 160 B.C. part of it, the "Tetrarchy of Lycaonia," was added to Galatia; and in 129 B.C. the eastern half (usually called during the following 200 years Lycaonia proper) was given to Cappadocia as an eleventh strategia. In the readjustment of the Provinciae, 64 B.C., by Pompey after the Mithradatic wars, he gave the northern part of the tetrarchy to Galatia and the eastern part of the eleventh strategia to Cappadocia. The remainder was attached to Cilicia. Its administration and grouping changed often under the Romans. In A.D. 371 Lycaonia was first formed into a separate province. It now forms part of the Konia vilâyet.

The Lycaonians appear to have retained a distinct nationality in the time of Strabo, but their ethnical affinities are unknown. The mention of the Lycaonian language in the Acts of the Apostles (xiv. 11) shows that the native language was spoken by the common people at Lystra about A.D. 50; and probably it was only later and under Christian influence that Greek took its place.

See Sir W. M. Ramsay, *Historical Geography of Asia Minor* (1890), *Historical Commentary on Galatians* (1899) and *Cities of St Paul* (1907); also an article on the topography in the *Jahreshefte des Oesterr. Archaeolog. Instituts*, 194 (Beiblatt) pp. 57-132.

(W. M. RA.)

LYCEUM, the latinized form of Gr. *Λύκειον*, the name of a gymnasium and garden with covered walks, near the temple of Apollo Lyceus (*Ἀπόλλων Λύκειος*) at Athens. Aristotle taught here, and hence the name was applied to his school of philosophy. The name had been used in many languages for places of instruction, &c. In France the term *lycée* is given to the secondary schools which are administered by the state, in contradistinction to the communal *collèges*.

LYCIA, in ancient geography, a district in the S.W. of Asia Minor, occupying the coast between Caria and Pamphylia, and extending inland as far as the ridge of Mt Taurus. The region thus designated is a peninsula projecting southward from the great mountain masses of the interior. It is for the most part a rugged mountainous country, traversed by offshoots of the Taurus range, which terminate on the coast in lofty promontories. The coast, though less irregular than that of Caria, is indented by a succession of bays—the most marked of which is the Gulf of Macri (anc. *Glaucus Sinus*) in the extreme west. A number of smaller bays, and broken rocky headlands, with a few small islets, constitute the coast-line thence to the S.E. promontory of Lycia, formed by a long narrow tongue of rocky hill, known in ancient times as the "Sacred Promontory" (Hiera Acra), with three small adjacent islets, called the Chelidonian islands, which was regarded by some ancient geographers as the commencement of Mt. Taurus. Though the mountain ranges of Lycia are all offshoots of Mt. Taurus, in ancient times several of them were distinguished by separate names. Such were Daedala in the west, adjoining the Gulf of Macri, Cragus on the sea-coast, west of the valley of the Xanthus, Massicytus (10,000 ft.) nearly in the centre of the region, and Solyma in the extreme east above Phaselis (7800 ft.). The steep and rugged pass between Solyma and the sea, called the Climax ("Ladder"), was the only direct communication between Lycia and Pamphylia.

The only two considerable rivers are: (1) the Xanthus, which descends from the central mass of Mt Taurus, and flows through a narrow valley till it reaches the city of the same name, below which it forms a plain of some extent before reaching the sea, and (2) the Limyrus, which enters the sea near Limyra. The small alluvial plains at the mouths of these rivers are the only level ground in Lycia, but the hills that rise thence towards the mountains are covered with a rich arborescent vegetation. The upper valleys and mountain sides afford good pasture for sheep, and the main Taurus range encloses several extensive upland basin-shaped valleys (*vailas*), which are characteristic of that range throughout its extent (see ASIA MINOR).

The limits of Lycia towards the interior seem to have varied at different times. The high and cold upland tract to the north-east, called Milyas, was by some writers included in that province, though it is naturally more connected with Pisidia. According to Artemidorus (whose authority is followed by Strabo), the towns that formed the Lycian league in the days of its integrity were twenty-three in number; but Pliny states that Lycia once possessed seventy towns, of which only twenty-six remained in his day. Recent researches have fully confirmed the fact that the sea-coast and the valleys were thickly studded with towns, many of which are proved by existing remains to have been places of importance. By the aid of inscriptions the position of the greater part of the cities mentioned in ancient authors can be fixed. On the gulf of Glaucus, near the frontiers of Caria, stood Telmessus, an important place, while a short distance inland from it were the small towns of Daedala and Cadyanda. At the entrance of the valley of the Xanthus were Patara, Xanthus itself, and, a little higher up, Pinara on the west and Tlos on the east side of the valley, while Araxa stood at the head of the valley, at the foot of the pass leading into the interior. Myra, one of the most important cities of Lycia, occupied the entrance of the valley of the Andriacus; on the coast between this and the mouth of the Xanthus stood Antiphellus, while in the interior at a short distance were found Phellus, Cyaneae and Candyba. In the alluvial plain formed by the rivers Arycandus and Limyrus stood Limyra, and encircling the same bay the three small towns of Rhodiapolis, Corydalla and Gagae. Arycanda commanded the upper valley of the river of the same name. On the east coast stood Olympus, one of the cities of the league, while Phaselis, a little farther north, which was a much more important place, never belonged to the Lycian league and appears always to have maintained an independent position.

The cold upland district of the Milyas does not seem to have contained any town of importance. Podalia appears to have been its chief place. Between the Milyas and the Pamphylian Gulf was the lofty mountain range of Solyma, which was supposed to derive its name from the Solymi, a people mentioned by Homer in connexion with the Lycians and the story of Bellerophon. In the flank of this mountain, near a place called Deliktash, was the celebrated fiery source called the Chimaera, which gave rise to many fables. It has been visited in modern times by Captain F. Beaufort, T. A. B. Spratt and Edward Forbes, and other travellers, and is merely a stream of inflammable gas issuing from crevices in the rocks, such as are found in several places in the Apennines. No traces of recent volcanic action exist in Lycia.

History.—The name of the Lycians, *Lukki*, is first met with in the Tel el-Amarna tablets (1400 B.C.) and in the list of the nations from the eastern Mediterranean who invaded Egypt in the reign of Mineptah, the successor of Rameses II. At that time they seem to have occupied the Cilician coast. Their occupation of Lycia was probably later, and since the Lycian inscriptions are not found far inland, we may conclude that they entered the country from the sea. On the other hand the name appears to be preserved in Lycaonia, where some bands of them may have settled. According to Herodotus they called themselves Termilae, written Trmmile in the native inscriptions, and he further states that the original inhabitants of the country were the Milyans and Solymi, the Lycians being invaders from Crete. In this tradition there is a reminiscence of the fact that the Lycians had been sea-rovers before their settlement in Lycia. The Lycian Sarpedon was believed to have taken part in the Trojan war. The Lydians failed to subdue Lycia, but after the fall of the Lydian empire it was conquered by Harpagus the general of Cyrus, Xanthus or Arnna, the capital, being completely destroyed. While acknowledging the suzerainty of Persia, however, the Lycians remained practically independent, and for a time joined the Delian league. "The son of Harpagus" on the obelisk of Xanthus boasts of having sacked numerous cities in alliance with the Athenian goddess. The Lycians were incorporated into the empire of Alexander and his successors, but even after their conquest by the Romans, preserved their federal institutions as late as the time of Augustus. According to Strabo the principal towns in the league were Xanthus, Patara, Pinara, Olympus, Myra and Tlos; each of these had three votes in the general assembly, while the other towns had only two or one. Taxation and the appointment of the Lyciarch and other magistrates were vested in the assembly. Under Claudius Lycia was formally annexed to the Roman empire, and united with Pamphylia: Theodosius made it a separate province.

Antiquities.—Few parts of Asia Minor were less known in modern times than Lycia up to the 19th century. Captain Beaufort was the first to visit several places on the sea-coast, and the remarkable rock-hewn tombs of Telmessus had been already described by Dr Clarke, but it was Sir Charles Fellows who first discovered and drew attention to the extraordinary richness of the district in ancient remains, especially of a sepulchral character. His visits to the country in 1838 and 1840 were followed by an expedition sent by the British government in 1842 to transport to England the valuable monuments now in the British Museum, while Admiral Spratt and Edward Forbes explored the interior, and laid down its physical features on an excellent map. The monuments thus brought to light are among the most interesting of those discovered in Asia Minor, and prove the existence of a distinct native architecture, especially in the rock-cut tombs. But the theatres found in almost every town, some of them of very large size, are sufficient to attest the pervading influence of Greek civilization; and this is confirmed by the sculptures, which are for the most part wholly Greek. None of them, indeed, can be ascribed to a very early period, and hardly any trace can be found of the influence of Assyrian or other Oriental art.

One of the most interesting results of these recent researches has been the discovery of numerous inscriptions in the native language of the country, and written in an alphabet peculiar to Lycia. A few of these inscriptions are bilingual, in Greek and Lycian, and the clue thus afforded to their interpretation has been followed up, first by Daniel Sharpe and Moritz Schmidt, and in more recent years by J. Imbert, W. Arkwright, V. Thomsen, A. Torp, S. Bugge and E. Kalinka.

The alphabet was derived from the Doric alphabet of Rhodes, but ten other characters were added to it to express vocalic and other sounds not found in Greek. The attempts to connect the language with the Indo-European family have been unsuccessful; it belongs to a separate family of speech which we may term "Asianic." Most of the inscriptions are sepulchral; by far the longest and most important is that on an obelisk found at Xanthus, which is a historical document, the concluding part of it being in a peculiar dialect, supposed to be an older and poetical form of the language. Among the deities mentioned are Trzzube (Trosobis) and Trqqiz or Trqqas.

Lycian art was modelled on that of the Greeks. The rock-cut tomb usually represented the house of the living, with an elaborate façade, but in one or two instances, notably that of the so-called Harpy-tomb, the façade is surmounted by a tall, square tower, in the upper part of which is the sepulchral chamber. Lycian sculpture followed closely the development of Greek sculpture, and many of the sculptures with which the tombs are adorned are of a high order of merit. The exquisite bas-reliefs on a Lycian sarcophagus now in the museum of Constantinople are among the finest surviving examples of classical art. The bas-reliefs were usually coloured. For the coinage, see NUMISMATICS, section "Asia Minor."

AUTHORITIES.—C. Fellows, *Journal in Asia Minor* (1839) and *Discoveries in Lycia* (1841); T. A. B. Spratt and E. Forbes, *Travels in Lycia* (1847); O. Benndorf and G. Niemann, *Reisen im südwestlichen Kleinasien* (1884); E. Petersen and F. von Luschan, *Reisen in Lykien* (1889); O. Treuber, *Geschichte der Lykier* (1887); G. Perrot and C. Chipiez, *Histoire de l'art dans l'antiquité*, v. (1890); P.

Kretschmer, *Einleitung in die Geschichte der griechischen Sprache* (1896); S. Bugge, *Lykische Studien* (from 1897); A. Torp, *Lykische Beiträge* (from 1898); V. Thomsen, *Études lyciennes* (1899); E. Kalinka and R. Heberdey, *Tituli Asiae Minoris*, i. (1901); see also articles XANTHUS, MYRA, PATARA. (A. H. S.)

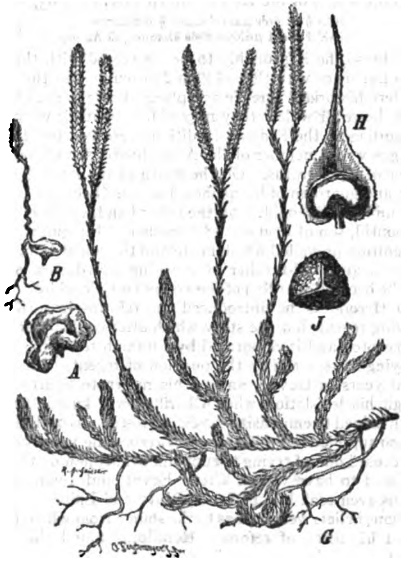
LYCK, or **LYK**, a town of Germany, in the Prussian province of East Prussia, 112 m. by rail S.E. of Königsberg, and close to the frontier of Poland, on a lake and river of the same name. Pop. (1900) 11,386. It is the chief town of the region known as Masuria. On an island in the lake is a castle formerly belonging to the Teutonic order, and dating from 1273, now used as a prison. There are iron-foundries, distilleries, breweries, tanneries, paper mills and flour mills, and a trade in grain and cattle.

LYCOPHRON, Greek poet and grammarian, was born at Chalcis in Euboea. He flourished at Alexandria in the time of Ptolemy Philadelphus (285–247 B.C.). According to Suidas, he was the son of Socles, but was adopted by Lycus of Rhegium. He was entrusted by Ptolemy with the task of arranging the comedies in the Alexandrian library, and as the result of his labours composed a treatise *On Comedy*. His own compositions, however, chiefly consisted of tragedies (Suidas gives the titles of twenty, of which very few fragments have been preserved), which secured him a place in the Pleiad of Alexandrian tragedians. One of his poems, *Alexandra* or *Cassandra*, containing 1474 iambic lines, has been preserved entire. It is in the form of a prophecy uttered by Cassandra, and relates the later fortunes of Troy and of the Greek and Trojan heroes. References to events of mythical and later times are introduced, and the poem ends with a reference to Alexander the Great, who was to unite Asia and Europe in his world-wide empire. The style is so enigmatical as to have procured for Lycophron, even among the ancients, the title of "obscure" (σκοτεινός). The poem is evidently intended to display the writer's knowledge of obscure names and uncommon myths; it is full of unusual words of doubtful meaning gathered from the older poets, and many long-winded compounds coined by the author. It has none of the qualities of poetry, and was probably written as a show-piece for the Alexandrian school. It was very popular in the Byzantine period, and was read and commented on very frequently; the collection of scholia by Isaac and John Tzetzes is very valuable, and the MSS. of the *Cassandra* are numerous.[1] A few well-turned lines which have been preserved from Lycophron's tragedies show a much better style; they are said to have been much admired by Menedemus of Eretria, although the poet had ridiculed him in a satyric drama. Lycophron is also said to have been a skilful writer of anagrams.

Editio princeps (1513); J. Potter (1697, 1702); L. Sebastiani (1803); L. Bachmann (1830); G. Kinkel (1880); E. Scheer (1881–1908), vol. ii. containing the scholia. The most complete edition is by C. von Holzinger (with translation, introduction and notes, 1895). There are translations by F. Dehèque (1853) and Viscount Royston (1806; a work of great merit). See also Wilamowitz-Möllendorff, *De Lycophronis Alexandra* (1884); J. Konze, *De Dictione Lycophronis* (1870). The commentaries of the brothers Tzetzes have been edited by C. O. Müller (1811).

LYCOPODIUM, the principal genus of the Lycopodiaceae, a natural order of the Fern-allies (see PTERIDOPHYTA). They are flowerless herbs, with an erect, prostrate or creeping widely-branched stem, with small simple leaves which thickly cover the stem and branches. The "fertile" leaves are arranged in cones, and bear spore-cases (sporangia) in their axils, containing spores of one kind only. The prothallium developed from the spore is a subterranean mass of tissue of considerable size, and bears the male and female organs (*antheridia* and *archegonia*). There are about a hundred species widely distributed in temperate and tropical climates; five occur in Britain on heaths and moors, chiefly in mountainous districts, and are known as club-mosses. The commonest species, *L. clavatum*, is also known as stag-horn moss.

Gerard, in 1597, described two kinds of lycopodium (*Herball*, p. 1373) under the names *Muscus denticulatus* and *Muscus clavatus* (*L. clavatum*) as "Club Mosse or Woolfes Clawe Mosse," the names being in Low Dutch, "Wolfs Clauwen," from the resemblance of the club-like or claw-shaped shoots to the toes of a wolf, "whereupon we first named it *Lycopodion*." Gerard also speaks of its emetic and many other supposed virtues. *L. Selago* and *L. catharticum* (a native of the Andes) have been said to be, at least when fresh, cathartic; but, with the exception of the spores of *L. clavatum* ("lycopodium powder"), lycopodium as a drug has fallen into disuse. The powder is used for rolling pills in, as a dusting powder for infants' sores, &c. A *tinctura lycopodii*, containing one part of the powder to ten of alcohol (90 %), has been given, in doses of 15 to 60 minims, in cases of irritation and spasm of the bladder. The powder is highly inflammable, and is used in pyrotechny and for artificial lightning on the stage. If the hand be covered with the powder it cannot be wetted on being plunged into water. Another use of lycopodium is for dyeing; woollen cloth boiled with species of lycopodium, as *L. clavatum*, becomes blue when dipped in a bath of Brazil wood.



From Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.

FIG. 1.—Lycopodium clavatum.

A, Old prothallus.
B, Prothallus bearing a young sporophyte.
G, Polian of a mature plant, showing the creeping habit, the adventitious roots and the specialized erect branches bearing the strobile or cones.
H, Sporophyte bearing the single sporangium on its upper surface.
J, Spore.

LYCOSURA (mod. *Palaeokastro* or *Siderokastro*), a city of Arcadia, reputed to be the most ancient city in Greece, and to have been founded by Lycaon the son of Pelasgus. Its fame in later times was chiefly associated with the temple of Despoena, containing the colossal group made by Damophon of Messene, of Despoena and Demeter seated, with Artemis and the Titan Anytus standing beside them. The temple and considerable remains of the group of sculpture were found in 1889. The date of both has been a matter of dispute, Damophon being placed at dates varying from the 4th century B.C. to the age of Hadrian. But it has now been shown that he lived in the 2nd century B.C. Remains of a portico, altars and other structures have also been found.

See Πρακτικὰ τῆς Ἀρχ. Ἑταιρίας (1896); G. Dickens, *Annual of British School at Athens*, xii. and xiii.

LYCURGUS (Gr. Λυκοῦργος), in Greek history, the reputed founder of the Spartan constitution. Plutarch opens his biography of Lycurgus with these words: "About Lycurgus the lawgiver it is not possible to make a single statement that is not called in question. His genealogy, his travels, his death, above all, his legislative and constitutional activity have been variously recorded, and there is the greatest difference of opinion as to his date." Nor has modern historical criticism arrived at any certain results. Many scholars, indeed, suppose him to be in reality a god or hero, appealing to the existence of a temple and cult of Lycurgus at Sparta as early as the time of Herodotus, (i. 66), and to the words of the Delphic oracle (Herod. i. 65)—

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[1] Two passages of the *Cassandra*, 1446–1450 and 1226–1282, in which the career of the Roman people and their universal empire are spoken of, could not possibly have been written by an Alexandrian poet of 250 B.C. Hence it has been maintained by Niebuhr and others that the poem was written by a later poet mentioned by Tzetzes, but the opinion of Welcker that these paragraphs are a later interpolation is generally considered more probable.

> δίζω ἤ σε θεὸν μαντεύσομαι ἤ ἄνθρωπον·
> ἀλλ' ἔτι καὶ μᾶλλον θεὸν ἔλπομαι, ὦ Λυκόοργε.

If this be so, he is probably to be connected with the cult of Apollo Lycius or with that of Zeus Lycaeus. But the majority of modern historians agree in accepting Lycurgus as an historical person, however widely they may differ about his work.

According to the Spartan tradition preserved by Herodotus, Lycurgus was a member of the Agiad house, son of Agis I. and brother of Echestratus. On the death of the latter he became regent and guardian of his nephew Labotas (Leobotes), who was still a minor. Simonides, on the other hand, spoke of him as a Eurypontid, son of Prytanis and brother of Eunomus, and later the tradition prevailed which made him the son of Eunomus and Dionassa, and half-brother of the king Polydectes, on whose death he became guardian of the young king Charillus. According to Herodotus he introduced his reforms immediately on becoming regent, but the story which afterwards became generally accepted and is elaborated by Plutarch represented him as occupying for some time the position of regent, then spending several years in travels, and on his return to Sparta carrying through his legislation when Charillus was king. This latter version helped to emphasize the disinterestedness of the lawgiver, and also supplied a motive for his travels—the jealousy of those who accused him of trying to supplant his nephew on the throne. He is said to have visited Crete, Egypt and Ionia, and some versions even took him to Spain, Libya and India.

Various beliefs were held as to the source from which Lycurgus derived his ideas of reform. Herodotus found the tradition current among the Spartans that they were suggested to Lycurgus by the similar Cretan institutions, but even in the 5th century there was a rival theory that he derived them from the Delphic oracle. These two versions are united by Ephorus, who argued that, though Lycurgus had really derived his system from Crete, yet to give it a religious sanction he had persuaded the Delphic priestess to express his views in oracular form.

The Reforms.—Herodotus says that Lycurgus changed "all the customs," that he created the military organization of ἐνωμοτίαι (*enomoties*), τριηκάδες (*triecades*) and συσσίτια (*syssitia*), and that he instituted the ephorate and the council of elders. To him, further, are attributed the foundation of the apella (the citizen assembly), the prohibition of gold and silver currency, the partition of the land (γῆς ἀναδασμός) into equal lots, and, in general, the characteristic Spartan training (ἀγωγή). Some of these statements are certainly false. The council of elders and the assembly are not in any sense peculiar to Sparta, but are present in the heroic government of Greece as depicted in the Homeric poems. The ephors, again, are almost universally held to be either an immemorial heritage of the Dorian stock or —and this seems more probable—an addition to the Spartan constitution made at a later date than can be assigned to Lycurgus. Further, the tradition of the Lycurgan partition of the land is open to grave objections. Grote pointed out (*History of Greece*, pt. ii. ch. 6) that even from the earliest historical times we find glaring inequalities of property at Sparta, and that the tradition was apparently unknown to all the earlier Greek historians and philosophers down to Plato and Aristotle: Isocrates (xii. 259) expressly denied that a partition of land had ever taken place in the Spartan state. Again, the tradition presupposes the conquest by the Spartans of the whole, or at least the greater part, of Laconia, yet Lycurgus must fall in the period when the Spartans had not yet subjugated even the middle Eurotas plain, in which their city lay. Finally, we can point to an adequate explanation of the genesis of the tradition in the ideals of the reformers of the latter part of the 3rd century, led by the kings Agis IV. and Cleomenes III. (*q.v.*). To them the cause of Sparta's decline lay in the marked inequalities of wealth, and they looked upon a redistribution of the land as the reform most urgently needed. But it was characteristic of the Greeks to represent the ideals of the present as the facts of the past, and so such a story as that of the Lycurgan γῆς ἀναδασμός may well have arisen at this time. It is at least noteworthy that the plan of Agis to give 4500 lots to Spartans and 15,000 to perioeci suspiciously resembles that of Lycurgus, in whose case the numbers are said to have been 9000 and 30,000 respectively. Lastly, the prohibition of gold and silver money cannot be attributed to Lycurgus, for at so early a period coinage was yet unknown in Greece.

Lycurgus, then, did not create any of the main elements of the Spartan constitution, though he may have regulated their powers and defined their position. But tradition represented him as finding Sparta the prey of disunion, weakness and lawlessness, and leaving her united, strong and subject to the most stable government which the Greek world had ever seen. Probably Grote comes near to the truth when he says that Lycurgus "is the founder of a warlike brotherhood rather than the lawgiver of a political community." To him we may attribute the unification of the several component parts of the state, the strict military organization and training which soon made the Spartan hoplite the best soldier in Greece, and above all the elaborate and rigid system of education which rested upon, and in turn proved the strongest support of, that subordination of the individual to the state which perhaps has had no parallel in the history of the world.

Lycurgus's legislation is very variously dated, and it is not possible either to harmonize the traditions or to decide with confidence between them. B. Niese (*Hermes*, xlii. 440 sqq.) assigns him to the first half of the 7th century B.C. Aristotle read Lycurgus's name, together with that of Iphitus, on the discus at Olympia which bore the terms of the sacred truce, but even if the genuineness of the document and the identity of this Lycurgus with the Spartan reformer be granted, it is uncertain whether the discus belongs to the so-called first Olympiad, 776 B.C., or to an earlier date. Most traditions place Lycurgus in the 9th century: Thucydides, whom Grote follows, dates his reforms shortly before 804, Isocrates and Ephorus go back to 869, and the chronographers are divided between 821, 828 and 834 B.C. Finally, according to a tradition recorded by Xenophon (*Resp. Laced.* x. 8), he was contemporary with the Heraclidae, in which case he would belong to the 10th century B.C.

AUTHORITIES.—Our chief ancient authorities, besides Plutarch's biography, are:—Herodotus i. 65; Xenophon, *Respublica Lacedaemoniorum*; Ephorus *ap.* Strabo x. 481, 482; Aristotle, *Politics*, ii.; Pausanias iii. and v. 4; and scattered passages in Plato, Isocrates, Polybius, Diodorus, Polyaenus, &c. Of modern works the most important are: E. Meyer, "Lykurgos von Sparta," in *Forschungen zur alten Geschichte* (Halle, 1892), i. 211 sqq.; A. Kopstadt, *De rerum Laconicarum constitutionis Lycurgeae origine et indole* (Greifswald, 1849); H. K. Stein, *Kritik der Überlieferung über den spartanischen Gesetzgeber Lykurg* (Glatz, 1882); S. Wide, "Bemerkungen zur spartanischen Lykurglegende," in *Skand. Archiv.* i. (1891), 90 sqq.; E. Nusselt, *Das Lykurgproblem* (Erlangen, 1898); H. Bazin, *De Lycurgo* (Paris, 1885); C. Reuss, *De Lycurgea quae fertur agrorum divisione* (Pforzheim, 1878); A. Busson, *Lykurgos und die grosse Rhetra* (Innsbruck, 1887); H. Gelzer, "Lykurg und die delphische Priesterschaft" in *Rhein. Mus.* xxviii. 1 sqq.; F. Winicker, *Stand der Lykurgischen Frage* (Graudenz, 1884); G. Attinger, *Essai sur Lycurgue et ses institutions* (Neuchâtel, 1892); the general Greek histories, and the works on the Spartan constitution cited under SPARTA. (M. N. T.)

LYCURGUS (*c.* 396–325 B.C.), one of the "ten" Attic orators. Through his father, Lycophron, he belonged to the old Attic priestly family of the Eteobutadae. He is said to have been a pupil both of Plato and of Isocrates. His early career is unknown, but after the real character of the struggle with Philip of Macedon became manifest he was recognized, with Demosthenes and Hypereides, as one of the chiefs of the national party. He left the care of external relations to his colleagues, and devoted himself to internal organization and finance. He managed the finances of Athens for twelve successive years (338–326), at first directly as treasurer of the revenues (ὁ ἐπὶ τῇ διοικήσει) for four years, and in two succeeding terms, when the actual office was forbidden him by law, through his son and a nominal official chosen from his party. Part of one of the deeds in which he rendered account of his term of office is still preserved in an inscription. During this time he raised the public income from 600 to 1200 talents yearly. He increased the navy, repaired the dockyards, and completed an arsenal, the *σκευοθήκη* designed by the architect Philo. He was also appointed to various other offices connected with the preservation and improvement of the city. He was very strict in his superintendence of the public morals, and passed a sumptuary law to restrain extravagance. He did much to beautify the city; he reconstructed the great Dionysiac theatre and the gymnasium in the Lyceum, and erected the Panathenaic stadium on the Ilissus. He is mentioned as the proposer of five laws, of which the most famous was that statues of the three great tragedians should be erected in the theatre, and that their works should be carefully edited and preserved among the state archives. For his services he was honoured with crowns, statues and a seat in the town hall; and after his death his friend Stratocles drew up a decree (still extant in pseudo-Plutarch, *Vit. dec. orat.* p. 851; see also E. L. Hicks, *Greek Historical Inscriptions*, 1st ed., No. 145), ordering the erection of a statue of bronze to Lycurgus, and granting the honours of the Prytaneum to his eldest son. He was one of the orators whose surrender was demanded by Alexander the Great, but the people refused to give him up. He died while president of the theatre of Dionysus, and was buried on the road leading to the Academy at the expense of the state.

Lycurgus was a man of action; his orations, of which fifteen were published, are criticized by the ancients for their awkward arrangement, harshness of style, and the tendency to digressions about mythology and history, although their noble spirit and lofty morality are highly praised. The one extant example, *Against Leocrates*, fully bears out this criticism. After the battle of Chaeroneia (338), in spite of the decree which forbade emigration under pain of death, Leocrates had fled from Athens. On his return (probably about 332) he was impeached by Lycurgus, but acquitted, the votes of the judges being equally divided.

The speech has been frequently edited. Editio princeps (Aldine, 1513); F. G. Kiessling (1847) with M. H. E. Meier's commentary on pseudo-Plutarch's *Life of Lycurgus* and the fragments of his speeches; C. Rehdantz (1876); T. Thalheim (1880); C. Scheibe (1885); F. Blass (ed. major, 1889), with bibliography of editions and articles (ed. minor, 1902); E. Sofer (Leipzig, 1905), with notes and introd. There is an index to Andocides, Lycurgus and Dinarchus by L. L. Forman (Oxford, 1897). The exhaustive treatise of F. Dürrbach, *L'Orateur Lycurgue* (1890), contains a list of the most important review articles on the financial and naval administration of Lycurgus and on his public works; see also C. Droege, *De Lycurgo publicarum pecuniarum administratore* (Minden, 1880). Several fragments of his various laws have been preserved in inscriptions (*Corpus inscriptionum atticarum*, ii. 162, 163, 173, 176, 180). On the history of the period see authorities under DEMOSTHENES.

LYCURGUS, "THE LOGOTHETE" (1772–1851), Greek leader in the War of Independence, was born in the island of Samos. He was educated at Constantinople, received the usual training, and followed the customary career of a Phanariot Greek. He accompanied Constantine Ypsilanti when he was appointed hospodar of Walachia, as secretary, and served Ypsilanti's successor, Alexander Soutzos, as treasurer and chancellor (Logothete). In 1802 he returned to Samos, and having become suspected by the Turkish government was imprisoned. He fled to Smyrna, when he was pardoned and released by the Turks. When the War of Independence began he induced his countrymen to declare Samos independent, and was chosen ruler. His share in the War of Independence is chiefly memorable because he provoked the massacre of Chios in 1822. Lycurgus conducted an expedition of 2500 to that island, which was held by a Turkish garrison under Velna Pasha. His force was insufficient, the time was ill-chosen, for a strong Turkish fleet was at sea, and Lycurgus displayed utter incapacity as a military leader. After these events, he was deposed by the Samians, but recovered some influence and had a share in the defence of Samos against the Turks in 1824. When the island was left under the authority of Turkey by the protocol of the 3rd of February 1830, he helped to obtain autonomy for the Samians. He retired to Greece and died on the 22nd of May 1851.

See G. Finlay, *History of the Greek Revolution* (London, 1861).

LYDD, a market town and municipal borough in the southern parliamentary division of Kent, England, 71½ m. S.E. by E. of London by a branch of the South-Eastern & Chatham railway. Pop. (1901) 2675. It lies in the open lowland of Dunge Marsh. To the south-east are the bare shingle banks of the promontory of Dungeness. Its church of All Saints has a beautiful Perpendicular tower with rich vaulting within. The neighbourhood affords pasture for large flocks of sheep. On the land known as the Rypes, in the neighbourhood, there is a military camp, with artillery and rifle ranges; hence the name given to the explosive "lyddite." The town is governed by a mayor, 4 aldermen and 12 councillors. Area, 12,043 acres.

The first settlement at Lydd (Hlide, Lide, Lyde) was probably due to its convenience as a fishing-station. After the Conquest it became a seaport of some consequence and although now, owing to the alteration of the coast, it stands nearly 3 m. inland a number of its inhabitants are still fishermen. In 774 land in Lydd was granted by Offa to the monks of Christ Church, Canterbury, and the archbishop of Canterbury evidently held the lordship of the town from an early date. At some time before the reign of Edward I. Lydd was made a member of the Cinque Port of Romney, and in 1290 was granted the same liberties and free customs as the Cinque Ports on condition of aiding the service of its head-port to the crown with one ship. This charter was confirmed by Edward III. in 1365. The corporation also possesses documents of 1154, 1399 and 1413, granting to the archbishop's men of Lydd the privileges enjoyed by the Cinque Ports and confirming all former privileges. Lydd is called a borough in the Hundred Rolls. Its incorporation under a bailiff, of which there is evidence in the 15th century, may have been due to the archbishop or to the court of Shepway, but it was not incorporated by the crown until 1885, when, by a charter under the Municipal Acts, the last bailiff was elected the first mayor. In 1494 a grant was made to the bailiff, jurats and commonalty of a yearly fair on the 12th of July and two days following. A fair was held under this grant until 1874.

LYDENBURG, a town and district of the Transvaal, South Africa. The town is 60 m. by rail N.N.E. of Belfast on the Pretoria-Delagoa Bay railway. Pop. (1904) 1523. It is picturesquely situated on the Spekboom tributary of the Olifants river at an altitude of 4900 ft. Some 15 m. E. is the Mauchberg (8725 ft.), the highest point in the Transvaal. The town is the chief centre for the Lydenburg goldfields. Next to Lydenburg the most important settlement in these goldfields is Pilgrim's Rest, pop. (1904) 1188, 23 m. N.E. of Lydenburg. Lydenburg (the town of suffering) was founded in 1846 by Boers who two years previously had established themselves farther north at Ohrigstad, which they abandoned on account of the fever endemic there. Lydenburg at once became the capital of a district (of the same name) which then embraced all the eastern part of the Transvaal. In 1856 the Boers of Lydenburg separated from their brethren and proclaimed an independent republic, which was, however, incorporated with the South African Republic in 1860. The discovery of gold near the town was made in 1869, and in 1873 the first successful goldfield in the Transvaal was opened here. It was not until 1910, however, that Lydenburg was placed in railway communication with the rest of the country. The present district of Lydenburg consists of the north-east and central parts of the original district. In the Lulu Mountains, a spur of the Drakensberg, and some 40 m. N.W. of Lydenburg, was the stronghold of the Kaffir chief Sikukuni, whose conflict with the Boers in 1876 was one of the causes which led to the annexation of the Transvaal by Great Britain in 1877. (See TRANSVAAL: *History*.)

LYDFORD, or **Lidford**, a village, once an important town, in the western parliamentary division of Devonshire, England, near the western confines of Dartmoor, 27 m. N. of Plymouth by the London & South-Western railway. From its Perpendicular church of St Petrock fine views of the Dartmoor tors are seen. The village stands on the small river Lyd, which traverses a deep narrow chasm, crossed by a bridge of single span; and at a little distance a tributary stream forms a cascade in an exquisite glen. Close to the church are slight remains of the castle of Lydford.

Lydford (*Lideford*) was one of the four Saxon boroughs of Devon, and possessed a mint in the days of Æthelred the Unready. It first appears in recorded history in 997, when the Danes made a plundering expedition up the Tamar and Tavy as far as "Hlidaforda." In the reign of Edward the Confessor it was the most populous centre in Devonshire after Exeter, but the Domesday Survey relates that forty houses had been laid waste since the Conquest, and the town never recovered its former prosperity; the history from the 13th century centres round the castle, which is first mentioned in 1216, when it was granted to William Briwere, and was shortly afterwards fixed as the prison of the stannaries and the meeting-place of the Forest Courts of Dartmoor. A gild at Lideford is mentioned in 1180, and the pipe roll of 1195 records a grant for the re-establishment of the market. In 1238 the borough, which had hitherto been crown demesne, was bestowed by Henry III. on Richard, earl of Cornwall, who in 1268 obtained a grant of a Wednesday market and a three days' fair at the feast of St Petrock. The borough had a separate coroner and bailiff in 1275, but it was never incorporated by charter, and only once, in 1300, returned members to parliament. Lydford prison is described in 1512 as "one of the most hainous, contagious and detestable places in the realm," and "Lydford Law" was a by-word for injustice. At the time of the Commonwealth the castle was entirely in ruins, but in the 18th century it was restored and again used as a prison and as the meeting-place of the manor and borough courts.

LYDGATE, JOHN (*c.* 1370–*c.* 1451), English poet, was born at the village of Lydgate, some 6 or 7 m. from Newmarket. It is, however, with the Benedictine abbey of Bury St Edmunds that he is chiefly associated. Probably he was educated at the school attached to the monastery, and in his *Testament* he has drawn a lively picture of himself as a typical orchard-robbing boy, who had scant relish for matins, fought, and threw creed and paternoster at the cock. He was ordained sub-deacon in 1389, deacon in 1393, and priest in 1397. These dates are valuable as enabling us to fix approximately the date of his birth, which must have occurred somewhere about 1370. Lydgate passed as a portent of learning, and, according to Bale, he pursued his studies not only at both the English universities but in France and Italy. Koeppel (see *Laurents de Premierfait und John Lydgates Bearbeitungen von Boccaccios De Casibus*, Munich, 1885) has thrown much doubt on this statement as regards Italy, but Lydgate knew France and visited Paris in an official capacity in 1426. Bale is also the authority for another assertion that figures in what has been aptly termed the poet's "traditional biography," viz. that Lydgate, on completing his own education, kept school for the sons of noblemen and gentlemen. This "traditional biography" prolongs his life to the year 1461, but it is quite improbable that he lived many years after 1446, when Abbot Curteys died and John Baret, treasurer of Bury, signed an extant receipt for a pension which he shared with Lydgate, and which continued to be paid till 1449. If it be true, as Bishop Alcock of Ely affirms, that Lydgate wrote a poem on the loss of France and Gascony, it seems necessary to suppose that he lived two years longer, and thus indications point to the year 1451, or thereabouts, as the date of his death.

Lydgate had a consuming passion for literature, and it was probably that he might indulge this taste more fully that in 1434 he retired from the priorate of Hatfield Broadoak (or Hatfield Regis), to which he had been appointed in June 1423. After 1390—but whilst he was still a young man—he made the acquaintance of Geoffrey Chaucer, with whose son Thomas he was on terms of considerable intimacy. This friendship appears to have decided Lydgate's career, and in his *Troy-book* and elsewhere are reverent and touching tributes to his "master." The passages in question do not exaggerate his obligations to the "well of English." The themes of all his more ambitious poems can be traced to Chaucerian sources. The *Story of Thebes*, for instance, was doubtless suggested by the "romance" which Cressida and her companions are represented as reading when interrupted by Pandarus (*Troilus and Cressida*, II. xii.-xvi.). The *Falls of Princes*, again, is merely the *Monk's Tale* "writ large."

Lydgate is a most voluminous writer. The *Falls of Princes* alone comprises 7000 stanzas; and his authentic compositions reach the enormous total of 150,000 lines. Cursed with such immoderate fluency Lydgate could not sustain himself at the highest level of artistic excellence; and, though imbued with a sense of the essentials of poetry, and eager to prove himself in its various manifestations, he stinted himself of the self-discipline necessary to perfection of form. As the result the bulk of his composition is wholly or comparatively rough-hewn. That he was capable of better work than is suggested by his average accomplishment is shown by two allegorical poems—the *Complaint of the Black Knight* and the *Temple of Glass* (once attributed to Hawes). In these he reveals himself as a not unworthy successor of Chaucer, and the pity of it is that he should have squandered his powers in a futile attempt to create an entire literature. For a couple of centuries Lydgate's reputation equalled, if it did not surpass, that of his master. This was in a sense only natural, since he was the real founder of the school of which Stephen Hawes was a distinguished ornament, and which "held the field" in English letters during the long and dreary interval between Chaucer and Spenser. One of the most obvious defects of this school is excessive attachment to polysyllabic terms. Lydgate is not quite so great a sinner in this respect as are some of his successors, but his tendency cannot be mistaken, and John Metham is amply justified in his censure—

> Eke John Lydgate, sometime monk of Bury,
> His books indited with terms of rhetoric
> And half-changed Latin, with conceits of poetry.

Pedantry was an inevitable effect of the early Renaissance. French literature passed through the same phase, from which indeed it was later in emerging; and the ultimate consequence was the enrichment of both languages. It must be conceded as no small merit in Lydgate that, in an age of experiment he should have succeeded so often in hitting the right word. Thomas Warton remarks on his lucidity. Since his writings are read more easily than Chaucer's, the inference is plain—that he was more effectual as a maker of our present English. In spite of that, Lydgate is characteristically medieval—medieval in his prolixity, his platitude, his want of judgment and his want of taste; medieval also in his pessimism, his Mariolatry and his horror of death. These attributes jarred on the sensitive Ritson, who racked his brains for contumelious epithets such as "stupid and disgusting," "cart-loads of rubbish," &c.; and during the greater part of the 18th and 19th centuries Lydgate's reputation was at its lowest ebb. Recent criticism has been far more impartial, and almost too much respect has been paid to his attainments, especially in the matter of metre, though Lydgate himself, with offensive lightheartedness, admits his poor craftsmanship.

Lydgate's most doughty and learned apologist is Dr Schick, whose preface to the *Temple of Glass* embodies practically all that is known or conjectured concerning this author, including the chronological order of his works. With the exception of the *Damage and Destruction in Realms*—an account of Julius Caesar, his wars and his death—they are all in verse and extremely multifarious—narrative, devotional hagiological, philosophical and scientific, allegorical and moral, historical, satirical and occasional. The *Troy-book*, undertaken at the command of Henry V., then prince of Wales, dates from 1412–1420; the *Story of Thebes* from 1420–1422; and the *Falls of Princes* towards 1430. His latest work was *Secreta Secretorum* or *Secrets of Old Philosophers*, rhymed extracts from a pseudo-Aristotelian treatise. Lydgate certainly possessed extraordinary versatility, which enabled him to turn from elaborate epics to quite popular poems like the *Mumming at Hertford*, *A Ditty of Women's Horns* and *London Lickpenny*. The humour of this last is especially bright and effective, but, unluckily for the author, the piece is believed to have been retouched by some other hand. The longer efforts partake of the nature of translations from sundry medieval compilations like those of Guido di Colonna and Boccaccio, which are in Latin.

See publications of the Early English Text Society, especially the *Temple of Glass*, edited by Dr Schick; Koeppel's *Lydgate's Story of Thebes, eine Quellenuntersuchung* (Munich, 1884), and the same scholar's *Laurents de Premierfait und John Lydgates Bearbeitungen von Boccaccios De Casibus Illustrium Virorum* (Munich, 1885); Warton's *History of English Poetry*; Ritson's *Bibliotheca Anglo-Poetica*; Furnivall's *Political Poems* (E. E. T. S.); and Sidney Lee's article in the *Dict. Nat. Biog.* (F. J. S.)

LYDIA, in ancient geography, a district of Asia Minor, the boundaries of which it is difficult to fix, partly because they varied at different epochs. The name is first found under the form of *Luddi* in the inscriptions of the Assyrian king Assur-bani-pal, who received tribute from Gyges about 660 B.C. In Homer we read only of Maeonians (*Il.* ii. 865, v. 43, x. 431), and the place of the Lydian capital Sardis is taken by Hydē (*Il.* xx. 385), unless this was the name of the district in which Sardis stood (see Strabo xiii. p. 626).[1] The earliest Greek writer who mentions the name is Mimnermus of Colophon, in the 37th Olympiad. According to Herodotus (i. 7), the Meiones (called Maeones by other writers) were named Lydians after Lydus, the son of Attis, in the mythical epoch which preceded the rise of the Heraclid dynasty. In historical times the Maeones were a tribe inhabiting the district of the upper Hermus, where a town called Maeonia existed (Pliny, *N.H.* v. 30; Hierocles, p. 670). The Lydians must originally have been an allied tribe which bordered upon them to the north-west, and occupied the plain of Sardis or Magnesia at the foot of Tmolus and Sipylus. They were cut off from the sea by the Greeks, who were in possession, not only of the Bay of Smyrna, but also of the country north of Sipylus as far as Temnus in the pass (*boghaz*), through which the Hermus forces its way from the plain of Magnesia into its lower valley.[2] In a Homeric epigram the ridge north of the Hermus, on which the ruins of Temnus lie, is called Sardenē. Northward the Lydians extended at least as far as the Gygaean Lake (Lake Coloe, mod. Mermereh), and the Sardenē range (mod. Dumanli Dagh). The plateau of the Bin Bir Tepē, on the southern shore of the Gygaean Lake, was the chief burial-place of the inhabitants of Sardis, and is still thickly studded with tumuli, among which is the "tomb of Alyattes" (260 ft. high). Next to Sardis the chief city was Magnesia ad Sipylum (*q.v.*), in the neighbourhood of which is the famous seated figure of "Niobe" (*Il.* xxiv. 614-617), cut out of the rock, and probably intended to represent the goddess Cybele, to which the Greeks attached their legend of Niobe. According to Pliny (v. 31), Tantalis, afterwards swallowed up by earthquake in the pool Salē or Saloē, was the ancient name of Sipylus and "the capital of Maeonia" (Paus. vii. 24; Strabo xii. 579). Under the Heraclid dynasty the limits of Lydia must have been already extended, since according to Strabo (xiii. 590), the authority of Gyges reached as far as the Troad. Under the Mermnads Lydia became a maritime as well as an inland power. The Greek cities were conquered, and the coast of Ionia included within the Lydian kingdom. The successes of Alyattes and of Croesus finally changed the Lydian kingdom into a Lydian empire, and all Asia Minor westward of the Halys, except Lycia, owned the supremacy of Sardis. Lydia never again shrank back into its original dimensions. After the Persian conquest the Maeander was regarded as its southern boundary, and in the Roman period it comprised the country between Mysia and Caria on the one side and Phrygia and the Aegean on the other.

Lydia proper was exceedingly fertile. The hill-sides were clothed with vine and fir, and the rich broad plain of Hermus produced large quantities of corn and saffron. The climate of the plain was soft but healthy, though the country was subject to frequent earthquakes. The Pactolus, which flowed from the fountain of Tarnē in the Tmolus mountains, through the centre of Sardis, into the Hermus, was believed to be full of golden sand; and gold mines were worked in Tmolus itself, though by the time of Strabo the proceeds had become so small as hardly to pay for the expense of working them (Strabo xiii. 591). Maeonia on the east contained the curious barren plateau known to the Greeks as the Katakekaumenē ("Burnt country"), once a centre of volcanic disturbance. The Gygaean lake (where remains of pile dwellings have been found) still abounds with carp.

Herodotus (i. 171) tells us that Lydus was a brother of Mysus and Car. The statement is on the whole borne out by the few Lydian, Mysian and Carian words that have been preserved, as well as by the general character of the civilization prevailing among the three nations. The race was probably a mixed one, consisting of aborigines and Aryan immigrants. It was characterized by industry and a commercial spirit, and, before the Persian conquest, by bravery. The religion of the Lydians resembled that of the other civilized nations of Asia Minor. It was a nature worship, which at times became wild and sensuous. By the side of the supreme god Medeus stood the sun-god Attis, as in Phrygia the chief object of the popular cult. He was at once the son and bridegroom of Cybele (*q.v.*) or Cybebe, the mother of the gods, whose image carved by Broteas, son of Tantalus, was adored on the cliffs of Sipylus (Paus. iii. 22). The cult may have been brought westward by the Hittites who have left memorials of themselves in the pseudo-Sesostris figures of Kara-bel (between Sardis and Ephesus) as well as in the figure of the Mother-goddess, the so-called Niobe. At Ephesus, where she was adored under the form of a meteoric stone, she was identified with the Greek Artemis (see also Great Mother of the Gods). Her mural crown is first seen in the Hittite sculptures of Boghaz Keui (see Pteria and Hittites) on the Halys. The priestesses by whom she was served are depicted in early art as armed with the double-headed axe, and the dances they performed in her honour with shield and bow gave rise to the myths which saw in them the Amazons, a nation of woman-warriors. The pre-Hellenic cities of the coast—Smyrna, Samorna (Ephesus), Myrina, Cyme, Priene and Pitane—were all of Amazonian origin, and the first three of them have the same name as the Amazon Myrina, whose tomb was pointed out in the Troad. The prostitution whereby the Lydian girls gained their dowries (Herod. i. 93) was a religious exercise, as among the Semites, which marked their devotion to the goddess Cybele. In the legend of Heracles, Omphale takes the place of Cybele, and was perhaps her Lydian title. Heracles is here the sun-god Attis in a new form; his Lydian name is unknown, since E. Meyer has shown (*Zeitschr. d. Morg. Gesell.* xxxi. 4) that Sandon belongs not to Lydia but to Cilicia. By the side of Attis stood Manes or Men, identified later with the Moon-god.

According to the native historian Xanthus (460 B.C.) three dynasties ruled in succession over Lydia. The first, that of the Attiads, is mythical. It was headed by a god, and included geographical personages like Lydus, Asies and Meles, or such heroes of folk-lore as Cambletes, who devoured his wife. To this mythical age belongs the colony which, according to Herodotus (i. 94), Tyrsenus, the son of Attis, led to Etruria. Xanthus, however, puts Torrhebus in the place of Tyrsenus, and makes him the eponym of a district in Lydia. It is doubtful whether Xanthus recognized the Greek legends which brought Pelops from Lydia, or rather Maeonia, and made him the son of Tantalus. The second dynasty was also of divine origin, but the names which head it prove its connexion with the distant East. Its founder, a descendant of Heracles and Omphale, was, Herodotus tells us (i. 7), a son of Ninus and grandson of Belus. The Assyrian inscriptions have shown that the Assyrians had never crossed the Halys, much less known the name of Lydia, before the age of Assur-bani-pal, and consequently the theory which brought the Heraclids from Nineveh must be given up. But the Hittites, another Oriental people, deeply imbued with the elements of Babylonian culture, had overrun Asia Minor and established themselves on the shores of the Aegean before the reign of the Egyptian king Rameses II.

The subject allies who then fight under their banners include the Masu or Mysians and the Dardani of the Troad, while the

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[1] Pliny (v. 30) makes it the Maeonian name.

[2] See Sir W. M. Ramsay in the *Journal of Hellenic Studies*, ii. 2.

Hittites have left memorials in Lydia. G. Dennis discovered an inscription in Hittite hieroglyphics attached to the figure of "Niobe" on Sipylus, and a similar inscription accompanies the figure (in which Herodotus, ii. 106, wished to see Sesostris or Rameses II.) in the pass of Karabel. We learn from Eusebius that Sardis was first captured by the Cimmerii 1078 B.C.; and since it was four centuries later before the real Cimmerii (*q.v.*) appeared on the horizon of history, we may perhaps find in the statement a tradition of the Hittite conquest. As the authority of the Hittite satraps at Sardis began to decay the Heraclid dynasty arose. According to Xanthus, Sadyattes and Lixus were the successors of Tylon the son of Omphale. After lasting five hundred and five years, the dynasty came to an end in the person of Sadyattes, as he is called by Nicolas of Damascus, whose account is doubtless derived from Xanthus. The name Candaules, given him by Herodotus, meant "dog strangler" and was a title of the Lydian Hermes. Gyges (*q.v.*) put him to death and established the dynasty of the Mermnads, 687 B.C. Gyges initiated a new policy, that of making Lydia a maritime power; but towards the middle of his reign the kingdom was overrun by the Cimmerii. The lower town of Sardis was taken, and Gyges sent tribute to Assur-bani-pal, as well as two Cimmerian chieftains he had himself captured in battle. A few years later Gyges joined in the revolt against Assyria, and the Ionic and Carian mercenaries he despatched to Egypt enabled Psammetichus to make himself independent. Assyria, however, was soon avenged. The Cimmerian hordes returned, Gyges was slain in battle (652 B.C.), and Ardys his son and successor returned to his allegiance to Nineveh. The second capture of Sardis on this occasion was alluded to by Callisthenes (Strabo xiii. 627). Alyattes, the grandson of Ardys, finally succeeded in extirpating the Cimmerii, as well as in taking Smyrna, and thus providing his kingdom with a port. The trade and wealth of Lydia rapidly increased, and the Greek towns fell one after the other before the attacks of the Lydian kings. Alyattes's long reign of fifty-seven years saw the foundation of the Lydian empire. All Asia Minor west of the Halys acknowledged his sway, and the six years' contest he carried on with the Medes was closed by the marriage of his daughter Aryenis to Astyages. The Greek cities were allowed to retain their own institutions and government on condition of paying taxes and dues to the Lydian monarch, and the proceeds of their commerce thus flowed into the imperial exchequer. The result was that the king of Lydia became the richest prince of his age. Alyattes was succeeded by Croesus (*q.v.*), who had probably already for some years shared the royal power with his father, or perhaps grandfather, as V. Floigl thinks (*Geschichte des semitischen Alterthums*, p. 20). He reigned alone only fifteen years, Cyrus the Persian, after an indecisive battle on the Halys, marching upon Sardis, and capturing both acropolis and monarch (546 B.C.). The place where the acropolis was entered was believed to have been overlooked by the mythical Meles when he carried the lion round his fortress to make it invulnerable; it was really a path opened by one of the landslips, which have reduced the sandstone cliff of the acropolis to a mere shell, and threaten to carry it altogether into the plain below. The revolt of the Lydians under Pactyas, whom Cyrus had appointed to collect the taxes, caused the Persian king to disarm them, though we can hardly credit the statement that by this measure their warlike spirit was crushed. Sardis now became the western capital of the Persian empire, and its burning by the Athenians was the indirect cause of the Persian War. After Alexander the Great's death, Lydia passed to Antigonus; then Achaeus made himself king at Sardis, but was defeated and put to death by Antiochus. The country was presented by the Romans to Eumenes, and subsequently formed part of the proconsular province of Asia. By the time of Strabo (xiii. 631) its old language was entirely supplanted by Greek.

The Lydian empire may be described as the industrial power of the ancient world. The Lydians were credited with being the inventors, not only of games such as dice, huckle-bones and ball (Herod. i. 94), but also of coined money. The oldest known coins are the electrum coins of the earlier Mermnads (Madden, *Coins of the Jews*, pp. 19-21), stamped on one side with a lion's head or the figure of a king with bow and quiver; these were replaced by Croesus with a coinage of pure gold and silver. To the latter monarch were probably due the earliest gold coins of Ephesus (Head, *Coinage of Ephesus*, p. 16). The electrum coins of Lydia were of two kinds, one weighing 168·4 grains for the inland trade, and another of 224 grains for the trade with Ionia. The standard was the silver mina of Carchemish (as the Assyrians called it) which contained 8656 grains. Originally derived by the Hittites from Babylonia, but modified by themselves, this standard was passed on to the nations of Asia Minor during the period of Hittite conquest, but was eventually superseded by the Phoenician mina of 11,225 grains, and continued to survive only in Cyprus and Cilicia (see also NUMISMATICS). The inns, which the Lydians were said to have been the first to establish (Herod. i. 94), were connected with their attention to commercial pursuits. Their literature has wholly perished. They were celebrated for their music and gymnastic exercises, and their art formed a link between that of Asia Minor and that of Greece. R. Heberdey's excavations at Ephesus since 1896, like those of D. G. Hogarth in 1905, belong to the history of Greek and not native art. The ivory figures, however, found by Hogarth on the level of the earliest temple of Artemis show Asiatic influence, and resemble the so-called "Phoenician" ivories from the palace of Sargon at Calah (Nimrud). For a description of a pectoral of white gold, ornamented with the heads of animals, human faces and the figure of a goddess, discovered in a tomb on Tmolus, see *Academy*, January 15, 1881, p. 45. Lydian sculpture was probably similar to that of the Phrygians. Phallic emblems, for averting evil, were plentiful; the summit of the tomb of Alyattes is crowned with an enormous one of stone, about 9 ft. in diameter. The tumulus itself is 281 yds. in diameter and about half a mile in circumference. It has been partially excavated by G. Spiegelthal and G. Dennis, and a sepulchral chamber discovered in the middle, composed of large well-cut and highly polished blocks of marble, the chamber being 11 ft. long, nearly 8 ft. broad and 7 ft. high. Nothing was found in it except a few ashes and a broken vase of Egyptian alabaster. The stone basement which, according to Herodotus, formerly surrounded the mound has disappeared.

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LYDUS ("THE LYDIAN"), **JOANNES LAURENTIUS**, Byzantine writer on antiquarian subjects, was born at Philadelphia in Lydia about A.D. 490. At an early age he set out to seek his fortune in Constantinople, and held high court and state offices under Anastasius and Justinian. In 552 he lost favour, and was dismissed. The date of his death is not known, but he was probably alive during the early years of Justin II. (reigned 565–578). During his retirement he occupied himself in the compilation of works on the antiquities of Rome, three of which have been preserved: (1) *De Ostentis* (Περὶ διοσημειῶν), on the origin and progress of the art of divination; (2) *De Magistratibus reipublicae Romanae* (Περὶ ἀρχῶν τῆς Ῥωμαίων πολιτείας), especially valuable for the administrative details of the time of Justinian; (3) *De Mensibus* (Περὶ μηνῶν), a history of the different festivals of the year. The chief value of these books consists in the fact that the author made use of the works (now lost) of old Roman writers on similar subjects. Lydus was also commissioned by Justinian to compose a panegyric on the emperor, and a history of his successful campaign against Persia; but these, as well as some poetical compositions, are lost.

Editions of (1) by C. Wachsmuth (1897), with full account of the authorities in the prolegomena; of (2) and (3) by R. Wünsch (1898–1903); see also the essay by C. B. Hase (the first editor of the *De Ostentis*) prefixed to I. Bekker's edition of Lydus (1837) in the Bonn *Corpus scriptorum hist. Byzantinae*.

LYE (O. Eng. *lēag*, cf. Dutch *loog*, Ger. *Lauge*, from the root meaning to wash, see in Lat. *lavare*, and Eng. "lather," froth of soap and water, and "laundry"), the name given to the solution of alkaline salts obtained by leaching or lixiviating wood ashes with water, and sometimes to a solution of a caustic alkali. Lixiviation (Lat. *lixivium*, lye, *lix*, ashes) is the action of separating, by the percolation of water, a soluble from an insoluble substance. "Leaching," the native English term for this process, is from "leach," to water, the root probably being the same as in "lake."

LYELL, SIR CHARLES (1797–1875), British geologist, was the eldest son of Charles Lyell of Kinnordy, Forfarshire, and was born on the 14th of November 1797, on the family estate in Scotland. His father (1767–1849) was known both as a botanist and as the translator of the *Vita Nuova* and the *Convito* of Dante: the plant *Lyellia* was named after him. From his boyhood Lyell had a strong inclination for natural history, especially entomology, a taste which he cultivated at Bartley Lodge in the New Forest, to which his family had removed soon after his birth. In 1816 he entered Exeter College, Oxford, where the lectures of Dr Buckland first drew his attention to geological study. After taking his degree of B.A. in 1819 (M.A. in 1821) he entered Lincoln's Inn, and in 1825, after a delay caused by chronic weakness of the eyes, he was called to the bar, and went on the western circuit for two years. During this time he was slowly gravitating towards the life of a student of science. In 1819 he had been elected a fellow of the Linnean and Geological Societies, communicating his first paper, "On a Recent Formation of Freshwater Limestone in Forfarshire," to the latter society in 1822, and acting as one of the honorary secretaries in 1823. In that year he went to France, with introductions to Cuvier, Humboldt and other men of science, and in 1824 made a geological tour in Scotland in company with Dr Buckland. In 1826 he was elected a fellow of the Royal Society, from which in later years he received both the Copley and Royal medals; and in 1827 he finally abandoned the legal profession, and devoted himself to geology.

At this time he had already begun to plan his chief work, *The Principles of Geology*. The subsidiary title, "An Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes now in Operation," gives the keynote of the task to which Lyell devoted his life. A journey with Murchison in 1828 gave rise to joint papers on the volcanic district of Auvergne and the Tertiary formations of Aix-en-Provence. After parting with Murchison he studied the marine remains of the Italian Tertiary Strata and then conceived the idea of dividing this geological system into three or four groups, characterized by the proportion of recent to extinct species of shells. To these groups, after consulting Dr Whewell as to the best nomenclature, he gave the names now universally adopted—Eocene (*dawn of recent*), Miocene (*less of recent*), and Pliocene (*more of recent*), and with the assistance of G. P. Deshayes he drew up a table of shells in illustration of this classification. The first volume of the *Principles of Geology* appeared in 1830, and the second in January 1832. Received at first with some opposition, so far as its leading theory was concerned, the work had ultimately a great success, and the two volumes had already reached a second edition in 1833 when the third, dealing with the successive formations of the earth's crust, was added. Between 1830 and 1872 eleven editions of this work were published, each so much enriched with new material and the results of riper thought as to form a complete history of the progress of geology during that interval. Only a few days before his death Sir Charles finished revising the first volume of the 12th edition; the revision of the second volume was completed by his nephew Mr (afterwards Sir) Leonard Lyell; and the work appeared in 1876.

In August 1838 Lyell published the *Elements of Geology*, which, from being originally an expansion of one section of the *Principles*, became a standard work on stratigraphical and palaeontological geology. This book went through six editions in Lyell's lifetime (some intermediate editions being styled *Manual of Elementary Geology*), and in 1871 a smaller work, the *Student's Elements of Geology*, was based upon it. His third great work, *The Antiquity of Man*, appeared in 1863, and ran through three editions in one year. In this he gave a general survey of the arguments for man's early appearance on the earth, derived from the discoveries of flint implements in post-Pliocene strata in the Somme valley and elsewhere; he discussed also the deposits of the Glacial epoch, and in the same volume he first gave in his adhesion to Darwin's theory of the origin of species. A fourth edition appeared in 1873.

In 1831–1833 Lyell was professor of geology at King's College, London, and delivered while there a course of lectures, which became the foundation of the *Elements of Geology*. In 1832 he married Mary (1809–1873) eldest daughter of Leonard Horner (*q.v.*), and she became thenceforward associated with him in all his work, and by her social qualities making his home a centre of attraction. In 1834 he made an excursion to Denmark and Sweden, the result of which was his Bakerian lecture to the Royal Society "On the Proofs of the gradual Rising of Land in certain Parts of Sweden." He also brought before the Geological Society a paper "On the Cretaceous and Tertiary Strata of Seeland and Möen." In 1835 he became president of the Geological Society. In 1837 he was again in Norway and Denmark, and in 1841 he spent a year in travelling through the United States, Canada and Nova Scotia. This last journey, together with a second one to America in 1845, resulted not only in papers, but also in two works not exclusively geological, *Travels in North America* (1845) and *A Second Visit to the United States* (1849). During these journeys he estimated the rate of recession of the falls of Niagara, the annual average accumulation of alluvial matter in the delta of the Mississippi, and studied those vegetable accumulations in the "Great Dismal Swamp" of Virginia, which he afterwards used in illustrating the formation of beds of coal. He also studied the coal-formations in Nova Scotia, and discovered in company with Dr (afterwards Sir J. W.) Dawson (*q.v.*) of Montreal, the earliest known landshell, *Pupa vetusta*, in the hollow stem of a Sigillaria. In bringing a knowledge of European geology to bear upon the extended formations of North America Lyell rendered immense service. Having visited Madeira and Teneriffe in company with G. Hartung, he accumulated much valuable evidence on the age and deposition of lava-beds and the formation of volcanic cones. He also revisited Sicily in 1858, when he made such observations upon the structure of Etna as refuted the theory of "craters of elevation" upheld by Von Buch and Élie de Beaumont (see *Phil. Trans.*, 1859).

Lyell was knighted in 1848, and was created a baronet in 1864, in which year he was president of the British Association at Bath. He was elected corresponding member of the French Institute and of the Royal Academy of Sciences at Berlin, and was created a knight of the Prussian Order of Merit.

During the later years of his life his sight, always weak, failed him altogether. He died on the 22nd of February 1875, and was buried in Westminster Abbey. Among his characteristics were his great thirst for knowledge, his perfect fairness and sound judgment; while the extreme freshness of his mind enabled him to accept and appreciate the work of younger men.

The LYELL MEDAL, established in 1875 under the will of Sir Charles Lyell, is cast in bronze and is to be awarded annually (or from time to time) by the Council of the Geological Society. The medallist may be of any country or either sex. Not less than one-third of the annual interest of a sum of £2000 is to be awarded with the medal; the remaining interest, known as the LYELL GEOLOGICAL FUND, is to be given in one or more portions at the discretion of the Council for the encouragement of geological science.

See *Life, Letters and Journals of Sir Charles Lyell, Bart.*, edited by his sister-in-law, Mrs Lyell (2 vols., 1881); *Charles Lyell and Modern Geology*, by T. G. Bonney (1895). (H. B. Wo.)

LYLY (LILLY, or LYLIE), **JOHN** (1553–1606), English writer, the famous author of *Euphues*, was born in Kent in 1553 or 1554. At the age of sixteen, according to Wood, he became a student of Magdalen College, Oxford, where in due time he proceeded to his bachelor's and master's degrees (1573 and 1575), and from whence we find him in 1574 applying to Lord Burghley "for the queen's letters to Magdalen College to admit him fellow." The fellowship, however, was not granted, and Lyly shortly after left the university. He complains of what seems to have been a sentence of rustication passed upon him at some period in his academical career, in his address to the gentlemen scholars of Oxford affixed to the second edition of the first part of *Euphues*, but in the absence of any further evidence it is impossible to fix either its date or its cause. If we are to believe Wood, he never took kindly to the proper studies of the university. "For so it was that his genius being naturally bent to the pleasant paths of poetry (as if Apollo had given to him a wreath of his own bays without snatching or struggling) did in a manner neglect academical studies, yet not so much but that he took the degrees in arts, that of master being compleated 1575." After he left Oxford, where he had already the reputation of "a noted wit," Lyly seems to have attached himself to Lord Burghley. "This noble man," he writes in the "Glasse for Europe," in the second part of *Euphues* (1580), "I found so ready being but a straunger to do me good, that neyther I ought to forget him, neyther cease to pray for him, that as he hath the wisdom of Nestor, so he may have the age, that having the policies of Ulysses he may have his honor, worthy to lyve long, by whom so many lyve in quiet, and not unworthy to be advaunced by whose care so many have been preferred." Two years later we possess a letter of Lyly to the treasurer, dated July 1582, in which the writer protests against some accusation of dishonesty which had brought him into trouble with his patron, and demands a personal interview for the purpose of clearing his character. What the further relations beween them were we have no means of knowing, but it is clear that neither from Burghley nor from the queen did Lyly ever receive any substantial patronage. In 1578 he began his literary career by the composition of *Euphues, or the Anatomy of Wit*, which was licensed to Gabriel Cawood on the 2nd of December, 1578, and published in the spring of 1579. In the same year the author was incorporated M.A. at Cambridge, and possibly saw his hopes of court advancement dashed by the appointment in July of Edmund Tylney to the office of master of the revels, a post at which, as he reminds the queen some years later, he had all along been encouraged to "aim his courses." *Euphues and his England* appeared in 1580, and, like the first part of the book, won immediate popularity. For a time Lyly was the most successful and fashionable of English writers. He was hailed as the author of "a new English," as a "raffineur de l'Anglois"; and, as Edmund Blount, the editor of his plays, tells us in 1632, "that beautie in court which could not parley Euphuism was as little regarded as she which nowe there speakes not French." After the publication of *Euphues*, however, Lyly seems to have entirely deserted the novel form himself, which passed into the hands of his imitators, and to have thrown himself almost exclusively into play-writing, probably with a view to the mastership of revels whenever a vacancy should occur. Eight plays by him were probably acted before the queen by the children of the Chapel Royal and the children of St Paul's between the years 1584 and 1589, one or two of them being repeated before a popular audience at the Blackfriars Theatre. Their brisk lively dialogue, classical colour and frequent allusions to persons and events of the day maintained that popularity with the court which *Euphues* had won. Lyly sat in parliament as member for Hindon in 1589, for Aylesbury in 1593, for Appleby in 1597 and for Aylesbury a second time in 1601. In 1589 Lyly published a tract in the Martin Marprelate controversy, called *Pappe with an hatchet, alias a figge for my Godsonne; Or Crack me this nut; Or a Countrie Cuffe, &c.*[1] About the same time we may probably date his first petition to Queen Elizabeth. The two petitions, transcripts of which are extant among the Harleian MSS., are undated, but in the first of them he speaks of having been ten years hanging about the court in hope of preferment, and in the second he extends the period to thirteen years. It may be conjectured with great probability that the ten years date from 1579, when Edmund Tylney was appointed master of the revels with a tacit understanding that Lyly was to have the next reversion of the post. "I was entertained your Majestie's servaunt by your own gratious favor," he says, "strengthened with condicions that I should ayme all my courses at the Revells (I dare not say with a promise, but with a hopeful Item to the Reverción) for which these ten yeres I have attended with an unwearyed patience." But in 1589 or 1590 the mastership of the revels was as far off as ever—Tylney in fact held the post for thirty-one years—and that Lyly's petition brought him no compensation in other directions may be inferred from the second petition of 1593. "Thirteen yeres your highnes servant but yet nothing. Twenty freinds that though they saye they will be sure, I finde them sure to be slowe. A thousand hopes, but all nothing; a hundred promises but yet nothing. Thus casting up the inventory of my friends, hopes, promises and tymes, the *summa totalis* amounteth to just nothing." What may have been Lyly's subsequent fortunes at court we do not know. Edmund Blount says vaguely that Elizabeth "graced and rewarded" him, but of this there is no other evidence. After 1590 his works steadily declined in influence and reputation; other stars were in possession of the horizon; and so far as we know he died poor and neglected in the early part of James I.'s reign. He was buried in London at St Bartholomew the Less on the 20th of November, 1606. He was married, and we hear of two sons and a daughter.

Comedies.—In 1632 Edmund Blount published "Six Court Comedies," including *Endymion* (1591), *Sappho and Phao* (1584), *Alexander and Campaspe* (1584), *Midas* (1592), *Mother Bombie* (1594) and *Gallathea* (1592). To these should be added the *Woman in the Moone* (Lyly's earliest play, to judge from a passage in the prologue and therefore earlier than 1584, the date of *Alexander and Campaspe*), and *Love's Metamorphosis*, first printed in 1601. Of these, all but the last are in prose. *A Warning for Faire Women* (1599) and *The Maid's Metamorphosis* (1600) have been attributed to Lyly, but on altogether insufficient grounds. The first editions of all these plays were issued between 1584 and 1601, and the majority of them between 1584 and 1592, in what were Lyly's most successful and popular years. His importance as a dramatist has been very differently estimated. Lyly's dialogue is still a long way removed from the dialogue of Shakespeare. But at the same time it is a great advance in rapidity and resource upon anything which had gone before it; it represents an important step in English dramatic art. His nimbleness, and the wit which struggles with his pedantry, found their full development in the dialogue of *Twelfth Night* and *Much Ado about Nothing*, just as "Marlowe's mighty line" led up to and was eclipsed by the majesty and music of Shakespearian passion. One or two of the songs introduced into his plays are justly famous and show a real lyrical gift. Nor in estimating his dramatic position and his effect upon his time must it be forgotten that his classical and mythological plots, flavourless and dull as they would be to a modern audience, were charged with interest to those courtly hearers who saw in Midas Philip II., Elizabeth in Cynthia and perhaps Leicester's unwelcome marriage with Lady Sheffield in the love affair between Endymion and Tellus which brings the former under Cynthia's displeasure. As a matter of fact his reputation and popularity as a play-writer were considerable. Gabriel Harvey dreaded lest Lyly should make a play upon their quarrel; Meres, as is well known, places him among "the best for comedy"; and Ben Jonson names him among those foremost rivals who were "outshone" and outsung by Shakespeare.

Euphues.—It was not, however, as a dramatist, but as the author of *Euphues*, that Lyly made most mark upon the Elizabethan world. His plays amused the court circle, but the "new English" of his novel threatened to permanently change the course of English style. The plot of *Euphues* is extremely simple. The hero, whose name may very possibly have been suggested by a passage in Ascham's *Schoolmaster*, is introduced to us as still in bondage to the follies of youth, "preferring fancy before friends, and this present humour before honour to come." His travels bring him to Naples, where he falls in love with Lucilla, the governor's light-minded daughter. Lucilla is already pledged to Euphues's friend Philautus, but Euphues's passion betrays his friendship, and the old lover finds himself thrown over by both friend and mistress. Euphues himself, however, is very soon forsaken for a more attractive suitor. He and Philautus make up their quarrel, and Euphues writes his friend "a cooling card," to be "applied to all lovers," which is so severe upon the fair sex that Lyly feels it necessary to balance it by a sort of apology addressed "to the grave matrons and honest maidens of Italy." Euphues then leaves Naples for his native Athens, where he gives himself up to study, of which the first fruits are two long treatises—the first, "Euphues and his Ephoebus," a disquisition on the art of education addressed to parents, and the second, "Euphues and Atheos," a discussion of the first principles of religion. The remainder of the book is filled up with correspondence between Euphues and his friends. We have letters from Euphues to Philautus on the death of Lucilla, to another friend on the death of his daughter, to one Botonio "to take his exile patiently," and to the youth Alcius, remonstrating with him on his bad behaviour at the university. Finally a pair of letters, the first from Livia "at the emperour's court to Euphues at Athens," answered by "Euphues to Livia," wind up the first part, and announce to us Euphues's intention of visiting England. An address from Lyly to Lord Delawarr is affixed, to which was added in the second edition "An Address to the Gentlemen Scholars of England."

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[1] The evidence for his authorship may be found in Gabriel Harvey's *Pierce's Supererogation* (written November 1589, published 1593), in Nash's *Have with you to Saffron Walden* (1596), and in various allusions in Lyly's own plays. See Fairholt's *Dramatic Works of John Lilly*, i. 20.

Euphues and his England is rather longer than the first part. Euphues and Philautus travel from Naples to England. They arrive at Dover, halt for the night at Fidus's house at Canterbury, and then proceed to London, where they make acquaintance with Surius, a young English gentleman of great birth and noble blood; Psellus, an Italian nobleman reputed "great in magick"; Martius, an elderly Englishman; Camilla, a beautiful English girl of insignificant family; Lady Flavia and her niece Fraunces. After endless correspondence and conversation on all kinds of topics, Euphues is recalled to Athens, and from there corresponds with his friends. "Euphues' Glasse for Europe" is a flattering description of England sent to Livia at Naples. It is the most interesting portion of the book, and throws light upon one or two points of Lyly's own biography. The author naturally seized the opportunity for paying his inevitable tribute to the queen, and pays it in his most exalted style. "O fortunate England that hath such a queene, ungratefull if thou praye not for hir, wicked if thou do not love hir, miserable if thou lose hir!"—and so on. The book ends with Philautus's announcement of his marriage to Fraunces, upon which Euphues sends characteristic congratulations and retires, "tormented in body and grieved in mind," to the Mount of Silexedra, "where I leave him to his musing or Muses."

Such is a brief outline of the book which for a time set the fashion for English prose. Two editions of each part appeared within the first year after publication, and thirteen editions of both are enumerated up to 1636, after which, with the exception of a modernized version in 1718, *Euphues* was never reprinted until 1868, when Dr Arber took it in hand. The reasons for its popularity are not far to seek. As far as matter was concerned it fell in with all the prevailing literary fashions. Its long disquisitions on love, religion, exile, women or education, on court life and country pleasures, handled all the most favourite topics in the secularized speculation of the time; its foreign background and travel talk pleased a society of which Lyly himself said "trafic and travel hath woven the nature of all nations into ours and made this land like arras full of device which was broadcloth full of workmanship"; and, although Lyly steered clear in it of the worst classical pedantries of the day, the book was more than sufficiently steeped in classical learning, and based upon classical material, to attract a literary circle which was nothing if not humanist. A large proportion of its matter indeed was drawn from classical sources. The general tone of sententious moralizing may be traced to Plutarch, from whom the treatise on education, "Euphues and his Ephoebus," and that on exile, "Letter to Botonio to take his exile patiently," are literally translated, as well as a number of other shorter passages either taken direct from the Latin versions or from some of the numerous English translations of Plutarch then current. The innumerable illustrations based upon a kind of pseudo natural history are largely taken from Pliny, while the mythology is that of Virgil and Ovid.

It was not the matter of *Euphues*, however, so much as the style which made it famous (see EUPHUISM). The source of Lyly's peculiar style has been traced by Dr Landmann (*Der Euphuismus, sein Wesen, seine Quelle, seine Geschichte*, &c. Giessen, 1881) to the influence of Don Antonio de Guevara, whose *Libro Aureo de Marco Aurelio* (1529)—a sort of historical romance based upon Plutarch and upon Marcus Aurelius's *Meditations*, the object of which was to produce a "mirror for princes," of the kind so popular throughout the Renaissance—became almost immediately popular in England. The first edition, or rather a French version of it, was translated into English by Lord Berners in 1531, and published in 1534. Before 1560 twelve editions of Lord Berners's translation had been printed, and before 1578 six different translators of this and later works of Guevara had appeared. The translation, however, which had most influence upon English literature was that by North, the well-known translator of Plutarch, in 1557, called *The Dial for Princes, Compiled by the Reverend Father in God Don Antony of Guevara, Byshop of Guadix, &c., Englished out of the Frenche by Th. North.* The sententious and antithetical style of the *Dial for Princes* is substantially that of *Euphues*, though Guevara on the whole handles it better than his imitator, and has many passages of real force and dignity. The general plan of the two books is also much the same. In both the biography is merely a peg on which to hang moral disquisitions and treatises. The use made of letters is the same in both. Even the names of some of the characters are similar. Thus Guevara's Lucilla is the flighty daughter of Marcus Aurelius. Lyly's Lucilla is the flighty daughter of Ferardo, governor of Naples; Guevara's Livia is a lady at the court of Marcus Aurelius, Lyly's Livia is a lady at the court "of the emperor," of whom no further description is given. The 9th, 10th, 11th and 12th chapters of the *Dial for Princes* suggested the discussion between Euphues and Atheos. The letter from Euphues to Alcius is substantially the same in subject and treatment as that from Marcus Aurelius to his nephew Epesipo. Both Guevara and Lyly translated Plutarch's work *De educatione liberorum*, Lyly, however, keeping closer than the Spanish author to the original. The use made by Lyly of the university of Athens was an anachronism in a novel intended to describe his own time. He borrowed it, however, from Guevara, in whose book a university of Athens was of course entirely in place. The "cooling card for all fond lovers" and the address to the ladies and gentlemen of Italy have their counterparts among the miscellaneous letters by Guevara affixed by North to the *Dial for Princes*; and other instances of Lyly's use of these letters, and of two other treatises by Guevara on court and country life, could be pointed out.

Lyly was not the first to appropriate and develop the Guevaristic style. The earliest book in which it was fully adopted was *A petite Pallace of Pettie his Pleasure*, by George Pettie, which appeared in 1576, a production so closely akin to *Euphues* in tone and style that it is difficult to believe it was not by Lyly. Lyly, however, carried the style to its highest point, and made it the dominant literary fashion. His principal followers in it were Greene, Lodge and Nash, his principal opponent Sir Philip Sidney; the *Arcadia* in fact supplanted *Euphues*, and the Euphuistic taste proper may be said to have died out about 1590 after a reign of some twelve years. According to Landmann, Shakespeare's *Love's Labour Lost* is a caricature of the Italianate and pedantic fashions of the day, not of the peculiar style of *Euphues*. The only certain allusion in Shakespeare to the characteristics of Lyly's famous book is to be found in *Henry IV.*, where Falstaff, playing the part of the king, says to Prince Hal, "Harry, I do not only marvel where thou spendest thy time, but also how thou art accompanied; for, though the camomile the more it is trodden on the faster it grows, yet youth the more it is wasted the sooner it wears." Here the pompous antithesis is evidently meant to caricature the peculiar Euphuistic sentence of court parlance. (M. A. W.)

See Lyly's *Complete Works*, ed. R. W. Bond (3 vols., 1902); *Euphues*, from early editions, by Edward Arber (1868); A. W. Ward, *English Dramatic Literature*, i. 151; J. P. Collier, *History of Dramatic Poetry*, iii. 172; "John Lilly and Shakespeare," by C. C. Hense in the *Jahrbuch der deutschen Shakesp. Gesellschaft*, vols. vii. and viii. (1872, 1873); F. W. Fairholt, *Dramatic Works of John Lilly* (2 vols.,

1858); *Shakespeare's Euphuism*, by W. L. Rushton; H. Morley, "Euphuism" in the *Quarterly Review* (1861); R. W. Bond, "John Lyly, Novelist and Dramatist," in the *Quarterly Review* (Jan. 1896); J. A. Symonds, *Shakespeare's Predecessors* (1883); J. D. Wilson, *John Lyly* (Cambridge, 1905); A. Ainger, "Euphuism," in *Lectures and Essays* (1905); and Albert Feuillerat, *John Lyly. Contribution à l'histoire de la Renaissance en Angleterre* (1910).

LYME REGIS, a market town and municipal borough and watering-place in the western parliamentary division of Dorsetshire, England, 151 m. W.S.W. of London by the London & South Western railway, the terminus of a light railway from Axminster. Pop. (1901) 2095. It is situated at the mouth of a narrow combe or valley opening upon a fine precipitous coast-line; there is a sandy shore affording excellent bathing, and the country inland is beautiful. The church of St Michael and All Angels is mainly Perpendicular, but the tower (formerly central) and the portion west of it are Norman. A guildhall and assembly rooms are the chief public buildings. The principal industries are stone-quarrying and the manufacture of cement. There is a curved pier of ancient foundation known as the Cobb. The harbour, with a small coasting trade, is under the authority of the corporation. The borough is under a mayor, 4 aldermen and 12 councillors. Area, 1237 acres.

No evidence of settlement on the site of Lyme Regis exists before that afforded by a grant, dated 774, purporting to be by Cynewulf, king of the West-Saxons, of land here to the church of Sherborne, and a similar grant by King Æthelstan to the church of Glastonbury. In 1086 three manors of Lyme are mentioned: that belonging to Sherborne abbey, which was granted at the dissolution to Thomas Goodwin, who alienated it in the following year; that belonging to Glastonbury, which seems to have passed into lay lands during the middle ages, and that belonging to William Belet. The last was acquired by the family of Bayeux, from whom it passed by marriage to Elias de Rabayne, whose nephew, Peter Baudrat, surrendered it to the crown in 1315–1316 when the king became lord of one moiety of the borough, henceforth known as Lyme Regis. Lyme ranked as a port in 1234, and Edward I. in 1284 granted to the town a charter making it a free borough, with a merchant gild, and in the same year the mayor and bailiffs are mentioned. In the following January the bailiffs were given freedom from pleading without the borough, freedom from toll and privileges implying considerable foreign trade; the importance of the port is also evident from the demand of two ships for the king's service in 1311. In 1332–1333 Edward III. granted Lyme to the burgesses at a fee-farm of 32 marks; on the petition of the inhabitants, who were impoverished by tempests and high tides, this was reduced to 100 shillings in 1410 and to 5 marks in 1481. In 1591 Elizabeth incorporated Lyme, and further charters were obtained from James I., Charles II. and William III. Lyme returned two members to parliament from 1295 to 1832 when the representation was reduced to one. The borough was disfranchised in 1867. The fairs granted in 1553 for the 1st of February and the 20th of September are now held on altered dates. Trade with France in wine and cloth was carried on as early as 1284, but was probably much increased on the erection of the Cobb, first mentioned in 1328 as built of timber and rock. Its medieval importance as the only shelter between Portland Roads and the river Exe caused the burgesses to receive grants of quayage for its maintenance in 1335 and many subsequent years, while its convenience probably did much to bring upon Lyme the unsuccessful siege by Prince Maurice in 1644. In 1685 Lyme was the scene of the landing of James, duke of Monmouth, in his attempt upon the throne.

LYMINGTON, a municipal borough and seaport in the New Forest parliamentary division of Hampshire, England, 98 m. S.W. from London by the London & South Western railway. Pop. (1901) 4165. It lies on the estuary of the Lymington, which opens into the Solent. The church of St Thomas à Becket is an irregular structure, dating from the reign of Henry VI., but frequently restored. There is some coasting trade, and yacht-building is carried on. Regular passenger steamers serve Yarmouth in the Isle of Wight. In summer the town is frequented for sea-bathing. It is governed by a mayor, 4 aldermen and 12 councillors. Area, 1515 acres.

There was a Roman camp near Lymington (*Lentune, Lementon*), and Roman relics have been found, but there is no evidence that a town existed here until after the Conquest. Lymington dates its importance from the grant of the town to Richard de Redvers, earl of Devon, in the reign of Henry I. No charter has been found, but a judgment given under a writ of *quo warranto* in 1578 confirms to the burgesses freedom from toll, passage and pontage, the tolls and stallage of the quay and the right to hold two fairs—privileges which they claimed under charters of Baldwin de Redvers and Isabel de Fortibus, countess of Albemarle, in the 13th century, and Edward Courtenay, earl of Devon, in 1405. The town was governed by the mayor and burgesses until the corporation was reformed in 1835. A writ for the election of a member to parliament was issued in the reign of Edward III., but no return was made. From 1585 two members were regularly returned; the number was reduced to one in 1867, and in 1885 the representation was merged in that of the county. Fairs on the 13th and 14th of May and the 2nd and 3rd of October, dating from the 13th century, are still held. The Saturday market probably dates from the same century. Lymington was made a port in the reign of Henry I., and its large shipping trade led to frequent disputes with Southampton as to the levying of duties. The case was tried in 1329 and decided against Lymington, but in 1750 the judgment was reversed, and since then the petty customs have been regularly paid. From an early date and for many centuries salt was the staple manufacture of Lymington. The rise of the mineral salt-works of Cheshire led to its decline in the 18th century, and later the renewed importance of Southampton completed its decay.

See E. King, *Borough and Parish of Lymington* (London, 1879).

LYMPH and LYMPH FORMATION. Lying close to the blood-vessels of a limb or organ a further set of vessels may be observed. They are very pale in colour, often almost transparent and very thin-walled. Hence they are frequently difficult to find and dissect. These are the lymphatic vessels, and they are found to be returning a fluid from the tissues to the blood-stream. When traced back to the tissues they are seen to divide and ultimately to form minute anastomosing tubules, the *lymph capillaries*. The capillaries finally terminate in the spaces between the structures of the tissue, but whether their free ends are closed or are in open communication with the tissue spaces is still undecided. The study of their development shows that they grow into the tissue as a closed system of minute tubes, which indicates that in all probability they remain permanently closed. If we trace the lymphatic vessels towards the thorax we find that in some part of their course they terminate in structures known as lymphatic glands. From these again fresh lymphatic vessels arise which carry the fluid towards the main lymph-vessel, the *thoracic duct*. This runs up the posterior wall of the thorax close to the aorta, and finally opens into the junction of the internal jugular and left subclavian veins. The lymph-vessels from the right side of the head and neck and from the right arm open, however, into the right subclavian vein (see LYMPHATIC SYSTEM below).

Chemical Constitution of Lymph.—The lymph collected from the thoracic duct during hunger is almost water clear and yellowish in colour. Its specific gravity varies from 1015 to 1025. It tastes salt and has a faint odour. It is alkaline in reaction, but is much less alkaline than blood-serum. Like blood it clots, but clots badly, only forming a soft clot which quickly contracts. The lymph collected from a lymphatic before it has passed through a lymph gland contains a few leucocytes, and though the number of lymphocytes is greater in the lymph after it has flowed through a gland it is never very great. In normal states there are no red blood corpuscles.

The total solids amount to 3·6 to 5·7%, the variations depending upon the amount of protein present. The lymph during hunger contains only a minute quantity of fat. Sugar (dextrose) is present in the same concentration as in the blood. The inorganic constituents are the same as in blood, but apparently the amounts of Ca, Mg and P_2O_5 are rather less than in serum. Urea is present to the same amount as in blood. If the lymph be collected after a meal, one important alteration is to be found. It now contains an abundance of fat in a very fine state of subdivision, if fat be present in the food. The concentrations of protein and dextrose are not altered during the absorption of these substances.

The Significance of Lymph.—In considering the significance and use of lymph we must note in the first place that it forms an alternative medium for the removal of water, dissolved materials, formed elements or particles away from the tissues. All materials supplied to a tissue are brought to it by the blood, and are discharged from the blood through the capillary wall. They thus come to lie in the tissue spaces between the cells, and from this supply of material in a dissolved state the cells take up the food they require. In the opposite direction the cell discharges its waste products into this same tissue fluid. The removal of material from the tissue fluid may be effected either by its being absorbed through the capillary wall into the blood-stream, or by sending it into the lymphatic vessels and thus away from the tissue. From this point of view the lymphatics may be looked upon in a sense as a drainage system of the tissues. Again, besides discharging fluid and dissolved material into the tissue spaces, the blood may also discharge leucocytes, and under many conditions this emigration of leucocytes may be very extensive. These also may leave the tissue space by the path of the lymph channels. Moreover, the tissues are at any time liable to be injured, and the injury as well as damaging many cells may cause rupture of capillaries (as in bruising) with escape of red blood-cells into the tissue spaces. If this occurs we know that the damaged cells are destroyed and their débris removed either by digestion by leucocytes or by disintegration and solution. The damage of a tissue also commonly involves an infection of the damaged area with living micro-organisms, and these are at once admitted to the tissue spaces. Hence we see that the lymphatics may be provided as channels by which a variety of substances can be removed from the tissue spaces. The question at once arises, is the lymph channel at all times open to receive the materials present in the tissue space? If such be the case, lymph is simply tissue fluid, and anything that modifies the constitution or amount of the tissue fluid should in like proportion lead to a variation in the amount and constitution of the lymph. But if the lymph capillary is a closed tubule at its commencement this does not follow.

From these considerations we see that in the first instance the whole problem of lymph formation is intimately bound up with the study of the interchanges of material between the blood and the various tissue cells. The exchange of material between blood and tissue cell may possibly be determined in one or both of two ways. Either it may result from changes taking place within the tissue cell, or the tissue cell remaining passive material may be sent to or withdrawn from it owing to a change occurring either in the composition of the blood or to a change in the circulation through the tissue. Let us take first the results following increased activity of a tissue. We know that increased activity of a tissue means increased chemical change within the tissue and the production of new chemical bodies of small molecular size (*e.g.* water, carbonic acid, &c.). The production of these metabolites means the destruction of some of the tissue substance, and to make good this loss the tissue must take a further amount of material from the blood. We know that this takes place, and moreover that the waste products resulting from activity are ultimately removed. The question then becomes: When does this restoration take place, and what is the intermediate state of the tissue? We know that increased activity is always accompanied by an increase in the blood-supply, indicating a greater supply of nutritive material, though it may be that the increased supply required at the actual time of activity is oxygen only. Simultaneously the opportunity for a more rapid removal of the waste products is provided. We have to inquire then: Does this increased vascularity necessarily mean an increased outpouring of water and dissolved material into the tissues, for this might follow directly from the greater filling of the capillaries, or from the increased attracting power of the tissues to water (osmotic effect) due to the sudden production of substances of small molecular size within the tissue? The other possibility is that the increased volume of blood sent to the tissue is for the sole purpose of giving it a more rapid supply of oxygen, and that the ordinary normal blood-supply would amply suffice for renewing the chemical material used up during activity. Tissues undoubtedly vary among themselves in the amount of water and other materials they take from the blood when thrown into activity, and their behaviour in this respect depends upon the work they are called upon to perform. We must discriminate between the substance required by and consumed by the tissue, the chemical food which on combustion yields the energy by which the tissue performs work, and, on the other hand, the substance taken from the blood and either with or without further elaboration discharged from the tissue (as, for instance, in the process of secretion). The tissue contains in itself a store of food amply sufficient to enable it to continue working for a long time after its blood-supply has been stopped, and everything indicates that the supply of chemical energy to the tissue may be slow or even withheld for a considerable time. Hence we are led to conclude that the increased flow of blood sent to a tissue when it is thrown into activity is first and foremost to give that tissue an increased oxygen supply; secondly, to remove waste carbonic acid; thirdly, and only in the case of some tissues, to provide water salts and other materials for the outpouring of a secretion, as an instance of which we may take the kidney as a type. Hence there is no need to suppose that an extensive accumulation of fluid and dissolved substances takes place within a tissue when it becomes active. This must be an accumulation which would lead to an engorgement of the tissue spaces and then to a discharge of fluid along the lymph channels. To enable us to determine the various points just raised we must know whether an increased blood-supply to a tissue necessarily means an increased exudation of fluid into the tissue spaces, and moreover we must study the exchange of fluid between a tissue and the blood under as varied a series of conditions as possible, subsequently examining whether exchange of fluid and other substances between the tissue and the blood necessarily determines quantitatively the amount of lymph flowing from the tissue. Hence we will first study the exchanges between the blood and a tissue, and then turn our attention to the lymph-flow from the tissues.

The Exchanges of Fluids and dissolved Substances between the Blood and the Tissues.—Numerous experiments have been performed in studying the conditions under which fluid passes into the tissues and tissue spaces—or in the reverse direction into the blood. We may group them into (1) conditions during which the total volume of circulating fluid is increased or decreased; (2) conditions in which the character of the blood is altered, *e.g.* it is made more watery or its saline concentration is altered; (3) conditions in which the blood-supply to the part is altered; (4) conditions in which the physical character of the capillary wall is altered.

1. The total volume of blood in an animal has been increased among other ways by the transfusion of the blood of one animal directly into the veins of a second of the same species. It is found that within a very short time a large percentage of the plasma has been discharged from the blood-vessels. It has been sent into the tissues, notably the muscles, and it may be noted in passing without producing any increase in the lymph-flow from these vessels. An analogous experiment, but one which avoids the fallacy introduced by injecting a second animal's blood, has been performed by driving all the blood out of one hind limb by applying a rubber bandage tightly round it from the foot upwards. This increases the volume of blood circulating in the rest of the body, and again a rapid disappearance of the fluid part of the blood from the vessels was observed—the fluid being mainly sent into the muscles, as was indicated by showing that the specific gravity of the muscles fell during the experiment. The experiments converse to these have also been studied

Bleeding is very rapidly followed by a large inflow of fluid into the circulating blood—this fluid being derived from all the tissues, and especially again from the muscles. Or again, when the bandage from the limb in the above-cited experiment was removed, the total capacity of the circulatory system was thereby suddenly increased, and it was found that the total volume of blood increased correspondingly, the increased volume of fluid being drawn from the tissues and especially again from the muscles. The rapidity with which this movement of fluid into or out of the blood takes place is very striking. The explanation usually offered is that the movement is effected by changes in the capillary pressure due to the alteration in the volume of blood circulating. While this seems feasible when the volume of blood is increased, it does not offer a satisfactory explanation of the rapid movement of fluid from the tissues when the volume of the blood is decreased. One must therefore look for yet further factors in this instance.

2. Let us next turn attention to the second of our three main variations, viz. that in which the composition of the blood is altered. It has long been known that the injection of water, or of solutions of soluble bodies such as salts, urea, sugar, &c., leads to a very rapid exchange of water and salts between the blood and the tissues. Thus if a solution less concentrated than the blood be injected, the blood is thereby diluted, but with very great rapidity water leaves the blood and is taken up by the tissues. Again, if a strong sugar or salt solution be injected, the first effect is a big discharge of water from the tissues into the blood and the movement of fluid is effected with great rapidity. In these instances a new physical factor is brought into play, viz. that of osmosis. When a solution of lower osmotic pressure than the blood is injected the osmotic pressure of the blood falls temporarily below that of the tissues, and water is therefore attracted to the tissues. The converse is the case when a solution of osmotic pressure higher than the blood is injected. This at first sight seems to be an all-sufficient explanation of the results recorded, but difficulties arise when we find that the tissues are not equally active in producing the effects. Thus it is found that the muscles and skin act as the chief water depot, while such tissues as the liver, intestines or pancreas take a relatively small share in the exchange. Again, when a strong sodium chloride solution is injected a considerable part of the sodium chloride is soon found to have left the blood, and it has been shown that the chloride depot is not identical with the water depot. The lung, for instance, is found to take up relatively far more of the salt than other tissues. Simultaneously with the passage of the salt into the tissue an exchange of water from the tissue into the blood can be observed, both processes being carried out very rapidly. The result is that the blood very quickly returns to a state in which its osmotic pressure is only slightly raised; the tissue, on the other hand, loses water and gains salt, and its osmotic pressure and specific gravity therefore rises. Again, the tissues do not participate equally in producing the final result, nor is the tissue which gives up the largest amount of water necessarily that which gains the largest amount of salt. The results following the injection of solutions of other bodies of small molecular size, *e.g.* urea or sugar, are quite analogous to those above described in the case of the nontoxic salt solutions. Hence we see that the rate of exchange of fluid and dissolved substance between a tissue and the blood can be extremely rapid and that the exchange can take place in either direction. We may also conclude that the main cause of the exchange, and possibly the only one, is the osmotic action set up by the solution injected, and that muscle tissue is particlarly active in the process.

Seeing that a very considerable amount of water or of dissolved substance can be taken up from the blood into a tissue, the question next arises: Where is this material held, in the tissue cell or in the tissue space? Immediately the water or salt leaves the blood it reaches the tissue space, but unless the process be extreme in amount it probably passes at once into the tissue cell itself and is stored there. If the process is excessive oedema is set up and fluid accumulates in the tissue space.

These, taken quite briefly, are some of the more important conditions under which fluid exchanges take place. They are selected here because of the extent and rapidity of the changes effected.

3. The third factor which may bring about a change in the amount of fluid sent to a tissue is a variation in the capillary pressure. A rise in capillary pressure will, if filtration can occur through the capillary wall, cause an increased exudation of fluid from the blood. Thus the rise in general blood-pressure following the injection of a salt solution could cause an increased filtration into the tissues. Or again, the hydraemia following a salt injection would favour an increased exudation because the blood would be more readily filtrable. We, however, know very little of the effect of changes in capillary pressure upon movement of fluid into the tissue spaces and tissues, most of such observations being confined to a study of their effect upon lymph-flow. We will therefore return to them in this connexion.

4. The remaining factor to be mentioned is a change in the character of the capillary wall. It is well known that many poisons can excite an increased exudation from the blood and the tissue may become oedematous. Of such bodies we may mention cantharidin and the lymphogogues of Class 1 (see later). A like change is also probably the cause of the oedema of nephritis and of heart disease. It has also been suggested that the capillaries of different organs show varying degrees of permeability, a suggestion to which we will return later.

Lymph Formation.—There are two theories current at the present day offering explanations of the manner in which lymph is formed. The first, which owes its inception to Ludwig, explains lymph formation upon physical grounds. Thus according to this theory the lymphatics are open capillary vessels at their origin in the tissues along which the tissue fluid is driven. The tissue fluid is discharged from the blood by filtration, and therefore its amount varies directly with the capillary pressure. The amount of fluid movement also is further determined by osmotic actions and by the permeability of the capillary wall.

The second theory first actively enunciated by Heidenhain regards lymph formation as a secretory process of the capillary wall, *i.e.* one in the discharge of which these cells perform work and are not merely passive as in the former theory. As we shall see, it is now probable that neither theory is completely correct.

In considering lymph formation we have to examine both the total amount of lymph formed in the body and the variations in amount leaving each separate organ under different conditions. In most investigations the lymph was collected from the thoracic duct, *i.e.* it was the lymph returned from all parts of the body with the exception of the right arm and right side of the head and neck. The collection of the lymph from organs is much more difficult to effect, and hence has not, to the present, been so extensively studied. We will consider first variations in the amount of the thoracic duct lymph. Lymph is always flowing along the thoracic duct, and if the body is at rest, it has been shown that this lymph is coming practically entirely from the intestines and liver, chiefly, moreover, from the liver. The variations in the amount flowing under various conditions has been extensively studied. We will discuss them under the following headings: Changes brought about (*a*) by altered circulatory conditions, (*b*) by the injection of various substances, and (*c*) as a result of throwing an organ into activity.

Ligature of the portal vein leads to an increased flow of duct lymph. Ligature of the inferior vena cava above the diaphragm also leads to a large increase in the flow of duct lymph. Ligature of the aorta may result in either an increased or decreased flow of direct lymph. One explanation of these results has been offered from a study of the changes in capillary pressure set up in the main organs involved. Thus, after ligature of the portal vein the capillary pressure in the intestines rises, and it was proved that the increase in thoracic duct lymph came from the intestines. Ligaturing the inferior vena cava causes a big rise in the pressure in the liver capillaries, the intestinal capillary pressure remaining practically unaltered. Here it was proved that the increase in lymph-flow came from the liver and was more copious in amount than in the former instance. A further difference is that this lymph is more concentrated, a feature which always characterizes liver lymph. Ligature of the aorta may or may not cause a rise in the liver capillary pressure, and it has been shown that if the pressure rises there is an increased lymph-flow from the liver and conversely. The increase of lymph comes entirely in this instance also from the liver. It is in fact but a special instance of the former experiment. From these results it has been argued that lymph formation is simply a filtration fundamentally, and the lymph-flow is determined mainly by the capillary pressure. Variations in the quantity of lymph issuing from different organs have been on this theory ascribed to differences in the permeability of the capillaries of the organs. Thus as liver lymph is richest in protein content and is produced in greatest amount, it has been concluded that the liver capillaries possess the highest permeability. The intestines stand next in producing a concentrated lymph, and their capillaries are therefore assumed to stand second as regards permeability. Lastly, the lymph coming from limbs and other organs is much poorer in solids and much less copious in amount. Hence it is argued that their capillaries show the least permeability. It is, however, very unsafe to compare the liver capillaries with those of other organs, since they are not in reality capillaries but rather venous sinuses, and their relation to the liver cells is characteristically different from that of ordinary capillaries. If an animal is at rest, no lymph flows from the hind limbs. To obtain a sample of limb lymph it is necessary to massage the limb. If, however, the veins to the limb be ligatured, we obtain a flow of lymph. The ligature of course causes a rise of the capillary pressure, and it has been argued that this rise of pressure starts a filtration through the capillary wall and hence a flow of lymph. But the stoppage of the blood-flow also damages the capillary wall and tissue cells by asphyxiation, and the resulting lymph-flow is in all probability the resultant of many complex processes. This case is analogous to the production of oedema in cases of heart disease where the circulation is feeble and the oxygen supply to the parts deficient. The results of these experiments form the main evidence in support of the filtration theory of lymph formation. They were first systematically studied by Heidenhain, to whom we owe so much of our knowledge of lymph formation. He did not, however, conclude that they established the filtration theory.

In continuing his observations Heidenhain next studied the results following the injection of a number of substances into the blood. He found many which on injection gave rise to an increased lymph-flow from the thoracic duct, and arranged them in two classes. As instances of lymphogogues of the first class we may mention extract of mussels, leech extract, peptone, extract of crayfish muscle, extract of strawberries, of raspberries and many other like substances. Lymphogogues of the second class comprise neutral salt solutions, urea, sugar, &c. Considering the latter class first we may take as a type a solution of sodium chloride. Injection of such a solution causes a large increase in the lymph-flow, and it has been proved that the lymph comes from the liver and intestines only—chiefly from the former. It is especially to be noted that there is no lymph-flow from the limbs, and the same is true for all lymphogogues of this class. As indicated above, the injection of a saline solution leads to a large and rapidly effected transport of fluid from the blood into muscle tissue, but though there is this large increase in tissue fluid, no lymph flows from the tissue. This result very powerfully disfavours the filtration theory of lymph formation. It practically refutes the idea that lymph formation is solely dependent upon such processes as filtration, osmosis and capillary permeability only. It brings out quite clearly that the exchange of fluid and dissolved salts, &c., between the blood and a tissue, and the flow of lymph from that tissue, are two separate and distinct processes, and especially that the first does not determine the second. Also it is to be noted that the injection of a strong salt solution also excites a flow of duct lymph, again arising from the liver and intestines, but none from the limbs. In this instance, as previously stated, the muscles of the limbs are losing water, and so presumably are the liver and intestinal cells. This independence of tissue-blood exchange and lymph-flow is distinctly in favour of the view, which is rapidly gaining ground from histological observations, that in all instances the lymphatics commence in a tissue as closed capillary vessels.

Turning, in the next place, to the lymphogogues of the first class, it has been proved that the origin of this increase of flow is again from the liver. Very many of the substances of this class are bodies which may when taken cause urticarial (nettle-rash) eruptions, a state which is generally regarded as being due to an action upon the capillary endothelium. Their action as lymphogogues is also generally ascribed to an effect upon the capillary wall rendering it according to some more permeable, according to others leading to a direct secretory action on the part of the endothelium. We also know that many of the bodies of this class act upon the liver in other directions than in exciting an increased lymph production. Thus they may cause an increase in bile secretion, or, as in the case of peptone, the liver cells may be excited to produce a new chemical material, in this instance an antithrombin.

We have now to consider the effect of throwing an organ into activity upon the lymph-flow from the organ. In all cases in which it has been examined it is found that increased activity is accompanied by increased lymph-flow. Thus, to take the instance of the submaxillary gland, which at rest does not discharge any lymph, stimulation of the chorda tympani is followed by a flow of lymph accompanying the flow of saliva simultaneously excited. The stimulation of the nerve also produces dilatation of the blood-vessels and therefore a rise in capillary pressure. But that this vascular change is not the factor determining the lymph-flow is proved by the administration of a small dose of atropine, which arrests the secretion without influencing the vascular reaction following chorda stimulation. After the atropine no lymph-flow occurs on stimulating the nerve. Many other instances of a similar kind might be adduced. Thus, we have seen that peptone specifically excites the liver cells and also causes an increased lymph-flow from the liver; or, as a last instance, the injection of bile salt excites a flow of bile and also excites a flow of lymph from the liver. The supporters of the filtration theory have argued that as activity of a tissue is necessarily accompanied by the discharge of metabolites from the active tissue cells, and as these are of small molecular size, they must set up an osmotic effect. Water is therefore drawn into the tissue spaces, and this rise in fluid content results mechanically in a flow of lymph from the organ. The lymph simply drains away along the open lymphatics. This argument, however, loses all its force when we recall the fact that we may set up an enormous flow of fluid and salt into a tissue and its tissue spaces without causing the least flow of lymph. Further, there is no reason to suppose that the metabolites discharged from a tissue during activity are produced in large quantities. The chief metabolite is undoubtedly carbonic acid, and this diffuses very rapidly and is quickly carried away by the blood. If, moreover, as is probably the case, the lymphatics commence as closed capillaries, we have a further difficulty in explaining how the fluid is driven through the lymphatic wall. Either we must imagine the wall to be porous or there must be a greater pressure outside than inside, and it is very difficult to conceive how this is possible. As a general conclusion, then, it seems much more probable that we are here dealing with a secretory process, and that the active tissue produces some substance or substances—it may be carbonic acid—which throws the lymphatic capillary cells into activity.

To sum up in a few words the present state of our knowledge as to lymph formation we may say that the exchange of water and salts between the blood and the tissues is probably entirely determined by processes of filtration and osmosis. Further, that the physical condition of the capillary cells is frequently altered by many chemical substances, and that in consequence it may permit exudation into the tissue spaces much more freely. In the next place, the flow of lymph from a tissue is not solely determined by the amount of the tissue fluids. The lymph capillaries start as closed tubules, and the endothelial walls of these tubules play an active part (secretory) in determining when water and other substances shall be admitted into the capillary and further determine the quantity of such discharge. Apparently, too, these cells are specifically excited when the tissue is thrown into activity, the exciting substance being a metabolite from the active tissue. Leucocytes also are capable of passing through or between the endothelial cells of the lymph capillary. (T. G. Br.)

LYMPHATIC SYSTEM. In anatomy, the lymphatic system (Lat. *lympha*, clear water) comprises the *lymphoid* or *adenoid* tissue so plentifully distributed about the body, especially in the course of the alimentary canal (see CONNECTIVE TISSUES), *lymph spaces*, *lymphatic vessels* of which the lacteals are modifications, *lymphatic glands*, *haemolymph glands*, and the *thoracic* and *right lymphatic ducts* by which the lymph (*q.v.*) finally reaches the veins.

Lymph spaces are mere spaces in the connective tissue, which usually have no special lining, though sometimes there is a layer of endothelial cells like those of the lymphatic and blood vessels. Most of these spaces are very small, but sometimes, as in the case of the *sub-epicranial space* of the scalp, the *capsule of Tenon* in the orbit, and the *retropharyngeal space* in the neck, they are large and are adaptations to allow free movement. Opening from these spaces, and also communicating with the serous membranes by small openings called stomata,[1] are the *lymph capillaries* (see VASCULAR SYSTEM), which converge to the *lymphatic vessels*. These resemble veins in having an internal layer of endothelium, a middle unstriped muscular coat, and an external coat of fibrous tissue, though in the smaller vessels the middle coat is wanting. They have numerous endothelial valves, formed of two crescentic segments allowing the lymph to pass toward the root of the neck. When the vessels are engorged these valves are marked by a constriction, and so the lymphatics have a beaded appearance. The vessels divide and anastomose very freely, and for this reason they do not, like the veins, increase in calibre as they approach their destination. It is usual to divide the lymphatic vessels into a superficial and a deep set; speaking generally, the superficial ones are found near the course of the superficial veins, while the deeper ones accompany the arteries. Probably any single drop of lymph passes sooner or later through one or more lymphatic glands, and so those vessels which are approaching a gland are called *afferent*, while those leaving are spoken of as *efferent lymphatics*. The *lacteals* are special lymphatic vessels which carry the chyle from the intestine; they begin in lymphatic spaces in the villi and round the solitary and agminated glands, and pass into the mesentery, where they come in contact with a large number of *mesenteric glands* before reaching the *receptaculum chyli*.

The *lymphatic glands* are pink bodies situated in the course of the lymphatic vessels, to which they act as filters. They are generally oval in shape and about the size of a bean, but sometimes, especially in the groin, they form irregular flattened masses 2 in. long, while, at other times, they are so small as almost to escape notice. They are usually found in groups.

Each gland has a fibrous capsule from which trabeculae pass toward the centre, where they break up and interlace, forming a network, and in this way a cortical and medullary region for each gland is distinguished; the intervals are nearly filled by lymphoid tissue, but close to the trabeculae is a lymph path or sinus, which is only crossed by the reticular stroma of the lymphoid tissue, and this probably acts as a mechanical sieve, entangling foreign particles; as an example of this the bronchial glands are black from carbon strained off in its passage from the lungs, while the axillary glands in a tattooed arm are blue. The blood-vessels enter at one spot, the *hilum*, and are distributed along the trabeculae. In addition to their function as filters the lymphatic glands are probably one of the sources from which the leucocytes are derived.

The exact position of the various groups of glands is very important from a medical point of view, but here it is only possible to give a brief sketch which will be helped by reference to the accompanying diagram. In the head are found *occipital* and *mastoid glands* (fig. 1, β), which drain the back of the scalp; *internal maxillary glands*, in the zygomatic fossa, draining the orbit, palate, nose and membranes of the brain; *preauricular glands* (fig. 1, α), embedded in the parotid, draining the side of the scalp, pinna, tympanum and lower eyelid; and *buccal glands*, draining the cheek region. In the neck are the *superficial cervical glands* (fig. 1, γ), along the course of the external jugular vein, draining the surface of the neck; the *submaxillary glands* (fig. 1, δ), lying just above the salivary gland of the same name and draining the front of the face and scalp; the *submental glands* (fig. 1, ε), beneath the chin, draining the lower lip, as well as sometimes the upper, and the front of the tongue; the *retropharyngeal glands*, draining the naso-pharynx and tympanum; the *pretracheal glands*, draining the trachea and lower part of the thyroid body; and the *deep cervical glands*, which are by far the most important and form a great mass close to the internal jugular vein; they receive afferent vessels from most of the glands already mentioned and so are liable to be affected in any trouble of the head or neck, especially of the deeper parts. Into them the lymphatics of the brain pass directly. The lower part of this mass is sometimes distinguished as a separate group called the *supra-clavicular glands*, which drain the back of the neck and receive afferents from the occipital and axillary glands. The efferents from the deep cervical glands join to form a common vessel known as the *jugular lymphatic trunk*, and this usually opens into the thoracic duct on the left side and the right lymphatic duct on the right.

In the thorax are found *intercostal glands* (fig. 2, I.), near the vertebral column draining the back of the thoracic walls and pleura; *internal mammary glands*, draining the front of the same parts as well as the inner part of the breast and the upper part of the abdominal wall; *diaphragmatic glands*, draining that structure and the convex surface of the liver; *anterior, middle, posterior and superior mediastinal glands*, draining the contents of those cavities. The *bronchial glands*, draining the lungs, have already been referred to.

In the abdomen and pelvis the glands are usually grouped round the large arteries and are divided into visceral and parietal. Among the visceral are the *gastric glands*, draining the stomach (these are divided into *coronary*, *subpyloric* and *retropyloric* groups); the *splenic glands* at the hilum of the spleen, draining that organ, the tail of the pancreas and the fundus of the stomach; the *hepatic glands* in the small omentum, draining the lower surface and deep parts of the liver; the *pancreatic glands*, behind the lesser sac of the peritoneum, draining the head and body of the pancreas, the *superior mesenteric glands*; from one to two hundred in number, lying in the mesentery and receiving the lacteals; the *ileo-caecal glands*, draining the caecum, one of which is known as the *appendicular* gland and drains the vermiform appendix and right ovary; the *colic glands* along the right and middle colic arteries, draining the ascending and transverse colon; the *inferior mesenteric glands* in the course of that artery, draining the descending iliac and pelvic colons; the *rectal* glands, behind the rectum, draining its upper part.

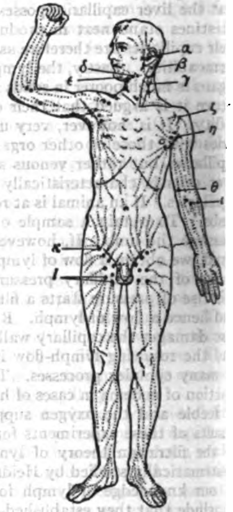

FIG. 1.—Superficial Lymphatic Vessels and Glands.

α,	Preauricular.
β,	Mastoid.
γ,	Superficial cervical.
δ,	Submaxillary.
ε,	Submental.
ζ,	Infraclavicular.
η,	Anterior axillary.
θ,	Supratrochlear.
ι,	Antecubital.
κ,	Inguinal.
l,	Superficial femoral.

Among the parietal glands are the *external iliac glands*, divided into a lateral and mesial set (see fig. 2, E.I.), and receiving the inguinal efferent vessels and lymphatics from the bladder, prostate, cervix uteri, upper part of the vagina, glans penis vel clitoridis and urethra. The *supra* and *infra-umbilical glands* receive the deep lymphatics of the abdominal wall, the former communicating with the liver, the latter with the bladder. From the latter, vessels pass to the epigastric gland lying in front of the termination of the external iliac artery. The *internal iliac glands* (fig. 2, I. I.) are situated close to the branches of this artery and drain the rectum, vagina, prostate, urethra, buttock and perinaeum. *Common iliac glands* (fig. 2, C.I.) lie around that artery and receive afferents from the external and internal iliac glands as well as a few from the pelvic viscera.[2] The

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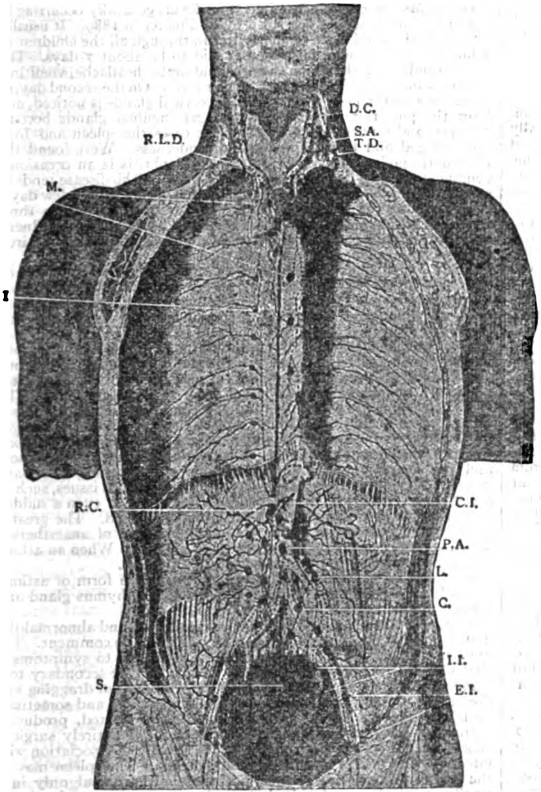
[1] It has recently been stated that stomata do not exist in the peritoneum.

[2] For further details of the pelvic glands see "Seventh Report of the Committee of Collective Investigation," *Journ. Anat. and Phys.* xxxii. 164.

aortic glands are grouped all round the length of the aorta, and are divided into *pre-*, *retro-* and *lateral aortic* groups (fig. 2 P.A. and L), all of which communicate freely. The upper preaortic glands are massed round the coeliac axis, and receive afferents from the gastric, hepatic, splenic and pancreatic glands; they are known as *coeliac glands*. The *lateral aortic glands* drain the kidney, adrenal, testis, ovary, fundus of uterus and lateral abdominal walls. In the upper extremity a few small glands are sometimes found near the deep arteries of the forearm. At the bend of the elbow are the *antecubital* glands (fig. 1 λ) and just above the internal condyle, one or two *supra-trochlear glands* (fig. 1, θ). The *axillary glands* (fig. 1, η) are perhaps the most practically important in the body. They are divided into four sets: (1) *external*, along the axillary vessels, draining the greater part of the arm; (2) *anterior*, behind the lower border of the pectoralis major muscle, draining the surface of the thorax including the breast and upper part of the abdomen; (3) *posterior* along the subscapular artery, draining the back and side of the trunk as low as the umbilical zone; (4) superior or *infra-clavicular glands* (fig. 1, ζ), receiving the efferents of the former groups as well as lymphatics accompanying the cephalic vein. In the lower limb all the superficial lymphatics pass up to the groin, where there are two sets of glands arranged like a T. The *superficial femoral* glands (fig. 1, λ) are the vertical ones, and are grouped round the internal saphenous vein; they are very large, drain the surface of the leg, and are usually in two parallel rows. The *inguinal glands* form the cross bar of the T (fig. 1, κ), and drain part of the buttock, the surface of the abdomen below the umbilicus and the surface of the genital organs. The deep lymphatics of the leg drain into the *anterior tibial gland* on that artery, the *popliteal glands* in that space, and the *deep femoral glands* surrounding the common femoral vein.



From A. M. Paterson, Cunningham's *Text-book of Anatomy*.

FIG. 2.—Deep Lymphatic Glands and Vessels of the Thorax and Abdomen (diagrammatic). Afferent vessels are represented by continuous lines and efferent and interglandular vessels by dotted lines.

C.	Common iliac glands.
C.I.	Common intestinal trunk.
D.C.	Deep cervical glands.
E.I.	External iliac glands.
I.	Intercostal glands and vessels.
I.I	Internal iliac glands.
L.	Lateral aortic glands.
M.	Mediastinal glands and vessels.
P.A.	Pre-aortic glands and vessels.
R.C.	Receptaculum chylii.
R.L.D.	Right lymphatic duct.
S.	Sacral glands.
S.A.	Scalenus anticus muscle.
T.D.	Thoracic duct.

The *thoracic duct* begins as an irregular dilatation known as the *receptaculum chyli*, opposite the first and second lumbar vertebrae, which receives all the abdominal lymphatics as well as those of the lower intercostal spaces. The duct runs up on the right of the aorta through the posterior mediastinum and then traverses the superior mediastinum to the left of the oesophagus. At the root of the neck it receives the lymphatics of the left arm and left side of the neck and opens into the beginning of the left innominate vein, usually by more than one opening.

The *right lymphatic duct* collects the lymphatics from the right side of the neck and thorax, the right arm, right lung, right side of the heart and upper surface of the liver; it is often represented by several ducts which open separately into the right innominate vein.

Haemolymph glands are structures which have only been noticed since 1884. They differ from lymphatic glands in their much greater vascularity. They assist the spleen in the destruction of red blood corpuscles, and probably explain or help to explain the fact that the spleen can be removed without ill effects. In man they extend along the vertebral column from the coeliac axis to the pelvis, but are specially numerous close to the renal arteries.

T. Lewis suggests that lymphatic and haemolymph glands should be classified in the following way:—

- Haemolymph Glands.
  - Haemal glands.
    - Simple.
    - Specialized (Spleen).
  - Haemal lymphatic glands.
    - 1. Blood and lymph sinuses separate.
    - 2. Blood lymph sinuses.
    - 3. Other combined forms.
  - Lymphatic glands.

Details and references will be found in papers by T. Lewis, *J. Anat. & Phys.* vol. xxxviii. p. 312; W. B. Drummond, *Journ. Anat. and Phys.* vol. xxxiv. p. 198; A. S. Warthin, *Journ. Med. Research*, 1901, p. 3, and H. Dayton, *Am. Journ. of Med. Sciences*, 1904, p. 448. For further details of man's lymphatic system see *The Lymphatics* by Delamere, Poirier and Cuneo, translated by C. H. Leaf (London, 1903).

Embryology.—The lymphatic vessels are possibly developed by the hollowing out of mesenchyme cells in the same way that the arteries are; these cells subsequently coalesce and form tubes (see VASCULAR SYSTEM). There is, however, a good deal of evidence to show that they are originally offshoots of the venous system, and that their permanent openings into the veins are either their primary points of communication or are secondarily acquired. The lymphatic and haemolymph glands are probably formed by the proliferation of lymphocytes around networks of lymphatic vessels; the dividing lymphocytes form the lymphoid tissue, and eventually the network breaks up to form distinct glands into which blood vessels penetrate. If the blood vessels enlarge more than the lymphatic, haemolymph glands result, but if the lymphatic vessels become predominant ordinary lymphatic glands are formed. At an early stage in the embryo pig two thoracic ducts are formed, one on either side of the aorta, and the incomplete fusion of these may account for the division often found in man's duct. In the embryo pig too there have been found two pairs of lymph hearts for a short period.

See A. S. Warthin, *Journ. Med. Research*, vol. vii. p. 435; F. R. Sabin, *Am. Journ. of Anat.* i., 1902; and, for literature, *Development of the Human Body*, by J. P. McMurrich (London, 1906), and Quain's *Anatomy* (vol. i., London, 1908).

Comparative Anatomy.—A lymphatic system is recognized in all the Craniata, and in the lower forms (fishes and Amphibia) it consists chiefly of lymph spaces and sinuses in communication with the coelom. In fishes, for instance, there is a large *subvertebral lymph sinus* surrounding the aorta and another within the spinal canal. In Amphibia the subvertebral sinus is also found, and in the Anura (frogs and toads) there is a great *subcutaneous lymph sinus*. *Lymph hearts* are muscular dilatations of vessels and are found in fishes, amphibians, reptiles and bird embryos, and drive the lymph into the veins; they are not known in adult mammals.

In birds the thoracic duct is first recognized, and opens into both right and left precaval veins, as it always does in some mammals. In birds, however, some of the lymphatics open into the sacral veins, and it is doubtful whether true lymphatic glands ever occur. In birds and mammals lymphatic vessels become more definite and numerous and are provided with valves.

Haemolymph glands are present in mammals and birds, but have not been seen lower in the scale, though S. Vincent and S. Harrison point out the resemblance of the structure of the head kidney of certain Teleostean fishes to them (*Journ. Anat. and Phys.* vol. xxxi. p. 176).

For further details see *Comparative Anat. of Vertebrates*, by R. Wiedersheim (London, 1907). (F. G. P.)

Diseases of the Lymphatic System and Ductless Glands.

Lymphadenitis or inflammatory infection of the lymphatic glands, is a condition characterized by hyperaemia of and exudation into the gland, which becomes redder, firmer and larger than usual. Three varieties may be distinguished: simple, suppurative and tuberculous. The cause is always the absorption of some toxic or infective material from the periphery. This may take place in several of the acute infectious diseases, notably in scarlet fever, mumps, diphtheria and German measles, or may be the result of poisoned wounds. The lymphatic glands are also affected in constitutional diseases such as syphilis. Simple lymphadenitis usually subsides of its own accord, but if toxins are produced in the inflamed area the enlargement is obvious and painful, while if pyogenic organisms are absorbed the inflammation progresses to suppuration.

Tuberculous lymphadenitis (scrofula) is due to the infection of the lymph glands by Koch's tubercle bacillus. This was formerly known as "King's Evil," as it was believed that the touch of the royal hand had power to cure it. It occurs most commonly in children and young adults whose surroundings are unhealthy, and who are liable to develop tuberculous disease from want of sufficient food and fresh air. Some local focus of irritation is usually present. The ways in which the tubercle bacillus enters the body are much disputed, but catarrh of the mucous membranes is regarded as a predisposing factor, and the tonsils as a probable channel of infection. Any lymphoid tissue in the body may be the seat of tuberculous disease, but the glands of the neck are the most commonly involved. The course of the disease is slow and may extend over a period of years. The earliest manifestation is an enlargement of the gland. It is possible in this stage for spontaneous healing to take place, but usually the disease progresses to caseation, in which tuberculous nodules are found diffused throughout the gland. Occasionally this stage may end in calcification of the caseous matter, the gland shrinking and becoming hard; but frequently suppuration follows from liquefaction of the caseating material. Foci of pus occur throughout the gland, causing destruction of the tissue, so that the gland may become a single abscess cavity. If left to itself the abscess sooner or later bursts at one or several points, leaving ulcerated openings through which a variable amount of pus escapes. Temporary healing may take place, to be again followed by further breaking down of the gland. This condition, if untreated, may persist for years and may finally give rise to a general tuberculosis. The treatment consists mainly in improving the general health with good diet, fresh air (particularly sea air), cod-liver oil and iron, and the removal of all sources of local irritation such as enlarged tonsils, adenoids, &c. Vaccination with tuberculin (TR) may be useful. Suppuration and extension of the disease require operative measures, and removal of the glands *en masse* can now be done through so small an opening as to leave only a very slight scar.

In *Tabes mesenterica* (tuberculosis of the mesenteric glands), usually occurring in children, the glands of the mesentery and retroperitonaeum become enlarged, and either caseate or occasionally suppurate. The disease may be primary or may be secondary to tuberculous disease of the intestines or to pulmonary phthisis. The patients are pale, wasted and anaemic, and the abdomen may be enormously enlarged. There is usually moderate fever, and thin watery diarrhoea. The caseating glands may liquefy and give rise to an inflammatory attack which may simulate appendicitis. Limited masses are amenable to surgical treatment and may be removed, while in the earlier stages constitutional treatment gives good results. Tuberculous peritonitis frequently supervenes on this condition.

Lymphadenoma (Hodgkin's Disease), a disease which was first fully described by Hodgkin in 1832, is characterized by a progressive enlargement of the lymphatic glands all over the body, and generally starts in the glands of the neck. The majority of cases occur in young adults, and preponderate in the male sex. The first symptom is usually enlargement of a gland in the neck, with generally progressive growth of the glands in the submaxillary region and axilla. The inguinal glands are early involved, and after a time the internal lymph glands follow. The enlargements are at first painless, but in the later stages symptoms are caused by pressure on the surrounding organs, and when the disease starts in the deeper structures the first symptoms may be pain in the chest and cough, pain in the abdomen, pain and oedema in the legs. The glands may increase until they are as large as eggs, and later may become firmly adherent one to another, forming large lobulated tumours. Increase of growth in this manner in the neck may cause obstructive dyspnoea and even death. In the majority of cases the spleen enlarges, and in rare instances lymphoid tumours may be found on its surface. Anaemia is common and is secondary in character; slight irregular fever is present, and soon a great and progressive emaciation takes place. The cases are of two types, the acute cases in which the enlargements take place rapidly and death may occur in two to three months, and the chronic cases in which the disease may remain apparently stationary. In acute lymphadenoma the prognosis is very unfavourable. Recovery sometimes takes place in the chronic type of the disease. Early surgical intervention has in some cases been followed by success. The application of X-rays is a valuable method of treatment, superficial glands undergoing a rapid diminution in size. Of drugs arsenic is of the most service, and mercurial inunction has been recommended by Dreschfeld. Organic extracts have of late been used in the treatment of lymphadenoma.

Glandular Fever is an acute infectious fever, generally occurring in epidemics, and was first described by E. Pfeiffer in 1889. It usually affects childrenand has a tendency to run through all the children of a family. The incubation period is said to be about 7 days. The onset is sudden, with pain in the neck and limbs, headache, vomiting, difficulty in swallowing and high temperature. On the second day, or sometimes on the first, swelling of the cervical glands is noticed, and later the posterior cervical, axillary and inguinal glands become enlarged and tender. In about half the cases the spleen and liver are enlarged and there is abdominal tenderness. West found the mesenteric nodes enlarged in 37 cases. Nephritis is an occasional complication, and constipation is very usual. The disease tends to subside of itself, and the fever usually disappears after a few days; the glandular swellings may, however, persist from one to three weeks. Considerable anaemia has been noticed to follow the illness. Rest in bed while the glands are enlarged, and cod-liver oil and iron to meet the anaemia, are the usual treatment.

Status lymphaticus (lymphatism) is a condition found in children and some adults, characterized by an enlargement of the lymphoid tissues throughout the body and more particularly by enlargement of the thymus gland. There is a special lowering of the patient's powers of resistance, and it has been said to account for a number of cases of sudden death. In all cases of status lymphaticus the thymus has been found enlarged. At birth the gland (according to Bovaird and Nicoll) weighs about 6 grammes, and does not increase after birth. In lymphatism it may weigh from 10 to 50 grammes. The clinical features are indefinite, and the condition frequently passes unrecognized during life. In most cases there is no hint of danger until the fatal syncope sets in, which may be after any slight exertion or shock, the patient becoming suddenly faint, gasping and cyanosed, and the heart stopping altogether before the respirations have ceased. The most trifling causes have brought on fatal issues, such as a wet pack (Escherich) or a hypodermic injection, or even a sudden plunge into water though the head is not immersed. The greater number of deaths occur during the administration of anaesthetics, which seem peculiarly dangerous to these subjects. When an attack of syncope takes place no treatment is of any avail.

Virchow, West and Goodhardt have described a form of asthma in adults which they ascribe to a hypertrophied thymus gland and term "thymic asthma."

Diseases of the Spleen.—Physiological variations and abnormalities and absence of the spleen are so rare as to require no comment. The most usual pathological condition which gives rise to symptoms is that of *wandering spleen*, which may or may not be secondary to a wandering left kidney. It may produce symptoms of dragging and discomfort, dyspepsia, vomiting and abdominal pain, and sometimes jaundice (Treves), or the pedicle may become twisted, producing extremely severe symptoms. The treatment is entirely surgical. Abscess in the spleen occasionally occurs, usually in association with infective endocarditis or with general pyaemia. The spleen may be the seat of primary *new growths*, but these are rare, and only in a small portion of cases does it share in the metastatic reproduction of carcinoma. Infection of the spleen plays a prominent part in many diseases, such as malaria, typhoid fever, lymphadenoma and leucaemia.

Diseases of the thyroid gland (see GOITRE) and *Addison's disease* (of the suprarenal glands) are treated separately. (H. L. H.)

LYNCH, PATRICIO (1825–1886) Chilean naval officer, was born in Valparaiso on the 18th of December 1825, his father being a wealthy Irish merchant resident in Chile, and his mother, Carmen Solo de Saldiva, a descendant of one of the best-known families in the country. Entering the navy in 1837, he took part in the operations which led to the fall of the dictator, Santa Cruz. Next, he sought a wider field, and saw active service in the China War on board the British frigate "Calliope." He was mentioned in despatches for bravery, and received the grade of midshipman in the British service. Returning to Chile in 1847 he became lieutenant, and seven years later he received the command of a frigate, but was deprived of his command for refusing to receive on board his ship political suspects under arrest. The Spanish War saw him again employed, and he was successively maritime prefect of Valparaiso, colonel of National Guards, and, finally, captain and minister of marine in 1872. In the Chile-Peruvian War a brilliant and destructive naval raid, led by him, was followed by the final campaign of Chorrillos and Miraflores (1880), in which he led at first a brigade (as colonel) and afterwards a division under Baquedano. His services at the battle of Chorrillos led to his appointment to command the Army of Occupation in Peru. This difficult post he filled with success, but his action in putting the Peruvian president, Garcia Calderon, under arrest excited considerable comment. His last act was to invest Iglesias with supreme power in Peru, and he returned to his own country in 1883. Promoted rear-admiral, he served as Chilean Minister at Madrid for two years, and died at sea in 1886. Lynch is remembered as one of the foremost of Chile's naval heroes.

LYNCHBURG, a city of Campbell county, Virginia, U.S.A., on the James river, about 125 m. W. by S. of Richmond. Pop. (1900) 18,891, of whom 8254 were negroes; (1910) 29,494. It is served by the Southern, the Chesapeake & Ohio and the Norfolk & Western railways. Its terraced hills command fine views of mountain, valley and river scenery, extending westward to the noble Peaks of Otter and lesser spurs of the Blue Ridge about 20 m. distant. On an elevation between Rivermont Avenue and the James river are the buildings of Randolph-Macon Woman's college (opened in 1893), which is conducted by a self-perpetuating board under the auspices of the Methodist Episcopal Church, South, and is one of the Randolph-Macon system of colleges and academies (see ASHLAND, VA.). In Lynchburg, too, are the Virginia Christian college (co-educational, 1903), and the Virginia collegiate and industrial school for negroes. The city has a public library, well-equipped hospitals, public parks and the Rivermont Viaduct, 1100 ft. long and 140 ft. high. Lynchburg is the see of a Protestant Episcopal bishop. Tobacco of a superior quality and large quantities of coal, iron ore and granite are produced in the neighbourhood. Good water power is furnished by the James river, and Lynchburg is one of the principal manufacturing cities of the state. The boot and shoe industry was established in 1900, and is much the most important. In 1905 the city was the largest southern manufacturer of these articles and one of the largest distributors in the country. The factory products increased in value from $2,993,551 in 1900 to $4,965,435 in 1905, or 65·9%.

Lynchburg, named in honour of John Lynch, who inherited a large tract of land here and in 1757 established a ferry across the James, was established as a village by Act of Assembly in 1786, was incorporated as a town in 1805, and became a city in 1852. During the Civil War it was an important base of supplies for the Confederates; on the 16th of June 1864 it was invested by Major-General David Hunter (1802–1886), but three days later he was driven away by General Jubal A. Early. In 1908 the city's corporate limits were extended.

LYNCH LAW, a term loosely applied to various forms of executing rough popular justice, or what is thought to be justice, for the punishment of offenders by a summary procedure, ignoring, or even contrary to, the strict forms of law. The word *lynching* "originally signified a whipping for reformatory purposes with more or less disregard for its legality" (Cutler), or the infliction of minor punishments without recourse to law; but during and after the Reconstruction Period in the United States, it came to mean, generally, the summary infliction of capital punishment. Lynch law is frequently prevalent in sparsely settled or frontier districts where government is weak and officers of the law too few and too powerless to enforce law and preserve order. The practice has been common in all countries when unsettled frontier conditions existed, or in periods of threatened anarchy. In what are considered civilized countries it is now found mainly in Russia, south-eastern Europe and in America, but it is essentially and almost peculiarly an American institution. The origin of the name is obscure; different writers have attempted to trace it to Ireland, to England, to South Carolina, to Pennsylvania and to Virginia. It is certain that the name was first used in America, but it is not certain whether it came from Lynch's Creek, South Carolina, where summary justice was administered to outlaws, or from Virginia and Pennsylvania, where men named Lynch were noted for dealing out summary punishment to offenders.[1] In Europe early examples of a similar phenomenon are found in the proceedings of the Vehmgerichte in medieval Germany, and of Lydford law, gibbet law or Halifax law, Cowper justice and Jeddart justice in the thinly settled and border districts of Great Britain; and since the term "lynch law" came into colloquial use, it is loosely employed to cover any case in which a portion of the community takes the execution of its ideas of justice into its own hands, irrespective of the legal authorities.

In America during the 18th and 19th centuries the population expanded westward faster than well-developed civil institutions could follow, and on the western frontier were always desperadoes who lived by preying on the better classes. To suppress these desperadoes, in the absence of strong legal institutions, resort was continually made to lynch law. There was little necessity for it until the settlement crossed the Alleghany Mountains, but the following instances of lynching in the East may be mentioned: (1) the mistreatment of Indians in New England and the Middle Colonies in disregard of laws protecting them; (2) the custom found in various colonies of administering summary justice to wife-beaters, idlers and other obnoxious persons; (3) the acts of the Regulators of North Carolina, 1767–1771; (4) the popular tribunals of the Revolutionary period, when the disaffection toward Great Britain weakened the authority of the civil governments and the war replaced them by popular governments, at a time when the hostilities between "Patriots" and "Tories" were an incentive to extra-legal violence. In the South, lynching methods were long employed in dealing with agitators, white and black, who were charged with endeavouring to excite the slaves to insurrection or to crime against their masters, and in dealing with anti-slavery agitators generally.

In the West, from the Alleghanies to the Golden Gate, the pioneer settlers resorted to popular justice to get rid of bands of outlaws, and to regulate society during that period when laws were weak or confused, when the laws made in the East did not suit western conditions, and when courts and officials were scarce and distant. The Watauga settlements and the "State" of Franklin furnished examples of lynch law procedure almost reduced to organization. Men trained in the rough school of the wilderness came to have more regard for quick, ready-made, personal justice than for abstract justice and statutes; they were educated to defend themselves, to look to no law for protection or regulation; consequently they became impatient of legal forms and lawyers' technicalities; an appeal to statute law was looked upon with suspicion, and, if some personal matter was involved, was likely to result in deadly private feuds. Thus were formed the habits of thought and action of the western pioneers. Lynch law, not civil law, cleared the western forests, valleys and mountain passes of horse and cattle thieves, and other robbers and outlaws, gamblers and murderers. This was especially true of California and the states of the far West. H. H. Bancroft, the historian of *Popular Tribunals*, wrote in 1887 that "thus far in the history of these Pacific States far more has been done toward righting wrongs and administering justice outside the pale of law than within it." However, the lack of regard for law fostered by the conditions described led to a survival of the lynching habit after the necessity for it passed away. In parts of the Southern states, where the whites are few and greatly outnumbered by the blacks, certain of the conditions of the West have prevailed, and since emancipation released the blacks from restraint many of the latter have been lawless and turbulent. The Reconstruction, by giving to the blacks temporary political supremacy, increased the friction between the races, and greatly deepened prejudice. The numerous protective societies of whites, 1865–1876, culminating in the Ku Klux movement, may be described as an application of lynch law. With the increase of negro crimes came an increase of lynchings, due to prejudice, to the fact that for some time after Reconstruction the governments were relatively weak, especially in the districts where the blacks outnumber the whites, to the fact that negroes nearly always shield criminals of their own race against the whites, and to the frequent occurrence of the crime of rape by negro men upon white women.

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[1] The usual explanation is that the name was derived from Charles Lynch (1736–1796), a justice of the peace in Virginia after 1774, who in 1780, toward the close of the War of Independence, greatly exceeded his powers in the punishment of Tories or Loyalists detected in a conspiracy in the neighbourhood of his home in Bedford county, Va. Lynch was a man of influence in his community, was for many years a member of the Virginia legislature, was a member of the famous Virginia Convention of 1776 and was later (in 1781) an officer in the American army. See an article, "The Real Judge Lynch," in the *Atlantic Monthly*, vol. lxxxviii. (Boston, 1901).

Since 1882 the Chicago *Tribune* has collected statistics of lynching, and some interesting facts may be deduced from these tables.[1] During the twenty-two years from 1882 to 1903 inclusive, the total number of persons lynched in the United States was 3337, the number decreasing during the last decade; of these 2385 were in the South and 752 in the North; of those lynched in the East and West 602 were white and 75 black, and of those in the South 567 were white and 1985 black.[2] Lynchings occur mostly during periods of idleness of the lower classes; in the summer more are lynched for crimes against the person and in the winter (in the West) for crimes against property; the principal causes of lynching in the South are murder and rape, in the North and West, murder and offences against property; more blacks than whites were lynched between 1882 and 1903, the numbers being 2060 negroes, of whom 40 were women, and 1169 whites, of whom 23 were women; of the 707 blacks lynched for rape 675 were in the South; 783 blacks were lynched for murder, and 753 of these were in the South; most of the lynchings of whites were in the West; the lynching of negroes increased somewhat outside of the South and decreased somewhat in the South. Lynching decreases and disappears in a community as the population grows denser and civil institutions grow stronger; as better communications and good police make it harder to commit crime; and as public sentiment is educated to demand legal rather than illegal and irregular infliction of punishment for even the most horrible of crimes.

See James E. Cutler, *Lynch Law* (New York, 1905), an admirable and unbiased discussion of the subject; H. H. Bancroft, *Popular Tribunals* (2 vols., San Francisco, 1887); C. H. Shinn, *Mining Camps: A Study in American Frontier Government* (New York, 1885); and J. C. Lester and D. L. Wilson, *Ku Klux Klan* (New York, 1905). (W. L. F.)

LYNDHURST, JOHN SINGLETON COPLEY, Baron (1772–1863), lord chancellor of England, was born at Boston, Massachusetts, in 1772. He was the son of John Singleton Copley, the painter. He was educated at a private school and Cambridge university, where he was second wrangler and fellow of Trinity. Called to the bar at Lincoln's Inn in 1804, he gained a considerable practice. In 1817 he was one of the counsel for Dr J. Watson, tried for his share in the Spa Fields riot. On this occasion Copley so distinguished himself as to attract the attention of Castlereagh and other Tory leaders, under whose patronage he entered parliament as member for Yarmouth in the Isle of Wight. He afterwards sat for Ashburton, 1818–1826, and for Cambridge university, 1826–1827. He was solicitor-general in 1819, attorney-general in 1824, master of the rolls in 1826 and lord chancellor in 1827, with the title of Lord Lyndhurst. Before being taken up by the Tories, Copley was a man of the most advanced views, a republican and Jacobin; and his accession to the Tories excited a good deal of comment, which he bore with the greatest good humour. He gave a brilliant and eloquent but by no means rancorous support to all the reactionary measures of his chief. The same year that he became solicitor-general he married the beautiful and clever widow of Lieut.-Colonel Charles Thomas of the Coldstream Guards, and began to take a conspicuous place in society, in which his noble figure, his ready wit and his never-failing *bonhomie* made him a distinguished favourite.

As solicitor-general he took a prominent part in the trial of Queen Caroline. To the great Liberal measures which marked the end of the reign of George IV. and the beginning of that of William IV. he gave a vigorous opposition. He was lord chief baron of the exchequer from 1831 to 1834. During the Melbourne administration from 1835 to 1841 he figured conspicuously as an obstructionist in the House of Lords. In these years it was a frequent practice with him, before each prorogation of parliament, to entertain the House with a "review of the session," in which he mercilessly attacked the Whig government. His former adversary Lord Brougham, disgusted at his treatment by the Whig leaders, soon became his most powerful ally in opposition; and the two dominated the House of Lords. Throughout all the Tory governments from 1827 Lyndhurst held the chancellorship (1827–1830 and 1834–1835); and in the Peel administration (1841–1846) he resumed that office for the last time. As Peel never had much confidence in Lyndhurst, the latter did not exert so great an influence in the cabinet as his position and experience entitled him to do. But he continued a loyal member of the party. As in regard to Catholic emancipation, so in the agitation against the corn laws, he opposed reform 'till his chief gave the signal for concession, and then he cheerfully obeyed. After 1846 and the disintegration of the Tory party consequent on Peel's adoption of free trade, Lord Lyndhurst was not so assiduous in his attendance in parliament. Yet he continued to an extreme old age to take a lively interest in public affairs, and occasionally to astonish the country by the power and brilliancy of his speeches. That which he made in the House of Lords on the 19th of June 1854, on the war with Russia, made a sensation in Europe; and throughout the Crimean War he was a strong advocate of the energetic prosecution of hostilities. In 1859 he denounced with his old energy the restless ambition of Napoleon III. When released from office he came forward somewhat as the advocate of liberal measures. His first wife had died in 1834, and in August 1837 he had married Georgina, daughter of Lewis Goldsmith. She was a Jewess; and it was therefore natural that he strenuously supported the admission of Jews into parliament. He also advocated women's rights in questions of divorce. At the age of eighty-four he passed the autumn at Dieppe, "helping to fly paper kites, and amusing himself by turns with the writings of the Greek and Latin fathers on divorce and the amorous novels of Eugene Sue." His last speech, marked by "his wonted brilliancy and vigour," was delivered in the House of Lords at the age of eighty-nine. He died in London on the 12th of October 1863. He left no male issue and the title became extinct.

See *Lives of the Lord Chancellors of England*, vol. viii. (Lords Lyndhurst and Brougham), by Lord Campbell (1869). Campbell was a personal friend, but a political opponent. Brougham's *Memoirs*; *Greville Memoirs*; *Life of Lord Lyndhurst* (1883) by Sir Theodore Martin; J. B. Atlay, *The Victorian Chancellors* (1906).

LYNDSAY, SIR DAVID (*c.* 1490–*c.* 1555), Scottish poet, was the son of David Lyndsay of the Mount, near Cupar-Fife, and of Garmylton, near Haddington. His place of birth and his school are undetermined. It is probable that his college life was spent at St Andrews university, on the books of which appears an entry "Da Lindesay" for the session 1508–1509. He was engaged at court, first as an equerry, then as an "usher" to the young Prince James, afterwards James V. In 1522 he married Janet Douglas, a court seamstress, and seven years later was appointed Lyon King of Arms, and knighted. He was several times engaged in diplomatic business (twice on embassies abroad—to the Netherlands and France), and he was, in virtue of his heraldic office, a general master of ceremonies. After the death of James V., in 1542, he continued to sit in parliament as commissioner for Cupar-Fife; and in 1548 he was member of a mission to Denmark which obtained certain privileges for Scottish merchants. There is reason to believe that he died in or about 1555.

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[1] They have been corrected and somewhat modified by Dr. J. E. Cutler, from whose book the figures above have been taken. Lynching as used in this connexion applies exclusively to the illegal infliction of capital punishment.

[2] For present purposes the former slave states (of 1860) constitute the South; the West is composed of the territory west of the Mississippi river, excluding Missouri, Arkansas, Louisiana, Texas and Oklahoma; the East includes those states east of the Mississippi river not included in the Southern group; the East and the West make up the North as here used—that is, the former free states of 1860.

Most of Lyndsay's literary work, by which he secured great reputation in his own day and by which he still lives, was written during the period of prosperity at court. In this respect he is unlike his predecessor Gavin Douglas (*q.v.*), who forsook literature when he became a politician. The explanation of the difference is partly to be found in the fact that Lyndsay's muse was more occasional and satirical, and that the time was suitable to the exercise of his special gifts. It is more difficult to explain how he enjoyed a freedom of speech which is without parallel even in more secure times. He chastised all classes, from his royal master to the most simple. There is no evidence that he abjured Catholicism; yet his leading purpose was the exposure of its errors and abuses. His aid was readily accepted by the reforming party, and by their use of his work he shared with their leaders throughout many generations a reputation which is almost exclusively political and ecclesiastical.

Lyndsay's longer poems are *The Dreme* (1134 lines), *The Testament and Complaynt of the Papynago* (1190 lines), *The Testament of Squyer Meldrum* (1859 lines), *Ane Dialog betwix Experience and ane Courteour of the Miserabyll Estait of the World* (6333 lines), and *Ane Pleasant Satyre of the Thrie Estaitis* (over 4000 lines). These represent, with reasonable completeness, the range of Lyndsay's literary talent. No single poem can give him a chief place, though here and there, especially in the last, he gives hints of the highest competence. Yet the corporate effect of these pieces is to secure for him the allowance of more than mere intellectual vigour and common sense. There is in his craftsmanship, in his readiness to apply the traditional methods to contemporary requirements, something of that accomplishment which makes even the second-rate man of letters interesting.

Lyndsay, the last of the Makars, is not behind his fellow-poets in acknowledgment to Chaucer. As piously as they, he reproduces the master's forms; but in him the sentiment and outlook have suffered change. His nearest approach to Chaucer is in *The Testament of Squyer Meldrum*, which recalls the sketch of the "young squire"; but the reminiscence is verbal rather than spiritual. Elsewhere his memory serves him less happily, as when he describes the array of the lamented Queen Magdalene in the words which Chaucer had applied to the eyes of his wanton Friar. So too, in the *Dreme*, the allegorical tradition survives only in the form. "Remembrance" conducts the poet over the old-world itinerary, but only to lead him to speculation on Scotland's woes and to an "Exhortatioun to the Kingis Grace" to bring relief. The tenor is well expressed in the motto from the Vulgate—"*Prophetias nolite spernere. Omnia autem probate: quod bonum est tenete.*" This didactic habit is freely exercised in the long *Dialog* (sometimes called the *Monarche*), a universal history of the medieval type, in which the falls of princes by corruption supply an object lesson to the unreformed church of his day. The *Satyre* is more direct in its attack on ecclesiastical abuse; and its dramatic form permits more lively treatment. This piece is of great historical interest, being the only extant example of a complete Scottish morality. It is in respect of literary quality Lyndsay's best work, and in dramatic construction and delineation of character it holds a high place in this *genre*. The farcical interludes (in places too coarse for modern taste) supply many touches of genuine comedy; and throughout the play there are passages, as in the speeches of Veritie in the First Part and of Dame Chastitie in the "Interlude of the Sowtar and the Taylor," in which word and line are happily conceived. The *Testament of the Papyngo* (popinjay), drawn in the familiar medieval manner, is another tract for the time, full of admonition to court and clergy. Of his shorter pieces, *The Complaynt and Publict Confessions of the Kingis Auld Hound, callit Bagsche, directit to Bawtie, the Kingis best belovit Dog, and his companyeonis*, and the *Answer to the Kingis Flyting* have a like pulpit resonance. The former is interesting as a forerunner of Burns's device in the "Twa Dogs." The *Deploratioun of the Deith of Queen Magdalene* is in the extravagant style of commemoration illustrated in Dunbar's Elegy on the Lord Aubigny. The *Justing betwix James Watsoun and Jhone Barbour* is a contribution to the popular taste for boisterous fun, in spirit, if not in form, akin to the *Christis Kirk on the Grene* series; and indirectly, with Dunbar's *Turnament* and *Of ane Blak-Moir*, a burlesque of the courtly tourney. Lyndsay approaches Dunbar in his satire *The Supplicatioun in contemptioun of syde taillis* ("wide" trains of the ladies), which recalls the older poet's realistic lines on the filthy condition of the city streets. In Lyndsay's *Descriptioun of Pedder Coffeis* (pedlars) we have an early example of the studies in vulgar life which are so plentiful in later Scottish literature. In *Kitteis Confessioun* he returns, but in more sprightly mood, to his attack on the church.

In Lyndsay we have the first literary expression in Scotland of the Renaissance. His interest lies on the theological side of the revival; he is in no sense a humanist, and he is indifferent to the artistic claims of the movement. Still he appeals to the principle which is fundamental to all. He demands first-hand impression. He feels that men must get their lesson direct, not from intermediaries who understand the originals no more "than they do the ravyng of the rukis." Hence his persistent plea for the vernacular, nowhere more directly put than in the *Dialog*, in the "Exclamatioun to the Redar, toucheyng the wrytting of the vulgare and maternall language." Though he is concerned only in the theological and ecclesiastical application of this, he undoubtedly stimulated the use of the vernacular in a Scotland which in all literary matters beyond the concern of the irresponsible poet still used the *lingua franca* of Europe.

A complete edition of Lyndsay's poetical works was published by David Laing in 3 vols. in 1879. This was anticipated during the process of preparation by a cheaper edition (slightly expurgated) by the same editor in 1871 (2 vols.). The E.E.T.S. issued the first part of a complete edition in 1865 (ed. F. Hall). Five parts have appeared, four edited by F. Hall, the fifth by J. A. H. Murray. For the bibliography see Laing's 3 vol. edition, *u.s.* iii. pp. 222 et seq., and the E.E.T.S. edition *passim*. See also the editions by Pinkerton (1792), Sibbald (1803), and Chalmers (1806); and the critical accounts in Henderson's *Scottish Vernacular Literature* (1898), Gregory Smith's *Transition Period* (1900), and J. H. Millar's *Literary History of Scotland* (1903). A professional work prepared by Lyndsay in the Lyon Office, entitled the *Register of Scottish Arms* (now preserved in MS. in the Advocates' Library), was printed in 1821 and reprinted in 1878. It remains the most authoritative document on Scottish heraldry. (G. G. S.)

LYNEDOCH, THOMAS GRAHAM, 1ST BARON (1748–1843), British general, was the son of Thomas Graeme, laird of Balgowan, and was born on the 19th of October 1748. He was educated by private tutors, among whom was James Macpherson (*q.v.*), and was a gentleman commoner of Christ Church, Oxford, between 1766 and 1768. He then travelled on the continent of Europe, and in 1772 unsuccessfully contested a parliamentary seat in Perthshire. In 1774 he married a daughter of the ninth Lord Cathcart, and took a house in the Leicestershire hunting country. After a few years, owing to the state of his wife's health, Graham was compelled to live mainly in the south of Europe, though while at home he was a prominent sportsman and agriculturist. In 1787 he bought the small estate of Lynedoch or Lednock, a few miles from Perth. In 1791 his wife died in the Mediterranean, off Hyères. Graham tried to find distraction in renewed travels, and during his wanderings fell in with Lord Hood's fleet on its way to Toulon. He joined it as a volunteer, served on Lord Mulgrave's staff during the British occupation of Toulon, and returned, after the failure of the expedition, to Scotland, where he organized a regiment of infantry, the 90th Foot, Perthshire Volunteers (now 2nd Battalion Scottish Rifles). Graham's men were the first regiment in the army to be equipped and trained wholly as light infantry, though they were not officially recognized as such for many years. In the same year (1794) Graham became member of parliament, in the Whig interest, for the county of Perth. He saw some active service in 1795 in "conjunct expeditions" of the army and navy, and in 1796, being then a brevet colonel, he was appointed British commissioner at the headquarters of the Austrian army in Italy. He took part in the operations against Napoleon Bonaparte, was shut up in Mantua with Würmser's army, escaped in disguise, and after many adventures reached the relieving army of Alvinzi just before the battle of Rivoli. On returning to his regiment he served in more "conjunct" expeditions, in one of which, at Messina, he co-operated with Nelson, and in 1799 he was sent as brigadier-general to invest the fortress of Valetta, Malta. He blockaded the place for two years, and though Major-General Pigot arrived shortly before the close of the blockade and assumed command, the conquest of Malta stands almost wholly to the credit of Graham and his naval colleague Sir Alexander Ball. In 1801 Graham proceeded to Egypt, where his regiment was engaged in Abercromby's expedition, but arrived too late to take part in any fighting. He took the opportunity afforded by the peace of Amiens to visit Turkey, Austria, Germany and France, and only resumed command of his regiment in 1804. When the latter was ordered to the West Indies he devoted himself to his duties as a member of parliament. He sat for Perthshire until 1807, when he was defeated, as he was again in 1812. Graham was with Moore in Sweden in 1808 and in Spain 1808–1809, and was present at his death at the battle of Corunna. In 1809 he became a major-general, and after taking part in the disastrous Walcheren expedition he was promoted lieutenant-general and sent to Cadiz (1810).

In 1811, acting in conjunction with the Spanish army under General la Peña (see PENINSULAR WAR), he took the offensive, and won the brilliant action of Barossa (5th of March). The victory was made barren of result by the timidity of the Spanish generals. The latter nevertheless claimed more than their share of the credit, and Graham answered them with spirit. One of the Spanish officers he called out, fought and disarmed, and after refusing with contempt the offer of a Spanish dukedom, he resigned his command in the south and joined Wellington in Portugal. His seniority as lieutenant-general made him second in command of Wellington's army. He took part in the siege of Ciudad Rodrigo, and commanded a wing of the army in the siege of Badajoz and the advance to Salamanca. In July 1812, his eyesight becoming seriously impaired, he went home, but rejoined in time to lead the detached wing of the army in the wide-ranging manœuvre which culminated in the battle of Vittoria. Graham was next entrusted with the investment and siege of San Sebastian, which after a desperate defence fell on the 9th of September 1813. He then went home, but in 1814 accepted the command of a corps to be despatched against Antwerp. His assault on Bergen op Zoom was, however, disastrously repulsed (3rd of February 1814).

At the peace Graham retired from active military employment. He was created Baron Lynedoch of Balgowan in the peerage of the United Kingdom, but refused the offered pension of £2000 a year. In 1813 he proposed the formation of a military club in London, and though Lord St Vincent considered such an assemblage of officers to be unconstitutional, Wellington supported it and the officers of the army and navy at large received the idea with enthusiasm. Lynedoch's portrait, by Sir T. Lawrence, is in possession of this club, the (Senior) United Service. In his latter years he resumed the habits of his youth, travelling all over Europe, hunting with the Pytchley so long as he was able to sit his horse, actively concerned in politics and voting consistently for liberal measures. At the age of ninety-two he hastened from Switzerland to Edinburgh to receive Queen Victoria when she visited Scotland after her marriage. He died in London on the 18th of December 1843. He had been made a full general in 1821, and at the time of his death was a G.C.B., Colonel of the 1st (Royal Scots) regiment, and governor of Dumbarton Castle.

See biographies by John Murray Graham (2nd ed., Edinburgh, 1877) and Captain A. M. Delavoye (London, 1880); also the latter's *History of the 90th (Perthshire Volunteers)* (London, 1880), *Philippart's Royal Military Calendar* (1820), ii. 147, and *Gentleman's Magazine*, new series, xxi. 197.

LYNN, a city and seaport of Essex county, Massachusetts, 9 m. N.E. of Boston, on the N. shore of Massachusetts Bay. Pop. (1900) 68,513, of whom 17,742 were foreign-born (6609 being English Canadians, 5306 Irish, 1527 English and 1280 French Canadians), and 784 were negroes; (1910 census) 89,336. It is served by the Boston & Maine and the Boston, Revere Beach & Lynn railways, and by an interurban electric railway, and has an area of 10·85 sq. m. The business part is built near the shore on low, level ground, and the residential sections are on the higher levels. Lynn Woods, a beautiful park, covers more than 2000 acres. On the shore, which has a fine boulevard, is a state bath house. The city has a handsome city hall, a free public library, founded in 1862, a soldiers' monument and two hospitals. Lynn is primarily a manufacturing city. The first smelting works in New England were established here in 1643. More important and earlier was the manufacture of boots and shoes, an industry introduced in 1636 by Philip Kertland, a Buckingham man; a corporation of shoemakers existed here in 1651, whose papers were lost in 1765. There were many court orders in the seventeenth century to butchers, tanners, bootmakers and cordwainers; and the business was made more important by John Adam Dagyr (d. 1808), a Welshman who came here in 1750 and whose work was equal to the best in England. In 1767 the output was 80,000 pairs; in 1795 about 300,000 pairs of women's shoes were made by 600 journeymen and 200 master workmen. The product of women's shoes had become famous in 1764, and about 1783 the use of morocco had been introduced by Ebenezer Breed. In 1900 and 1905 Lynn was second only to Brockton among the cities of the United States in the value of boots and shoes manufactured, and outranked Brockton in the three allied industries, the manufacture of boots and shoes, of cut stock and of findings. In the value of its total manufactured product Lynn ranked second to Boston in the state in 1905, having been fifth in 1900; the total number of factories in 1905 was 431; their capital was $23,139,185; their employees numbered 21,540; and their product was valued at $55,003,023 (as compared with $39,347,493 in 1900). Patent medicines and compounds and the manufacture of electrical machinery are prominent industries. The Lynn factories of the General Electric Company had in 1906 an annual product worth between $15,000,000 and $20,000,000. The foreign export of manufactured products is estimated at $5,000,000 a year.

Lynn was founded in 1629 and was called Saugus until 1637, when the present name was adopted, from Lynn Regis, Norfolk, the home of the Rev. Samuel Whiting (1597–1679), pastor at Lynn from 1636 until his death. From Lynn Reading was separated in 1644, Lynnfield in 1782, Saugus in 1815, and, after the incorporation of the city of Lynn in 1850, Swampscott in 1852, and in 1853 Nahant, S. of Lynn, on a picturesque peninsula and now a fashionable summer resort.

See James R. Newhall, *History of Lynn* (Lynn, 1883), and H. K. Sanderson, *Lynn in the Revolution* (1910).

LYNTON and **LYNMOUTH**, two seaside villages in the Barnstaple parliamentary division of Devonshire, England, on the Bristol Channel; 17 m. E. of Ilfracombe, served by the Lynton light railway, which joins the South Western and Great Western lines at Barnstaple. Both are favoured as summer resorts. Lynmouth stands where two small streams, the East Lyn and West Lyn, flow down deep and well-wooded valleys to the sea. Lynton is on the cliff-edge, 430 ft. above. A lift connects the villages. The industries are fishing and a small coasting trade. Not far off are the Doone Valley, part of the vale of the East Lyn, here called Badgeworthy water, once the stronghold of a notorious band of robbers and famous through R. D. Blackmore's novel *Lorna Doone*; Watersmeet, where two streams, the Tavy and Walkham, join amid wild and beautiful scenery; and the Valley of Rocks, a narrow glen strewn with immense boulders. Lynton is an urban district, with a population (1901) of 1641.

LYNX (Lat. *Lynx*, Gr. λύγξ, probably connected with λεύσσειν, to see), a genus of mammals of the family *Felidae*, by some naturalists regarded only as a subgenus or section of the typical genus *Felis* (see CARNIVORA). As an English word (lynx) the name is used of any animal of this group. It is not certain to which of these, if to any of them, the Greek name λύγξ was especially applied, though it was more probably the caracal (*q.v.*) than any of the northern species. The so-called lynxes of Bacchus were generally represented as resembling leopards rather than any of the species now known by the name. Various fabulous properties were attributed to the animal, whatever it was, by the ancients, that of extraordinary powers of vision, including ability to see through opaque substances, being one; whence the epithet "lynx-eyed," which has survived to the present day.

Lynxes are found in the northern and temperate regions of both the Old and New World; they are smaller than leopards, and larger than true wild cats, with long limbs, short stumpy tail, ears tufted at the tip, and pupil of the eye linear when contracted. Their fur is generally long and soft, and always longish upon the cheeks. Their colour is light brown or grey, and generally spotted with a darker shade. The naked pads of the feet are more or less covered by the hair that grows between them. The skull and skeleton do not differ markedly from those of the other cats. Their habits are exactly those of the other wild cats. Their food consists of any mammals or birds which they can overpower. They commit extensive ravages upon sheep and poultry. They generally frequent rocky places and forests, being active climbers, and passing much of their time among the branches of the trees. Their skins are of considerable value in the fur trade. The northern lynx (*L. lynx* or *L. borealis*) of Scandinavia, Russia, northern Asia, and till lately the forest regions of central Europe, has not inhabited Britain during the historic period, but its remains have been found in cave deposits of Pleistocene age. Dr W. T. Blanford says that the characters on which E. Blyth relied in separating the Tibetan lynx (*L. isabellinus*) from the European species are probably due to the nature of its habitat among rocks, and that he himself could find no constant character justifying separation. The pardine lynx (*L. pardinus*) from southern Europe is a very handsome species; its fur is rufous above and white beneath.

From a drawing by Wolf in Elliot's Monograph of the Felidae.

European Lynx.

Several lynxes are found in North America; the most northerly has been described as the Canadian lynx (*L. canadensis*); the bay lynx (*L. rufus*), with a rufous coat in summer, ranges south to Mexico, with spotted and streaked varieties—*L. maculatus* in Texas and southern California, and *L. fasciatus* in Washington and Oregon. The first three were regarded by St George Mivart as local races of the northern lynx. A fifth form, the plateau lynx (*L. baileyi*), was described by Dr C. H. Merriam in 1890, but the differences between it and the bay lynx are slight and unimportant.

LYON, MARY MASON (1797–1849), American educationalist, was born on the 28th of February 1797 on a farm near Buckland, Franklin county, Massachusetts. She began to teach when she was seventeen, and in 1817, with the earnings from her spinning and weaving, she went to Sanderson Academy, Ashfield. She supported herself there, at Amherst Academy, where she spent one term, and at the girls' school in Byfield, established in 1819 by Joseph Emerson (1777–1833), where she went in 1821, by teaching in district schools and by conducting informal normal schools. In 1822–1824 she was assistant principal of Sanderson Academy, and then taught in Miss Zilpah P. Grant's Adams Female Academy, in Londonderry (now Derry), N.H. This school had only summer sessions, and Miss Lyon spent her winters in teaching, especially at Buckland and at Ashfield, and in studying chemistry and natural science with Edward Hitchcock, the geologist. In 1828–1834 she taught in Miss Grant's school, which in 1828 had been removed to Ipswich, and for two years managed the school in Miss Grant's absence. In 1828–1830 she had kept up her winter "normal" school at Buckland, and this was the beginning of her greater plan, "a permanent institution consecrated to the training of young women for usefulness ... designed to furnish every advantage which the state of education in this country will allow ... to put within reach of students of moderate means such opportunities that none can find better." She was assisted by Dr Hitchcock, and her own mystical enthusiasm and practical common sense secured for her plan ready financial support. In 1835 a site was selected near the village of South Hadley and Mount Holyoke; in 1836 the school was incorporated as Mount Holyoke Female Seminary; and on the 8th of November 1837 it opened with Mary Lyon as principal, and, as assistant, Miss Eunice Caldwell, afterwards well known as Mrs J. P. Cowles of Ipswich Academy. Miss Lyon died at Mount Holyoke on the 5th of March 1849, having served nearly twelve years as principal of the seminary, on a salary of $200 a year. From her work at Holyoke sprang modern higher education for women in America.

See Edward Hitchcock, *Life and Labors of Mary Lyon* (1851); B. B. Gilchrist, *Life of Mary Lyon* (Boston, 1910).

LYON, NATHANIEL (1818–1861), American soldier, was born in Ashford, Connecticut, on the 14th of July 1818, and graduated at West Point in 1841. He was engaged in the Seminole War and the war with Mexico, won the brevet of captain for his gallantry at Contreras and Churubusco, and was wounded in the assault on the city of Mexico. In 1850, while serving in California, he conducted a successful expedition against the Indians. He was promoted captain in 1851, and two years later was ordered to the East, when he became an ardent opponent of "States' Rights" and slavery. He was stationed in Kansas and in Missouri on the eve of the Civil War. In Missouri not only was sentiment divided, but the two factions were eager to resort to force long before they were in the other border states. Lyon took an active part in organizing the Union party in Missouri, though greatly hampered, at first by the Federal government which feared to provoke hostilities, and afterwards by the military commander of the department, General W. S. Harney. On Harney's removal in April 1861, Lyon promptly assumed the command, called upon Illinois to send him troops, and mustered the Missouri contingent into the United States' service. He broke up the militia camp at St Louis established by the secessionist governor of Missouri, Claiborne F. Jackson, and but for the express prohibition of Harney, who had resumed the command, would have proceeded at once to active hostilities. In all this Lyon had co-operated closely with Francis P. Blair, Jr., who now obtained from President Lincoln the definitive removal of Harney and the assignment of Lyon to command the Department of the West, with the rank of brigadier-general. On Lyon's refusal to accede to the Secessionists' proposal that the state should be neutral, hostilities opened in earnest, and Lyon, having cleared Missouri of small hostile bands in the central part of the state, turned to the southern districts, where a Confederate army was advancing from the Arkansas border. The two forces came to action at Wilson's Creek on the 10th of August 1861. The Union forces, heavily outnumbered, were defeated, and Lyon himself was killed while striving to rally his troops. He bequeathed almost all he possessed, some $30,000, to the war funds of the national government.

See A. Woodward, *Memoir of General Nathaniel Lyon* (Hartford, 1862); James Peckham, *Life of Lyon* (New York, 1866); and T. L. Snead, *The Fight for Missouri* (New York, 1886). Also *Last Political Writings of General Nathaniel Lyon* (New York, 1862).

LYONNESSE, Lyonesse, Leonnoys or Leonais, a legendary country off the south coast of Cornwall, England. Lyonnesse is the scene of many incidents in the Arthurian romances, and especially in the romances of Tristram and Iseult. It also plays an important part in purely Cornish tradition and folklore. Early English chronicles, such as the *Chronicon e chronicis* of Florence of Worcester, who died in 1118, described minutely and without a suggestion of disbelief the flourishing state of Lyonnesse, and its sudden disappearance beneath the sea. The legend may be a greatly exaggerated version of some actual subsidence of inhabited land. There is also a very ancient local tradition, apparently independent of the story of Lyonnesse, that the Scilly Islands formed part of the Cornish mainland within historical times.

See *Florentii Wigorniensis monachi Chronicon ex chronicis*, &c., ed. B. Thorpe (London, 1848–1849).

LYONS, EDMUND LYONS, Baron (1790–1858), British admiral, was born at Burton, near Christchurch, Hampshire, on the 21st of November 1790. He entered the navy, and served in the Mediterranean, and afterwards in the East Indies, where in 1810 he won promotion by distinguished bravery. He became post-captain in 1814, and in 1826 commanded the "Blonde" frigate at the blockade of Navarino, and took part with the French in the capture of Kasteo Morea. Shortly before his ship was paid off in 1835 he was knighted. From 1840 till 1853 Lyons was employed on the diplomatic service, being successively minister to Greece, Switzerland and Sweden. On the outbreak of the war with Russia he was appointed second in command of the British fleet in the Black Sea under Admiral Dundas, whom he succeeded in the chief command in 1854. As admiral of the inshore squadron he had the direction of the landing of the troops in the Crimea, which he conducted with marvellous energy and despatch. According to Kinglake, Lyons shared the "intimate counsels" of Lord Raglan in regard to the most momentous questions of the war, and toiled, with a "painful consuming passion," to achieve the object of the campaign. His principal actual achievements in battle were two—the support he rendered with his guns to the French at the Alma in attacking the left flank of the Russians, and the bold and brilliant part he took with his ship the "Agamemnon" in the first bombardment of the forts of Sebastopol; but his constant vigilance, his multifarious activity, and his suggestions and counsels were much more advantageous to the allied cause than his specific exploits. In 1855 he was created vice-admiral; in June 1856 he was raised to the peerage with the title of Baron Lyons of Christchurch. He died on the 23rd of November 1858.

See Adam S. Eardley-Wilmot, R.N., *Life of Lord Lyons* (1898).

LYONS, RICHARD BICKERTON PEMELL LYONS, 1st Earl (1817–1887), British diplomatist, son of the preceding, was born at Lymington on the 26th of April 1817. He entered the diplomatic service, and in 1859–1864 was British minister at Washington, where, after the outbreak of the Civil War, the extremely important negotiations connected with the arrest of the Confederate envoys on board the British mail-steamer "Trent" devolved upon him. After a brief service at Constantinople, he succeeded Lord Cowley at the Paris embassy in 1867. In the war of 1870 he used his best efforts as a mediator, and accompanied the provisional government to Tours. He continued to hold his post with universal acceptance until November 1887. He died on the 5th of December 1887, when the title became extinct.

LYONS (Fr. *Lyon*), a city of eastern France, capital of the department of Rhône, 315 m. S.S.E. of Paris and 218 m. N. by W. of Marseilles on the Paris-Lyon railway. Pop. (1906) town, 430,186; commune, 472,114. Lyons, which in France is second only to Paris in commercial and military importance, is situated at the confluence of the Rhone and the Saône at an altitude of 540 to 1000 ft. above sea-level. The rivers, both flowing south, are separated on the north by the hill on which lies the populous working quarter of Croix-Rousse, then by the narrow tongue of land ending in the Perrache Quarter. The peninsula thus formed is over 3 m. long and from 650 to 1000 yds. broad. It is traversed lengthwise by the finest streets of the city, the rue de la République, the rue de l'Hôtel de Ville, and the rue Victor Hugo. Where it enters Lyons the Saône has on its right the faubourg of Vaise and on its left that of Serin, whence the ascent is made to the top of the hill of Croix-Rousse. Farther on, its right bank is bordered by the scarped heights of Fourvière, St Irénée, Ste Foy, and St Just, leaving room only for the quays and one or two narrow streets; this is the oldest part of the city. The river sweeps in a semicircle around this eminence (410 ft. above it), which is occupied by convents, hospitals and seminaries, and has at its summit the famous church of Notre-Dame de Fourvière, the resort of many thousands of pilgrims annually.

On the peninsula between the rivers, at the foot of the hill of Croix-Rousse, are the principal quarters of the town: the Terreaux, containing the hôtel de ville, and the chief commercial establishments; the wealthy residential quarter, centring round the Place Bellecour, one of the finest squares in France; and the Perrache. The Rhone and Saône formerly met on the site of this quarter, till, in the 18th century, the sculptor Perrache reclaimed it; on the peninsula thus formed stands the principal railway station, the Gare de Perrache with the Cours du Midi, the most extensive promenade in Lyons, stretching in front of it. Here, too, are the docks of the Saône, factories, the arsenal, gas-works and prisons. The Rhone, less confined than the Saône, flows swiftly in a wide channel, broken when the water is low in spring by pebbly islets. On the right hand it skirts first St Clair, sloping upwards to Croix-Rousse, and then the districts of Terreaux, Bellecour and Perrache; on the left it has a low-lying plain, occupied by the Parc de la Tête d'Or and the quarters of Brotteaux and Guillotière. The park, together with its lake, comprises some 285 acres, and contains a zoological collection, botanical and pharmaceutical gardens, and the finest greenhouses in France, with unique collections of orchids, palm-trees and *Cycadaceae*. It is defended from the Rhone by the Quai de la Tête d'Or, while on the east the railway line to Geneva separates it from the race-course. Brotteaux is a modern residential quarter. Guillotière to the south consists largely of workmen's dwellings, bordering wide, airy thoroughfares. To the east extend the manufacturing suburbs of Villeurbanne and Montchat. The population, displaced by the demolition of the lofty old houses and the widening of the streets on the peninsula, migrates to the left bank of the Rhone, the extension of the city into the plain of Dauphiné being unhindered.

The Rhone and the Saône are bordered by fine quays and crossed by 24 bridges—11 over the Rhone, 12 over the Saône, and 1 at the confluence. Of these the Pont du Change over the Saône and the Pont de la Guillotière over the Rhone have replaced medieval bridges, the latter of the two preserving a portion of the old structure.

Public Buildings.

Of the ancient buildings Notre-Dame de Fourvière is the most celebrated. The name originally applied to a small chapel built in the 9th century on the site of the old forum (*forum vetus*) from which it takes its name. It has been often rebuilt, the chief feature being a modern Romanesque tower surmounted by a cupola and statue of the Virgin. In 1872 a basilica was begun at its side in token of the gratitude of the city for having escaped occupation by the German troops. The building, finished in 1894, consists of a nave without aisles flanked at each exterior corner by a turret and terminating in an apse. The façade, the lower half of which is a lofty portico supported on four granite columns, is richly decorated on its upper half with statuary and sculpture. Marble and mosaic have been lavishly used in the ornamentation of the interior and of the crypt. Round the apse runs a gallery from which, according to an old custom, a benediction is pronounced upon the town annually on the 8th of September. From this gallery a magnificent view of the city and the surrounding country can be obtained. At the foot of the hill of Fourvière rises the cathedral of St Jean, one of the finest examples of early Gothic architecture in France. Begun in the 12th century, to the end of which the transept and choir belong, it was not finished till the 15th century, the gable and flanking towers of the west front being completed in 1480. A triple portal surmounted by a line of arcades and a rose window gives entrance to the church. Two additional towers, that to the north containing one of the largest bells in France, rise at the extremities of the transept. The nave and choir contain fine stained glass of the 13th and 14th centuries as well as good modern glass. The chapel of St Louis or of Bourbon, to the right of the nave, is a masterpiece of Flamboyant Gothic. To the right and left of the altar stand two crosses preserved since the council of 1274 as a symbol of the union then agreed upon between the Greek and Latin churches. Adjoining St Jean is the ancient Manécanterie or singers' house, much mutilated and frequently restored, but still preserving graceful Romanesque arcades along its front. St Martin d'Ainay, on the peninsula, is the oldest church in Lyons, dating from the beginning of the 6th century and subsequently attached to a Benedictine abbey. It was rebuilt in the 10th and 11th centuries and restored in modern times, and is composed of a nave with four aisles, a transept and choir terminating in three semicircular apses ornamented with paintings by Hippolyte Flandrin, a native of Lyons. The church is surmounted by two towers, one in the middle of the west front, the other at the crossing; the four columns supporting the latter are said to have come from an altar to Augustus. A mosaic of the 12th century, a high altar decorated with mosaic work and a beautifully carved confessional are among the works of art in the interior. St Nizier, in the heart of the city, was the first cathedral of Lyons; and the crypt in which St Pothinus officiated still exists. The present church is a Gothic edifice of the 15th century, with the exception of the porch, constructed by Philibert Delorme, a native of Lyons, in the 16th century. The Church of St Paul (12th and 15th centuries), situated on the right bank of the Saône, preserves an octagonal central tower and other portions of Romanesque architecture; that of St Bonaventure, originally a chapel of the Cordeliers, was rebuilt in the 15th and 19th centuries. With the exception of the imposing prefecture, the vast buildings of the faculties, which are in the Guillotière quarter, and the law court, the colonnade of which overlooks the Saône from its right bank, the chief civil buildings are in the vicinity of the Place des Terreaux. The east side of this square (so called from the *terreaux* or earth with which the canal formerly connecting the Rhone and the Saône hereabouts was filled) is formed by the hôtel de ville (17th century), the east façade of which, towards the Grand Theatre, is the more pleasing. The south side of the square is occupied by the Palais des Arts, built in the 17th century as a Benedictine convent and now accommodating the school of fine arts, the museums of painting and sculpture, archaeology and natural history, and the library of science, arts and industry. The museums are second in importance only to those of Paris. The collection of antiquities, rich in Gallo-Roman inscriptions, contains the bronze tablets discovered in 1528, on which is engraved a portion of a speech delivered in A.D. 48, by the emperor Claudius, advocating the admission of citizens of Gallia Comata to the Roman senate. The "Ascension," a masterpiece of Perugino, is the chief treasure of the art collection, in which are works by nearly all the great masters. A special gallery contains the works of artists of Lyons, among whom are numbered Antoine Berjon, Meissonier, Paul Chenavard, Puvis de Chavannes. In the Rue de la Republique, between the Place de la Bourse and the Place des Cordeliers, each of which contains one of its highly ornamented fronts, stands the Palais du Commerce et de la Bourse, the finest of the modern buildings of Lyons. The Bourse (exchange) has its offices on the ground floor round the central glass-roofed hall; the upper storeys accommodate the commercial tribunal, the council of trade arbitration, the chamber of commerce and the *Musée historique des Tissus*, in which the history of the weaving industry is illustrated by nearly 400,000 examples. In the buildings of the lycée on the right bank of the Rhone are the municipal library and a collection of globes, among them the great terrestrial globe made at Lyons in 1701, indicating the great African lakes.

The Hôtel Dieu, instituted according to tradition in the beginning of the 6th century by King Childebert, is still one of the chief charitable establishments in the city. The present building dates from the 18th century; its façade, fronting the west quay of the Rhone for over 1000 ft., was begun according to the designs of Soufflot, architect of the Pantheon at Paris. The Hospice de la Charité and the military hospital are on the same bank slightly farther down stream. The Hospice de l'Antiquaille, at Fourvière, occupies the site of the palace of the praetorian prefects, in which Germanicus, Claudius and Caracalla were born. Each of these hospitals contains more than 1000 beds. Lyons has many other benevolent institutions, and is also the centre of the operations of the Société de la Propagation de la Foi. The chief monuments are the equestrian statue of Louis XIV. in the Place Bellecour, the monuments of President Carnot, Marshal Suchet, the physicist André-Marie Ampère, and those in honour of the Republic and in memory of the citizens of the department who fell in the war of 1870–71. The most noteworthy fountain is that in the Place des Terreaux with the leaden group by Bartholdi representing the rivers on their way to the ocean.

There are Roman remains—baths, tombs and the relics of a theatre—in the St Just quarter on the right bank of the Saône. Three ancient aqueducts on the Fourvière level, from Montromant, Mont d'Or and Mont Pilat, can still be traced. Magnificent remains of the latter work may be seen at St Irénée and Chaponost. Traces also exist along the Rhone of a subterranean canal conveying the water of the river to a *naumachia* (lake for mimic sea-fights). Agrippa made Lyons the starting-point of the principal Roman roads throughout Gaul; and it remains an important centre in the general system of communication owing to its position on the natural highway from north to south-eastern France. The Saône above the town and the Rhone below have large barge and steamboat traffic. The main line of the Paris-Lyon-Méditerranée railway runs first through the station at Vaise, on the right bank of the Saône, and thence to that of Perrache, the chief station in the city. The line next in importance, that to Geneva, has its station in the Brotteaux quarter, and the line of the eastern Lyonnais to St Genix d'Aoste has a terminus at Guillotière; both these lines link up with the Paris-Lyon main line. The railway to Montbrison starts from the terminus of St Paul in Fourvière and that to Bourg, Trévoux and the Dombes region from the station of Croix-Rousse. A less important line to Vaugneray and Mornant has a terminus at St Just. Besides the extensive system of street tramways, cable tramways (*ficelles*) run to the summits of the eminences of Croix-Rousse, Fourvière and St Just.

Defence.

Lyons is, next to Paris, the principal fortress of the interior of France, and, like the capital, possesses a military governor. The immediate protection of the city is provided for on the east side by a modern enceinte, of simple trace, in the plain (subsidiary to this is a group of fairly modern detached forts forming an advanced position at the village of Bron), and on the west by a line of detached forts, not of recent design, along the high ground on the right bank of the Saône. Some older forts and a portion of the old enceinte are still kept up in the city itself, and two of these forts, Montessuy and Caluire, situated on the peninsula, serve with their annexes to connect the northern extremities of the two lines above mentioned. The main line of defence is as usual the outer fort-ring, the perimeter of which is more than 40 m., and the mean distance from the centre of the city 6½ m. This naturally divides into four sections. In the eastern plain, well in advance of the enceinte, eight principal sites have been fortified, Feyzin, Corbas, St Priest, Genas, Azieu, Meyzieux, Décines and Chaurant. These form a semicircle from the lower to the upper reaches of the Rhone. The northern (or north eastern) section, between the Rhone and the Saône, has forts Neyron and Vancia as its principal defences; these and their subsidiary batteries derive some additional support from the forts Montessuy and Caluire mentioned above. On the north-west side there is a strong group of works disposed like a redan, of which the salient, fort Verdun and annexes, is on the high plateau of Mont d'Or pointing northward, and the faces, represented by forts Frêta and Paillet, are lower down on the spurs of the ridge, facing north-east and north-west respectively. The south-western section comprises three principal groups, Bruisson, Côte-Lorette and Montcorin-Champvillard, the last-named crossing its fire over the Lower Rhone with Fort Feyzin. Lastly a connecting battery was built near Chapoly in 1895 to close the gap between the north-western and south-western sections and to command the westward approaches by the valley of Charbonnières.

Lyons is the headquarters of the XIV. army-corps, the seat of an archbishop who holds the title of primate of the Gauls and also that of archbishop of Vienne, and of a prefect, a court of appeal, a court of assizes, tribunals of commerce and of first instance, and of two boards of trade arbitration (*conseils de prud'hommes*). It is the centre of an *académie* (educational division) and has a university with faculties of law, letters, science and medicine and pharmacy. There are also Catholic faculties (*facultés libres*) of law, theology, science and letters, three *lycées*, training colleges for teachers and numerous minor educational establishments. There are besides many special schools at Lyons, the more important being the school of fine arts which was founded in the 18th century to train competent designers for the textile manufactures, but has also done much for painting and sculpture; an army medical school, schools of drawing, agriculture, music, commerce (*école supérieure de commerce*), weaving, tanning, watch-making and applied chemistry, and the écoles La Martinière for free instruction in science and art as applied to industry. The veterinary school, instituted in 1761, was the first of its kind in Europe; its laboratory for the study of comparative physiology is admirably equipped. Besides the *Académie des Sciences, Belles Lettres et Arts* (founded in 1700), Lyons possesses societies of agriculture, natural history, geography, horticulture, &c.

Industry and trade.

Its trade in silk and silk goods has formed the basis of the prosperity of Lyons for several centuries. Derived from Italy, this industry rapidly developed, thanks to the monopoly granted to the city in 1450 by Charles VII. and to the patronage of Francis I., Henry II. and Henry IV. From time to time new kinds of fabrics were invented—silk stuffs woofed with wool or with gold and silver threads, shawls, watered silks, poplins, velvets, satinades, moires, &c. In the beginning of the 19th century J. M. Jacquard introduced his famous loom by which a single workman was enabled to produce elaborate fabrics as easily as the plainest web, and by changing the "cartoons" to make the most different textures on the same looms. In the 17th century the silk manufacture employed at Lyons, 9000 to 12,000 looms. After the revocation of the edict of Nantes the number sank to 3000 or 4000; but after the Reign of Terror was past it rose again about 1801 to 12,000. Towards the middle of the 19th century the weaving branch of the industry began to desert Lyons for the surrounding districts. The city remains the business centre for the trade and carries on dyeing, printing and other accessory processes. Lyons disputes with Milan the position of the leading silk market of Europe. In 1905 the special office (*la Condition des soies*) which determines the weight of the silk examined over 4700 tons of silk. France furnished barely one-tenth of this quantity, two-thirds came from China and Japan, the rest from Italy and the Levant. The traders of Lyons re-export seven-twelfths of these silks, the industries of the town employing the remainder. An almost equal quantity of cotton, wool and waste-silk threads is mixed with the silk. A few thousand hand-looms are still worked in the town, more especially producing the richest materials, 50,000 or 55,000 in the surrounding districts, and some 33,000 machine looms in the suburbs and neighbouring departments. Allied industries such as dyeing, finishing and printing, employ 12,000 workers. Altogether 300,000 workpeople depend upon the silk industry. In 1905 the total value of the manufacture was £15,710,000, the chief items being pure silk textures (plain) £3,336,000; textures of silk mixed with other materials £3,180,000; silk and foulards £1,152,000; muslins £3,800,000, this product having increased from £100,000 in 1894. Speaking roughly the raw material represents half the value, and the value of the labour the remaining half. About 30% of the silk goods of Lyons finds a market in France. Great Britain imported them to the value of over £6,000,000, and the United States to the value of over £1,600,000, notwithstanding the heavy duty. The dyeing industry and the manufacture of chemicals have both developed considerably to meet the requirements of the silk trade. Large quantities of mineral and vegetable colouring matters are produced and there is besides a large output of glue, gelatine, superphosphates and phosphorus, all made from bones and hides, of picric, tartaric, sulphuric and hydrochloric acids, sulphates of iron and copper, and pharmaceutical and other chemical products.

Lyons does a large trade in metals, iron, steel and copper, and utilizes them in the manufacture of iron buildings, framework, bridges, machinery, railway material, scales, metal cables, pins and needles, copper-founding and the making of clocks and bronzes. Gold and silver-working is of importance, especially for embroidery and articles used in religious ceremonies. Other industries are those of printing, the manufacture of glass goods, of tobacco (by the state), the preparation of hides and skins (occupying 20,000 workmen), those connected with the miller's trade, the manufacture of various forms of dried flour-paste (macaroni, vermicelli, &c.), brewing, hat-making, the manufacture of chocolate, and the pork-butcher's industry. Apart from the dealings in silk and silk goods, trade is in cloth, coal and charcoal, metals and metal goods, wine and spirits, cheese and chestnuts. Four miles south-west of Lyons is Oullins (pop. 9859) which has the important works of the Paris-Lyon railway.

Lyons is the seat of important financial companies; of the Crédit Lyonnais, which does business to the amount of £200,000,000 annually in Lyons alone; also of coal and metallurgical companies and gas companies, the former extending their operations as far as Russia, the latter lighting numerous towns in France and foreign countries.

History.—The earliest Gallic occupants of the territory at the confluence of the Rhone and the Saône were the Segusians. In 59 B.C. some Greek refugees from the banks of the Hérault, having obtained permission of the natives to establish themselves beside the Croix-Rousse, called their new town by the Gallic name Lugudunum (*q.v.*) or Lugdunum; and in 43 B.C. Lucius Munatius Plancus brought a Roman colony to Fourvières from Vienne. This settlement soon acquired importance, and was made by Agrippa the starting-point of four great roads. Augustus, besides building aqueducts, temples and a theatre, gave it a senate and made it the seat of an annual assembly of deputies from the sixty cities of Gallia Comata. At the same time the place became the Gallic centre for the worship of Rome and the emperor. Under the emperors the colony of Forum Vetus and the municipium of Lugdunum were united, receiving the *jus senatus*. The town was burnt in A.D. 59 and afterwards rebuilt in a much finer style with money given by Nero; it was also adorned by Trajan, Adrian and Antoninus. The martyrdom of Pothinus and Blandina occurred under Marcus Aurelius (A.D. 177), and some years later a still more savage persecution of the Christians took place under Septimius Severus, in which Irenaeus, according to some authors, perished.

After having been ravaged by the barbarians and abandoned by the empire, Lyons in 478 became capital of the kingdom of the Burgundians. It afterwards fell into the hands of the Franks, and suffered severely from the Saracens, but revived under Charlemagne, and after the death of Charles the Bald became part of the kingdom of Provence. From 1032 it was a fief of the emperor of Germany. Subsequently the authority over the town was a subject of dispute between the archbishops of Lyons and the counts of Forez; but the supremacy of the French kings was established under Philip the Fair in 1312. The citizens were constituted into a commune ruled by freely elected consuls (1320). In the 13th century two ecclesiastical councils were held at Lyons—one in 1245, presided over by Innocent IV., at which the emperor Frederick II. was deposed; the second, the oecumenical, under the presidency of Gregory X., in 1274, at which five hundred bishops met. Pope Clement V. was crowned here in 1305, and his successor, John XXII., elected in 1316. The Protestants obtained possession of the place in 1562; their acts of violence were fiercely avenged in 1572 after the St Bartholomew massacre. Under Henry III. Lyons sided with the League; but it pronounced in favour of Henry IV. The executions of Henri d'Effiat, marquis of Cinq-Mars, and of François de Thou, who had plotted to overthrow Richelieu, took place on the Place des Terreaux in 1642. In 1793 the Royalists and Girondists, powerful in the city, rose against the Convention, but were compelled to yield to the army of the republic under General Kellermann after enduring a siege of seven weeks (October 10). Terrible chastisement ensued: the name of Lyons was changed to that of Ville-affranchie; the demolition of its buildings was set about on a wholesale scale; and vast numbers of the proscribed, whom the scaffold had spared, were butchered with grape shot. The town resumed its old name after the fall of Robespierre, and the terrorists in their turn were drowned in large numbers in the Rhone. Napoleon rebuilt the Place Bellecour, reopened the churches, and made the bridge of Tilsit over the Saône between Bellecour and the cathedral. In 1814 and 1815 Lyons was occupied by the Austrians. In 1831, 1834, 1849, 1870 and 1871 it was the scene of violent industrial or political disturbances. In 1840 and 1856 disastrous floods laid waste portions of the city. International exhibitions were held here in 1872 and 1894, the latter occasion being marked by the assassination of President Carnot.

See S. Charléty, *Histoire de Lyon* (Lyon, 1903); J. Godart, *L'Ouvrier en soie. Monographie du tisseur lyonnais* (Lyon, 1899); A. Vachet, *A travers les rues de Lyon* (Lyon, 1902); A. Steyert, *Nouvelle Histoire de Lyon et des provinces de Lyonnais Forez, Beaujolais* (3 vols., Lyon, 1895–1899).

LYONS, COUNCILS OF. The first Council of Lyons (the thirteenth general council) met at the summons of Pope Innocent

IV. in June and July of 1245, to deliberate on the conflict between Church and emperor, on the assistance to be granted to the Holy Land and the Eastern empire, on measures of protection against the Tatars, and on the suppression of heresy. Among the tasks of the council mentioned in the writs of convocation, the most important, in the eyes of the pope, was that it should lend him effectual aid in his labours to overthrow the emperor Frederick II.; and, with this object in view, he had described the synod as a general council. Since its numbers were not far in excess of 150 bishops and archbishops, and the great majority of these came from France, Italy and Spain; while the schismatic Greeks and the other countries—especially Germany, whose interests were so deeply involved—were but weakly represented; the ambassador of Frederick, Thaddaeus of Suessa, contested its oecumenicity in the assembly itself. The condemnation of the emperor was a foregone conclusion. The articles of indictment described him as the “prince of tyranny, the destroyer of ecclesiastical dogma, the annihilator of the faith, the master of cruelty,” and so forth; while the grossest calumnies were treated as approved facts. The objections of the ambassador, that the accused had not been regularly cited, that the pope was plaintiff and judge in one, and that therefore the whole process was anomalous, achieved as little success as his appeal to the future pontiff and to a truly oecumenical council. The representatives of the kings of England and France were equally unfortunate in their claim for a prorogation of the decision. On the 17th of July the verdict was pronounced by Innocent IV., excommunicating Frederick and dethroning him on the grounds of perjury, sacrilege, heresy and felony. All oaths of fealty sworn to him were pronounced null and void, and the German princes were commanded to proceed with the election of a new sovereign. In addition the council enacted decrees against the growing irregularities in the Church, and passed resolutions designed to support the Crusaders and revive the struggle for the Holy Land.

See Mansi, *Collectio conciliorum*, tom. xxiii.; Huillard-Bréholles, *Historia diplomatica Frederici II.*, 6 tom. (Paris, 1852–1861); Hefele, *Conciliengeschichte*, ed. 2, vol. v. (1886), pp. 1105-1126; Fr. W. Schirrmacher, *Kaiser Friederich der Zweite* (4 vols., Göttingen, 1859–1865); H. Schulz, in Herzog-Hauck, *Realencyklopädie*, ed. 3, vol. ix. (1901), p. 122 sqq., *s.v.* “Innocenz IV. ; A. Folz, *Kaiser Friedrich II. u. Papst Innocenz IV.* (Strassburg, 1905).

The second Council of Lyons (the fourteenth general council) met from the 7th of May to the 17th of July 1274, under the presidency of Pope Gregory X., and was designed to resolve three problems: to terminate the Greek schism, to decree a new Crusade, and to counteract the moral corruption among clerics and laity. The council entered on its third task at a very late period, with the result that the requisite time for an adequate deliberation was not available. Nevertheless, on the 1st of November, Gregory was enabled to publish thirty-one constitutions, which may be taken to represent the fruits of the synod and its labours. The most important of the enactments passed is that regulating the papal election. It prescribed that the new election conducted by the college of cardinals should be held in conclave (*q.v.*), and its duration abridged by progressive simplification of the cardinal's diet. The motive for this decision, which has maintained its ground in ecclesiastical law, was given by the circumstances which followed the death of Clement IV. (1268). The pope felt a peculiar interest in the Holy Land, from which he was recalled by his elevation to the pontifical throne. He succeeded in bringing influential interests to work in the cause; but his scheme of a great enterprise backed by the whole force of the West came to nothing, for the day of the Crusades was past. His projected Crusade was interwoven with his endeavours to end the schism; and the political straits of the emperor Michael Palaeologus in Constantinople came to the aid of these aspirations. To ensure his safety against the attacks of King Charles of Sicily, who had pledged himself to assist the ex-emperor Baldwin in his reconquest of the Latin empire, Michael was required to own the supremacy of the pope in the spiritual domain; while Gregory, in return, would restrain the Sicilian monarch from his bellicose policy with regard to the Eastern empire. The ambassadors of the emperor appeared at the council with letters acknowledging the Roman pontiff and the confession of faith previously dispatched from the eternal city, and submitted similarly-worded declarations from the heads of the Byzantine Church. One member of the embassy, the Logothete Georgius Acropolites, was authorized by the emperor to take an oath in his name, renouncing the schism. In short, the subjection of the East to the Roman see was completed in the most binding forms, and the long-desired union seemed at last assured. Gregory himself did not live to discover its illusory character. The Council of Lyons was, moreover, of importance for the German dynastic struggle: for Gregory took the first public step in favour of Count Rudolph of Habsburg, the king-elect, by receiving his deputy and denying an audience to the delegate of the rival claimant, King Alphonso of Castile.

See Mansi, *Collectio conciliorum*, tom. xxiv.; Hefele, *Conciliengeschichte*, vol. vi. ed. 2 (1890), p. 119 sqq. Also C. Mirbt, in Herzog-Hauck, *Realencyklop. f. protestantische Theologie*, vol. vii. (1899), p. 122, *s.v.* “Gregor X.” (C. M.)

LYRA (“The Harp”), in astronomy, a constellation in the northern hemisphere, mentioned by Eudoxus (4th century B.C.) and Aratus (3rd century B.C.). Ptolemy catalogued 10 stars in this constellation; Tycho Brahe 11 and Hevelius 17. *α Lyrae* or Vega, is the second brightest star in the northern hemisphere, and notable for the whiteness of its light, which is about 100 times that of the sun. The name “vega” is a remnant of an Arabic phrase meaning “falling eagle,” “Altair,” or *α Aquilae*, is the similar remnant of “flying eagle.” *ε Lyrae* is a multiple star, separated by the naked eye or by a small telescope into two stars; these are each resolved into two stars by a 3″ telescope, while a more powerful instrument (4″) reveals three smaller stars between the two pairs. *β Lyrae* and *R. Lyrae* are short period variables. There is the famous ring or annular nebula, *M. 57 Lyrae*, in the middle of which is a very faint star, which is readily revealed by photography; and also the meteoric swarm named the *Lyrids*, which appear in April and have their radiant in this constellation (see METEOR).

LYRE (Gr. *λύρα*), an ancient stringed musical instrument. The recitations of the Greeks were accompanied by it. Yet the lyre was not of Greek origin; no root in the language has been discovered for *λύρα*, although the special names bestowed upon varieties of the instrument are Hellenic. We have to seek in Asia the birthplace of the genus, and to infer its introduction into Greece through Thrace or Lydia. The historic heroes and improvers of the lyre were of the Aeolian or Ionian colonies, or the adjacent coast bordering on the Lydian empire, while the mythic masters, Orpheus, Musaeus and Thamyris, were Thracians. Notwithstanding the Hermes tradition of the invention of the lyre in Egypt, the Egyptians seem to have adopted it from Assyria or Babylonia.

To define the lyre, it is necessary clearly to separate it from the allied harp and guitar. In its primal form the lyre differs from the harp, of which the earliest, simplest notion is found in the bow and bowstring. While the guitar (and lute) can be traced back to the typical “nefer” of the fourth Egyptian dynasty, the fretted finger-board of which, permitting the production of different notes by the shortening of the string, is as different in conception from the lyre and harp as the flute with holes to shorten the column of air is from the syrinx or Pandean pipes. The frame of a lyre consists of a hollow body or sound-chest (*ἠχεῖον*). From this sound-chest are raised two arms (*πήχεις*), which are sometimes hollow, and are bent both outward and forward. They are connected near the top by a crossbar or yoke (*ζυγόν*, *ζύγωμα*, or, from its having once been a reed, *κάλαμος*). Another crossbar (*μάλας*, *ὑπολύριον*), fixed on the sound-chest, forms the bridge which transmits the vibrations of the strings. The deepest note was the farthest from the player; but, as the strings did not differ much in length, more weight may have been gained for the deeper notes by thicker strings, as in the violin and similar modern instruments, or they were turned with slacker tension. The strings were of gut (*χορδή*, whence chord). They were stretched between the yoke and bridge, or to a tailpiece below the bridge. There were two ways of tuning: one was to fasten the strings to pegs which might be turned (κόλλαβοι, κόλλοπες); the other was to change the place of the string upon the crossbar; probably both expedients were simultaneously employed. It is doubtful whether ἡ χορδοτόνος meant the tuning key or the part of the instrument where the pegs were inserted. The extensions of the arms above the yoke were known as κέρατα, horns.

The number of strings varied at different epochs, and possibly in different localities—four, seven and ten having been favourite numbers. They were used without a finger-board, no Greek description or representation having ever been met with that can be construed as referring to one. Nor was a bow possible, the flat sound-board being an insuperable impediment. The plectrum, however (πλῆκτρον), was in constant use. It was held in the right hand to set the upper strings in vibration (κρέκειν, κρούειν τῷ πλήκτρῳ); at other times it hung from the lyre by a ribbon. The fingers of the left hand touched the lower strings (ψάλλειν).

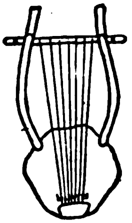
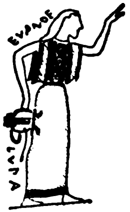


Fig. 1.—Chelys or Lyre from a vase in the British Museum, where also are fragments of such an instrument, the back of which is of shell.

With Greek authors the lyre has several distinct names; but we are unable to connect these with anything like certainty to the varieties of the instrument. Chelys (χέλυς, "tortoise") may mean the smallest lyre, which, borne by one arm or supported by the knees, offered in the sound-chest a decided resemblance to that familiar animal. That there was a difference between lyre and cithara (κιθάρα) is certain, Plato and other writers separating them. Hermes and Apollo had an altar at Olympia in common because the former had invented the lyre and the latter the cithara. The lyre and chelys on the one hand, and the cithara and phorminx on the other, were similar or nearly identical. Apollo is said to have carried a golden phorminx. (A. J. H.)

There are three lines of evidence that establish the difference between the lyre and cithara: (1) There are certain vase paintings in which the name λύρα accompanies the drawing of the instrument, as, for instance, in fig. 2 where the tortoise-shell lyre is obviously represented.[1] (2) In all legends accounting for the invention of the lyre, the shell or body of the tortoise is invariably mentioned as forming the back of the instrument, whereas the tortoise has never been connected with the cithara. (3) The lyre is emphatically distinguished as the most suitable instrument for the musical training of young men and maidens and as the instrument of the amateur, whereas the cithara was the instrument of *citharoedus* or *citharista*, professional performers at the Pythian Games, at ceremonies and festivals, the former using his instrument to accompany epic recitations and odes, the latter for purely instrumental music. The costume worn by citharoedus and citharista was exceedingly rich and quite distinct from any other.[2]



Gerhard, *Auserl. griech. Vasenbilder.*

Fig. 2.—Tortoise-shell Lyre from a Greek vase in Munich.

We find the lyre represented among scenes of domestic life, in lessons, receptions, at banquets and in mythological scenes; it is found in the hands of women no less than men, and the costume of the performer is invariably that of an ordinary citizen. Lyres were of many sizes and varied in outline according to period and nationality.

We therefore possess irrefutable evidence of identification in both cases, all of which tallies exactly. Examination of the construction of the instruments thus indentified reveals the fact that both possessed characteristics which have persisted throughout the middle ages to the present day in various instruments evolved from these two archetypes. The principal feature of both lyre and cithara was the peculiar method of construction adopted in the sound-chest, which may be said to have been almost independent of the outline. In the lyre the sound-chest consisted of a vaulted back, in imitation of the tortoise, over which was directly glued a flat sound-board of wood or parchment. In the cithara (*q.v.*) the sound-chest was shallower, and the back and front were invariably connected by sides or ribs. These two methods of constructing the sound-chests of stringed instruments were typical, and to one or the other may be referred every stringed instrument with a neck which can be traced during the middle ages in miniatures, early printed books, on monuments and other works of art. (K. S.)

Passing by the story of the discovery of the lyre from a vibrating tortoise-shell by Hermes, we will glance at the real lyres of Egypt and Semitic Asia. The Egyptian lyre is unmistakably Semitic. The oldest representation that has been discovered is in one of the tombs of Beni Hassan, the date of the painting being in the XIIth Dynasty, that is, shortly before the invasion of "the shepherd kings" (the Hyksos). In this painting, which both Rosellini and Lepsius have reproduced, an undoubted Semite carries a seven or eight-stringed lyre, or rather cithara in transition, similar to the *rotta* of the middle ages. The instrument has a four-cornered body and an irregular four-cornered frame above it, and the player carries it horizontally from his breast, just as a modern Nubian would his kissar. He plays as he walks, using both hands, a plectrum being in the right. Practical knowledge of these ancient instruments may be gained through two remarkable specimens preserved in the museums of Berlin (fig. 3) and Leiden (see CITHARA). During the rule of the Hyksos the lyre became naturalized in Egypt, and in the 18th dynasty it is frequently depicted, and with finer grace of form. In the 19th and 20th dynasties the lyre is sometimes still more slender, or is quite unsymmetrical and very strong, the horns surmounted by heads of animals as in the Berlin one, which has horses' heads at those extremities. Prokesch copied one in the ruins of Wadi Halfa, splendid in blue and gold, with a serpent wound round it. The Egyptians always strung their lyres fan-shaped, like the modern Nubian kissar. Their paintings show three to eight or nine strings, but the painters' accuracy may not be unimpeachable; the Berlin instrument had fifteen. The three-stringed lyre typified the three seasons of the Egyptian year—the water, the green and the harvest; the seven, the planetary system from the moon to Saturn. The Greeks had the same notion of the harmony of the spheres.

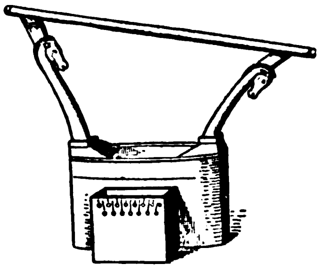
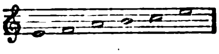


Fig. 3.—Egyptian Cithara now at Berlin.

There is no evidence as to what the stringing of the Greek lyre was in the heroic age. Plutarch says that Olympus and Terpander used but three strings to accompany their recitation. As the four strings led to seven and eight by doubling the tetrachord, so the trichord is connected with the hexachord or six-stringed lyre depicted on so many archaic Greek vases. We cannot insist on the accuracy of this representation, the vase painters being little mindful of the complete expression of details; yet we may suppose their tendency would be rather to imitate than to invent a number. It was their constant practice to represent the strings as being damped by the fingers of the left hand of the player, after having been struck by the plectrum which he held in the right hand. Before the Greek civilization had assumed its historic form, there was likely to be great freedom and independence of different localities in the matter of lyre stringing, which is corroborated by the antique use of the chromatic (half-tone) and enharmonic (quarter-tone) tunings, pointing to an early exuberance, and perhaps also to an Asiatic bias towards refinements of intonation, from which came the χρόαι, the hues of tuning, old Greek modifications of tetrachords entirely disused in the classic period. The common scale of Olympus



remained, a double trichord which had served as the scaffolding for the enharmonic varieties.

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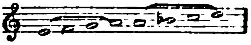
[1] See Ed. Gerhard, *Auserlesene griech. Vasenbilder*, part iii. (Berlin, 1847), pl. 236 and p. 157.

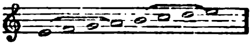
[2] See Aristotle, *Polit.* v. 6. 5.

We may regard the Olympus scale, however, as consisting of two tetrachords, eliding one interval in each, for the tetrachord, or series of four notes, was very early adopted as the fundamental principle of Greek music, and its origin in the lyre itself appears sure. The basis of the tetrachord is the employment of the thumb and first three fingers of the left hand to twang as many strings, the little finger not being used on account of natural weakness. As a succession of three whole tones would form the disagreeable and untunable interval of a tritonus, two whole tones and a half-tone were tuned, fixing the tetrachord in the consonant interval of the perfect fourth. This succession of four notes being in the grasp of the hand was called *συλλαβή*, just as in language a group of letters incapable of further reduction is called syllable. In the combination of two syllables or tetrachords the modern diatonic scales resemble the Greek so-called disjunct scale, but the Greeks knew nothing of our categorical distinctions of major and minor. We might call the octave Greek scale minor, according to our descending minor form, were not the keynote in the middle the thumb note of the deeper tetrachord. The upper tetrachord, whether starting from the keynote (conjunct) or from the note above (disjunct), was of exactly the same form as the lower, the position of the semitones being identical. The semitone was a limma (*λεῖμμα*), rather less than the semitone of our modern equal temperament, the Greeks tuning both the whole tones in the tetrachord by the same ratio of 8:9, which made the major third a dissonance, or rather would have done so had they combined them in what we call harmony. In melodious sequence the Greek tetrachord is decidedly more agreeable to the ear than the corresponding series of our equal temperament. And although our scales are derived from combined tetrachords, in any system of tuning that we employ, be it just, mean-tone, or equal, they are less logical than the conjunct or disjunct systems accepted by the Greeks. But modern harmony is not compatible with them, and could not have arisen on the Greek melodic lines.

The conjunct scale of seven notes

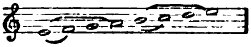


attributed to Terpander, was long the norm for stringing and tuning the lyre. When the disjunct scale

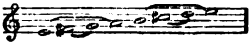


the octave scale attributed to Pythagoras, was admitted, to preserve the time-honoured seven strings one note had to be omitted; it was therefore customary to omit the C, which in Greek practice was a dissonance. The Greek names for the strings of seven and eight stringed lyres, the first note being highest in pitch and nearest the player, were as follows: *Nete*, *Paranete*, *Paramese*; *Mese*, *Lichanos*, *Parhypate*, *Hypate*; or *Nete*, *Paranete*, *Trite*, *Paramese*; *Mese*, *Lichanos*, *Parhypate*, *Hypate*—the last four from Mese to Hypate being the finger tetrachord, the others touched with the plectrum. The highest string in pitch was called the last, *νεάτη*; the lowest in pitch was called the highest, *ὑπάτη*, because it was, in theory at least, the longest string. The keynote and thumb string was *μέση*, middle; the next lower was *λίχανος*, the first finger or lick-finger string; *τρίτη*, the third, being in the plectrum division, was also known as *ὀξεῖα*, sharp, perhaps from the dissonant quality to which we have referred as the cause of its omission. The plectrum and finger tetrachords together were *διαπασῶν*, through all; in the disjunct scale, an octave.

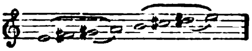
In transcribing the Greek notes into our notation, the absolute pitch cannot be represented; the relative positions of the semitones are alone determined. We have already quoted the scale of Pythagoras, the Dorian or true Greek succession:—



Shifting the semitone one degree upwards in each tetrachord, we have the Phrygian



Another degree gives the Lydian



which would be our major scale of E were not the keynote A. The names imply an Asiatic origin. We need not here pursue further the much-debated question of Greek scales and their derivation; it will suffice to remark that the outside notes of the tetrachords were fixed in their tuning as perfect fourths—the inner strings being, as stated, in diatonic sequence, or when chromatic two half-tones were tuned, when enharmonic two quarter-tones, leaving respectively the wide intervals of a minor and major third, and both impure, to complete the tetrachord. (A. J. H.)

See the article by Théodore Reinach in Daremberg and Saglio, *Antiquités grecques et romaines*; Wilhelm Johnsen, *Die Lyra, ein Beitrag zur griechischen Kunstgeschichte* (Berlin, 1876); Hortense Panum, "Harfe und Lyra in Nord Europa," *Intern. Mus. Ges.*, Sbd. vii. 1, pp. 1-40 (Leipzig, 1905); A. J. Hipkins, "Dorian and Phrygian, reconsidered from a non-harmonic point of view," in *Intern. Mus Ges.* (Leipzig. 1903), iv. 3.

LYRE-BIRD, the name by which one of the most remarkable birds of Australia is commonly known, the *Menura superba* or *M. novae-hollandiae* of ornithologists. It was first observed in 1798 in New South Wales, and though called by its finders a "pheasant"- from its long tail—the more learned of the colony seem to have regarded it as a bird-of-Paradise.[1] A specimen having reached England in 1799, it was described by General Davies as forming a new genus of birds, in the Linnean Society's *Transactions* (vi. p. 207, pl. xxii.), no attempt, however, being made to fix its systematic place. In 1802 L. P. Vieillot figured and described it in a supplement to his *Oiseaux Dorés* as a bird-of-Paradise (ii. pp. 30 seq., pls. 14-16), from drawings by Sydenham Edwards, sent him by Parkinson, the manager of the Leverian Museum. The first to describe any portion of its anatomy was T. C. Eyton, who in 1841 (*Ann. Nat. History*, vii. pp. 49-53) perceived that it was a Passerine bird and that it presented some points of affinity to the South American genus *Pteroptochus*. In 1867 Huxley stated that he was disposed to divide his very natural assemblage the *Coracomorphae* (essentially identical with Eyton's *Insessores*) into two groups, "one containing *Menura*, and the other all the other genera which have yet been examined" (*Proc. Zool. Soc.*, 1867, p. 472)—a still further step in advance.[2] In 1875 A. Newton put forth the opinion in his article on birds, in the 9th edition of this *Encyclopaedia*, that *Menura* had an ally in another Australian form, *Atrichia* (see SCRUB-BIRD), which he had found to present peculiarities hitherto unsuspected, and he regarded them as standing by themselves, though each constituting a distinct family. This opinion was partially adopted in the following year by A. H. Garrod, who (*Proc. Zool. Society*, 1876, p. 518) formally placed these two genera together in his group of Abnormal Acromyodian *Oscines* under the name of *Menurinae*; ornithologists now generally recognize at once the alliance and distinctness of the families Menuridae and Atrichiidae, and place them together to form the group *Suboscines* of the Diacromyodian *Passeres*.

Since the appearance in 1865 of J. Gould's *Handbook to the Birds of Australia*, little important information has been published concerning the habits of this form, and the account therein given must be drawn upon for what here follows. Of all birds, says that author, the *Menura* is the most shy and hard to procure. He has been among the rocky and thick "brushes"—its usual haunts—hearing its loud and liquid call-notes for days together without getting sight of one. Those who wish to see it must advance only while it is singing or scratching up the earth and leaves; and to watch its actions they must keep perfectly still. The best way of procuring an example seems to be by hunting it with dogs, when it will spring upon a branch to the height of 10 ft. and afford an easy shot ere it has time to ascend farther or escape as it does by leaps. Natives are said to hunt it by fixing on their heads the erected tail of a cock-bird, which alone is allowed to be seen above the brushwood. The greater part of its time is said to be passed upon the ground, and seldom are more than a pair to be found in company. One of the habits of the cock is to form small round hillocks, which he constantly visits during the day, mounting upon them and displaying his tail by erecting it over his head, drooping his wings, scratching and pecking at the soil, and uttering various cries—some his own natural notes, others an imitation of those of other animals. The tail, his most characteristic feature, only attains perfection in the bird's third or fourth year, and then not until the month of June, remaining until October, when the feathers are shed to be renewed the following season. The food consists of insects, especially beetles and myriapods, as well as snails. The nest is placed near to or on the ground, at the base of a rock or foot of a tree, and is closely woven of fine but strong roots or other fibres, and lined with feathers, around all which is heaped a mass, in shape of an oven, of sticks, grass, moss and leaves, so as to project over and shelter the interior structure, while an opening in the side affords entrance and exit. Only one egg is laid, and this of rather large size in proportion to the bird, of a purplish-grey colour, suffused and blotched with dark purplish-brown.

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[1] Collins, *Account of New South Wales*, ii. 87-92 (London, 1802).

[2] Owing to the imperfection of the specimen at his disposal, Huxley's brief description of the bones of the head in *Menura* is not absolutely correct. A full description of them, with elaborate figures, is given by Parker in the same Society's *Transactions* (ix. 306-309, pl. lvi. figs. 1-5).

Incubation is believed to begin in July or August, and the young is hatched about a month later. It is at first covered with dark down, and appears to remain for some weeks in the nest. It is greatly to be hoped that so remarkable a form as the lyre-bird, the nearly sole survivor apparently of a very ancient race of beings, will not be allowed to become extinct—its almost certain fate so far as can be judged—without many more observations of its manners being made. Several examples of *Menura* have been brought alive to Europe, and some have long survived in captivity.

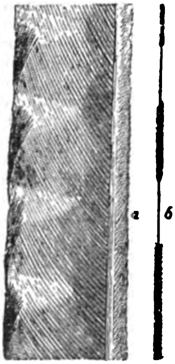

FIG. 1.

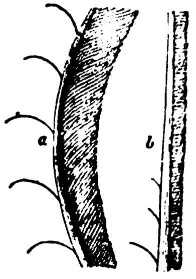

FIG. 2.

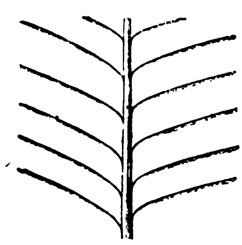

FIG. 3.

Three species of *Menura* have been indicated—the old *M. superba*, the lyre-bird proper, which inhabits New South Wales, the southern part of Queensland, and perhaps some parts of Victoria; *M. victoriae*, separated from the former by Gould (*Proc. Zool. Soc.*, 1862, p. 23), and said to take its place near Melbourne; and *M. alberti*, first described by C. L. Bonaparte (*Consp. Avium*, i. 215) on Gould's authority, and, though discovered on the Richmond river in New South Wales, having apparently a more northern range than the other two. All those have the apparent bulk of a hen pheasant, but are really much smaller, and their general plumage is of a sooty brown, relieved by rufous on the chin, throat, some of the wing-feathers and the tail-coverts. The wings, consisting of twenty-one remiges, are rather short and rounded; the legs[1] and feet very strong, with long, nearly straight claws. In the immature and female the tail is somewhat long, though affording no very remarkable character, except the possession of sixteen rectrices; but in the fully-plumaged male of *M. superba* and *M. victoriae* it is developed in the extraordinary fashion that gives the bird its common English name. The two exterior feathers (fig. 1, *a*, *b*) have the outer web very narrow, the inner very broad, and they curve at first outwards, then somewhat inwards, and near the tip outwards again, bending round forwards so as to present a lyre-like form. But this is not all; their broad inner web, which is of a lively chestnut colour, is apparently notched at regular intervals by spaces that, according to the angle at which they are viewed, seem either black or transparent; and this effect is, on examination, found to be due to the barbs at those spaces being destitute of barbules. The middle pair of feathers (fig. 2, *a*, *b*) is nearly as abnormal. These have no outer web, and the inner web very narrow; near their base they cross each other, and then diverge, bending round forwards near their tip. The remaining twelve feathers (fig. 3) except near the base are very thinly furnished with barbs, about ¼ in. apart, and those they possess, on their greater part, though long and flowing, bear no barbules, and hence have a hair-like appearance. The shafts of all are exceedingly strong. In the male of *M. alberti* the tail is not only not lyriform, but the exterior rectrices are shorter than the rest. (A.N.).

LYRICAL POETRY, a general term for all poetry which is, or can be supposed to be, susceptible of being sung to the accompaniment of a musical instrument. In the earliest times it may be said that all poetry was of its essence lyrical. The primeval oracles were chanted in verse, and the Orphic and Bacchic Mysteries, which were celebrated at Eleusis and elsewhere, combined, it is certain, metre with music. Homer and Hesiod are each of them represented with a lyre, yet if any poetry can be described as non-lyrical, it is surely the archaic hexameter of the *Iliad* and the *Erga*. These poems were styled epic, in direct contradistinction to the lyric of Pindar and Bacchylides. But inexactly, since it is plain that they were recited, with a plain accompaniment on a stringed instrument. However, the distinction between epical and lyrical, between τὰ ἔπη, what was said, and τὰ μέλη, what was sung, is accepted, and neither Homer nor Hesiod is among the lyrists. This distinction, however, is often without a difference, as for example, in the case of the so-called *Hymns* of Homer, epical in form but wholly lyrical in character. Hegel, who has gone minutely into this question in his *Esthetik*, contends that when poetry is objective it is epical, and when it is subjective it is lyrical. This is to ignore the metrical form of the poem, and to deal with its character only. It would constrain us to regard Wordsworth's *Excursion* as a lyric, and Tennyson's *Revenge* (where the subject is treated exactly as one of the Homeridae would have treated an Ionian myth) as an epic. This is impossible, and recalls us to the importance of taking the form into consideration. But, with this warning, the definition of Hegel is valuable. It is, as he insists, the personal thought, or passion, or inspiration, which gives its character to lyrical poetry.

The lyric has the function of revealing, in terms of pure art, the secrets of the inner life, its hopes, its fantastic joys, its sorrows, its delirium. It is easier to exclude the dramatic species from lyric than to banish the epic. There are large sections of drama which it is inconceivable should be set to music, or sung, or even given in recitative. The tragedies of Racine, for example, are composed of the purest poetry, but they are essentially non-lyrical, although lyrical portions are here and there attached to them. The intensity of feeling and the melody of verse in *Othello* does not make that work an example of lyrical poetry, and this is even more acutely true of *Le Misanthrope*, which is, nevertheless, a poem. The tendency of modern drama is to divide itself further and further from lyric, but in early ages the two kinds were indissoluble. Tragedy was goat-song, and the earliest specimens of it were mainly composed of choruses. As Prof. G. G. Murray says, in the *Suppliants* of Aeschylus, the characters "are singing for two-thirds of the play," accompanied by tumultuous music. This primitive feature has gradually been worn away; the chorus grew less and less prominent, and disappeared; the very verse-ornament of drama tends to vanish, and we have plays essentially so poetical as those of Ibsen and Maeterlinck written from end to end in bare prose.

To return again to Greece, there was an early distinction, soon accentuated, between the poetry chanted by a choir of singers, and the song which expressed the sentiments of a single poet. The latter, the μέλος or song proper, had reached a height of technical perfection in "the Isles of Greece, where burning Sappho loved and sung," as early as the 7th century B.C. That poetess, and her contemporary Alcaeus, divide the laurels of the pure Greek song of Dorian inspiration. By their side, and later, flourished the great poets who set words to music for choirs, Alcman, Arion, Stesichorus, Simonides and Ibycus, who lead us at the close of the 5th century to Bacchylides and Pindar, in whom the magnificent tradition of the dithyrambic odes reached its highest splendour of development. The practice of Pindar and Sappho, we may say, has directed the course of lyrical poetry ever since, and will, unquestionably, continue to do so. They discovered how, with the maximum of art, to pour forth strains of personal magic and music, whether in a public or a private way. The ecstasy, the uplifted magnificence, of lyrical poetry could go no higher than it did in the unmatched harmonies of these old Greek poets, but it could fill a much wider field and be expressed with vastly greater variety. It did so in their own age. The gnomic verses of Theognis were certainly sung; so were the satires of Archilochus and the romantic reveries of Mimnermus.

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[1] The metatarsals are very remarkable in form, as already noticed by Eyton (*loc. cit.*), and their tendons strongly ossified.

At the Renaissance, when the traditions of ancient life were taken up eagerly, and hastily comprehended, it was thought proper to divide poetry into a diversity of classes. The earliest English critic who enters into a discussion of the laws of prosody, William Webbe, lays it down, in 1586, that in verse "the most usual kinds are four, the heroic, elegiac, iambic and lyric." Similar confusion of terms was common among the critics of the 15th and 16th centuries, and led to considerable error. It is plain that a border ballad is heroic, and may yet be lyrical; here the word "heroic" stands for "epic." It is plain that whether a poem is lyrical or not had nothing to do with the question whether it is composed in an iambic measure. Finally, it is undoubted that the early Greek "elegies" were sung to an accompaniment on the flute, whether they were warlike, like those of Tyrtaeus, or philosophical and amatory like those of Theognis. But (see Elegy) the present significance of "elegy," and this has been the case ever since late classical times, is funereal; in modern parlance an elegy is a dirge. Whether the great Alexandrian dirges, like those of Bion and of Moschus, on which our elegiacal tradition is founded, were actually sung to an accompaniment or not may be doubted; they seem too long, too elaborate, and too ornate for that. But, at any rate, they were composed on the convention that they would be sung, and it is conceivable that music might have been wedded to the most complex of these Alexandrian elegies. Accordingly, although *Lycidas* and *Adonais* are not habitually "set to music," there is no reason why they should not be so set, and their rounded and limited although extensive form links them with the song, not with the epic. There are many odes of Swinburne's for which it would be more difficult to write music than for his *Ave atque Vale.* In fact, in spite of its solemn and lugubrious regularity, the formal elegy or dirge is no more nor less than an ode, and is therefore entirely lyrical.

More difficulty is met with in the case of the sonnet, for although no piece of verse, when it is inspired by subjective passion, fits more closely with Hegel's definition of what lyrical poetry should be, yet the rhythmical complication of the sonnet, and its rigorous uniformity, seem particularly ill-fitted to interpretation on a lyre. When F. M. degli Azzi put the book of Genesis (1700) into sonnets, and Isaac de Benserade the *Metamorphoses* of Ovid (1676) into rondeaux, these eccentric and laborious versifiers produced what was epical rather than lyrical poetry, if poetry it was at all. But the sonnet as Shakespeare, Wordsworth and even Petrarch used it was a cry from the heart, a subjective confession, and although there is perhaps no evidence that a sonnet was ever set to music with success, yet there is no reason why that might not be done without destroying its sonnet-character.

Jouffroy was perhaps the first aesthetician to see quite clearly that lyrical poetry is, really, nothing more than another name for poetry itself, that it includes all the personal and enthusiastic part of what lives and breathes in the art of verse, so that the divisions of pedantic criticism are of no real avail to us in its consideration. We recognize a narrative or epical poetry; we recognize drama; in both of these, when the individual inspiration is strong, there is much that trembles on the verge of the lyrical. But outside what is pure epic and pure drama, all, or almost all, is lyrical. We say almost all, because the difficulty arises of knowing where to place descriptive and didactic poetry. The *Seasons* of Thomson, for instance, a poem of high merit and lasting importance in the history of literature—where is that to be placed? What is to be said of the *Essay on Man?* In primitive times, the former would have been classed under epic, the second would have been composed in the supple iambic trimeter which so closely resembled daily speech, and would not have been sharply distinguished from prose. Perhaps this classification would still serve, were it not for the element of versification, which makes a sharp line of demarcation between poetic art and prose. This complexity of form, rhythmical and stanzaic, takes much of the place which was taken in antiquity by such music as Terpander is supposed to have supplied. In a perfect lyric by a modern writer the instrument is the metrical form, to which the words have to adapt themselves. There is perhaps no writer who has ever lived in whose work this phenomenon may be more fruitfully studied than it may be in the songs and lyrics of Shelley. The temper of such pieces as "Arethusa" and "The Cloud" is indicated by a form hardly more ambitious than a guitar; Hellas is full of passages which suggest the harp; in his songs Shelley touches the lute or viol de gamba, while in the great odes to the "West Wind" and to "Liberty" we listen to a verse-form which reminds us by its volume of the organ itself. On the whole subject of the nature of lyric poetry no commentary can be more useful to the student than an examination of the lyrics of Shelley in relation to those of the song-writers of ancient Greece.

See Hegel, *Die Phänomenologie des Geistes* (1807); T. S. Jouffroy, *Cours d'esthétique* (1843); W. Christ, *Metrik der Griechen und Römer*, 2te. Aufl. (1879). (E. G.)

LYSANDER (Gr. *Λύσανδρος*), son of Aristocritus, Spartan admiral and diplomatist. Aelian (*Var. Hist.* xii. 43) and Phylarchus (*ap.* Athen. vi. 271 e) say that he was a *mothax*, *i.e.* the son of a helot mother (see Helots), but this tradition is at least doubtful; according to Plutarch he was a Heraclid, though not of either royal family. We do not know how he rose to eminence: he first appears as admiral of the Spartan navy in 407 B.C. The story of his influence with Cyrus the Younger, his naval victory off Notium, his quarrel with his successor Callicratidas in 406, his appointment as ἐπιστολεύς in 405, his decisive victory at Aegospotami, and his share in the siege and capitulation of Athens belong to the history of the Peloponnesian War (*q.v.*). By 404 he was the most powerful man in the Greek world and set about completing the task of building up a Spartan empire in which he should be supreme in fact if not in name. Everywhere democracies were replaced by oligarchies directed by bodies of ten men (decarchies, *δεκαρχίαι*) under the control of Spartan governors (harmosts, *ἁρμοσταί*). But Lysander's boundless influence and ambition, and the superhuman honours paid him, roused the jealousy of the kings and the ephors, and, on being accused by the Persian satrap Pharnabazus, he was recalled to Sparta. Soon afterwards he was sent to Athens with an army to aid the oligarchs, but Pausanias, one of the kings, followed him and brought about a restoration of democracy. On the death of Agis II., Lysander secured the succession of Agesilaus (*q.v.*), whom he hoped to find amenable to his influence. But in this he was disappointed. Though chosen to accompany the king to Asia as one of his thirty advisers (*σύμβουλοι*), he was kept inactive and his influence was broken by studied affronts, and finally he was sent at his own request as envoy to the Hellespont. He soon returned to Sparta to mature plans for overthrowing the hereditary kingship and substituting an elective monarchy open to all Heraclids, or even, according to another version, to all Spartiates. But his alleged attempts to bribe the oracles were fruitless, and his schemes were cut short by the outbreak of war with Thebes in 395. Lysander invaded Boeotia from the west, receiving the submission of Orchomenus and sacking Lebadea, but the enemy intercepted his despatch to Pausanias, who had meanwhile entered Boeotia from the south, containing plans for a joint attack upon Haliartus. The town was at once strongly garrisoned, and when Lysander marched against it he was defeated and slain. He was buried in the territory of Panopeus, the nearest Phocian city. An able commander and an adroit diplomatist, Lysander was fired by the ambition to make Sparta supreme in Greece and himself in Sparta. To this end he shrank from no treachery or cruelty; yet, like Agesilaus, he was totally free from the characteristic Spartan vice of avarice, and died, as he had lived, a poor man.

See the biographies by Plutarch and Nepos; Xen. *Hellenica*, i. 5–iii. 5; Diod. Sic. xiii. 70 sqq., 104 sqq., xiv. 3, 10, 13, 81; Lysias xii. 60 sqq.; Justin v. 5-7; Polyaenus i. 45, vii. 19; Pausanias iii., ix. 32, 5-10, x. 9, 7-11; C. A. Gehlert, *Vita Lysandri* (Bautzen, 1874); W. Vischer, *Alkibiades und Lysandros* (Basel, 1845); O. H. J. Nitzsch, *De Lysandro* (Bonn, 1847); and the Greek histories in general.

(M. N. T.)

LYSANIAS, tetrarch of Abilene (see Abila), according to Luke iii. 1, in the time of John the Baptist. The only Lysanias mentioned in profane history as exercising authority in this district was executed in 36 B.C. by M. Antonius (Mark Antony). This Lysanias was the son of Ptolemy Mennaeus, the ruler of an independent state, of which Abilene formed only a small portion. According to Josephus (*Ant.* xix. 5, 1) the emperor Claudius in A.D. 42 confirmed Agrippa I. in the possession of "Abila of Lysanias" already bestowed upon him by Caligula, elsewhere described as "Abila, which had formed the tetrarchy of Lysanias." It is argued that this cannot refer to the Lysanias executed by M. Antonius, since his paternal inheritance, even allowing for some curtailment by Pompey, must have been of far greater extent. It is therefore assumed by some authorities that the Lysanias in Luke (A.D. 28–29) is a younger Lysanias, tetrarch of Abilene only, one of the districts into which the original kingdom was split up after the death of Lysanias I. This younger Lysanias may have been a son of the latter, and identical with, or the father of, the Claudian Lysanias. On the other hand, Josephus knows nothing of a younger Lysanias, and it is suggested by others that he really does refer to Lysanias I. The explanation given by M. Krenkel (*Josephus und Lucas*, Leipzig, 1894, p. 97) is that Josephus does not mean to imply that Abila was the only possession of Lysanias, and that he calls it the tetrarchy or kingdom of Lysanias because it was the last remnant of the domain of Lysanias which remained under direct Roman administration until the time of Agrippa. The expression was borrowed from Josephus by Luke, who wrongly imagined that Lysanias I. had ruled almost up to the time of the bestowal of his tetrarchy upon Agrippa, and therefore to the days of John the Baptist. Two inscriptions are adduced as evidence for the existence of a younger Lysanias—Böckh, *C.I.G.* 4521 and 4523. The former is inconclusive, and in the latter the reading *Λυσ[ανιου]* is entirely conjectural; the name might equally well be Lysimachus or Lysias.

See E. Schürer, *Geschichte des jüdischen Volkes* (3rd ed., 1901), i. p. 712; and (especially on the inscriptional evidence) E. Renan, "Mémoire sur la dynastie des Lysanias d'Abilène" in *Mémoires de l'institut impérial de France* (xxvi., 1870); also P. W. Schmiedel in the *Encyclopaedia Biblica*, s.v.

LYSIAS, Attic orator, was born, according to Dionysius of Halicarnassus and the author of the life ascribed to Plutarch, in 459 B.C. This date was evidently obtained by reckoning back from the foundation of Thurii (444 B.C.), since there was a tradition that Lysias had gone thither at the age of fifteen. Modern critics would place his birth later,—between 444 and 436 B.C.,—because, in Plato's *Republic*, of which the scene is laid about 430 B.C., Cephalus, the father of Lysias, is among the *dramatis personae*, and the emigration of Lysias to Thurii was said to have followed his father's death. The latter statement, however, rests only on the Plutarchic life; nor can Plato's dialogue be safely urged as a minutely accurate authority. The higher date assigned by the ancient writers agrees better with the tradition that Lysias reached, or passed, the age of eighty.[1] Cephalus, his father, was a native of Syracuse, and on the invitation of Pericles had settled at Athens. The opening scene of Plato's *Republic* is laid at the house of his eldest son, Polemarchus, in Peiraeus. The tone of the picture warrants the inference that the Sicilian family were well known to Plato, and that their houses must often have been hospitable to such gatherings.

At Thurii, the colony newly planted on the Tarentine Gulf (see Pericles), the boy may have seen Herodotus, now a man in middle life, and a friendship may have grown up between them. There, too, Lysias is said to have commenced his studies in rhetoric—doubtless under a master of the Sicilian school—possibly, as tradition said, under Tisias, the pupil of Corax, whose name is associated with the first attempt to formulate rhetoric as an art. In 413 B.C. the Athenian armament in Sicily was annihilated. The desire to link famous names is illustrated by the ancient ascription to Lysias of a rhetorical exercise purporting to be a speech in which the captive general Nicias appealed for mercy to the Sicilians. The terrible blow to Athens quickened the energies of an anti-Athenian faction at Thurii. Lysias and his elder brother Polemarchus, with three hundred other persons, were "accused of Atticizing." They were driven from Thurii and settled at Athens (412 B.C.).

Lysias and Polemarchus were rich men, having inherited property from their father; and Lysias claims that, though merely resident aliens, they discharged public services with a liberality which shamed many of those who enjoyed the franchise (*In Eratosth.* 20). The fact that they owned house property shows that they were classed as *ἰσοτελεῖς*, *i.e.* foreigners who paid only the same tax as citizens, being exempt from the special tax (*μετοίκιον*) on resident aliens. Polemarchus occupied a house in Athens itself, Lysias another in the Peiraeus, near which was their shield manufactory, employing a hundred and twenty skilled slaves. In 404 the Thirty Tyrants were established at Athens under the protection of a Spartan garrison. One of their earliest measures was an attack upon the resident aliens, who were represented as disaffected to the new government. Lysias and Polemarchus were on a list of ten singled out to be the first victims. Polemarchus was arrested, and compelled to drink hemlock. Lysias had a narrow escape, with the help of a large bribe. He slipped by a back-door out of the house in which he was a prisoner, and took boat to Megara. It appears that he had rendered valuable services to the exiles during the reign of the tyrants, and in 403 Thrasybulus proposed that these services should be recognized by the bestowal of the citizenship. The Boulē, however, had not yet been reconstituted, and hence the measure could not be introduced to the ecclesia by the requisite "preliminary resolution" (*προβούλευμα*). On this ground it was successfully opposed.

During his later years Lysias—now probably a comparatively poor man owing to the rapacity of the tyrants and his own generosity to the Athenian exiles—appears as a hard-working member of a new profession—that of writing speeches to be delivered in the law-courts. The thirty-four extant are but a small fraction. From 403 to about 380 B.C. his industry must have been incessant. The notices of his personal life in these years are scanty. In 403 he came forward as the accuser of Eratosthenes, one of the Thirty Tyrants. This was his only direct contact with Athenian politics. The story that he wrote a defence for Socrates, which the latter declined to use, probably arose from a confusion. Several years after the death of Socrates the sophist Polycrates composed a declamation against him, to which Lysias replied. A more authentic tradition represents Lysias as having spoken his own *Olympiacus* at the Olympic festival of 388 B.C., to which Dionysius I. of Syracuse had sent a magnificent embassy. Tents embroidered with gold were pitched within the sacred enclosure; and the wealth of Dionysius was vividly shown by the number of chariots which he had entered. Lysias lifted up his voice to denounce Dionysius as, next to Artaxerxes, the worst enemy of Hellas, and to impress upon the assembled Greeks that one of their foremost duties was to deliver Sicily from a hateful oppression. The latest work of Lysias which we can date (a fragment of a speech *For Pherenicus*) belongs to 381 or 380 B.C. He probably died in or soon after 380 B.C.

Lysias was a man of kindly and genial nature, warm in friendship, loyal to country, with a keen perception of character.

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[1] [W. Christ, *Gesch. der griech. Litt.*, gives the date of birth as about 450.]

and a fine though strictly controlled sense of humour. The literary tact which is so remarkable in the extant speeches is that of a singularly flexible intelligence, always obedient to an instinct of gracefulness. He owes his distinctive place to the power of concealing his art. It was obviously desirable that a speech written for delivery by a client should be suitable to his age, station and circumstances. Lysias was the first to make this adaptation really artistic. His skill can be best appreciated if we turn from the easy flow of his graceful language to the majestic emphasis of Antiphon, or to the self-revealing art of Isaeus. Translated into terms of ancient criticism, he became the model of the "plain style" (*ἰσχνὸς χαρακτήρ, ἰσχνή, λιτή, ἀφελὴς λέξις*: *genus tenue* or *subtile*). Greek and then Roman critics distinguished three styles of rhetorical composition—the "grand" (or "elaborate"), the "plain" and the "middle," the "plain" being nearest to the language of daily life. Greek rhetoric began in the "grand" style; then Lysias set an exquisite pattern of the "plain"; and Demosthenes might be considered as having effected an almost ideal compromise.

The vocabulary of Lysias is pure and simple. Most of the rhetorical "figures" are sparingly used—except such as consist in the parallelism or opposition of clauses. The taste of the day—not yet emancipated from the influence of the Sicilian rhetoric—probably demanded a large use of antithesis. Lysias excels in vivid description; he has also a happy knack of marking the speaker's character by light touches. The structure of his sentences varies a good deal according to the dignity of the subject. He has equal command over the "periodic" style (*κατεστραμμένη λέξις*) and the non-periodic or "continuous" (*εἰρομένη, διαλελυμένη*). His disposition of his subject-matter is always simple. The speech has usually four parts—introduction (*προοίμιον*), narrative of facts (*διήγησις*), proofs (*πίστεις*), which may be either external, as from witnesses, or internal, derived from argument on the facts, and, lastly, conclusion (*ἐπίλογος*). It is in the introduction and the narrative that Lysias is seen at his best. In his greatest extant speech—that *Against Eratosthenes*—and also in the fragmentary *Olympiacus*, he has pathos and fire; but these were not characteristic qualities of his work. In Cicero's judgment (*De Orat.* iii. 7, 28) Demosthenes was peculiarly distinguished by force (*vis*), Aeschines by resonance (*sonitus*), Hypereides by acuteness (*acumen*), Isocrates by sweetness (*suavitas*); the distinction which he assigns to Lysias is *subtilitas*, an Attic refinement—which, as he elsewhere says (*Brutus*, 16, 64) is often joined to an admirable vigour (*lacerti*). Nor was it oratory alone to which Lysias rendered service; his work had an important effect on all subsequent Greek prose, by showing how perfect elegance could be joined to plainness. Here, in his artistic use of familiar idiom, he might fairly be called the Euripides of Attic prose. And his style has an additional charm for modern readers, because it is employed in describing scenes from the everyday life of Athens.[1]

Thirty-four speeches (three fragmentary) have come down under the name of Lysias; one hundred and twenty-seven more, now lost, are known from smaller fragments or from titles. In the Augustan age four hundred and twenty-five works bore his name, of which more than two hundred were allowed as genuine by the critics. Our thirty-four works may be classified as follows:—

A. Epideictic.—1. *Olympiacus*, xxxiii. 388 B.C.; 2. *Epitaphius*, ii. (purporting to have been spoken during the Corinthian War; certainly spurious), perhaps composed about 380–340 B.C. ("soon after 387," Blass).

B. Deliberative.—Plea for the Constitution, xxxiv., 403 B.C.

C. Forensic, in Public Causes.—I. *Relating to Offences directly against the State* (*γραφαὶ δημοσίων ἀδικημάτων*); *such as treason, malversation in office, embezzlement of public moneys*. 1. For Polystratus, xx., 407 B.C.; 2. Defence on a Charge of Taking Bribes, xxi., 402 B.C.; 3. Against Ergocles, xxviii., 389 B.C.; 4. Against Epicrates, xxvii., 389 B.C.; 5. Against Nicomachus, xxx., 399 B.C.; 6. Against the Corndealers, xxii., 386 B.C. (?) II. *Cause relating to Unconstitutional Procedure* (*γραφὴ παρανόμων*). On the Property of the Brother of Nicias, xviii., 395 B.C. III. *Causes relating to Claims for Money withheld from the State* (*ἀπογραφαί*). 1. For the Soldier, ix. (probably not by Lysias, but by an imitator, writing for a real cause), 394 B.C. (?); 2. On the Property of Aristophanes, xix., 387 B.C.; 3. Against Philocrates, xxix., 389 B.C. IV. *Causes relating to a Scrutiny* (*δοκιμασία*); *especially the Scrutiny, by the Senate, of Officials Designate*. 1. Against Evandrus, xxvi., 382 B.C.; 2. For Mantitheus, xvi., 392 B.C.; 3. Against Philon, xxxi., between 404 and 395 B.C.; 4. Defence on a Charge of Seeking to Abolish the Democracy, xxv., 401 B.C.; 5. For the Invalid, xxiv., 402 B.C. (?) V. *Causes relating to Military Offences* (*γραφαὶ λιποταξίου, ἀστρατείας*). 1. Against Alcibiades, I. and II. (xiv., xv.), 395 B.C. VI. *Causes relating to Murder or Intent to Murder* (*γραφαὶ φόνου, τραύματος ἐκ προνοίας*). 1. Against Eratosthenes, xii., 403 B.C.; 2. Against Agoratus, xiii., 399 B.C.; 3. On the Murder of Eratosthenes, i. (date uncertain); 4. Against Simon, iii., 393 B.C.; 5. On Wounding with Intent, iv. (date uncertain). VII. *Causes relating to Impiety* (*γραφαὶ ἀσεβείας*). 1. Against Andocides, vi. (certainly spurious, but perhaps contemporary); 2. For Callias, v. (date uncertain); 3. On the Sacred Olive, vii., not before 395 B.C.

D. Forensic, in Private Causes.—I. *Action for Libel* (*δίκη κακηγορίας*). Against Theomnestus, x., 384–383 B.C. (the so-called second speech, xi., is merely an epitome of the first). II. *Action by a Ward against a Guardian* (*δίκη ἐπιτροπῆς*). Against Diogeiton, xxxii., 400 B.C. III. *Trial of a Claim to Property* (*διαδικασία*). On the property of Eraton, xvii., 397 B.C. IV. *Answer to a Special Plea* (*πρὸς παραγραφήν*). Against Pancleon, xxiii. (date uncertain).

E. Miscellaneous.—1. To his Companions, a Complaint of Slanders, viii. (certainly spurious); 2. The *ἐρωτικός* in Plato's *Phaedrus*, pp. 230 E-234. This has generally been regarded as Plato's own work; but the certainty of this conclusion will be doubted by those who observe (1) the elaborate preparations made in the dialogue for a recital of the *ἐρωτικός* which shall be *verbally exact*, and (2) the closeness of the criticism made upon it. If the satirist were merely analysing his own composition, such criticism would have little point. Lysias is the earliest writer who is known to have composed *ἐρωτικοί*; it is as representing both rhetoric and a false *ἔρως* that he is the object of attack in the *Phaedrus*.

F. Fragments.—Three hundred and fifty-five of these are collected by Sauppe, *Oratores Attici*, ii. 170–216. Two hundred and fifty-two of them represent one hundred and twenty-seven speeches of known title; and of six the fragments are comparatively large. Of these, the fragmentary speech *For Pherenicus* belongs to 381 or 380 B.C., and is thus the latest known work of Lysias.[2]

In literary and historical interest, the first place among the extant speeches of Lysias belongs to that *Against Eratosthenes* (403 B.C.), one of the Thirty Tyrants, whom Lysias arraigns as the murderer of his brother Polemarchus. The speech is an eloquent and vivid picture of the reign of terror which the Thirty established at Athens; the concluding appeal, to both parties among the citizens, is specially powerful. Next in importance is the speech *Against Agoratus* (399 B.C.), one of our chief authorities for the internal history of Athens during the months which immediately followed the defeat at Aegospotami. The *Olympiacus* (388 B.C.) is a brilliant fragment, expressing the spirit of the festival at Olympia, and exhorting Greeks to unite against their common foes. The *Plea for the Constitution* (403 B.C.) is interesting for the manner in which it argues that the wellbeing of Athens—now stripped of empire—is bound up with the maintenance of democratic principles. The speech *For Mantitheus* (392 B.C.) is a graceful and animated portrait of a young Athenian *ἱππεύς*, making a spirited defence of his honour against the charge of disloyalty. The defence *For the Invalid* is a humorous character-sketch. The speech *Against Pancleon* illustrates the intimate relations between Athens and Plataea, while it gives us some picturesque glimpses of Athenian town life. The defence of the person who had been charged with destroying a *moria*, or sacred olive, places us amidst the country life of Attica. And the speech *Against Theomnestus* deserves attention for its curious evidence of the way in which the ordinary vocabulary of Athens had changed between 600 and 400 B.C.

All MSS. of Lysias yet collated have been derived, as H. Sauppe first showed, from the Codex Palatinus X. (Heidelberg). The next most valuable MS. is the Laurentianus C (15th century), which I. Bekker chiefly followed. Speaking generally, we may say that these two MSS. are the only two which carry much weight where the text is seriously corrupt. In *Oratt.* i.-ix. Bekker occasionally consulted eleven other MSS., most of which contain only the above nine speeches: viz., Marciani F, G, I, K (Venice); Laurentiani D, E (Florence); Vaticani M, N; Parisini U, V; Urbinas O.

Bibliography.—Editio princeps, Aldus (Venice, 1513); by I. Bekker (1823) and W. S. Dobson (1828) in *Oratores Attici*; C. Scheibe (1852) and T. Thalheim (1901, Teubner series, with bibliography); C. G. Cobet (4th ed., by J. J. Hartman, 1905); with variorum notes, by J. J. Reiske (1772). Editions of select speeches by J. H. Bremi (1845); R. Rauchenstein (1848, revised by C. Fuhr, 1880–1881); H. Frohberger (1866–1871); H. van Herwerden (1863); A. Weidner (1888); E. S. Shuckburgh (1882); A. Westermann and W. Binder (1887–1890); G. P. Bristol (1892), M. H. Morgan (1895), C. D. Adams (1905), all three published in America. There is a special lexicon to Lysias by D. H. Holmes (Bonn, 1895). See also Jebb's *Attic Orators* (1893) and *Selections from the Attic Orators* (2nd ed., 1888) and F. Blass, *Die Attische Beredsamkeit* (2nd ed., 1887–1898); W. L. Devries, *Ethopoiia. A rhetorical study of the types of character in the orations of Lysias* (Baltimore, 1892). (R. C. J.; X.)

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[1] See further Jebb, *The Attic Orators from Antiphon to Isaeus*, i. 142-316.

[2] [Some remains of the speech against Theozotides have been found in the Hibeh papyri; see W. H. D. Rouse's *The Year's Work in Classical Studies* (1907)].

LYSIMACHUS (*c.* 355–281 B.C.), Macedonian general, son of Agathocles, was a citizen of Pella in Macedonia. During Alexander's Persian campaigns he was one of his immediate bodyguard and distinguished himself in India. After Alexander's death he was appointed to the government of Thrace and the Chersonese. For a long time he was chiefly occupied with fighting against the Odrysian king Seuthes. In 315 he joined Cassander, Ptolemy and Seleucus against Antigonus, who, however, diverted his attention by stirring up Thracian and Scythian tribes against him. In 309, he founded Lysimachia in a commanding situation on the neck connecting the Chersonese with the mainland. He followed the example of Antigonus in taking the title of king. In 302 when the second alliance between Cassander, Ptolemy and Seleucus was made, Lysimachus, reinforced by troops from Cassander, entered Asia Minor, where he met with little resistance. On the approach of Antigonus he retired into winter quarters near Heraclea, marrying its widowed queen Amastris, a Persian princess. Seleucus joined him in 301, and at the battle of Ipsus Antigonus was slain. His dominions were divided among the victors, Lysimachus receiving the greater part of Asia Minor. Feeling that Seleucus was becoming dangerously great, he now allied himself with Ptolemy, marrying his daughter Arsinoë. Amastris, who had divorced herself from him, returned to Heraclea. When Antigonus's son Demetrius renewed hostilities (297), during his absence in Greece, Lysimachus seized his towns in Asia Minor, but in 294 concluded a peace whereby Demetrius was recognized as ruler of Macedonia. He tried to carry his power beyond the Danube, but was defeated and taken prisoner by the Getae, who, however, set him free on amicable terms. Demetrius subsequently threatened Thrace, but had to retire in consequence of a rising in Boeotia, and an attack from Pyrrhus of Epirus. In 288 Lysimachus and Pyrrhus in turn invaded Macedonia, and drove Demetrius out of the country. Pyrrhus was at first allowed to remain in possession of Macedonia with the title of king, but in 285 he was expelled by Lysimachus. Domestic troubles embittered the last years of Lysimachus's life. Amastris had been murdered by her two sons; Lysimachus treacherously put them to death. On his return Arsinoë asked the gift of Heraclea, and he granted her request, though he had promised to free the city. In 284 Arsinoë, desirous of gaining the succession for her sons in preference to Agathocles (the eldest son of Lysimachus), intrigued against him with the help of her brother Ptolemy Ceraunus; they accused him of conspiring with Seleucus to seize the throne, and he was put to death. This atrocious deed of Lysimachus aroused great indignation. Many of the cities of Asia revolted, and his most trusted friends deserted him. The widow of Agathocles fled to Seleucus, who at once invaded the territory of Lysimachus in Asia. Lysimachus crossed the Hellespont, and in 281 a decisive battle took place at the plain of Corus (Corupedion) in Lydia. Lysimachus was killed; after some days his body, watched by a faithful dog, was found on the field, and given up to his son Alexander, by whom it was interred at Lysimachia.

See Arrian, *Anab.* v. 13, vi. 28; Justin xv. 3, 4, xvii. 1; Quintus Curtius v. 3, x. 30; Diod. Sic. xviii. 3; Polybius v. 67; Plutarch, *Demetrius*, 31. 52, *Pyrrhus*, 12; Appian, *Syriaca*, 62; Thirlwall, *History of Greece*, vol. viii. (1847); J. P. Mahaffy, *Story of Alexander's Empire*; Droysen, *Hellenismus* (2nd ed., 1877); A. Holm, *Griechische Geschichte*, vol. iv. (1894); B. Niese, *Gesch. d. griech. u. maked. Staaten*, vols. i. and ii. (1893, 1899); J. Beloch, *Griech. Gesch.* vol. iii. (1904); Hünerwadel, *Forschungen zur Gesch. des Königs Lysimachus* (1900); Possenti, *Il Re Lisimaco di Tracia* (1901); Ghione, *Note sul regno di Lisimaco* (*Atti d. real. Accad. di Torino*, xxxix.); and MACEDONIAN EMPIRE. (E. R. B.)

LYSIPPUS, Greek sculptor, was head of the school of Argos and Sicyon in the time of Philip and Alexander of Macedon. His works are said to have numbered 1500, some of them colossal. Some accounts make him the continuer of the school of Polyclitus; some represent him as self-taught. The matter in which he especially innovated was the proportions of the male human body; he made the head smaller than his predecessors, the body more slender and hard, so as to give the impression of greater height. He also took great pains with hair and other details. Pliny (*N.H.* 34, 61) and other writers mention many of his statues. Among the gods he seems to have produced new and striking types of Zeus (probably of the Otricoli class), of Poseidon (compare the Poseidon of the Lateran, standing with raised foot), of the Sun-god and others; many of these were colossal figures in bronze. Among heroes he was specially attracted by the mighty physique of Hercules. The Hercules Farnese of Naples, though signed by Glycon of Athens, and a later and exaggerated transcript, owes something, including the motive of rest after labour, to Lysippus. Lysippus made many statues of Alexander the Great, and so satisfied his patron, no doubt by idealizing him, that he became the court sculptor of the king, from whom and from whose generals he received many commissions. The extant portraits of Alexander vary greatly, and it is impossible to determine which among them go back to Lysippus. The remarkable head from Alexandria (Plate II. fig. 56, in GREEK ART) has as good a claim as any.

As head of the great athletic school of Peloponnese Lysippus naturally sculptured many athletes; a figure by him of a man scraping himself with a strigil was a great favourite of the Romans in the time of Tiberius (Pliny, *N.H.* 34, 61); and this has been usually regarded as the original copied in the Apoxyomenus of the Vatican (GREEK ART, Plate VI. fig. 79). If so, the copyist has modernized his copy, for some features of the Apoxyomenus belong to the Hellenistic age. With more certainty we may see a copy of an athlete by Lysippus in the statue of Agias found at Delphi (GREEK ART, Plate V. fig. 74), which is proved by inscriptions to be a replica in marble of a bronze statue set up by Lysippus in Thessaly. And when the Agias and the Apoxyomenus are set side by side their differences are so striking that it is difficult to attribute them to the same author, though they may belong to the same school. (P. G.)

LYSIS OF TARENTUM (d. *c.* 390 B.C.), Greek philosopher. His life is obscure, but it is generally accepted, that in the persecution of the Pythagoreans at Crotona and Metapontum he escaped and went to Thebes, where he came under the influence of Philolaus. The friend and companion of Pythagoras, he has been credited with many of the works usually attributed to Pythagoras himself. Diogenes Laertius viii. 6 gives him three, and Mullach even assigns to him the *Golden Verses*. But it is generally held that these verses are a collection of lines by many authors rather than the work of one man.

LYSISTRATUS, a Greek sculptor of the 4th century B.C., brother of Lysippus of Sicyon. We are told by Pliny (*Nat. Hist.* 35, 153) that he followed a strongly realistic line, being the first sculptor to take impressions of human faces in plaster.

LYTE, HENRY FRANCIS (1793–1847), Anglican divine and hymn-writer, was born near Kelso on the 1st of June 1793, and was educated at Enniskillen school and at Trinity College, Dublin. He took orders in 1815, and for some time held a curacy near Wexford. Owing to infirm health he came to England, and after several changes settled, in 1823, in the parish of Brixham. In 1844 his health finally gave way; and he died at Nice on the 20th of November 1847.

Lyte's first work was *Tales in Verse illustrative of Several of the Petitions in the Lord's Prayer* (1826), which was written at Lymington and was commended by Wilson in the *Noctes Ambrosianae*. He next published (1833) a volume of *Poems, chiefly Religious*, and in 1834 a little collection of psalms and hymns entitled *The Spirit of the Psalms*. After his death, a volume of *Remains* with a memoir was published, and the poems contained in this, with those in *Poems, chiefly Religious*, were afterwards issued in one volume (1868). His best known hymns are "Abide with me! fast falls the eventide", "Jesus, I my cross have taken"; "Praise, my soul, the King of Heaven"; and "Pleasant are Thy courts above."

LYTHAM, an urban district and watering-place in the Blackpool parliamentary division of Lancashire, England, on the north shore of the estuary of the Ribble, 13½ m. W. of Preston by a joint line of the London & North Western and Lancashire & Yorkshire railways. Pop. (1901) 7185. It has a pier, a pleasant promenade and drive along the shore, and other appointments of a seaside resort, but it is less wholly devoted to holiday visitors than Blackpool, which lies 8 m. N.W. A Benedictine cell was founded here at the close of the 12th century by the lord of the manor, Richard Fitz-Roger.

LYTTELTON, GEORGE LYTTELTON, 1ST BARON (1709–1773), English statesman and man of letters, born at Hagley, Worcestershire, was a descendant of the great jurist Sir Thomas Littleton (*q.v.*). He was the eldest son of Sir Thomas Lyttelton, 4th bart. (d. 1751), who at the revolution of 1688 and during the following reign was one of the ablest Whig debaters of the House of Commons.[1] Lyttelton was educated at Eton and Oxford, and in 1728 set out on the grand tour, spending considerable periods at Paris and Rome. On his return to England he sat in parliament for Okehampton, Devonshire, beginning public life in the same year with Pitt. From 1744 to 1754 he held the office of a lord-commissioner of the treasury. In 1755 he succeeded Legge as chancellor of the exchequer, but in 1756 he quitted office, being raised to the peerage as Baron Lyttelton, of Frankley, in the county of Worcester. In the political crisis of 1765, before the formation of the Rockingham administration, it was suggested that he might be placed at the head of the treasury, but he declined to take part in any such scheme. The closing years of his life were devoted chiefly to literary pursuits. He died on the 22nd of August 1773.

Lyttelton's earliest publication (1735), *Letters from a Persian in England to his Friend at Ispahan*, appeared anonymously. Much greater celebrity was achieved by his *Observations on the Conversion and Apostleship of St Paul*, also anonymous, published in 1747. It takes the form of a letter to Gilbert West, and is designed to show that St Paul's conversion is of itself a sufficient demonstration of the divine character of Christianity. Dr Johnson regarded the work as one "to which infidelity has never been able to fabricate a specious answer." Lord Lyttelton's *Dialogues of the Dead*, a creditable performance, though hardly rivalling either Lucian or Landor, appeared in 1760. His *History of Henry II.* (1767–1771), the fruit of twenty years' labour, is not now cited as an authority, but is painstaking and fair. Lyttelton was also a writer of verse; his *Monody* on his wife's death has been praised by Gray for its elegiac tenderness, and his *Prologue* to the *Coriolanus* of his friend Thomson shows genuine feeling. He was also the author of the well-known stanza in the *Castle of Indolence*, in which the poet himself is described. A complete collection of the *Works* of Lord Lyttelton was published by his nephew, G. E. Ayscough in 1774.

His son THOMAS (1744–1779), who succeeded as 2nd baron, played some part in the political life of his time, but his loose and prodigal habits were notorious, and he is known, in distinction to his father "the good lord," as the wicked Lord Lyttelton. He left no lawful issue, and the barony became extinct; but it was revived in 1794 in the person of his uncle WILLIAM HENRY, 1st baron of the new creation (1724–1808), who was governor of S. Carolina and later of Jamaica, and ambassador to Portugal. The new barony went after him to his two sons. The 3rd baron (1782–1837) was succeeded by his son GEORGE WILLIAM LYTTELTON, 4th baron (1817–1876), who was a fine scholar, and brother-in-law of W. E. Gladstone, having married Miss Mary Glynne. He did important work in educational and poor law reform. He had eight sons, of whom the eldest, CHARLES GEORGE (b. 1842), became 5th baron, and in 1889 succeeded, by the death of the 3rd duke of Buckingham and Chandos, to the viscounty of COBHAM, in which title the barony of Lyttelton is now merged. Other distinguished sons were Arthur Temple Lyttelton (d. 1903), warden of Selwyn College, Cambridge, and bishop-suffragan of Southampton; Edward Lyttelton (b. 1855), headmaster of Haileybury (1890–1905) and then of Eton; and Alfred Lyttelton (b. 1857), secretary of state for the colonies (1903–1906). It was a family of well-known cricketers, Alfred being in his day the best wicket-keeper in England as well as a fine tennis player.

For the 1st baron see Sir R. Phillimore's *Memoirs and Correspondence of Lord Lyttelton, 1734–1773* (2 vols., 1845).

LYTTELTON, a borough of New Zealand, the port of Christchurch (*q.v.*) on the E. coast of South Island, on an inlet on the north-western side of Banks Peninsula. Pop. (1906) 3941. It is surrounded by abrupt hills rising to 1600 ft., through which a railway communicates with Christchurch (7 m. N.W.) by a tunnel 1¾ m. long. Great breakwaters protect the harbour, which has an area of 110 acres, with a low-tide depth of 20 to 27 ft. There is a graving dock accessible for vessels of 6000 tons. The produce of the rich agricultural district of Canterbury is exported, frozen or preserved. Lyttelton, formerly called Port Cooper and Port Victoria, was the original settlement in this district (1850).

LYTTON, EDWARD GEORGE EARLE LYTTON, BULWER-LYTTON, 1ST BARON (1803–1873), English novelist and politician, the youngest son of General William Earle Bulwer of Heydon Hall and Wood Dalling, Norfolk, was born in London on the 25th of May 1803. He had two brothers, William (1799–1877) and Henry (1801–1872), afterwards Lord Dalling (*q.v.*). Bulwer's father died when the boy was four years old. His mother, Elizabeth Barbara, daughter of Richard Warburton Lytton of Knebworth, Hertfordshire, after her husband's death settled in London. Bulwer, who was delicate and neurotic, gave evidence of precocious talent and was sent to various boarding schools, where he was always discontented, until in the establishment of a Mr Wallington at Ealing he found in his master a sympathetic and admiring listener. Mr Wallington induced him to publish, at the age of fifteen, an immature volume entitled *Ishmael and other Poems*. About this time Bulwer fell in love, and became extremely morbid under enforced separation from the young lady, who was induced by her father to marry another man. She died about the time that Bulwer went to Cambridge, and he declared that her loss affected all his after-life. In 1822 he entered Trinity College, Cambridge, but removed shortly afterwards to Trinity Hall, and in 1825 won the Chancellor's medal for English verse with a poem on "Sculpture." In the following year he took his B.A. degree and printed for private circulation a small volume of poems, *Weeds and Wild Flowers*, in which the influence of Byron was easily traceable. In 1827 he published *O'Neill, or the Rebel*, a romance, in heroic couplets, of patriotic struggle in Ireland, and in 1831 a metrical satire, *The Siamese Twins*. These juvenilia he afterwards ignored.

Meanwhile he had begun to take his place in society, being already known as a dandy of considerable pretensions, who had acted as second in a duel and experienced the fashionable round of flirtation and intrigue. He purchased a commission in the army, only to sell it again without undergoing any service, and in August 1827 married, in opposition to his mother's wishes, Rosina Doyle Wheeler (1802–1882), an Irish beauty, niece and adopted daughter of General Sir John Doyle. She was a brilliant but passionate girl, and upon his marriage with her, Bulwer's mother withdrew the allowance she had hitherto made him. He had £200 a year from his father, and less than £100 a year with his wife, and found it necessary to set to work in earnest. In the year of his marriage he published *Falkland*, a novel which was only a moderate success, but in 1828 he attracted general attention with *Pelham*, a novel for which he had gathered material during a visit to Paris in 1825. This story, with its intimate study of the dandyism of the age, was immediately popular, and gossip was busy in identifying the characters of the romance with the leading men of the time. In the same year he published *The Disowned*, following it up with *Devereux* (1829), *Paul Clifford* (1830), *Eugene Aram* (1832) and *Godolphin* (1833). All these novels were designed with a didactic purpose, somewhat upon the German model. To embody the leading features of a period, to show how a criminal may be reformed by the development of his own character, to explain the secrets of failure and success in life, these were the avowed objects of his art, and there were not wanting critics ready to call in question his sincerity and his morality. Magazine controversy followed, in which Bulwer was induced to take a part, and about the same time he began to make a mark in politics. He became a follower of Bentham, and in 1831 was elected member for St Ives in Huntingdon. During this period of feverish activity his relations with his wife grew less and less satisfactory. At first she had cause to complain that he neglected her in the pursuit of literary reputation; later on his disregard became rather active than passive. After a series of distressing differences they decided to live apart, and were legally separated in 1836. Three years later his wife published a novel called *Cheveley, or the Man of Honour*, in which Bulwer was bitterly caricatured, and in June 1858, when her husband was standing as parliamentary candidate for Hertfordshire, she appeared at the hustings and indignantly denounced him. She was consequently placed under restraint as insane, but liberated a few weeks later. For years she continued her attacks upon her husband's character, and outlived him by nine years, dying at Upper Sydenham in March 1882. There is little doubt that her passionate imagination gravely exaggerated the tale of her wrongs, though Bulwer was certainly no model for husbands. It was a case of two undisciplined natures in domestic bondage, and the consequences of their union were as inevitable as they were unfortunate.

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[1] Sir Thomas (or Thomas de) Littleton, the jurist, had three sons, William, Richard and Thomas. From the first, William, was descended Sir Thomas Lyttelton, 1st bart. of Frankley (1596–1650), whose sons were Sir Henry, 2nd bart. (d. 1693), and Sir Charles, 3rd bart. (1629–1716), governor of Jamaica. The latter's son was Sir Thomas, 4th bart., above mentioned, who was also the father of Charles Lyttelton (1714–1768), bishop of Carlisle, and president of the Society of Antiquaries. The male descendants of the second, Richard, died out with Sir Edward Littleton, bart., of Pillaton, Staffordshire, in 1812, but the latter's grandnephew, Edward John Walhouse (1791–1863) of Hatherton, took the estates by will and also the name of Littleton, and was created 1st Baron Hatherton in 1835; he was chief secretary for Ireland (1833–1834). From Thomas, the third son, was descended, in one line, Edward, Lord Littleton, of Munslow (1589–1645), recorder of London, chief justice of the common pleas, and eventually lord keeper; and in another line, the baronets of Stoke St Milborough, Shropshire, of whom the best known and last was Sir Thomas Littleton, 3rd bart. (1647–1710), speaker of the House of Commons (1698–1700), and treasurer of the navy.

Bulwer, meanwhile, was full of activity, both literary and political. After representing St Ives, he was returned for Lincoln in 1832, and sat in parliament for that city for nine years. He spoke in favour of the Reform Bill, and took the leading part in securing the reduction, after vainly essaying the repeal, of the newspaper stamp duties. His pamphlet, issued when the Whigs were dismissed from office in 1834, and entitled "A Letter to a Late Cabinet Minister on the Crisis," was immensely influential, and Lord Melbourne offered him a lordship of the admiralty, which he declined as likely to interfere with his activity as an author. At this time, indeed, his pen was indefatigable. *Godolphin* was followed by *The Pilgrims of the Rhine* (1834), a graceful fantasy, too German in sentiment to be quite successful in England, and then in *The Last Days of Pompeii* (1834) and *Rienzi* (1835) he reached the height of his popularity. He took great pains with these stories, and despite their lurid colouring and mannered over-emphasis, they undoubtedly indicate the high-water mark of his talent. Their reception was enthusiastic, and *Ernest Maltravers* (1837) and *Alice, or the Mysteries* (1838) were hardly less successful. At the same time he had been plunging into journalism. In 1831 he undertook the editorship of the *New Monthly*, which, however, he resigned in the following year, but in 1841, the year in which he published *Night and Morning*, he started the *Monthly Chronicle*, a semi-scientific magazine, for which he wrote *Zicci*, an unfinished first draft afterwards expanded into *Zanoni* (1842). As though this multifarious fecundity were not sufficient, he had also been busy in the field of dramatic literature. In 1838 he produced *The Lady of Lyons*, a play which Macready made a great success at Covent Garden: in 1839 *Richelieu* and *The Sea Captain*, and in 1840 *Money*. All, except *The Sea Captain*, were successful, and this solitary failure he revived in 1869 under the title of *The Rightful Heir*. Of the others it may be said that, though they abound in examples of strained sentiment and false taste, they have nevertheless a certain theatrical *flair*, which has enabled them to survive a whole library of stage literature of greater sincerity and truer feeling. *The Lady of Lyons* and *Money* have long held the stage, and to the last-named, at least, some of the most talented of modern comedians have given new life and probability.

In 1838 Bulwer, then at the height of his popularity, was created a baronet, and on succeeding to the Knebworth estate in 1843 added Lytton to his surname, under the terms of his mother's will. From 1841 to 1852 he had no seat in parliament, and spent much of his time in continental travel. His literary activity waned somewhat, but was still remarkably alert for a man who had already done so much. In 1843 he issued *The Last of the Barons*, which many critics have considered the most historically sound and generally effective of all his romances; in 1847 *Lucretia, or the Children of the Night*, and in 1848 *Harold, the last of the Saxon Kings*. In the intervals between these heavier productions he had thrown off a volume of poems in 1842, another of translations from Schiller in 1844, and a satire called *The New Timon* in 1846, in which Tennyson, who had just received a Civil List pension, was bitterly lampooned as "school miss Alfred," with other unedifying amenities; Tennyson retorted with some verses in which he addressed Bulwer-Lytton as "you band-box." These poetic excursions were followed by his most ambitious work in metre, a romantic epic entitled *King Arthur*, of which he expected much, and he was greatly disappointed by its apathetic reception. Having experienced some rather acid criticism, questioning the morality of his novels, he next essayed a form of fiction which he was determined should leave no loophole to suspicion, and in *The Caxtons* (1849), published at first anonymously, gave further proof of his versatility and resource. *My Novel* (1853) and *What will he do with it?* were designed to prolong the same strain.

In 1852 he entered the political field anew, and in the conservative interest. He had differed from the policy of Lord John Russell over the corn laws, and now separated finally from the liberals. He stood for Hertfordshire and was elected, holding the seat till 1866, when he was raised to the peerage as Baron Lytton of Knebworth. His eloquence gave him the ear of the House of Commons, and he often spoke with influence and authority. In 1858 he was appointed secretary for the colonies. In the House of Lords he was comparatively inactive. His last novels were *A Strange Story* (1862), a mystical romance with spiritualistic tendencies; *The Coming Race* (1871), *The Parisians* (1873)—both unacknowledged at the time of his death, and *Kenelm Chillingly*, which was in course of publication in *Blackwood's Magazine* when Lytton died at Torquay on the 18th of January 1873. The last three of his stories were classed by his son, the 2nd Lord Lytton, as a trilogy, animated by a common purpose, to exhibit the influence of modern ideas upon character and conduct

Bulwer-Lytton's attitude towards life was theatrical, the language of his sentiments was artificial and over-decorated, and the tone of his work was often so flamboyant as to give an impression of false taste and judgment. Nevertheless, he built up each of his stories upon a deliberate and careful framework: he was assiduous according to his lights in historical research; and conscientious in the details of workmanship. As the fashion of his day has become obsolete the immediate appeal of his work has diminished. It will always, however, retain its interest, not only for the merits of certain individual novels, but as a mirror of the prevailing intellectual movement of the first half of the 19th century.

See T. H. S. Escott, *Edward Bulwer, 1st Baron Lytton of Knebworth* (1910). (A. WA.)

LYTTON, EDWARD ROBERT BULWER-LYTTON, 1ST EARL OF (1831–1891), English diplomatist and poet, was the only son of the 1st Baron Lytton. He was born in Hertford Street, Mayfair, on the 8th of November 1831. Robert Lytton and his sister were brought up as children principally by a Miss Green. In 1840 the boy was sent to a school at Twickenham, in 1842 to another at Brighton, and in 1845 to Harrow. From his earliest childhood Lytton read voraciously and wrote copiously, quickly developing a genuine and intense love of literature and a remarkable facility of expression. In 1849 he left Harrow and studied for a year at Bonn with an English tutor, and on his return with another tutor in England. In 1850 he entered the diplomatic service as unpaid *attaché* to his uncle, Sir Henry Bulwer, who was then minister at Washington. His advance in the diplomatic service was continuous, his successive appointments being: as second secretary—1852, Florence; 1854, Paris; 1857, The Hague; 1859, Vienna; as first secretary or secretary of legation—1863, Copenhagen; 1864, Athens; 1865, Lisbon; 1868, Madrid; 1868, Vienna; 1873, Paris; as minister—1875, Lisbon. In 1887 he was appointed to succeed Lord Lyons as ambassador at Paris, and held that office until his death in 1891. This rapid promotion from one European court to another indicates the esteem in which Lytton was held by successive foreign secretaries. In 1864, immediately before taking up his appointment at Athens, he married Edith, daughter of Edward Villiers, brother of the earl of Clarendon, and in 1873, upon the death of his father, he succeeded to the peerage and the estate of Knebworth in Hertfordshire.

Early in 1875 Lord Lytton declined an offer of appointment as governor of Madras, and in November of that year he was nominated governor-general of India by Disraeli. The moment was critical in the history of India. In Central Asia the advance of Russia had continued so steadily and so rapidly that Shere Ali, the amir of Afghanistan, had determined to seek safety as the vassal of the tsar. Lytton went out to India with express instructions from the British government to recover the friendship of the amir if possible, and if not so to arrange matters on the north-west frontier as to be able to be indifferent to his hostility. For eighteen months Lytton and his council made every effort to conciliate the friendship of the amir, but when a Russian agent was established at Kabul, while the mission of Sir Neville Chamberlain was forcibly denied entrance into the amir's dominions, no choice was left between acknowledging the right of a subsidized ally of Great Britain to place himself within Russian control and depriving him of the office which he owed to British patronage and assistance. The inevitable war began in November 1878, and by the close of that year the forces prepared by Lytton for that purpose had achieved their task with extraordinary accuracy and economy. Shere Ali fled from Kabul, and shortly afterwards died, and once more it fell to the Indian government to make provision for the future of Afghanistan. By the treaty of Gandamak in May 1879 Yakub Khan, a son of Shere Ali, was recognized as amir, the main conditions agreed upon being that the districts of Kuram, Pishin and Sibi should be "assigned" to British administration, and the Khyber and other passes be under British control; that there should be a permanent British Resident at Kabul, and that the amir should be subsidized in an amount to be afterwards determined upon. The endeavour of the Indian government was to leave the internal administration of Afghanistan as little affected as possible, but considerable risk was run in trusting so much, and especially the safety of a British envoy, to the power and the goodwill of Yakub Khan. Sir Louis Cavagnari, the British envoy entered Kabul at the end of July, and was, with his staff, massacred in the rising which took place on the 3rd of September. The war of 1879–80 immediately began, with the occupation of Kandahar by Stewart and the advance upon Kabul by Roberts, and the military operations which followed were not concluded when Lytton resigned his office in April 1880.

A complete account of Lytton's viceroyalty, and a lucid exposition of the principles of his government and the main outlines of his policy, may be found in *Lord Lytton's Indian Administration*, by his daughter, Lady Betty Balfour (London, 1899). The frontier policy which he adopted, after the method of a friendly and united Afghanistan under Yakub Khan had been tried and had failed, was that the Afghan kingdom should be destroyed. The province of Kandahar was to be occupied by Great Britain, and administered by a vassal chief, Shere Ali Khan, who was appointed "Wali" with a solemn guarantee of British support (unconditionally withdrawn by the government succeeding Lytton's). The other points of the Indian frontier were to be made as secure as possible, and the provinces of Kabul and Herat were to be left absolutely to their own devices. In consequence of what had been said of Lytton by the leaders of the parliamentary opposition in England, it was impossible for him to retain his office under a government formed by them, and he accordingly resigned at the same time as the Beaconsfield ministry. This part of his policy was thereupon revoked. Abdur Rahman, proving himself the strongest of the claimants to the throne left vacant by Yakub Khan's deposition, became amir as the subsidized ally of the Indian government.

The two most considerable events of Lytton's viceroyalty, besides the Afghan wars, were the assumption by Queen Victoria of the title of empress of India on the 1st of January 1877, and the famine which prevailed in various parts of India in 1876–78. He satisfied himself that periodical famines must be expected in Indian history, and that constant preparation during years of comparative prosperity was the only condition whereby their destructiveness could be modified. Accordingly he obtained the appointment of the famine commission of 1878, to inquire, upon lines laid down by him, into available means of mitigation. Their report, made in 1880, is the foundation of the later system of irrigation, development of communications, and "famine insurance." The equalization and reduction of the salt duty were effected, and the abolition of the cotton duty commenced, during Lytton's term of office, and the system of Indian finance profoundly modified by decentralization and the regulation of provincial responsibility, in all which matters Lytton enthusiastically supported Sir John Strachey, the financial member of his council.

Upon Lytton's resignation in 1880 an earldom was conferred upon him in recognition of his services as viceroy. He lived at Knebworth until 1887, in which year he was appointed to succeed Lord Lyons as ambassador at Paris. He died at Paris on the 24th of November 1891, of a clot of blood in the heart, when apparently recovering from a serious illness. He was succeeded by his son (b. 1876) as 2nd earl.

Lytton is probably better known as a poet—under the pen-name of "Owen Meredith"—than as a statesman. The list of his published works is as follows: *Clytemnestra, and other Poems*, 1855; *The Wanderer*, 1858; *Lucile*, 1860; *Serbski Pesme, or National Songs of Servia*, 1861, *Tannhäuser* (in collaboration with Mr Julian Fane), 1861; *Chronicles and Characters*, 1867; *Orval, or The Fool of Time*, 1868; *Fables in Song* (2 vols.), 1874; *Glenaveril, or The Metamorphoses*, 1885; *After Paradise, or the Legends of Exile, and other Poems*, 1887; *Marah*, 1892; *King Poppy*, 1892. The two last-mentioned volumes were published posthumously. A few previously unpublished pieces are included in a volume of *Selections* published, with an introduction by Lady Betty Balfour, in 1894. His metrical style was easy and copious, but not precise. It often gives the impression of having been produced with facility, because the flow of his thought carried him along, and of not having undergone prolonged or minute polish. It was frequently suggestive of the work of other poets, especially in his earlier productions. The friend who wrote the inscription for the monument to be erected to him at St Paul's described him as "a poet of many styles, each the expression of his habitual thoughts." *Lucile*, a novel in verse, presents a romantic style and considerable wit; and *Glenaveril*, which also contains many passages of great beauty and much poetic thought, has much of the same narrative character. Besides his volumes of poetry, Lytton published in 1883 two volumes of a biography of his father. The second of these contains the beginning of the elder Lytton's unfinished novel, *Greville*, and his life is brought down only to the year 1832, when he was twenty-six years of age, so that the completion of the book upon the same scale would have required at least four more volumes. The executrix of Lytton's mother chose to consider that the publication was injurious to that lady's memory, and issued a volume purporting to contain Bulwer-Lytton's letters to his wife. This Lytton suppressed by injunction, thereby procuring a fresh exposition of the law that the copyright in letters remains in the writer or his representatives, though the property in them belongs to the recipient. Lytton's appointment to the Parisian embassy caused the biography of his father to be finally laid aside.

The *Personal and Literary Letters of Robert, 1st Earl of Lytton*, have been edited by Lady Betty Balfour (1906). (H. S*.)

M The thirteenth letter of the Phoenician and Greek alphabets, the twelfth of the Latin, and the thirteenth of the languages of western Europe. Written originally from right to left, it took the form Ϻ which survivies in its earliest representations in Greek. The greater length of the first limb of *m* is characteristic of the earliest forms. From this form, written from left to right, the Latin abbreviation M' for the praenomen Manius is supposed to have developed, the apostrophe representing the fifth stroke of the original letter. In the early Greek alphabets the four-stroke M with legs of equal length represents not *m* but *s*; *m* when written with four strokes is Μ. The five-stroke forms, however, are confined practically to Crete, Melos and Cumae; from the last named the Romans received it along with the rest of their alphabet. The Phoenician name of the symbol was *mem*, the Greek name *μῦ* is formed on the analogy of the name for *n*. M represents the bilabial nasal sound, which was generally voiced. It is commonly a stable sound, but many languages, *e.g.* Greek, Germanic and Celtic, change it when final into *-n*, its dental correlative. It appears more frequently as an initial sound in Greek and Latin than in the other languages of the same stock, because in these *s* before *m* (as also before *l* and *n*) disappeared at the beginning of words. The sounds *m* and *b* are closely related, the only difference being that, in pronouncing *m*, the nasal passage is not closed, thus allowing the sound to be prolonged, while *b* is an instantaneous or explosive sound. In various languages *b* is inserted between *m* and a following consonant, as in the Gr. *μεσημβρία* "mid-day," or the English "number," Fr. *nombre* from Lat. *numerus*. The sound *m* can in unaccented syllables form a syllable by itself without an audible vowel, *e.g.* the Enghlish word *fathom* comes from an Anglo-Saxon *faþm*, where the *m* was so used. (For more details as to this phonetic principle, which has important results in the history of language, see under N.) (P. Gi.)

MAAS, JOSEPH (1847–1886), English tenor singer, was born at Dartford, and became a chorister in Rochester Cathedral. He went to study singing in Milan in 1869; in February 1871 he made his first success by taking Sims Reeves's place at a concert in London. In 1878 he became principal tenor in Carl Rosa's company, his beautiful voice and finished style more than compensating for his poor acting. He died in London on the 16th of January 1886.

MAASIN, a town on the S.W. coast of the island of Leyte, Philippine Islands, at the mouth of the Maasin River. Pop. (1903), 21,638. Maasin is an important port for hemp and copra. The well-built town occupies a narrow coastal plain. The river valleys in the vicinity produce cotton, pepper, tobacco, rice, Indian corn and fruit. Native cloths and pottery are manufactured. Maasin is the only place on the west coast of Leyte where a court of justice is held. The language is Visayan.

MAASSLUIS, a river port of Holland, in the province of South Holland, on the New Waterway, 10 m. by rail W. of Rotterdam. Pop. (1903), 8011. It rose into importance as a fishing harbour towards the end of the 16th century, and its prosperity rapidly increased after the opening of the New Waterway (the Maas ship canal) from Rotterdam to the sea. The fort erected here in 1572 by Philip of Marnix, lord of St Aldegonde, was captured by the Spanish in 1573.

MAASTRICHT, or MAESTRICHT, a frontier town and the capital of the province of Limburg, Holland, on the left bank of the Maas at the influx of the river Geer, 19 m. by rail N.N.E. of Liége in Belgium. Pop. (1904), 36,146. A small portion of the town, known as Wyk, lies on the right bank. A stone bridge connecting the two replaced a wooden structure as early as 1280, and was rebuilt in 1683. Formerly a strong fortress, Maastricht is still a considerable garrison town, but its ramparts were dismantled in 1871–1878. The town-hall, built by Pieter Post and completed in 1683, contains some interesting pictures and tapestry. The old town-hall (Oud Stadhuis), a Gothic building of the 15th century, is now used as a museum of antiquities. The church of St Servatius is said to have been founded by Bishop Monulphus in the 6th century, thus being the oldest church in Holland; according to one account it was rebuilt and enlarged as early as the time of Charlemagne. The crypt with the tomb of the patron saint dates from the original building. The varied character of its late Romanesque and later Gothic architecture bears evidence of the frequency with which the church has been restored and altered. Over the porch is the fine emperor's hall, and the church has a marble statue of Charlemagne. The church of Our Lady, a late Romanesque building, has two ancient crypts and a 13th-century choir of exceptional beauty, but the nave suffered severely from a restoration in 1764. The present Gothic building of St Martin (in Wyk) was erected in 1859, the original church is said by tradition to have occupied the site of an old heathen temple. The Protestant St Janskerk, a Gothic building of the 13th and 15th centuries, with a fine tower, was formerly the baptistery of the cathedral. The various hospitals, the poor-house, the orphanage and most of the other charitable foundations are Roman Catholic institutions. Maastricht contains the provincial archives, a library and geological collections. Though mainly indebted for its commercial prosperity to its position on the river, the town did not begin to reap the full advantages of its situation till the opening of the railways between 1853 and 1865. At first a trade was carried on in wine, colonial wares, alcoholic liquors and salt; there are now manufactures of earthenware, glass and crystal, arms, paper, woollens, tools, lead, copper and zinc work, as well as breweries, and tobacco and cigar factories, and a trade in corn and butter.

A short distance south of Maastricht are the great sandstone quarries of Pietersberg, which were worked from the time of the Romans to near the end of the 19th century; the result is one of the most extraordinary subterranean labyrinths in the world, estimated to cover an area 15 m. by 9 m. In the time of the Spanish wars these underground passages served to hide the peasants and their cattle.

Maastricht was originally the *trajectus superior* (upper ford) of the Romans, and was the seat of a bishop from 382 to 721. Having formed part of the Frankish realm, it was ruled after 1204 jointly by the dukes of Brabant and the prince-bishops of Liége. In 1579 it was besieged by the Spaniards under the duke of Parma, being captured and plundered after a heroic resistance. It was taken by the French in 1673, 1748 and 1794.

MABILLON, JOHN (1632–1707), Benedictine monk of the Congregation of St Maur (see MAURISTS), was the son of a peasant near Reims. In 1653 he became a monk in the abbey of St Remi at Reims. In 1664 he was placed at St Germain-des-Prés in Paris, the great literary workshop of the Maurists, where he lived and worked for twenty years, at first under d'Achery, with whom he edited the nine folio volumes of *Acta* of the Benedictine Saints. In Mabillon's Prefaces (reprinted separately) these lives were for the first time made to illustrate the ecclesiastical and civil history of the early middle ages. Mabillon's masterpiece was the *De re diplomatica* (1681; and a supplement, 1704) in which were first laid down the principles for determining the authenticity and date of medieval charters and manuscripts. It practically created the science of Latin palaeography, and is still the standard work on the subject. In 1685–1686 Mabillon visited the libraries of Italy, to purchase MSS. and books for the King's Library. On his return to Paris he was called upon to defend against de Rancé, the abbot of La Trappe, the legitimacy for monks of the kind of studies to which the Maurists devoted themselves: this called forth Mabillon's *Traité des études monastiques* and his *Réflexions sur la réponse de M. l'abbé de la*

Trappe (1691–1692), works embodying the ideas and programme of the Maurists for ecclesiastical studies. Mabillon produced in all some twenty folio volumes and as many of lesser size, nearly all works of monumental erudition (the chief are named in the article MAURISTS). A very competent judge declared that, "he knew well the 7th, 8th, 9th, 10th and 11th centuries, but nothing earlier or later." Mabillon never allowed his studies to interfere with his life as a monk; he was noted for his regular attendance at the choral recitation of the office and the other duties of the monastic life, and for his deep personal religion, as well as for a special charm of character. He died on the 26th of December 1707, in the midst of the production of the colossal Benedictine Annals.

The chief authority for his life is the *Abrégé de la vie de D. J. M.* (also in Latin), by his disciple and friend Ruinart (1709). See also, for a full summary of his works, Tassin, *Hist. littéraire de la congr. de St Maur* (1770), pp. 205–269. Of modern biographies the best are those of de Broglie (2 vols., 1888) and Bäumer (1892)—the former to be especially recommended. A brief sketch by E. C. Butler may be found in the *Downside Review* (1893). (E. C. B.)

MABINOGION (plural of Welsh *mabinogi*, from *mabinog*, a bard's apprentice), the title given to the collection of eleven Welsh prose tales (from the Red Book of Hergest) published (1838) by Lady Charlotte Guest, but applied in the Red Book to four only. (See CELT: *Welsh Literature*.)

MABUSE, JAN (d. 1532), the name adopted (from his birthplace, Maubeuge) by the Flemish painter JENNI GOSART, or JENNYN VAN HENNEGOUWE (Hainault), as he called himself when he matriculated in the gild of St Luke, at Antwerp, in 1503. We know nothing of his early life, but his works tell us that he stood in his first period under the influence of artists to whom plastic models were familiar; and this leads to the belief that he spent his youth on the French border rather than on the banks of the Scheldt. Without the subtlety or power of Van der Weyden, he had this much in common with the great master of Tournai and Brussels, that his compositions were usually framed in architectural backgrounds. But whilst Mabuse thus early betrays his dependence on the masters of the French frontier, he also confesses admiration for the great painters who first gave lustre to Antwerp; and in the large altar-pieces of Castle Howard and Scawby he combines in a quaint and not unskilful medley the sentiment of Memling, the bright and decided contrasts of pigment peculiar to coloured reliefs, the cornered and packed drapery familiar to Van der Weyden, and the bold but Socratic cast of face remarkable in the works of Quentin Matsys. At Scawby he illustrates the legend of the count of Toulouse, who parted with his wordly goods to assume the frock of a hermit. At Castle Howard he represents the Adoration of the Kings, and throws together some thirty figures on an architectural background, varied in detail, massive in shape and fanciful in ornament. He surprises us by pompous costume and flaring contrasts of tone. His figures, like pieces on a chess-board, are often rigid and conventional. The landscape which shows through the colonnades is adorned with towers and steeples in the minute fashion of Van der Weyden. After a residence of a few years at Antwerp, Mabuse took service with Philip, bastard of Philip the Good, at that time lord of Somerdyk and admiral of Zeeland. One of his pictures had already become celebrated —a Descent from the Cross (50 figures), on the high altar of the monastery of St Michael of Tongerloo. Philip of Burgundy ordered Mabuse to execute a replica for the church of Middelburg; and the value which was then set on the picture is apparent from the fact that Dürer came expressly to Middelburg (1521) to see it. In 1568 the altar-piece perished by fire. In 1508 Mabuse accompanied Philip of Burgundy on his Italian mission; and by this accident an important revolution was effected in the art of the Netherlands. Mabuse appears to have chiefly studied in Italy the cold and polished works of the Leonardesques. He not only brought home a new style, but he also introduced the fashion of travelling to Italy; and from that time till the age of Rubens and Van Dyck it was considered proper that all Flemish painters should visit the peninsula. The Flemings grafted Italian mannerisms on their own stock; and the cross turned out so unfortunately that for a century Flemish art lost all trace of originality.

In the summer of 1509 Philip returned to the Netherlands, and, retiring to his seat of Suytburg in Zeeland, surrendered himself to the pleasures of planning decorations for his castle and ordering pictures of Mabuse and Jacob of Barbari. Being in constant communication with the court of Margaret of Austria at Malines, he gave the artists in his employ fair chances of promotion. Barbari was made court painter to the regent, whilst Mabuse received less important commissions. Records prove that Mabuse painted a portrait of Leonora of Portugal, and other small pieces, for Charles V. in 1516. But his only signed pictures of this period are the Neptune and Amphitrite of 1516 at Berlin, and the Madonna, with a portrait of Jean Carondelet of 1517, at the Louvre, in both of which we clearly discern that Vasari only spoke by hearsay of the progress made by Mabuse in "the true method of producing pictures full of nude figures and poesies." It is difficult to find anything more coarse or misshapen than the Amphitrite, unless we except the grotesque and ungainly drayman who figures for Neptune. In later forms of the same subject—the Adam and Eve at Hampton Court, or its feebler replica at Berlin—we observe more nudity, combined with realism of the commonest type. Happily, Mabuse was capable of higher efforts. His St Luke painting the portrait of the Virgin in Sanct Veit at Prague, a variety of the same subject in the Belvedere at Vienna, the Madonna of the Baring collection in London, or the numerous repetitions of Christ and the scoffers (Ghent and Antwerp), all prove that travel had left many of Mabuse's fundamental peculiarities unaltered. His figures still retain the character of stone; his architecture is as rich and varied, his tones are as strong as ever. But bright contrasts of gaudy tints are replaced by soberer greys; and a cold haze, the *sfumato* of the Milanese, pervades the surfaces. It is but seldom that these features fail to obtrude. When they least show, the master displays a brilliant palette combined with smooth surface and incisive outlines. In this form the Madonnas of Munich and Vienna (1527), the likeness of a girl weighing gold pieces (Berlin), and the portraits of the children of the king of Denmark at Hampton Court, are fair specimens of his skill. As early as 1523, when Christian II. of Denmark came to Belgium, he asked Mabuse to paint the likenesses of his dwarfs. In 1528 he requested the artist to furnish to Jean de Hare the design for his queen Isabella's tomb in the abbey of St Pierre near Ghent. It was no doubt at this time that Mabuse completed the portraits of John, Dorothy and Christine, children of Christian II., which came into the collection of Henry VIII. No doubt, also, these portraits are identical with those of three children at Hampton Court, which were long known and often copied as likenesses of Prince Arthur, Prince Henry and Princess Margaret of England. One of the copies at Wilton, inscribed with the forged name of "Hans Holbein, ye father," and the false date of 1495, has often been cited as a proof that Mabuse came to England in the reign of Henry VII.; but the statement rests on no foundation whatever. At the period when these portraits were executed Mabuse lived at Middelburg. But he dwelt at intervals elsewhere. When Philip of Burgundy became bishop of Utrecht, and settled at Duerstede, near Wyck, in 1517, he was accompanied by Mabuse, who helped to decorate the new palace of his master. At Philip's death, in 1524, Mabuse designed and erected his tomb in the church of Wyck. He finally retired to Middelburg, where he took service with Philip's brother, Adolph, lord of Veeren. Van Mander's biography accuses Mabuse of habitual drunkenness; yet it describes the splendid appearance of the artist as, dressed in gold brocade, he accompanied Lucas of Leyden on a pleasure trip to Ghent, Malines and Antwerp in 1527. The works of Mabuse are those of a hardworking and patient artist; the number of his still extant pictures practically demonstrates that he was not a debauchee. The marriage of his daughter with the painter Henry Van der Heyden of Louvain proves that he had a home, and did not live habitually in taverns, as Van Mander suggests. His death at Antwerp, on the 1st of October 1532, is recorded in the portrait engraved by Jerome Cock. (J. A. C.)

MACABEBE, a town of the province of Pampanga, island of Luzon, Philippine Islands, on the Pampanga Grande river, about 10 m. above its mouth and about 25 m. N.W. of Manila. Pop. (1903), after the annexation of San Miguel, 21,481. The language is Pampango. Many of the male inhabitants serve in the U.S. Army as scouts. Macabebe's principal industries are the cultivation of rice and sugar cane, the distilling of nipa alcohol, and the weaving of hemp and cotton fabrics.

MACABRE, a term applied to a certain type of artistic or literary composition, characterized by a grim and ghastly humour, with an insistence on the details and trappings of death. Such a quality, deliberately adopted, is hardly to be found in ancient Greek and Latin writers, though there are traces of it in Apuleius and the author of the *Satyricon*. The outstanding instances in English literature are John Webster and Cyril Tourneur, with E. A. Poe and R. L. Stevenson. The word has gained its significance from its use in French, *la danse macabre*, for that allegorical representation, in painting, sculpture and tapestry, of the ever-present and universal power of death, known in English as the "Dance of Death," and in German as *Totentanz*. The typical form which the allegory takes is that of a series of pictures, sculptured or painted, in which Death appears, either as a dancing skeleton or as a shrunken corpse wrapped in grave-clothes to persons representing every age and condition of life, and leads them all in a dance to the grave. Of the numerous examples painted or sculptured on the walls of cloisters or churchyards through medieval Europe few remain except in woodcuts and engravings. Thus the famous series at Basel, originally at the Klingenthal, a nunnery in Little Basel, dated from the beginning of the 14th century. In the middle of the 15th century this was moved to the churchyard of the Predigerkloster at Basel, and was restored, probably by Hans Kluber, in 1568; the fall of the wall in 1805 reduced it to fragments, and only drawings of it remain. A Dance of Death in its simplest form still survives in the Marienkirche at Lübeck in a 15th-century painting on the walls of a chapel. Here there are twenty-four figures in couples, between each is a dancing Death linking the groups by outstretched hands, the whole ring being led by a Death playing on a pipe. At Dresden there is a sculptured life-size series in the old Neustädter Kirchhoff, removed here from the palace of Duke George in 1701 after a fire. At Rouen in the *aître* (atrium) or cloister of St Maclou there also remains a sculptured *danse macabre*. There was a celebrated fresco of the subject in the cloister of Old St Paul's in London, and another in the now destroyed Hungerford Chapel at Salisbury, of which a single woodcut, "Death and the Gallant," alone remains. Of the many engraved reproductions, the most celebrated is the series drawn by Holbein. Here the long ring of connected dancing couples is necessarily abandoned, and the Dance of Death becomes rather a series of *imagines mortis*.

Concerning the origin of this allegory in painting and sculpture there has been much dispute. It certainly seems to be as early as the 14th century, and has often been attributed to the overpowering consciousness of the presence of death due to the Black Death and the miseries of the Hundred Years' War. It has also been attributed to a form of the Morality, a dramatic dialogue between Death and his victims in every station of life, ending in a dance off the stage (see Du Cange, *Gloss.*, *s.v.* "Machabaeorum chora"). The origin of the peculiar form the allegory has taken has also been found, somewhat needlessly and remotely, in the dancing skeletons on late Roman sarcophagi and mural paintings at Cumae or Pompeii, and a false connexion has been traced with the "Triumph of Death," attributed to Orcagna, in the Campo Santo at Pisa.

The etymology of the word *macabre* is itself most obscure. According to Gaston Paris (*Romania*, xxiv., 131; 1895) it first occurs in the form *macabré* in Jean le Févre's *Respit de la mort* (1376), "Je lis de Macabré la danse," and he takes this accented form to be the true one, and traces it in the name of the first painter of the subject. The more usual explanation is based on the Latin name, *Machabaeorum chora*. The seven tortured brothers, with their mother and Eleazar (2 Macc. vi., vii.) were prominent figures on this hypothesis in the supposed dramatic dialogues. Other connexions have been suggested, as for example with St Macarius, or Macaire, the hermit, who, according to Vasari, is to be identified with the figure pointing to the decaying corpses in the Pisan "Triumph of Death," or with an Arabic word *magbarah*, "cemetery."

See Peignot, *Recherches sur les danses des morts* (1826); Douce, *Dissertation on the Dance of Death* (1833); Massmann, *Litteratur der Totentänze* (1840); J. Charlier de Gerson, *La Danse macabre des Stes Innocents de Paris* (1874); Seelmann, *Die Totentänze des Mittelalters* (1893).

McADAM, JOHN LOUDON (1756–1836), Scottish inventor, who gave his name to the system of road-making known as "macadamizing," was born at Ayr, Scotland, on the 21st of September 1756, being descended on his father's side from the clan of the McGregors. While at school he constructed a model road-section. In 1770 he went to New York, entering the counting-house of a merchant uncle. He returned to Scotland with a considerable fortune in 1783, and purchased an estate at Sauhrie, Ayrshire. Among other public offices he held that of road trustee. The highways of Great Britain were at this time in a very bad condition, and McAdam at once began to consider how to effect reforms. At his own expense he began at Sauhrie, despite much opposition, a series of experiments in road-making. In 1798 he removed to Falmouth, where he had received a government appointment, and continued his experiments there. His general conclusion was that roads should be constructed of broken stone (see Roads). In 1815, having been appointed surveyor-general of the Bristol roads, he was able to put his theories into practice. In 1819 he published a *Practical Essay on the Scientific Repair and Preservation of Roads*, followed, in 1820, by the *Present State of Road-making*. As the result of a parliamentary inquiry in 1823 into the whole question of road-making, his views were adopted by the public authorities, and in 1827 he was appointed general surveyor of roads. In pursuing his investigations he had travelled over thirty thousand miles of road and expended over £5000. Parliament recouped him for his expenses and gave him a handsome gratuity, but he declined a proffered knighthood. He died at Moffat, Dumfriesshire, on the 26th of November 1836.

MACAIRE, a French *chanson de geste*. *Macaire* (12th century) and *La reine Sibille* (14th century) are two versions of the story of the false accusation brought against the queen of Charlemagne, called Blanchefleur in *Macaire* and Sibille in the later poem. *Macaire* is only preserved in the Franco-Venetian *geste* of Charlemagne (Bibl. St Mark MS. fr. xiii.). *La Reine Sibille* only exists in fragments, but the tale is given in the chronicle of Alberic Trium Fontium and in a prose version. *Macaire* is the product of the fusion of two legends: that of the unjustly repudiated wife and that of the dog who detects the murderer of his master. For the former motive see Geneviève of Brabant. The second is found in Plutarch, *Script. moral.*, ed. Didot ii. (1186), where a dog, like Aubri's hound, stayed three days without food by the body of its master, and subsequently attacked the murderers, thus leading to their discovery. The duel between Macaire and the dog is paralleled by an interpolation by Giraldus Cambrensis in a MS. of the *Hexameron* of Saint Ambrose. Aubri's hound received the name of the "dog of Montargis," because a representation of the story was painted on a chimney-piece in the château of Montargis in the 15th century. The tale was early divorced from Carolingian tradition, and Jean de la Taille, in his *Discours notable des duels* (Paris, 1607), places the incident under Charles V.

See *Macaire* (Paris, 1866), ed. Guessard in the series of *Anc. poètes de la France*; P. Paris in *Hist. litt. de la France*, vol. xxiii. (1873); L. Gautier, *Épopées françaises*, vol. iii. (2nd ed., 1880); G. Paris, *Hist. poét. de Charlemagne* (1865); M. J. G. Isola, *Storie nerbonesi*, vol. i. (Bologna, 1877); F. Wolf, *Über die beiden . . . Volksbücher von der K. Sibille u. Huon de Bordeaux* (Vienna, 1857) and *Über die neuesten Leistungen der Franzosen* (Vienna, 1833). *The Dog of Montargis; or, The Forest of Bondy*, imitated from the play of G. de Pixérécourt, was played at Covent Garden (Sept. 30, 1814).

"Robert Macaire" was the name given to the modern villain in the *Auberge des Adrets* (1823), a melodrama in which Frédérick

Lemaître made his reputation. The type was sensibly modified in *Robert Macaire* (1834), a sequel written by Lemaître in collaboration with Benjamin Antier, and well-known on the English stage as *Macaire*. R. L. Stevenson and W. E. Henley used the same type in their play *Macaire*.

McALESTER, a city and the county-seat of Pittsburg county, Oklahoma, about 110 m. E.S.E. of Guthrie. Pop. (1900), 3479; (1907) 8144 (1681 negroes and 105 Indians); (1910) 12,954. McAlester is served by the Chicago, Rock Island & Pacific and the Missouri, Kansas & Texas railways and is an important railway junction; it is connected with the neighbouring mining district by an electric line. There are undeveloped iron deposits and rich coal-mines in the surrounding country, and coke-making is the principal manufacturing industry of the city. There is a fine Scottish Rite Masons' consistory and temple in McAlester. The city owns its waterworks. The vicinity was first settled in 1885. The city of South McAlester was incorporated in 1899, and in 1906 it annexed the town of McAlester and adopted its name.

MACALPINE (or MACCABEUS), **JOHN** (d. 1557), Protestant theologian, was born in Scotland about the beginning of the 16th century, and graduated at some Scottish university. From 1532 to 1534 he was prior of the Dominican convent of Perth; but having in the latter year been summoned with Alexander Ales (*q.v.*) and others to answer for heresy before the bishop of Ross, he fled to England, where he was granted letters of denization on the 7th of April 1537, and married Agnes Macheson, a fellow-exile for religion; her sister Elizabeth became the wife of Miles Coverdale. The reaction of 1539 made England a doubtful refuge, and on the 25th of November 1540 Macalpine matriculated at the university of Wittenberg. He had already graduated B.A. at Cologne, and in 1542 proceeded to his doctorate at Wittenberg. In that year, being now known as Maccabeus, he accepted Christian III.'s offer of the chair of theology at the university of Copenhagen, which had been endowed out of the spoils of the Church. Melanchthon spoke well of Macalpine, and with Peter Plade (Palladius), who had also studied at Wittenberg, Macalpine took a prominent part in building up the Lutheran Church of Denmark. A joint exposure by Plade and Macalpine of Osiander's errors was published in 1552 and reprinted at Leipzig and Copenhagen in 1768; and Macalpine was one of the four translators of Luther's German Bible into Danish. He also encouraged Sir David Lindsay, who visited him in 1548, to publish his *Monarchie*, and persuaded Christian III. to intercede with Queen Mary Tudor on behalf of Coverdale and invite him to Denmark. Macalpine died at Copenhagen on the 6th of December 1557.

See *Dict. Nat. Biog.* and authorities there cited; *Corpus reformatorum*, iii. (1066), iv. 771, 793; Foerstemann, *Album academiae vitebergensis* (1841), p. 186, and *Liber decanorum* (1838), p. 32; Rockwell, *Die Doppelehe des Landgrafen Philipp* (1904), pp. 114–116; *Letters and Papers of Henry VIII.* (1537), i. 1103 (12); (1542), pp. 46,218. (A. F. P.)

MACAO (A-Ma-ngao, "Harbour of the goddess A-Ma"; Port. *Macau*), a Portuguese settlement on the coast of China, in 22° N., 132° E. Pop. (1896), Chinese, 74,568; Portuguese, 3898; other nationalities, 161—total, 78,627. It consists of a tongue of land 2½ m. in length and less than 1 m. in breadth, running S.S.W. from the island of Hiang Shang (Port. *Ançam*) on the western side of the estuary of the Canton River. Bold and rocky hills about 300 ft. high occupy both extremities of the peninsula, the picturesque city, with its flat-roofed houses painted blue, green and red, lying in the undulating ground between. The forts are effective additions to the general view, but do not add much to the strength of the place. Along the east side of the peninsula runs the Praya Grande, or Great Quay, the chief promenade in Macao, on which stand the governor's palace, the administrative offices, the consulates and the leading commercial establishments. The church of St Paul (1594–1602), the seat of the Jesuit college in the 17th century, was destroyed by fire in 1835. The Hospital da Misericordia (1569) was rebuilt in 1640. The Camoens grotto, where the exiled poet found leisure to celebrate the achievements of his ungrateful country, lies in a secluded spot to the north of the town, which has been partly left in its native wildness strewn with huge granite boulders and partly transformed into a fine botanical garden. During the south-west (summer) monsoon great quantities (67 in.) of rain fall, especially in July and August. The mean temperature is 74·3° F.; in July, the hottest month, the temperature is 84·2°; in February, the coldest, it is 59°. On the whole the climate is moist. Hurricanes are frequent. Of the Portuguese inhabitants more than three-fourths are natives of Macao—a race very inferior in point of physique to their European ancestors. Macao is connected with Hong-Kong by a daily steamer. Being open to the south-west sea breezes, it is a favourite place of resort from the oppressive heat of Hong-Kong. It is ruled by a governor, and, along with Timor (East Indies), constitutes a bishopric, to which belong also the Portuguese Christians in Malacca and Singapore. Though most of the land is under garden cultivation, the mass of the people is dependent more or less directly on mercantile pursuits; for, while the exclusive policy both of Chinese and Portuguese which prevented Macao becoming a free port till 1845–1846 allowed what was once the great emporium of European commerce in eastern Asia to be outstripped by its younger and more liberal rivals, the local, though not the foreign, trade of the place is still of very considerable extent. Since the middle of the 19th century, indeed, much of it has run in the most questionable channels; the nefarious coolie traffic gradually increased in extent and in cruelty from about 1848 till it was prohibited in 1874, and much of the actual trade is more or less of the nature of smuggling. The commodities otherwise mostly dealt in are opium, tea, rice, oil, raw cotton, fish and silk. The total value of exports and imports was in 1876–1877 upwards of £1,536,000. In 1880 it had increased to £2,259,250, and in 1898 to £3,771,615. Commercial intercourse is most intimate with Hong-Kong, Canton, Batavia and Goa. The preparation and packing of tea is the principal industry in the town. In fishing a large number of boats and men are employed.

In 1557 the Portuguese were permitted to erect factories on the peninsula, and in 1573 the Chinese built across the isthmus the wall which still cuts off the barbarian from the rest of the island. Jesuit missionaries established themselves on the spot; and in 1580 Gregory XIII. constituted a bishopric of Macao. A senate was organized in 1583, and in 1628 Jeronimo de Silveira became first royal governor of Macao. Still the Portuguese remained largely under the control of the Chinese, who had never surrendered their territorial rights and maintained their authority by means of mandarins—these insisting that even European criminals should be placed in their hands. Ferreira do Amaral, the Portuguese governor, put an end to this state of things in 1849, and left the Chinese officials no more authority in the peninsula than the representatives of other foreign nations; and, though his antagonists procured his assassination (Aug. 22), his successors succeeded in carrying out his policy.

Although Macao is de facto a colonial possession of Portugal, the Chinese government persistently refused to recognize the claim of the Portuguese to territorial rights, alleging that they were merely lessees or tenants at will, and until 1849 the Portuguese paid to the Chinese an annual rent of £71 per annum. This diplomatic difficulty prevented the conclusion of a commercial treaty between China and Portugal for a long time, but an arrangement for a treaty was come to in 1887 on the following basis: (1) China confirmed perpetual occupation and government of Macao and its dependencies by Portugal; (2) Portugal engaged never to alienate Macao and its dependencies without the consent of China; (3) Portugal engaged to co-operate in opium revenue work at Macao in the same way as Great Britain at Hong-Kong. The formal treaty was signed in the same year, and arrangements were made whereby the Chinese imperial customs were able to collect duties on vessels trading with Macao in the same way as they had already arranged for their collection at the British colony of Hong-Kong. For a short time in 1802, and again in 1808, Macao was occupied by the English as a precaution against seizure by the French.

MACAQUE, a name of French origin denoting the monkeys of the mainly Asiatic genus *Macacus*, of which one species, the Barbary ape, inhabits North Africa and the rock of Gibraltar. Displaying great variability in the length of the tail, which is reduced to a mere tubercle in the Barbary ape, alone representing the subgenus *Inuus*, macaques are heavily-built monkeys, with longer muzzles than their compatriots the langurs (see PRIMATES), and large naked callosities on the buttocks. They range all over India and Ceylon, thence northward to Tibet, and eastwards to China, Japan, Formosa, Borneo, Sumatra and Java; while by some naturalists the black ape of Celebes (*Cynopithecus niger*) is included in the same genus. Mention of some of the more important species, typifying distinct sub-generic groups, made in the article PRIMATES. Like most other monkeys, macaques go about in large troops, each headed by an old male. They feed on seeds, fruits, insects, lizards, &c.; and while some of the species are largely terrestrial, the Barbary ape is wholly so. Docile and easily tamed when young, old males of many of the species become exceedingly morose and savage in captivity. (R. L.*)

MACARONI (from dialectic Ital. *maccare*, to bruise or crush), a preparation of a glutinous wheat originally peculiar to Italy, where it is an article of food of national importance. The same substance in different forms is also known as *vermicelli*, *pasta* or Italian pastes, *spaghetti*, *taglioni*, *fanti*, &c. These substances are prepared from the hard, semi-translucent varieties of wheat which are largely cultivated in the south of Europe, Algeria and other warm regions, and distinguished by the Italians as *grano duro* or *grano da semolino*. These wheats are much richer in gluten and other nitrogenous compounds than the soft or tender wheats of more northern regions, and their preparations are more easily preserved. The various preparations are met with as fine thin threads (vermicelli), thin sticks and pipes (spaghetti, macaroni), small lozenges, stars, disks, ellipses, &c. (pastes). These various forms are prepared in a uniform manner from a granular product of hard wheat, which, under the name of semolina or middlings, is a commercial article. The semolina is thoroughly mixed with boiling water and incorporated in a kneading machine, such as is used in bakeries, into a stiff paste or dough. It is then further kneaded by passing frequently between rollers or under edge runners, till a homogeneous mass has been produced which is placed in a strong steam-jacketed cylinder, the lower end of which is closed with a thick disk pierced with openings corresponding with the diameter or section of the article to be made. Into this cylinder an accurately fitting plunger or piston is introduced and subjected to very great pressure, which causes the stiff dough to squeeze out through the openings in the disk in continuous threads, sticks or pipes, as the case may be. Vermicelli is cut off in short bundles and laid on trays to dry, while macaroni is dried by hanging it in longer lengths over wooden rods in stoves or heated apartments through which currents of air are driven. It is only genuine macaroni, rich in gluten, which can be dried in this manner; spurious fabrications will not bear their own weight, and must, therefore, be laid out flat to be dried. In making pastes the cylinder is closed with a disk pierced with holes having the sectional form of the pastes, and a set of knives revolving close against the external surface of the disk cut off the paste in thin sections as it exudes from each opening. True macaroni can be distinguished by observing the flattened mark of the rod over which it has been dried within the bend of the tubes; it has a soft yellowish colour, is rough in texture, elastic and hard, and breaks with a smooth glassy fracture. In boiling it swells up to double its original size without becoming pasty or adhesive. It can be kept any length of time without alteration or deterioration; and it is on that account, in many circumstances, a most convenient as well as a highly nutritious and healthful article of food.

MACARONICS, a species of burlesque poetry, in which words from a modern vernacular, with Latin endings, are introduced into Latin verse, so as to produce a ridiculous effect. Sometimes Greek is used instead of Latin. Tisi degli Odassi issued a *Carmen macaronicum de Patavinis* in 1490. The real founder of the practice, however, was Teofilo Folengo (1491–1544), whose mock-heroic *Liber Macaronices* appeared in 1517. Folengo (*q.v.*) was a Benedictine monk, who escaped from his monastery and wandered through Italy, living a dissolute life, and supporting himself by his absurd verses, which he described as an attempt to produce in literature something like macaroni, a gross, rude and rustic mixture of flour, cheese and butter. He wrote under the pseudonym of Merlinus Coccaius, and his poem is an elaborate burlesque epic, in twenty-five books, or *macaronea;* it is an extraordinary medley of chivalrous feats, ridiculous and squalid adventures, and satirical allegory. Its effect upon the mind of Rabelais was so extraordinary that no examination of *Pantagrud* can be complete without a reference to it (cf. *Gargantua*, i. 19). It was immediately imitated in Italy by a number of minor poets; and in France a writer whose real name was Antoine de la Sablé, but who called himself Antonius de Arena (d. 1544), published at Avignon in 1573 a *Meygra entrepriza*, which was a burlesque account of Charles V.'s disastrous campaign in Provence. Folengo in Italy and Arena in France are considered as the macaronic classics. In the 17th century, Joannes Caecilius Frey (1580–1631) published a *Recitus veritabilis*, on a skirmish between the vine-growers of Rueil and the bowmen of Paris. Great popularity was achieved later still by an anonymous macaronic, entitled *Funestissimus trepassus Micheli Morini*, who died by falling off the branch of an elm-tree:—

> De branche in brancham degringolat, et faciens pouf
> Ex ormo cadit, et clunes obvertit Olympo.

Molière employed macaronic verse in the ceremonial scene with the doctors in *Le Malade imaginaire*. Works in macaronic prose are rarer. An *Anti-Clopinus* by Antony Hotman may be mentioned and the amusing *Epistolae obscurorum virorum* (1515). Macaronic prose was not unknown as an artifice of serious oratory, and abounds (*e.g.*) in the sermons of Michel Menot (1440–1518), who says of the prodigal son, *Emit sibi pulcheras caligas d'écarlate, bien tirées*.

The use of true macaronics has never been frequent in Great Britain, where the only prominent example of it is the *Polemo-Middinia* ascribed to William Drummond of Hawthornden. This short epic was probably composed early in the 17th century, but was not published until 1684. The *Polemo-Middinia* follows the example set by Arena, and describes with burlesque solemnity a quarrel between two villages on the Firth of Forth. Drummond shows great ingenuity in the tacking on of Latin terminations to his Lowland Scots vernacular:—

> Lifeguardamque sibi saevas vocat improba lassas,
> Maggaeam, magis doctam milkare cowaeas,
> Et doctam sweepare flooras, et sternere beddas,
> Quaeque novit spinnare, et longas ducere threedas.

There is a certain macaronic character about many poems of Skelton and Dunbar, as well as the famous *Barnabae itinerarium* (1638) of Richard Brathwait (1588–1673), but these cannot be considered legitimate specimens of the type as laid down by Folengo.

See Ch. Nodier, *Du Langage factice appelé macaronique* (1834); Genthe, *Histoire de la poèsie macaronique* (1831). (E. G.)

MACARSCA (Serbo-Croatian, *Makarska*), the chief town of an administrative district in Dalmatia, Austria; situated opposite to the island of Brazza, about 32 m. S.E. of Spalato. Pop. (1900), of town 1805; of commune, 11,016, chiefly Serbo-Croatian. Macarsca is a port of call for the Austrian Lloyd steamers, and has a brisk trade in wine, grain and fruit. Under the name of *Mocrum*, Macarsca was a thriving Roman city, and a bishopric until 639, when it was destroyed by the Avars. In the 10th century it is mentioned by Constantine Porphyrogenitus as a city of the pagan Narentines. Its bishopric was revived in 1320, but the bishops resided at Almissa. In 1481 the city was purchased from the duke of Herzegovina by Venice; in 1499 it was conquered by the Turks; and in 1646, after a successful revolt, it again welcomed the sovereignty of Venice. The see of Macarsca was merged in that of Spalato in 1830.

MACARTNEY, GEORGE MACARTNEY, Earl (1737–1806), was descended from an old Scottish family, the Macartneys of Auchinleck, who had settled in 1649 at Lissanoure, Antrim, Ireland, where he was born on the 14th of May 1737. After graduating at Trinity College, Dublin, in 1759, he became a student of the Temple, London. Through Stephen Fox, elder brother of C. J. Fox, he was taken up by Lord Holland. Appointed envoy extraordinary to Russia in 1764, he succeeded in negotiating an alliance between England and that country. After occupying a seat in the English parliament, he was in 1769 returned for Antrim in the Irish parliament, in order to discharge the duties of chief secretary for Ireland. On resigning this office he was knighted. In 1775 he became governor of the Caribbee Islands (being created an Irish baron in 1776), and in 1780 governor of Madras, but he declined the governor-generalship of India, and returned to England in 1786. After being created Earl Macartney in the Irish peerage (1792), he was appointed the first envoy of Britain to China. On his return from a confidential mission to Italy (1795) he was raised to the English peerage as a baron in 1796, and in the end of the same year was appointed governor of the newly acquired territory of the Cape of Good Hope, where he remained till ill health compelled him to resign in November 1798. He died at Chiswick, Middlesex, on the 31st of May 1806, the title becoming extinct, and his property, after the death of his widow (daughter of the 3rd earl of Bute), going to his niece, whose son took the name.

An account of Macartney's embassy to China, by Sir George Staunton, was published in 1797, and has been frequently reprinted. The *Life and Writings of Lord Macartney*, by Sir John Barrow, appeared in 1807. See Mrs Helen Macartney Robbins's biography, *The First English Ambassador to China* (1908), based on previously unpublished materials in possession of the family.

MACASSAR (Makassar, Mangkasar), the capital of a district of the same name in the island of Celebes, Dutch East Indies, and the chief town of the Dutch government of Celebes. Pop. 17,925 (940 Europeans, 2618 Chinese, 168 Arabs). It stands on the west coast of the southern peninsula of the island, near the southern extremity of the Macassar Strait, which separates Celebes from Borneo. Macassar consists of the Dutch town and port, known as Vlaardingen, and the Malay town which lies inland. Macassar's trade amounts to about £1,250,000 annually, and consists mainly of coffee, trepang, copra, gums, spices and valuable timber.

For the Macassar people and for the Strait, see Celebes. "Macassar oil" is a trade name, not geographical: see Antimacassar.

MACAULAY, THOMAS BABINGTON MACAULAY, Baron (1800–1859), English historian, essayist and politician, was born at Rothley Temple, Leicestershire, on the 25th of October 1800. His father, Zachary Macaulay (1768–1838), had been governor of Sierra Leone, and was in 1800 secretary to the chartered company which had founded that colony; an ardent philanthropist, he did much to secure the abolition of the slave trade, and he edited the abolitionist organ, the *Christian Observer*, for many years. Happy in his home, the son at a very early age gave proof of a determined bent towards literature. Before he was eight years of age he had written a *Compendium of Universal History*, which gave a tolerably connected view of the leading events from the creation to 1800, and a romance in the style of Scott, in three cantos, called *The Battle of Cheviot*. A little later he composed a long poem on the history of Olaus Magnus, and a vast pile of blank verse entitled *Fingal, a Poem in Twelve Books*. After being at a private school, in October 1818 young Macaulay went to Trinity College, Cambridge, where he afterwards became a fellow. He gained in 1824 a college prize for an essay on the character of William III. He also won a prize for Latin declamation and a Craven scholarship, and wrote the prize poems of 1819 and 1821.

In 1826 Macaulay was called to the bar and joined the northern circuit. But he soon gave up even the pretence of reading law, and spent many more hours under the gallery of the house of commons than in the court. His first attempt at a public speech, made at an anti-slavery meeting in 1824, was described by the *Edinburgh Review* as "a display of eloquence of rare and matured excellence." His first considerable appearance in print was in No. 1 of Knight's *Quarterly Magazine*, a periodical which enjoyed a short but brilliant existence, and which was largely supported by Eton and Cambridge. In August 1825 began Macaulay's connexion with the periodical which was to prove the field of his literary reputation. The *Edinburgh Review* was at this time at the height of its power, not only as an organ of the growing opinion which leant towards reform, but as a literary tribunal from which there was no appeal. His essay on Milton (Aug. 1825), so crude that the author afterwards said that "it contained scarcely a paragraph such as his matured judgment approved," created for him at once a literary reputation which suffered no diminution to the last, a reputation which he established and confirmed, but which it would have been hardly possible to make more conspicuous. The publisher John Murray declared that it would be worth the copyright of *Childe Harold* to have Macaulay on the staff of the *Quarterly Review*; and Robert Hall, the orator, writhing with pain, and wellnigh worn out with disease, was discovered lying on the floor employed in learning by aid of grammar and dictionary enough Italian to enable him to verify the parallel between Milton and Dante.

This sudden blaze of popularity, kindled by a single essay, is partly to be explained by the dearth of literary criticism in England at that epoch. For, though a higher note had already been sounded by Hazlitt and Coleridge, it had not yet taken hold of the public mind, which was still satisfied with the feeble appreciations of the *Retrospective Review*, or the dashing and damnatory improvisation of Wilson in *Blackwood* or Jeffrey in the *Edinburgh*. Still, allowance being made for the barbarous partisanship of the established critical tribunals of the period, it seems surprising that a social success so signal should have been the consequence of a single article. The explanation is that the writer of the article on Milton was, unlike most authors, also a brilliant conversationalist. There has never been a period when an amusing talker has not been in great demand at London tables; but when Macaulay made his début witty conversation was studied and cultivated as it has ceased to be in the more busy age which has succeeded. At the university Macaulay had been recognized as pre-eminent for inexhaustible talk and genial companionship among a circle of such brilliant young men as Charles Austin, Romilly, Praed and Villiers. He now displayed these gifts on a wider theatre. Launched on the best that London had to give in the way of society, Macaulay accepted and enjoyed with all the zest of youth and a vigorous nature the opportunities opened for him. He was courted and admired by the most distinguished personages of the day. He was admitted at Holland House, where Lady Holland listened to him with deference, and scolded him with a circumspection which was in itself a compliment. Samuel Rogers spoke of him with friendliness and to him with affection. He was treated with almost fatherly kindness by "Conversation" Sharp.

Thus distinguished, and justifiably conscious of his great powers, Macaulay began to aspire to a political career. But the shadow of pecuniary trouble early began to fall upon his path. When he went to college his father believed himself to be worth £100,000. But commercial disaster overtook the house of Babington & Macaulay, and the son now saw himself compelled to work for his livelihood. His Trinity fellowship of £300 a year became of great consequence to him, but it expired in 1831; he could make at most £200 a year by writing; and a commissionership of bankruptcy, which was given him by Lord Lyndhurst in 1828, and which brought him in about £400 a year, was swept away, without compensation, by the ministry which came into power in 1830. Macaulay was reduced to such straits that he had to sell his Cambridge gold medal.

In February 1830 the doors of the House of Commons were opened to him through what was then called a "pocket borough." Lord Lansdowne, who had been struck by two articles on James Mill and the Utilitarians, which appeared in the *Edinburgh Review* in 1829, offered the author the seat at Calne. The offer was accompanied by the express assurance that the patron had no wish to interfere with Macaulay's freedom of voting. He thus entered parliament at one of the most exciting moments of English domestic history, when the compact phalanx of reactionary administration which for nearly fifty years had commanded a crushing majority in the Commons was on the point of being broken by the growing strength of the party of reform. Macaulay made his maiden speech on the 5th of April 1830, on the second reading of the Bill for the Removal of Jewish Disabilities. In July the king died and parliament was dissolved; the revolution took place in Paris. Macaulay, who was again returned for Calne, visited Paris, eagerly enjoying a first taste of foreign travel. On the 1st of March 1831 the Reform Bill was introduced, and on the second night of the debate Macaulay made the first of his reform speeches. It was, like all his speeches, a success. Sir Robert Peel said of it that "portions were as beautiful as anything I have ever heard or read."

Encouraged by this first success, Macaulay now threw himself with ardour into the life of the House of Commons, while at the same time he continued to enjoy to the full the social opportunities which his literary and political celebrity had placed within his reach. He dined out almost nightly, and spent many of his Sundays at the suburban villas of the Whig leaders, while he continued to supply the *Edinburgh Review* with articles. On the triumph of Earl Grey's cabinet, and the passing of the Reform Act in June 1832, Macaulay, whose eloquence had signalized every stage of the conflict, became one of the commissioners of the board of control, and applied himself to the study of Indian affairs. Giving his days to India and his nights to the House of Commons, he could only devote a few hours to literary composition by rising at five when the business of the house had allowed of his getting to bed in time on the previous evening. Between September 1831 and December 1833 he furnished the *Review* with eight important articles, besides writing his ballad on the Armada.

In the first Reform Parliament, January 1833, Macaulay took his seat as one of the two members for Leeds, which up to that date had been unrepresented in the House of Commons. He replied to O'Connell in the debate on the address, meeting the great agitator face to face, with high, but not intemperate, defiance. In July he defended the Government of India Bill in a speech of great power, and he was instrumental in getting the bill through committee without unnecessary friction. When the abolition of slavery came before the house as a practical question, Macaulay had the prospect of having to surrender office or to vote for a modified abolition, viz. twelve years' apprenticeship, which was proposed by the ministry, but condemned by the abolitionists. He was prepared to make the sacrifice of place rather than be unfaithful to the cause to which his father had devoted his life. He placed his resignation in Lord Althorp's hands, and spoke against the ministerial proposal. But the sense of the house was so strongly expressed as unfavourable that, finding they would be beaten if they persisted, the ministry gave way, and reduced apprenticeship to seven years, a compromise which the abolition party accepted; and Macaulay remained at the board of control.

While he was thus growing in reputation, and advancing his public credit, the fortunes of the family were sinking, and it became evident that his sisters would have no provision except such as their brother might be enabled to make for them. Macaulay had but two sources of income, both of them precarious—office and his pen. As to office, the Whigs could not have expected at that time to retain power for a whole generation; and, even while they did so, Macaulay's resolution that he would always give an independent vote made it possible that he might at any moment find himself in disagreement with his colleagues, and have to quit his place. As to literature, he wrote to Lord Lansdowne (1833), "it has been hitherto merely my relaxation; I have never considered it as the means of support. I have chosen my own topics, taken my own time, and dictated my own terms. The thought of becoming a bookseller's hack, of spurring a jaded fancy to reluctant exertion, of filling sheets with trash merely that sheets may be filled, of bearing from publishers and editors what Dryden bore from Tonson and what Mackintosh bore from Lardner, is horrible to me." Macaulay was thus prepared to accept the offer of a seat in the supreme council of India, created by the new India Act. The salary of the office was fixed at £10,000, out of which he calculated to be able to save £30,000 in five years. His sister Hannah accepted his proposal to accompany him, and in February 1834 the brother and sister sailed for Calcutta.

Macaulay's appointment to India occurred at the critical moment when the government of the company was being superseded by government by the Crown. His knowledge of India was, when he landed, but superficial. But at this juncture there was more need of statesmanship directed by general liberal principles than of a practical knowledge of the details of Indian administration. Macaulay's presence in the council was of great value; his minutes are models of good judgment and practical sagacity. The part he took in India has been described as "the application of sound liberal principles to a government which had till then been jealous, close and repressive." He vindicated the liberty of the press; he maintained the equality of Europeans and natives before the law; and as president of the committee of public instruction he inaugurated the system of national education.

A clause in the India Act 1833 occasioned the appointment of a commission to inquire into the jurisprudence of the Eastern dependency. Macaulay was appointed president of that commission. The draft of a penal code which he submitted became, after a revision of many years, and by the labour of many experienced lawyers, the Indian criminal code. Of this code Sir James Stephen said that "it reproduces in a concise and even beautiful form the spirit of the law of England, in a compass which by comparison with the original may be regarded as almost absurdly small. The Indian penal code is to the English criminal law what a manufactured article ready for use is to the materials out of which it is made. It is to the French code pénal, and to the German code of 1871, what a finished picture is to a sketch. It is simpler and better expressed than Livingston's code for Louisiana; and its practical success has been complete."

Macaulay's enlightened views and measures drew down on him, however, the abuse and ill-will of Anglo-Indian society. Fortunately for himself he was enabled to maintain a tranquil indifference to political detraction by withdrawing his thoughts into a sphere remote from the opposition and enmity by which he was surrounded. Even amid the excitement of his early parliamentary successes literature had balanced politics in his thoughts and interests. Now in his exile he began to feel more strongly each year the attraction of European letters and European history. He wrote to his friend Ellis: "I have gone back to Greek literature with a passion astonishing to myself. I have never felt anything like it. I was enraptured with Italian during the six months which I gave up to it; and I was little less pleased with Spanish. But when I went back to the Greek I felt as if I had never known before what intellectual enjoyment was." In thirteen months he read through, some of them twice, a large part of the Greek and Latin classics. The fascination of these studies produced their inevitable effect upon his view of political life. He began to wonder what strange infatuation leads men who can do something better to squander their intellect, their health and energy, on such subjects as those which most statesmen are engaged in pursuing. He was already, he says, "more than half determined to abandon politics and give myself wholly to letters, to undertake some great historical work, which may be at once the business and the amusement of my life, and to leave the pleasures of pestiferous rooms, sleepless nights, and diseased stomachs to Roebuck and to Praed."

In 1838 Macaulay and his sister Hannah, who had married Charles Trevelyan in 1834, returned to England. He at once entered parliament as member for Edinburgh. In 1839 he became secretary at war, with a seat in the cabinet in Lord Melbourne's ministry. His acceptance of office diverted him for a time from prosecuting the plan he had already formed of a great historical work. But in less than two years the Melbourne ministry fell. In 1842 appeared his *Lays of Ancient Rome*, and in the next year he collected and published his *Essays*. He returned to office in 1846, in Lord John Russell's administration, as paymaster-general. His duties were very light, and the contact with official life and the obligations of parliamentary attendance were even of benefit to him while he was engaged upon his *History*. In the sessions of 1846–1847 he spoke only five times, and at the general election of July 1847 he lost his seat for Edinburgh. The balance of Macaulay's faculties had now passed to the side of literature. At an earlier date he had relished crowds and the excitement of ever new faces; as years went forward, and absorption in the work of composition took off the edge of his spirits, he recoiled from publicity. He began to regard the prospect of business as worry, and had no longer the nerve to brace himself to the social efforts required of one who represents a large constituency.

Macaulay retired into private life, not only without regret, but with a sense of relief. He gradually withdrew from general society, feeling the bore of big dinners and country-house visits, but he still enjoyed close and constant intercourse with a circle of the most eminent men that London then contained. At that time social breakfasts were in vogue. Macaulay himself preferred this to any other form of entertainment. Of these brilliant reunions nothing has been preserved beyond the names of the men who formed them—Rogers, Hallam, Sydney Smith, Lord Carlisle, Lord Stanhope, Nassau Senior, Charles Greville, Milman, Panizzi, G. C. Lewis, Van de Weyer. His biographer thus describes Macaulay's appearance and bearing in conversation: "Sitting bolt upright, his hands resting on the arms of his chair, or folded over the handle of his walking-stick, knitting his eyebrows if the subject was one which had to be thought out as he went along, or brightening from the forehead downwards when a burst of humour was coming, his massive features and honest glance suited well with the manly sagacious sentiments which he set forth in his sonorous voice and in his racy and intelligible language. To get at his meaning people had never the need to think twice, and they certainly had seldom the time."

But, great as was his enjoyment of literary society and books, they only formed his recreation. In these years he was working with unflagging industry at the composition of his *History*. His composition was slow, his corrections both of matter and style endless; he spared no pains to ascertain the facts. He sacrificed to the prosecution of his task a political career, House of Commons fame, the allurements of society. The first two volumes of the *History of England* appeared in December 1848. The success was in every way complete beyond expectation. The sale of edition after edition, both in England and the United States, was enormous.

In 1852, when his party returned to office, he refused a seat in the cabinet, but he could not bring himself to decline the compliment of a voluntary amende which the city of Edinburgh paid him in returning him at the head of the poll at the general election in July of that year. He had hardly accepted the summons to return to parliamentary life before fatal weakness betrayed itself in deranged action of the heart; from this time forward till his death his strength continued steadily to sink. The process carried with it dejection of spirits as its inevitable attendant. The thought oppressed him that the great work to which he had devoted himself would remain a fragment. Once again, in June 1853, he spoke in parliament, and with effect, against the exclusion of the master of the rolls from the House of Commons, and at a later date in defence of competition for the Indian civil service. But he was aware that it was a grievous waste of his small stock of force, and that he made these efforts at the cost of more valuable work.

In November 1855 vols. iii. and iv. of the *History* appeared and obtained a vast circulation. Within a generation of its first appearance upwards of 140,000 copies of the *History* were printed and sold in the United Kingdom alone; and in the United States the sales were on a correspondingly large scale. The *History* was translated into German, Polish, Danish, Swedish, Hungarian, Russian, Bohemian, Italian, French, Dutch and Spanish. Flattering marks of respect were heaped upon the author by foreign academies. His pecuniary profits were (for that time) on a scale commensurate with the reputation of the book: the cheque he received for £20,000 has become a landmark in literary history.

In May 1856 he quitted the Albany, in which he had passed fifteen happy years, and went to live at Holly Lodge, Campden Hill, then, before it was enlarged, a tiny bachelor's dwelling, but with a lawn whose unbroken slope of verdure gave it the air of a considerable country house. In the following year (1857) he was raised to the peerage by the title of Baron Macaulay of Rothley. "It was," says Lady Trevelyan, "one of the few things that everybody approved; he enjoyed it himself, as he did everything, simply and cordially." It was a novelty in English life to see eminence which was neither that of territorial opulence nor of political or military services recognized and rewarded by elevation to the peerage.

But Macaulay's health, which had begun to give way in 1852, was every year visibly failing. In May 1858 he went to Cambridge for the purpose of being sworn in as high steward of the borough, to which office he had been elected on the death of Earl Fitzwilliam. When his health was given at a public breakfast in the town-hall he was obliged to excuse himself from speaking. In the upper house he never spoke. Absorbed in the prosecution of his historical work, he had grown indifferent to the party politics of his own day. Gradually he had to acquiesce in the conviction that, though his intellectual powers remained unimpaired, his physical energies would not carry him through the reign of Anne; and, though he brought down the narrative to the death of William III., the last half-volume wants the finish and completeness of the earlier portions. The winter of 1859 told on him, and he died on the 28th of December. On the 9th of January 1860 he was buried in Westminster Abbey, in Poets' Corner, near the statue of Addison.

Lord Macaulay never married. A man of warm domestic affections, he found their satisfaction in the attachment and close sympathy of his sister Hannah, the wife of Sir Charles Trevelyan. Her children were to him as his own. Macaulay was a steadfast friend, and no act inconsistent with the strictest honour and integrity was ever imputed to him. When a poor man, and when salary was of consequence to him, he twice resigned office rather than make compliances for which he would not have been severely blamed. In 1847, when his seat in parliament was at stake, he would not be persuaded to humour, to temporize, even to conciliate. He had a keen relish for the good things of life, and desired fortune as the means of obtaining them; but there was nothing mercenary or selfish in his nature. When he had raised himself to opulence, he gave away with an open hand, not seldom rashly. His very last act was to write a letter to a poor curate enclosing a cheque for £25. The purity of his morals was not associated with any tendency to cant.

The lives of men of letters are often records of sorrow or suffering. The life of Macaulay was eminently happy. Till the closing years (1857–1859), he enjoyed life with the full zest of healthy faculty, happy in social intercourse, happy in the solitude of his study, and equally divided between the two. For the last fifteen years of his life he lived for literature. His writings were remunerative to him far beyond the ordinary measure, yet he never wrote for money. He lived in his historical researches; his whole heart and interest were unreservedly given to the men and the times of whom he read and wrote. His command of literature was imperial. Beginning with a good classical foundation, he made himself familiar with the imaginative, and then with the historical, remains of Greece and Rome. He went on to add the literature of his own country, of France, of Italy, of Spain. He learnt Dutch enough for the purposes of his history. He read German, but for the literature of the northern nations he had no taste, and of the erudite labours of the Germans he had little knowledge and formed an inadequate estimate. The range of his survey of human things had other limitations more considerable still. All philosophical speculation was alien to his mind; nor did he seem aware of the degree in which such speculation had influenced the progress of humanity. A large—the largest—part of ecclesiastical history lay outside his historical view. Of art he confessed himself ignorant, and even refused a request to furnish a critique on Swift's poetry to the *Edinburgh Review*. Lessing's *Laocoon*, or Goethe's criticism on Hamlet, " filled " him " with wonder and despair."

Of the marvellous discoveries of science which were succeeding each other day by day he took no note; his pages contain no reference to them. It has been told already how he recoiled from the mathematical studies of his university. These deductions made, the circuit of his knowledge still remains very wide—as extensive perhaps as any human brain is competent to embrace. His literary outfit was as complete as has ever been possessed by any English writer; and, if it wants the illumination of philosophy, it has an equivalent resource in a practical acquaintance with affairs, with administration, with the interior of cabinets, and the humour of popular assemblies. Nor was the knowledge merely stored in his memory; it was always at his command. Whatever his subject, he pours over it his stream of illustration, drawn from the records of all ages and countries. His *Essays* are not merely instructive as history; they are, like Milton's blank verse, freighted with the spoils of all the ages. As an historian Macaulay has not escaped the charge of partisanship. He was a Whig; and in writing the history of the rise and triumph of Whig principles in the latter half of the 17th century he identified himself with the cause. But the charge of partiality, as urged against Macaulay, means more than that he wrote the history of the Whig revolution from the point of view of those who made it. When he is describing the merits of friends and the faults of enemies his pen knows no moderation. He has a constant tendency to glaring colours, to strong effects, and will always be striking violent blows. He is not merely exuberant but excessive. There is an overweening confidence about his tone; he expresses himself in trenchant phrases, which are like challenges to an opponent to stand up and deny them. His propositions have no qualifications. Uninstructed readers like this assurance, as they like a physician who has no doubt about their case. But a sense of distrust grows upon the more circumspect reader as he follows page after page of Macaulay's categorical affirmations about matters which our own experience of life teaches us to be of a contingent nature. We inevitably think of a saying attributed to Lord Melbourne: " I wish I were as cocksure of any one thing as Macaulay is of everything." Macaulay's was the mind of the advocate, not of the philosopher; it was the mind of Bossuet, which admits no doubts or reserves itself and tolerates none in others, and as such was disqualified from that equitable balancing of evidence which is the primary function of the historian.

Macaulay, the historian no less than the politician, is, however, always on the side of justice, fairness for the weak against the strong, the oppressed against the oppressor. But though a Liberal in practical politics, he had not the reformer's temperament. The world as it is was good enough for him. The glories of wealth, rank, honours, literary fame, the elements of vulgar happiness, made up his ideal of life. A successful man himself, every personage and every cause is judged by its success. " The brilliant Macaulay," says Emerson, " who expresses the tone of the English governing classes of the day, explicitly teaches that ' good ' means good to eat, good to wear, material commodity." Macaulay is in accord with the average sentiment of orthodox and stereotyped humanity on the relative values of the objects and motives of human endeavour. And this commonplace materialism is one of the secrets of his popularity, and one of the qualities which guarantee that that popularity will be enduring. (M. P.)

Macaulay's whole works were collected in 1866 by his sister, Lady Trevelyan, in 8 vols. The first four volumes are occupied by the *History*; the next three contain the *Essays*, and the *Lives* which he contributed to the *Encyclopaedia Britannica*. In vol. viii. are collected his *Speeches*, the *Lays of Ancient Rome*, and some miscellaneous pieces. The " life " by Dean Milman, printed in vol. viii. of the edition of 1858–1862, is prefixed to the " People's Edition " (4 vols., 1863–1864). Messrs. Longmans, Green & Co. published a complete edition, the " Albany," in 12 vols., in 1898. There are numerous editions of the *Critical and Historical Essays*, separately and collectively; they were edited in 1903 by F. C. Montagu.

The Life and Letters of Lord Macaulay (2 vols., 1876), by his nephew, Sir George Otto Trevelyan, is one of the best biographies in the English language. The life (1882) in the " English Men of Letters " series was written by J. Cotter Morison. For further criticism, see Hepworth Dixon, in his *Life of Penn* (1841); John Paget, *The New Examen: Inquiry into Macaulay's History* (1861) and *Paradoxes and Puzzles* (1874); Walter Bagehot, in the *National Review* (Jan. 1856), reprinted in his *Literary Studies* (1879); James Spedding, *Evenings with a Reviewer* (1881), discussing his essay on Bacon; Sir L. Stephen, *Hours in a Library*, vol. ii. (1892); Lord Morley, *Critical Miscellanies* (1877), vol. ii.; Lord Avebury, *Essays and Addresses* (1903); Thum, *Anmerkungen zu Macaulay's History of England* (Heilbronn, 1882). A bibliography of German criticism of Macaulay is given in G. Körting's *Grd. der engl. Literatur* (4th ed., Münster, 1905).

MACAW, or, as formerly spelt, MACCAW, the name given to some fifteen or more species of large, long-tailed birds of the parrot-family, natives of the neotropical region, and forming a very well-known and easily recognized genus *Ara*, and to the four species of Brazilian Hyacinthine macaws of the genera *Anodorhynchus* and *Cyanopsittacus*. Most of the macaws are remarkable for their gaudy plumage, which exhibits the brightest scarlet, yellow, blue and green in varying proportion and often in violent contrast, while a white visage often adds a very peculiar and expressive character.[1] With one exception the known species of *Ara* inhabit the mainland of America from Paraguay to Mexico, being especially abundant in Bolivia, where no fewer than seven of them (or nearly one half) have been found (*Proc. Zool. Soc.*, 1879, p. 634). The single extra-continental species, *A. tricolor*, is one of the most brilliantly coloured, and is peculiar to Cuba, where, according to Gundlach (*Ornitologia Cubana*, p. 126), its numbers are rapidly decreasing so that there is every chance of its becoming extinct.[2]

Of the best known species of the group, the blue-and-yellow macaw, *A. ararauna*, has an extensive range in South America from Guiana in the east to Colombia in the west, and southwards to Paraguay. Of large size, it is to be seen in almost every zoological garden, and it is very frequently kept alive in private houses, for its temper is pretty good, and it will become strongly attached to those who tend it. Its richly coloured plumage, sufficiently indicated by its common English name, supplies feathers eagerly sought by salmon-fishers for the making of artificial flies. The red-and-blue macaw, *A. macao*, is even larger and more gorgeously clothed, for, besides the colours expressed in its ordinary appellation, yellow and green enter into its adornment. It inhabits Central as well as South America as far as Bolivia, and is also a common bird in captivity, though perhaps less often seen than the foregoing. The red-and-yellow species, *A. chloroptera*, ranging from Panama to Brazil, is smaller, or at least has a shorter tail, and is not quite so usually met with in menageries. The red-and-green, *A. militaris*, smaller again than the last, is not unfrequent in confinement, and presents the colours of the name it bears. This has the most northerly extension of habitat, occurring in Mexico and thence southwards to Bolivia. In *A. manilata* and *A. nobilis* the prevailing colour is green and blue. The Hyacinthine macaws *A. hyacinthinus*, *A. leari*, *A. glaucus* and *Cyanopsittacus spixi* are almost entirely blue.

The macaws live well in captivity, either chained to a perch or kept in large aviaries in which their strong flight is noticeable. The note of these birds is harsh and screaming. The sexes are alike; the lustreless white eggs are laid in hollow trees, usually two at a time. The birds are gregarious but apparently monogamous. (A. N.)

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[1] This serves to separate the macaws from the long-tailed parakeets of the New World (*Conurus*), to which they are very nearly allied.

[2] There is some reason to think that Jamaica may have formerly possessed a macaw (though no example is known to exist), and if so it was most likely a peculiar species. Sloane (*Voyage*, ii. 297), after describing what he calls the " great maccaw " (*A. ararauna*), which he had seen in captivity in that island, mentions the " small maccaw " as being very common in the woods there, and P. H. Gosse (*Birds of Jamaica*, p. 260) gives, on the authority of Robinson, a local naturalist of the last century, the description of a bird which cannot be reconciled with any species now known, though it must have evidently been allied to the Cuban *A. tricolor*.

MACBETH, king of Scotland (d. 1058), was the son of Findlaech, *mormaer* or hereditary ruler of Moreb (Moray and Ross), who had been murdered by his nephews in 1020. He probably became mormaer on the death of Malcolm, one of the murderers, in 1029, and he may have been one of the chiefs (the Maclbaethe of the *Saxon Chronicle*) who submitted to Canute in 1031. Marianus records that in 1040 Duncan, the grandson and successor of Malcolm king of Scotland, was slain by Macbeth. Duncan had shortly before suffered a severe defeat at the hands of Thorfinn, the Norwegian earl of Orkney and Caithness, and it was perhaps this event which tempted Macbeth to seize the throne. As far as is known he had no claim to the crown except through his wife Gruach, who appears to have been a member of the royal family. Macbeth was apparently a generous benefactor to the Church, and is said to have made a pilgrimage to Rome in 1050. According to S. Berchan his reign was a time of prosperity for Scotland. The records of the period, however, are extremely meagre, and much obscurity prevails, especially as to his relations with the powerful earl Thorfinn. More than one attempt was made by members of the Scottish royal family to recover the throne; in 1045 by Crinan, the lay abbot of Dunkeld, son-in-law of Malcolm II., and in 1054 by Duncan's son Malcolm with the assistance of Siward the powerful earl of Northumbria, himself a connexion of the ousted dynasty. Three years later in 1057 Malcolm and Siward again invaded Scotland and the campaign ended with the defeat and death of Macbeth, who was slain at Lumphanan. Macbeth is, of course, chiefly famous as the central figure of Shakespeare's great tragedy.

See W. F. Skene, *Chronicles of the Picts and Scots* (1867) and *Celtic Scotland* (1876); Sir John Rhys, *Celtic Britain* (1904).

MACCABEES, the name (in the plural) of a distinguished Jewish family dominant in Jerusalem in the 2nd century B.C. According to 1 Macc. ii. 4, the name Maccabaeus (Gr. Μακκαβαῖος—? Heb. מכבי) was originally the distinctive surname of Judas, third son of the Jewish priest Mattathias, who struck the first blow for religious liberty during the persecution under Antiochus IV. (Epiphanes). Subsequently, however, it obtained a wider significance, having been applied first to the kinsmen of Judas, then to his adherents, and ultimately to all champions of religion in the Greek period. Thus the mother of the seven brethren, whose martyrdom is related in 2 Macc. vi., vii., is called by early Christian writers "the mother of the Maccabees." The name is used still more loosely in the titles of the so-called Third, Fourth and Fifth Books of Maccabees. It is now customary to apply it only to the sons and descendants of Mattathias. As, however, according to Josephus (*Ant.* xii. 6. 1), this brave priest's great-great-grandfather was called *Ḥasmon* (*i.e.* "rich"=magnate; cf. Ps. lxviii. 31 [32]), the family is more correctly designated by the name of Hasmonaeans or Asmoneans (*q.v.*). This name Jewish authors naturally prefer to that of Maccabees; they also style 1 and 2 Macc. "Books of the Hasmonaeans."

If Maccabee (*maqqābi*) is the original form of the name, the most probable derivation is from the Aramaic *maqqābā* (Heb. מקבה, Judg. iv. 21, &c.) = "hammer." The surname "hammerer" might have been applied to Judas either as a distinctive title pure and simple or symbolically as in the parallel case of Edward I., "Scotorum *malleus*." Even if *māqqāba* does denote the ordinary workman's hammer, and not the great smith's hammer which would more fitly symbolize the impetuosity of Judas, this is not a fatal objection. The doubled *k* of the Greek form is decisive against (1) the theory that the name Maccabee was made up of the initials of the opening words of Exod. xv. 11; (2) the derivation from מכבי = "extinguisher" (cf. Isa. xliii. 17), based by Curtiss (*The Name Machabee*, Leipzig, 1876) on the Latin spelling Machabaeus = Μαχχαβαῖος, which Jerome probably adopted in accordance with the usage of the times.

The Maccabaean revolt was caused by the attempt of Antiochus IV. (Epiphanes), king of Syria (175–164 B.C.), to force Hellenism upon Judaea (see SELEUCID DYNASTY; HELLENISM). Ever since the campaigns of Alexander the Great, Greek habits and ideas had been widely adopted in Palestine. Over the higher classes especially Hellenism had cast its spell. This called forth the organized opposition of the Ḥasīdīm (= "the pious"), who constituted themselves champions of the Law. Joshua, who headed the Hellenistic faction, graecized his name into Jason, contrived to have the high-priesthood taken from his brother Onias III., and conferred upon himself, and set up a gymnasium hard by the Temple. After three years' tenure of office Jason was supplanted by the Benjamite Menelaus, who disowned Judaism entirely. Antiochus punished an outburst of strife between the rivals by plundering the Temple and slaying many of the inhabitants (170 B.C.). Two years later Jerusalem was devastated by his general Apollonius, and a Syrian garrison occupied the citadel (Akra). The Jews were ordered under pain of death to substitute for their own observances the Pagan rites prescribed for the empire generally. In December 168 sacrifice was offered to Zeus upon an idol altar ("the abomination of desolation," Dan. x. 27) erected over the great altar of burnt-offering. But Antiochus had miscalculated, and by his extreme measures unwittingly saved Judaism from its internal foes. Many hellenizers rallied round those who were minded to die rather than abjure their religion. The issue of an important edict ordaining the erection of heathen altars in every township of Palestine, and the appointment of officers to deal with recusants, brought matters to a crisis. At Modin, Mattathias, an aged priest, not only refused to offer the first sacrifice, but slew an apostate Jew who was about to step into the breach. He also killed the king's commissioner and pulled down the altar. Having thus given the signal for rebellion, he then with his five sons took to the mountains. In view of the ruthless slaughter of a thousand sabbatarians in the wilderness, Mattathias and his friends decided to resist attack even on the sabbath. Many, including the Ḥasīdīm, thereupon flocked to his standard, and set themselves to revive Jewish rites and to uproot Paganism from the land. In 166 Mattathias died, after charging his sons to give their lives for their ancestral faith, and nominating Judas Maccabaeus as their leader in the holy campaign.

The military genius of Judas made this the most stirring chapter in Israelitish history. In quick succession he overthrew the Syrian generals Apollonius, Seron and Gorgias, and after the regent Lysias had shared the same fate at his hands he restored the Temple worship (165). These exploits dismayed his opponents and kindled the enthusiasm of his friends. When, however, Lysias returned in force to renew the contest, Judas had to fall back upon the Temple mount, and escaped defeat only because the Syrian leader was obliged to hasten back to Antioch in order to prevent a rival from seizing the regency. Under these circumstances Lysias unexpectedly guaranteed to the Jews their religious freedom (162). But though they had thus gained their end, the struggle did not cease; it merely assumed a new phase. The Ḥasīdīm indeed were satisfied, and declined to fight longer, but the Maccabees determined not to desist until their nation was politically as well as religiously free. In 161 Judas defeated Nicanor at Adasa, but within a few weeks thereafter, in a heroic struggle against superior numbers under Bacchides at Elasa, he was himself cut off. Even this, however, did not prove fatal to the cause which Judas had espoused. If in his brother Jonathan it did not possess so brilliant a soldier, it had in him an astute diplomatist who knew how to exploit the internal troubles of Syria. In the contest between Demetrius I. and Alexander Balas for the throne, Jonathan supported the latter, who in 153 nominated him high priest, and conferred on him the order of "King's Friend," besides other honours. After the accession of Demetrius II. (145) Jonathan contrived to win his favour, and helped him to crush a rebellion in Antioch on condition that the Syrian garrisons should be withdrawn from Judaea. When, however, Demetrius failed to keep his word, Jonathan transferred his allegiance to Antiochus VI., whom Tryphon had crowned as king. After subjugating the territory between Jerusalem and Damascus, he routed the generals of Demetrius on the plain of Hazor But as the Maccabees had now in the name of the Syrians cleared the Syrians out of Palestine, Tryphon's jealousy was aroused, and he resolved to be rid of Jonathan, who, with all his cunning, walked into a trap at Ptolemais, was made prisoner and ultimately slain (143). The leadership now devolved upon Simon, the last survivor of the sons of Mattathias. He soon got the better of Tryphon, who vainly tried to reach Jerusalem. Allying himself to Demetrius, Simon succeeded in negotiating a treaty whereby the political independence of Judaea was at length secured. The garrison in the Akra having been starved into submission, Simon triumphantly entered that fortress in May 142. In the following year he was by popular decree invested with absolute powers, being appointed leader, high priest and ethnarch. As these offices were declared hereditary in his family, he became the founder of the Hasmonaean dynasty. The first year of his reign (Seleucid year 170 = 143–142 B.C.) was made the beginning of a new era, and the issue of a Jewish coinage betokened the independence of his sovereignty. Under Simon's administration the country enjoyed signal prosperity. Its internal resources were assiduously developed; trade, agriculture, civic justice and religion were fostered; while at no epoch in its post-exilic history did Israel enjoy an equal measure of social happiness (1 Macc. xiv. 4 seq.). Simon's beneficent activities came, however, to a sudden and tragic end. In 135 he and two of his sons were murdered by Ptolemy his son-in-law, who had an eye to the supreme power. But Simon's third son, John Hyrcanus, warned in time, succeeded in asserting his rights as hereditary head of the state. All the sons of Mattathias had now died for the sake of "The Law"; and the result of their work, so valorously prosecuted for over thirty years, was a new-born enthusiasm in Israel for the ancestral faith. The Maccabaean struggle thus gave fresh life to the Jewish nation.

After the death of Antiochus VII. Sidetes in 128 left him a free hand, Hyrcanus (135–105) soon carved out for himself a large and prosperous kingdom, which, however, was rent by internal discord owing to the antagonism developed between the rival parties of the Pharisees and Sadducees. Hyrcanus was succeeded by his son Aristobulus, whose reign of but one year was followed by that of his brother, the warlike Alexander Jannaeus (104–78). The new king's Sadducean proclivities rendered him odious to the populace, which rose in revolt, but only to bring upon itself a savage revenge. The accession of his widow Salome Alexandra (78–69) witnessed a complete reversal of the policy pursued by Jannaeus, for she chose to rule in accordance with the ideals of the Pharisees. Her elder son, Hyrcanus II., a pliable weakling, was appointed high priest; her younger son, the energetic Aristobulus, who chafed at his exclusion from office, seized some twenty strongholds and with an army bore down upon Jerusalem. At this crisis Alexandra died, and Hyrcanus agreed to retire in favour of his masterful brother. A new and disturbing element now entered into Jewish politics in the person of the Idumaean Antipater, who for selfish ends deliberately made mischief between the brothers. An appeal to M. Aemilius Scaurus, who in 65 came into Syria as the legate of Pompey, led to the interference of the Romans, the siege of Jerusalem by Pompey, and the vassalage of the Jews (*q.v.*). Hyrcanus II. was appointed high priest and ethnarch, without the title of king (63). Repeated but fruitless attempts were made by the Hasmonaeans and their patriotic supporters to throw off the Roman yoke. In 47 Antipater, who curried favour with Rome, was made procurator of Judaea, and his sons Phasael and Herod governors of Jerusalem and Galilee respectively. Six years later the Idumaean brothers were appointed tetrarchs of Judaea. At length, in 40, the Parthians set up as king Antigonus, sole surviving son of Aristobulus. Thereupon Phasael committed suicide in prison, but Herod effected his escape and with the help of the Romans seated himself on the throne of Judaea (37 B.C.). Through the execution of Antigonus by M. Antonius (Mark Antony) the same year the Hasmonaean dynasty became extinct.

LITERATURE.—1 and 2 Macc. and Josephus are the main sources for the Maccabaean history. For references in classical authors see E. Schürer, *Geschichte des jüdischen Volkes* (1901, p 106 seq.). Besides the numerous modern histories of Israel (*e.g.* those by Derenbourg, Ewald, Stanley, Stade, Renan, Schürer, Kent, Wellhausen, Guthe), see also Madden, *Coins of the Jews* (1881), H. Weiss's *Judas Makkabaeus* (1897), and the articles in the *Ency. Bib.*, Hastings's *Dict. Bible*, the *Jewish Encyclopedia*. Among more popular sketches are Moss's *From Malachi to Matthew* (1893); Streane's *The Age of the Maccabees* (1898); Morrison's *The Jews under Roman Rule* ("Story of the Nations" series), W. Fairweather's *From the Exile to the Advent* (1901); E. R. Bevan's *Jerusalem under the High Priests* (1904); F. Henderson's *The Age of the Maccabees* (1907); also articles JEWS; SELEUCID DYNASTY. (W. F.*)

MACCABEES, BOOKS OF, the name given to several Apocryphal books of the Old Testament. The Vulgate contains two books of Maccabees which were declared canonical by the council of Trent (1546) and found a place among the Apocrypha of the English Bible. Three other books of this name are extant. Book iii. is included in the Septuagint but not in the Vulgate. Book iv. is embraced in the Alexandrian, Sinaitic, and other MSS. of the Septuagint, as well as in some MSS. of Josephus. A "Fifth" book is contained in the Ambrosian Peshitta, but it seems to be merely a Syriac reproduction of the sixth book of Josephus's history of the *Jewish War*. None of the books of Maccabees are contained in the Vatican (B); all of them are found in a Syriac recension.

1 Maccabees was originally written in Hebrew, but is preserved only in a Greek translation. Origen gives a transliteration of "its semitic title,"[1] and Jerome says distinctly: "The First Book of Maccabees I found in Hebrew." The frequent Hebraisms which mark the Greek translation, as well as the fact that some obscure passages in the Greek text are best accounted for as mistranslations from the Hebrew, afford internal evidence of the truth of this testimony. There are good reasons for regarding the book as a unity, although some scholars (Destinon, followed by Wellhausen) consider the concluding chapters (xiii.–xvi.) a later addition unknown to Josephus, who, however, seems to have already used the Greek. It probably dates from about the beginning of the first century B.C.[2]

As it supplies a detailed and accurate record of the forty years from the accession of Antiochus Epiphanes to the death of Simon (175–135 B.C.), without doubt the most stirring chapter in Jewish history, the book is one of the most precious historical sources we possess. In its careful chronology, based upon the Seleucid era, in the minuteness of its geographical knowledge, in the frankness with which it records defeat as well as victory, on the restraint with which it speaks of the enemies of the Jews, in its command of details, it bears on its face the stamp of genuineness. Not that it is wholly free from error or exaggeration, but its mistakes are due merely to defective knowledge of the outside world, and its overstatements, virtually confined to the matter of numbers, proceed from a patriotic desire to magnify Jewish victories. While the author presumably had some written sources at his disposal,[3] his narrative is probably for the most part founded upon personal knowledge and recollection of the events recorded, and upon such first-hand information as, living in the second generation after, he would still be in a position to obtain. His sole aim is honestly to relate what he knew of the glorious struggles of his nation.

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[1] Σαρβὴθ Σαβαναιὲλ (Sarbēth Sabanaiel). No satisfactory explanation of this title has yet been given from the Hebrew (see the commentaries). The book may, however, have been known to Origen only in an Aramaic translation, in which case, according to the happy conjecture of Dalman (*Gramm.* 6) the two words may have represented the Aramaic ספר בית חשמנאי ("book of the Hasmonaean house").

[2] If the book is a unity, ch. xvi. 23 implies that it was written after the death of Hyrcanus which occurred in 105 B.C. On the other hand the friendly references to Rome in ch. viii. show that it must have been written before the siege of Jerusalem by Pompey in 63 B.C.

[3] Cf. ix. 22, xi. 37, xiv. 18, 27.

Although written in the style of the historical books of the old Testament, the work is characterized by a religious reticence which avoids even the use of the divine name, and by the virtual absence of the Messianic hope. The observance of the law is strongly urged, and the cessation of prophecy deplored (iv. 46; xiv. 41). There is no allusion either to the immortality of the soul or to the resurrection of the dead. The rewards to which the dying Mattathias points his sons are all for this life. Many scholars are of opinion that the unknown author was a Sadducee,[1] but all that can be said with certainty is that he was a Palestinian Jew devotedly attached to the national cause.

Until the council of Trent 1 Maccabees had only "ecclesiastical" rank, and although not accepted as canonical by the Protestant churches, it has always been held in high estimation. Luther says "it closely resembles the rest of the books of Holy Scripture, and would not be unworthy to be enumerated with them."

2 Maccabees, the epitome of a larger work in five books by one Jason of Cyrene, deals with the same history as its predecessor, except that it begins at a point one year earlier (176 B.C.), and stops short at the death of Nicanor (161 B.C.), thus covering a period of only fifteen years. First of all[2] the writer describes the futile attempt of Heliodorus to rob the Temple, and the malicious intrigues of the Benjamite Simon against the worthy high priest Onias III. (iii. 1–iv. 6). As throwing light upon the situation prior to the Maccabaean revolt this section of the book is of especial value. Chapters iv. 7–vii. 42 contain a more detailed narrative of the events recorded in 1 Macc. i. 10–64. The remainder of the book runs parallel to 1 Macc. iii.–vii.

Originally written in excellent Greek, from a pronouncedly Pharisaic standpoint, it was possibly directed against the Hasmonaean dynasty. It shows no sympathy with the priestly class. Both in trustworthiness and in style it is inferior to 1 Macc. Besides being highly coloured, the narrative does not observe strict chronological sequence. Instead of the sober annalistic style of the earlier historian we have a work marked by hyperbole, inflated rhetoric and homiletic reflection. Bitter invective is heaped upon the national enemies, and strong predilection is shown for the marvellous. The fullness and inaccuracy of detail which are a feature of the book suggest that Jason's information was derived from the recollections of eye-witnesses orally communicated. In spite of its obvious defects, however, it forms a useful supplement to the first book.

The writer's interests are religious rather than historical. In 1 Macc. there is a keen sense of the part to be played by the Jews themselves, of the necessity of employing their own skill and valour; here they are made to rely rather upon divine intervention. Fantastic apparitions of angelic and supernatural beings, gorgeously arrayed and mostly upon horseback, are frequently introduced. In general, the views reflected in the book are those of the Pharisees. The ungodly will be punished mercilessly, and in exact correspondence to their sins.[3] The chastisements of erring Jews are of short duration, and intended to recall them to duty. If the faithful suffer martyrdom, it is in order to serve as an example to others, and they shall be compensated by being raised up "unto an eternal renewal of life." The eschatology of 2 Macc. is singularly advanced, for it combines the doctrine of a resurrection with that of immortality. It is worthy of note that the Roman Church finds support in this book for its teaching with reference to prayers for the dead and purgatory (xii. 43 seq.). An allusion to Jeremiah as "he who prayeth much for the people and the holy city" (xv. 14) it likewise appeals to as favouring its views respecting the intercession of the saints.

Neither of Jason's work, nor of the epitomizer's, can the precise date be determined. The changed relations with Rome (viii. 10, 36) prove, however, that the latter was written later than 1 Macc.; and it is equally clear that it was composed before the destruction of Jerusalem, A.D. 70.

The account given of the martyrs in chs. vi. and vii. led to frequent allusions to this book in early patristic literature. Only Augustine, however, was minded to give it the canonical rank to which it has been raised by the Roman Church. Luther judged of it as unfavourably as he judged of 1 Macc. favourably, and even "wished it had never existed."

3 Maccabees, although purporting to be an historical narrative, is really an animated, if somewhat vapid, piece of fiction written in Greek somewhere between 100 B.C. and A.D. 70,[4] and apparently preserved only in part.[5] It has no connexion with the Hasmonaeans, but is a story of the deliverance experienced by the Egyptian Jews from impending martyrdom at the hands of Ptolemy IV. Philopator, who reigned in the century previous to the Maccabaean rising (222–205 B.C.). The title is of later origin, and rendered possible only by the generalization of the name Maccabee so as to embrace all who suffered for the ancestral faith. Josephus refers the legend on which it is based to the time of Ptolemy VII. Physcon (146–117 B.C.). Some scholars (Ewald, Reuss, Hausrath) think that what the story really points to is the persecution under Caligula, but in that case Ptolemy would naturally have been represented as claiming divine honours. No other source informs us of a visit to Jerusalem, or of a persecution of the Jews, on the part of Philopator. Possibly, however, the story may be founded on some historical situation regarding which we have no definite knowledge. The purpose of the writer was evidently to cheer his Egyptian brethren during some persecution at Alexandria. Although the book was favourably regarded in the Syrian, it was apparently unknown to the Latin Church. Among the Jews it was virtually ignored.

Briefly, the tale is as follows:—After the battle of Raphia[6] (217 B.C.), Ptolemy IV. Philopator insisted on entering the sanctuary at Jerusalem, but was struck down by the Almighty in answer to the prayers of the horrified Jews. On his return to Egypt he revenged himself by curtailing the religious liberty of the Alexandrian Jews, and by depriving of their civic rights all who refused to worship Bacchus. Exasperated by their loyalty to their religion, the king ordered all the Jews in Egypt to be imprisoned in the hippodrome of Alexandria. Clerks were told off to prepare a list of the prisoners' names, but after forty days constant toil they had exhausted their writing materials without finishing their task. Ptolemy further commanded that 500 elephants should be intoxicated and let loose upon the occupants of the racecourse. Only an accident prevented the carrying out of this design; the king had slept until it was past the time for his principal meal. On the following day, in virtue of a divinely induced forgetfulness, Ptolemy recollected nothing but the loyalty of the Jews to his throne. The same evening, nevertheless, he repeated his order for their destruction. Accordingly, on the morning of the third day, when the king attended to see his commands executed, things had reached a crisis. The Jews prayed to the Lord for mercy, and two angels appeared from heaven, to the confusion of the royal troops, who were trampled down by the elephants. Ptolemy now vented his wrath upon his counsellors, liberated the Jews, and feasted them for seven days. They determined that these should be kept as festal days henceforth in commemoration of their deliverance. The provincial governors were enjoined to take the Jews under their protection, and leave was given to the latter to slay those of their kinsmen who had deserted the faith. They further celebrated their deliverance at Ptolemais, where they built a synagogue, and they reached their various abodes to find themselves not only reinstated in their possessions, but raised in the esteem of the Egyptians.

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[1] See especially Geiger, *Urschrift und Uebersetzungen der Bibel*, 206 seq.

[2] Prefixed to the book are two spurious letters from Palestinian Jews (i., ii. 18), having no real connexion with it, or even with one another, further than that they both urge Egyptian Jews to observe the Feast of the Dedication. Between these and the main narrative is inserted the writer's own preface, in which he explains the source and aim of his work (ii. 19–32).

[3] iv. 38, 42; v. 9 seq.; ix. 5–18.

[4] The date of composition can be only approximately determined. As the writer is acquainted with the Greek additions to Daniel (vi. 6), the first century B.C. forms the superior limit; and as the book found favour in the Eastern Church, the first century A.D. forms the inferior limit.

[5] Apart from its abrupt commencement, the references in i. 2 to "the plot" as something already specified, and in ii. 25 to the king's "before-mentioned" companions, of whom, however, nothing is said in the previous section of the book, point to the loss of at least an introductory chapter.

[6] The statements with reference to the war between Antiochus the Great and Ptolemy Philopator are in general agreement with those of the classical historians, and to this extent the tale may be said to have an historical setting. By Grimm (*Einl.* § 3), the observance of the two yearly festivals (vi. 26; vii. 19), and the existence of the synagogue at Ptolemais when the book was written, are viewed as the witness of tradition to the fact of some great deliverance. Fritzsche has well pointed out, however (art. "Makkabäer" in Schenkel's *Bibel-Lexicon*) that in the hands of Jewish writers of the period nearly every event of consequence has a festival attached to it.

4 Maccabees differs essentially from the other books of this name. While it does not itself aim at being a history, it makes striking use of Jewish history for purposes of edification. It bears, moreover, a distinctly philosophical character, and takes the form of a "tractate" or discourse, addressed to Jews only,[1] upon "the supremacy of pious reason over the passions."[2] The material is well arranged and systematically handled. In the prologue (i. 1–12) the writer explains the aim and scope of his work. Then follows the first main division (i. 13–iii. 18), in which he treats philosophically the proposition that reason is the mistress of the passions, inquiring what is meant by "reason" and what by "passion," as well as how many kinds of passion there are, and whether reason rules them all. The conclusion reached is that with the exception of forgetfulness and ignorance all the affections are under the lordship of reason, or at all events of *pious* reason. To follow the dictates of pious reason in opposition to natural inclination is to have learned the secret of victory over the passions. In the second part of the book (iii. 19–xviii. 5) the writer goes on to prove his thesis from Jewish history, dwelling in particular upon the noble stand made against the tyranny of Antiochus IV. Epiphanes by the priest Eleazar, the seven brothers and their mother—all of whom chose torture and death rather than apostatize from the faith. Finally he appeals to his readers to emulate these acts of piety (xvii. 7–xviii. 24). In his gruesome descriptions of physical sufferings the author offends against good taste even more than the writer of 2 Macc., while both contrast very unfavourably in this respect with the sober reserve of the gospel narratives.

The book is written in a cultured, if somewhat rhetorical, Greek style, and is unmistakably coloured by the Stoic philosophy. The four cardinal virtues are represented as forms of wisdom, which again is inseparable from the Mosaic law. That the writer owes no slavish adherence to any philosophical system is plain from his independent treatment of the affections. Although influenced by Hellenism, he is a loyal Jew, earnestly desirous that all who profess the same faith should adhere to it in spite of either Greek allurements or barbaric persecution. It is not to reason as such, but only to pious reason (*i.e.* to reason enlightened and controlled by the divine law), that he attributes lordship over the passions. While in his zeal for legalism he virtually adopts the standpoint of Pharisaism, he is at one with Jewish Hellenism in substituting belief in the soul's immortality for the doctrine of a bodily resurrection.

The name of the author is unknown. He was, however, clearly a Hellenistic Jew, probably resident in Alexandria or Asia Minor. In the early Church the work was commonly ascribed to Josephus and incorporated with his writings. But apart from the fact that it is found also in several MSS. of the Septuagint, the language and style of the book are incompatible with his authorship. So also is the circumstance that 2 Macc., which forms the basis of 4 Macc., was unknown to Josephus. Moreover, several unhistorical statements (such as, *e.g.* that Seleucus was succeeded by his *son* Antiochus Epiphanes, iv. 15) militate against the view that Josephus was the author. The date of composition cannot be definitely fixed. It is, however, safe to say that the book must have been written later than 2 Macc., and (in view of the acceptance it met with in the Christian Church) prior to the destruction of Jerusalem. Most likely it is a product of the Herodian period.

5 Maccabees. Writing in 1566 Sixtus Senensis mentions having seen at Lyons a manuscript of a so-called "Fifth Book of Maccabees" in the library of Santas Pagninus, which was soon afterwards destroyed by fire. It began with the words: "After the murder of Simon, John his son became high priest in his stead." Sixtus conjectures that it may have been a Greek translation of the "chronicles" of John Hyrcanus, alluded to in 1 Macc. xvi. 24. He acknowledges that it is a history of Hyrcanus practically on the lines of Josephus, but concludes from its Hebraistic style that it was not from that writer's pen. The probability, however, is that it was "simply a reproduction of Josephus, the style being changed perhaps for a purpose" (Schürer).

The Arabic "Book of Maccabees" contained in the Paris and London Polyglotts, and purporting to be a history of the Jews from the affair of Heliodorus (186 B.C.) to the close of Herod's reign, is historically worthless, being nothing but a compilation from 1 and 2 Macc. and Josephus. In the one chapter (xii.) where the writer ventures to detach himself from these works he commits glaring historical blunders. The book was written in somewhat Hebraistic Greek subsequent to A.D. 70. In Cotton's English translation of *The Five Books of Maccabees* it is this book that is reckoned the "Fifth."

The best modern editions of the Greek text of the four books of Maccabees are those of O. F. Fritzsche (1871) and H. B. Swete (Cambridge Septuagint, vol. iii., 1894). C. J. Ball's *The Variorum Apocrypha* will be found specially useful by those who cannot conveniently consult the Greek. The best modern commentary is that of C. L. W. Grimm (1853–1857). C. F. Keil's commentary on 1 and 2 Macc. is very largely indebted to Grimm. More recently there have appeared commentaries by E. C. Bissell on 1, 2 and 3 Macc. in Lange-Schaff's commentary, 1880—the whole Apocrypha being embraced in one volume, and much of the material being transferred from Grimm; G. Rawlinson on 1 and 2 Macc. in the *Speaker's Commentary* 1888 (containing much useful matter, but marred by too frequent inaccuracy); O. Zöckler, on 1, 2 and 3 Macc., 1891 (slight and unsatisfactory); W. Fairweather and J. S. Black on 1 Macc. in the *Cambridge Bible for Schools* (1897); E. Kautzsch on 1 and 3 Macc., A. Kamphausen on 2 Macc. and A. Deissmann on 4 Macc. in *Die Apok. u. Pseudepigr. des Alt. Test.*, 1898 (a most serviceable work for the student of apocryphal literature). Brief but useful introductions to all the four books of Maccabees are given in E. Schürer's *Geschichte des Jüdischen Volkes im Zeitalter Jesu Christi* (3rd ed., 1898–1901; Eng. tr. of earlier edition, 1886–1890). (W. F.*)

MACCARTHY, DENIS FLORENCE (1817–1882), Irish poet, was born in Dublin on the 26th of May 1817, and educated there and at Maynooth. His earlier verses appeared in *The Dublin Satirist*, and in 1843 he became a regular contributor of political verse to the recently founded *Nation*. He also took an active part in the Irish political associations. In 1846 he edited *The Poets and Dramatists of Ireland* and the *Book of Irish Ballads*. His collected *Ballads, Poems and Lyrics* (1850), including translations from nearly all the modern languages, took immensely with his countrymen on account of their patriotic ring. This was followed by *The Bellfounder* (1857), *Under-glimpses* and other poems (1857) and *The Early Life of Shelley* (1871). In 1853 he began a number of translations from the Spanish of Calderon's dramas, which won for him a medal from the Royal Spanish Academy. He had already been granted a civil list pension for his literary services. He died in Ireland on the 7th of April 1882.

M'CARTHY, JUSTIN (1830–), Irish politician, historian and novelist, was born in Cork on the 22nd of November 1830, and was educated at a school in that town. He began his career as a journalist, at the age of eighteen, in Cork. From 1853 to 1859 he was in Liverpool, on the staff of the *Northern Daily Times*, during which period he married (in March 1855) Miss Charlotte Allman. In 1860 he removed to London, as parliamentary reporter to the *Morning Star*, of which he became editor in 1864.

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[1] Even if with Freudenthal we regard the work as a homily actually delivered to a Jewish congregation—and there are difficulties in the way of this theory, particularly the absence of a Biblical text—it was clearly intended for publication. It is essentially a book in the form of a discourse, whether it was ever orally delivered or not. So Deissmann in Kautzsch, *Die Apok. u. Pseudepigr. des A. T.* ii. 151.

[2] Hence the title sometimes given to it: αὐτοκράτορος λογισμοῦ ("On the supremacy of reason"). It is also styled Μακκαβαίων δʹ, Μακκαβαϊκόν, εἰς τοὺς Μακκαβαίους.

He gave up his post in 1868, and, after a lecturing tour in the United States, joined the staff of the *Daily News* as leader-writer in 1870. In this capacity he became one of the most useful and respected upholders of the Liberal politics of the time. He lectured again in America in 1870–1871, and again in 1886–1887. He represented Co. Longford in Parliament as a Liberal and Home Ruler from 1879 to 1885; North Longford, 1885–1886; Londonderry, 1886–1892; and North Longford from 1892 to 1900. He was chairman of the Anti-Parnellites from the fall of C. S. Parnell in 1890 until January 1896; but his Nationalism was of a temperate and orderly kind, and though his personal distinction singled him out for the chairmanship during the party dissensions of this period, he was in no active sense the political leader. His real bent was towards literature. His earliest publications were novels, some of which, such as *A Fair Saxon* (1873), *Dear Lady Disdain* (1875), *Miss Misanthrope* (1878), *Donna Quixote* (1879), attained considerable popularity. His most important work is his *History of Our Own Times* (vols. i.–iv., 1879–1880; vol. v., 1897), which treats of the period between Queen Victoria's accession and her diamond jubilee. Easily and delightfully written, and on the whole eminently sane and moderate, these volumes form a brilliant piece of narrative from a Liberal standpoint. He also began a *History of the Four Georges* (1884–1901), of which the latter half was written by his son, Justin Huntly M'Carthy (b. 1860), himself the author of various clever novels, plays, poetical pieces and short histories. Justin M'Carthy, amongst other works, wrote biographies of Sir Robert Peel (1891), Pope Leo XIII. (1896) and W. E. Gladstone (1898); *Modern England* (1898); *The Reign of Queen Anne* (1902) and *Reminiscences* (2 vols., 1899).

McCHEYNE, ROBERT MURRAY (1813–1843), Scottish divine, was born at Edinburgh on the 21st of May 1813, was educated at the University and at the Divinity Hall of his native city, and held pastorates at Larbert, near Falkirk, and Dundee. A mission of inquiry among the Jews throughout Europe and in Palestine, and a religious revival at his church in Dundee, made him feel that he was being called to evangelistic rather than to pastoral work, but before he could carry out his plans he died, on the 25th of March 1843. McCheyne, though wielding remarkable influence in his lifetime, was still more powerful afterwards, through his *Memoirs and Remains*, edited by Andrew Bonar, which ran into far over a hundred English editions. Some of his hymns, *e.g.* "When this passing world is done," are well known.

See his *Life*, by J. C. Smith (1910).

McCLELLAN, GEORGE BRINTON (1826–1885), American soldier, was born in Philadelphia on the 3rd of December 1826. After passing two years (1840–1842) in the university of Pennsylvania, he entered the United States military academy, from which he graduated with high honours in July 1846. Sent as a lieutenant of engineers to the Mexican War, he took part in the battles under General Scott, and by his gallantry won the brevets of first-lieutenant at Contreras-Churubusco and captain at Chapultepec; he was afterwards detailed as assistant-instructor at West Point, and employed in explorations in the South-West and in Oregon. Promoted in 1855 captain of cavalry, he served on a military commission sent to Europe to study European armies and especially the war in the Crimea. On his return he furnished an able and interesting report, republished (1861) under the title of *Armies of Europe*. In 1856 he designed a saddle, which was afterwards well known as the McClellan. Resigning his commission in 1857, McClellan became successively chief engineer and vice-president of the Illinois Central railroad (1857–1860), general superintendent of the Mississippi & Ohio railroad, and, a little later, president of the eastern branch of the same, with his residence in Cincinnati. When the Civil War broke out he was, in April 1861, made major-general of three months' militia by the governor of Ohio; but General Scott's favour at Washington promoted him rapidly (May 14) to the rank of major-general, U.S.A., in command of the department of the Ohio. Pursuant to orders, on the 26th of May, McClellan sent a small force across the Ohio river to Philippi, dispersed the Confederates there early in June, and immensely aided the Union cause in that region by rapid and brilliant military successes, gained in the short space of eight days. These operations, though comparatively trivial as the Civil War developed, brought great results, in permanently dividing old Virginia by the creation of the state of West Virginia, and in presenting the first sharp, short and wholly successful campaign of the war.

Soon after the first Bull Run disaster he was summoned to Washington, and the Union hailed him as chieftain and preserver. Only thirty-four years old, and with military fame and promotion premature and quite in excess of positive experience, he reached the capital late in July and assumed command there. At first all was deference and compliance with his wishes. In November Scott retired that the young general might control the operations of the whole Union army. McClellan proved himself extraordinarily able as an organizer and trainer of soldiers. During the autumn, winter and spring he created the famous Army of the Potomac, which in victory and defeat retained to the end the impress of McClellan's work. But he soon showed petulance towards the civil authorities, from whom he came to differ concerning the political ends in view; and he now found severe critics, who doubted his capacity for directing an offensive war; but the government yielded to his plans for an oblique, instead of a direct, movement upon Richmond and the opposing army. At the moment of starting he was relieved as general-in-chief. By the 5th of April a great army was safely transported to Fortress Monroe, and other troops were sent later, though a large force was (much against his will) retained to cover Washington. McClellan laid slow siege to Yorktown, not breaking the thin line first opposed to him, but giving Johnston full time to reinforce and then evacuate the position. McClellan followed up the Confederate rearguard and approached Richmond, using White House on the Pamunkey as a base of supplies; this entailed a division of his forces on either bank of the Chickahominy. At Fair Oaks (Seven Pines) was fought on the 31st of May a bloody battle, ending the following day in a Confederate repulse. Johnston being severely wounded, Lee came to command on the Southern side. After a pause in the operations McClellan felt himself ready to attack at the moment when Lee, leaving a bare handful of men in the Richmond lines, despatched two-thirds of his entire force to the north of the Chickahominy to strike McClellan's isolated right wing. McClellan himself made little progress, and the troops beyond the Chickahominy were defeated after a strenuous defence; whereupon McClellan planned, and during the celebrated Seven Days' Battle triumphantly executed, a change of base to the James river. But the result was strategically a failure, and General Halleck, who was now general-in-chief, ordered the army to reinforce General Pope in central Virginia. The order was obeyed reluctantly.

Pope's disastrous defeats brought McClellan a new opportunity to retrieve his fame. Again in command of the Army of the Potomac, he was sent with all available forces to oppose Lee, who had crossed the Potomac into Maryland early in September. McClellan advanced slowly and carefully, reorganizing his army as he went. The battle of South Mountain placed him in a position to attack Lee, and a few days later was fought the great battle of Antietam, in which Lee was worsted. But the Confederates safely recrossed the Potomac, and McClellan showed his former faults in a tardy pursuit. On the eve of an aggressive movement, which he was at last about to make, he was superseded by Burnside (Nov. 7). McClellan was never again ordered to active command, and the political elements opposed to the general policy of Lincoln's administration chose him as presidential candidate in 1864, on a platform which denounced the war as a failure and proposed negotiating with the South for peace. McClellan, while accepting his candidacy, repudiated the platform, like a soldier and patriot. At the polls on the 8th of November Lincoln was triumphantly re-elected president. McClellan had previously resigned his commission in the army, and soon afterwards went to Europe, where he remained until 1868. Upon his return he took up his residence in New York City, where (1868–1869) he was engaged in superintending the construction of an experimental floating battery. In 1870–1872 he was engineer-in-chief of the city's department of docks. With Orange, N.J., as his next principal residence, he became governor of New Jersey (1878–1881). During his term he effected great reforms in the administration of the state and in the militia. He was offered, but declined, a second nomination. During his last years he made several tours of Europe, visited the East, and wrote much for the magazines. He also prepared monographs upon the Civil War, defending his own action. He died suddenly of heart-disease on the 29th of October 1885 at Orange.

McClellan was a clear and able writer and effective speaker, and his *Own Story*, edited by a friend and published soon after his death, discloses an honourable character, sensitive to reproach, and conscientious, even morbidly so, in his patriotism. He carried himself well in civil life and was of irreproachable private conduct. During the Civil War, however, he was promoted too early and rapidly for his own good, and the strong personal magnetism he inspired while so young developed qualities injurious to a full measure of success and usefulness, despite his great opportunities. The reasons for his final displacement in 1862 were both civil and military, and the president had been forbearing with him. As a soldier he possessed to an extraordinary degree the enthusiastic affection of his men. With the army that he had created the mere rumour of his presence was often a spur to the greatest exertions. That he was slow, and perhaps too tender-hearted, in handling armed masses for action may be admitted, and though admirable for defensive war and a safe strategist, he showed himself unfitted to take the highly essential initiative, both because of temperament and his habitual exaggeration of obstacles and opposing numbers. But he met and checked the armies of the Confederacy when they were at their best and strongest, and his work laid the foundations of ultimate success.

His son, George Brinton McClellan (b. 1865), graduated in 1886 at Princeton (from which he received the degree of LL.D. in 1905), and became a newspaper reporter and editor in New York City. He identified himself with the Tammany Hall organization, and in 1889–1892 was treasurer of the New York and Brooklyn Bridge under the city government. In 1892 he was admitted to the bar, and was elected to the board of aldermen, of which he was president in 1893 and 1894. In 1895–1903 he was a Democratic representative in Congress; in 1903 he was elected mayor of New York City on the Tammany ticket, defeating mayor Seth Low, the "Fusion" candidate; and in 1905 he was re-elected for a four-year term, defeating William M. Ivins (Republican) and William R. Hearst (Independence League). He published *The Oligarchy of Venice* (1904).

Besides the report mentioned above, General McClellan wrote a *Bayonet Exercise* (1852); *Report on Pacific Railroad Surveys* (1854); *Report on the Organization, &c., of the Army of the Potomac* (1864), a government publication which he himself republished with the addition of a memoir of the West Virginian campaign. He also wrote a series of articles on the Russo-Turkish War for *The North American Review*. See memoir prefaced to *McClellan's Own Story*, and Michie, *General McClellan* ("Great Commanders" series).

McCLERNAND, JOHN ALEXANDER (1812–1900), American soldier and lawyer, was born in Breckinridge county, Kentucky, on the 30th of May 1812. He was admitted to the bar in Shawneetown, Illinois, in 1832; in the same year served as a volunteer in the Black Hawk War, and in 1835 founded the *Shawneetown Democrat*, which he thereafter edited. As a Democrat he served in 1836 and in 1840–1843 in the Illinois House of Representatives, and in 1843–1851 and in 1859–1861 was a representative in Congress, where in his first term he vigorously opposed the Wilmot proviso, but in his second term was a strong Unionist and introduced the resolution of the 15th of July 1861, pledging money and men to the national government. He resigned from congress, raised in Illinois the "McClernand Brigade," and was commissioned (May 17, 1861) brigadier-general of volunteers. He was second in command at the battle of Belmont (Missouri) in November 1861, and commanded the right wing at Fort Donelson. On the 21st of March he became a major-general of volunteers. At Shiloh he commanded a division, which was practically a reserve to Sherman's. In October 1861 Stanton, secretary of war, ordered him north to raise troops for the expedition against Vicksburg; and early in January 1864, at Milliken's Bend, McClernand, who had been placed in command of one of the four corps of Grant's army, superseded Sherman as the leader of the force that was to move down the Mississippi. On the 11th of January he took Arkansas Post. On the 17th, Grant, after receiving the opinion of Admiral Foote and General Sherman that McClernand was unfit, united a part of his own troops with those of McClernand and assumed command in person, and three days later ordered McClernand back to Milliken's Bend. During the rest of this Vicksburg campaign there was much friction between McClernand and his colleagues; he undoubtedly intrigued for the removal of Grant; it was Grant's opinion that at Champion's Hill (May 16) he was dilatory; and because a congratulatory order to his corps was published in the press (contrary to an order of the department and another of Grant) he was relieved of his command on the 18th of June, and was replaced by General E. O. C. Ord. President Lincoln, who saw the importance of conciliating a leader of the Illinois War-Democrats, restored him to his command in 1864, but McClernand resigned in November of that year. He was district judge of the Sangamon (Illinois) District in 1870–1873, and was president of the National Democratic Convention in 1876. He died in Springfield, Illinois, on the 20th of September 1900.

His son, Edward John McClernand (b. 1848), graduated at the U.S. Military Academy in 1870. He served on the frontier against the Indians, notably in the capture of Chief Joseph in October 1877, became lieutenant-colonel and assistant adjutant-general of volunteers in 1898, and served in Cuba in 1898–99. He was then ordered to the Philippines, where he commanded various districts, and from April 1900 to May 1901, when he was mustered out of the volunteer service, was acting military governor.

MACCLESFIELD, CHARLES GERARD, 1st Earl of (*c.* 1618–1694), eldest son of Sir Charles Gerard, was a member of an old Lancashire family, his great-grandfather having been Sir Gilbert Gerard (d. 1593) of Ince, in that county, one of the most distinguished judges in the reign of Elizabeth. His mother was Penelope Fitton of Gawsworth, Cheshire. Charles Gerard was educated abroad, and in the Low Countries learnt soldiering, in which he showed himself proficient when on the outbreak of the Civil War in England he raised a troop of horse for the king's service. Gerard commanded a brigade with distinction at Edgehill, and gained further honours at the first battle of Newbury and at Newark in 1644, for which service he was appointed to the chief command in South Wales. Here his operations in 1644 and 1645 were completely successful in reducing the Parliamentarians to subjection; but the severity with which he ravaged the country made him personally so unpopular that when, after the defeat at Naseby in June 1645, the king endeavoured to raise fresh forces in Wales, he was compelled to remove Gerard from the local command. Gerard was, however, retained in command of the king's guard during Charles's march from Wales to Oxford, and thence to Hereford and Chester in August 1645; and having been severely wounded at Rowton Heath on the 23rd of September, he reached Newark with Charles on the 4th of October. On the 8th of November 1645 he was created Baron Gerard of Brandon in the county of Suffolk; but about the same time he appears to have forfeited Charles's favour by having attached himself to the party of Prince Rupert, with whom after the surrender of Oxford Gerard probably went abroad. He remained on the Continent throughout the whole period of the Commonwealth, sometimes in personal attendance on Charles II., at others serving in the wars under Turenne, and constantly engaged in plots and intrigues. For one of these, an alleged design on the life of Cromwell, his cousin Colonel John Gerard was executed in the Tower in July 1654. At the Restoration Gerard rode at the head of the king's life-guards in his triumphal entry into London; his forfeited estates were restored, and he received lucrative offices and pensions. In 1668 he retired from the command of the king's guard to make room for the duke of

Monmouth, receiving, according to Pepys, the sum of £12,000 as solatium. On the 23rd of July 1679 Gerard was created earl of Macclesfield and Viscount Brandon. A few months later he entered into relations with Monmouth, and co-operated with Shaftesbury in protesting against the rejection of the Exclusion Bill. In September 1685, a proclamation having been issued for his arrest, Macclesfield escaped abroad, and was outlawed. He returned with William of Orange in 1688, and commanded his body-guard in the march from Devonshire to London. By William he was made a privy councillor, and lord lieutenant of Wales and three western counties. Macclesfield died on the 7th of January 1694. By his French wife he left two sons and two daughters.

His eldest son CHARLES, 2nd earl of Macclesfield (c. 1659–1701), was born in France and was naturalized in England by act of parliament in 1677. Like his father he was concerned in the intrigues of the duke of Monmouth; in 1685 he was sentenced to death for being a party to the Rye House plot, but was pardoned by the king. In 1689 he was elected member of parliament for Lancashire, which he represented till 1694, when he succeeded to his father's peerage. Having become a major-general in the same year, Macclesfield saw some service abroad; and in 1701 he was selected first commissioner for the investiture of the elector of Hanover (afterwards King George I.) with the order of the Garter, on which occasion he also was charged to present a copy of the Act of Settlement to the dowager electress Sophia. He died on the 5th of November 1701, leaving no legitimate children.

In March 1698 Macclesfield was divorced from his wife Anna, daughter of Sir Richard Mason of Sutton, by act of parliament, the first occasion on which a divorce was so granted without a previous decree of an ecclesiastical court. The countess was the mother of two children, who were known by the name of Savage, and whose reputed father was Richard Savage, 4th Earl Rivers (d. 1712). The poet Richard Savage (*q.v.*) claimed that he was the younger of these children. The divorced countess married Colonel Henry Brett about the year 1700, and died at the age of eighty-five in 1753. Her daughter Anna Margaretta Brett was a mistress of George I. The 2nd earl of Macclesfield was succeeded by his brother Fitton Gerard, 3rd earl (c. 1665–1702), on whose death without heirs the title became extinct in December 1702.

In 1721 the title of earl of Macclesfield was revived in favour of THOMAS PARKER (c. 1666–1732). The son of Thomas Parker, an attorney at Leek, young Parker was a student at Trinity College, Cambridge, and became a barrister in 1691. In 1705 he was elected member of parliament for Derby, and having gained some reputation in his profession, he took a leading part in the proceedings against Sacheverell in 1710. In the same year he was appointed lord chief justice of the queen's bench, but he refused to become lord chancellor in the following year; however he accepted this office in 1718, two years after he had been made Baron Parker of Macclesfield by George I., who held him in high esteem. In 1721 he was created Viscount Parker and earl of Macclesfield, but when serious charges of corruption were brought against him he resigned his position as lord chancellor in 1725. In the same year Macclesfield was impeached, and although he made a very able defence he was found guilty by the House of Lords. His sentence was a fine of £30,000 and imprisonment until this was paid. He was confined in the Tower of London for six weeks, and after his release he took no further part in public affairs. The earl, who built a grammar school at Leek, died in London on the 28th of April 1732.

Macclesfield's only son, GEORGE, (c. 1697–1764) 2nd earl of Macclesfield of this line, was celebrated as an astronomer. As Viscount Parker he was member of parliament for Wallingford from 1722 to 1727, but his interests were not in politics. In 1722 he became a fellow of the Royal Society, and he spent most of his time in astronomical observations at his Oxfordshire seat, Shirburn Castle, which had been bought by his father in 1716; here he built an observatory and a chemical laboratory. The earl was very prominent in effecting the change from the old to the new style of dates, which came into operation in 1752. His action in this matter, however, was somewhat unpopular, as the opinion was fairly general that he had robbed the people of eleven days. From 1752 until his death on the 17th of March 1764 Macclesfield was president of the Royal Society, and he made some observations on the great earthquake of 1755. His successor was his son Thomas (1723–1795), from whom the present earl is descended.

For the earls of the Gerard family see Lord Clarendon, *History of the Rebellion*, ed. by W. D. Macray; E. B. G. Warburton, *Memoirs of Prince Rupert and the Cavaliers* (3 vols., 1849); *State Papers of John Thurloe* (7 vols., 1742); J. R. Phillips, *Memoirs of the Civil War in Wales and the Marches, 1642–49* (2 vols., 1874); and the duke of Manchester, *Court and Society from Elizabeth to Anne* (2 vols., 1864). For Lord Chancellor Macclesfield, see Lord Campbell, *Lives of the Lord Chancellors and Keepers of the Great Seal* (1845–1869).

MACCLESFIELD, a market town and municipal borough in the Macclesfield parliamentary division of Cheshire, England, 166 m. N.W. by N. of London, on the London & North-Western, North Staffordshire and Great Central railways. Pop. (1901), 34,624. It lies on and above the small river Bollin, the valley of which is flanked by high ground to east and west, the eastern hills rising sharply to heights above 1000 ft. The bleak upland country retains its ancient name of Macclesfield Forest. The church of St Michael, standing high, was founded by Eleanor, queen of Edward I., in 1278, and in 1740 was partly rebuilt and greatly enlarged. The lofty steeple by which its massive tower was formerly surmounted was battered down by the Parliamentary forces during the Civil War. Connected with the church there are two chapels, one of which, Rivers Chapel, belonged to a college of secular priests founded in 1501 by Thomas Savage, afterwards archbishop of York. Both the church and chapels contain several ancient monuments. The free grammar school, originally founded in 1502 by Sir John Percival, was refounded in 1552 by Edward VI., and a commercial school was erected in 1840 out of its funds. The county lunatic asylum is situated here. The town-hall is a handsome modern building with a Grecian frontage on two sides. Originally the trade of Macclesfield was principally in twist and silk buttons, but this has developed into the manufacture of all kinds of silk. Besides this staple trade, there are various textile manufactures and extensive breweries; while stone and slate quarries, as well as coal-mines, are worked in the neighbourhood. Recreation grounds include Victoria Park and Peel Park, in which are preserved the old market cross and stocks. Water communication is provided by the Macclesfield canal. The borough is under a mayor, 12 aldermen and 36 councillors. Area, 3214 acres. The populous suburb of SUTTON, extending S.S.E. of the town, is partly included in the borough.

Previous to the Conquest, Macclesfield (Makesfeld, Mackerfeld, Macclesfeld, Meulefeld, Maxfield) was held by Edwin, earl of Mercia, and at the time of the Domesday Survey it formed a part of the lands of the earl of Chester. The entry speaks of seven hedged enclosures, and there is evidence of fortification in the 13th century, to which the names Jordangate, Chestergate and Wallgate still bear witness. In the 15th century Henry Stafford, duke of Buckingham, had a fortified manor-house here, traces of which remain. There is a tradition, supported by a reference on a plea roll, that Randle, earl of Chester (1181–1232) made Macclesfield a free borough, but the earliest charter extant is that granted by Edward, prince of Wales and earl of Chester, in 1261, constituting Macclesfield a free borough with a merchant gild, and according certain privileges in the royal forest of Macclesfield to the burgesses. This charter was confirmed by Edward III. in 1334, by Richard II. in 1389, by Edward IV. in 1466 and by Elizabeth in 1564. In 1595 Elizabeth issued a new charter to the town, confirmed by James I. in 1605 and Charles II. in 1666, laying down a formal borough constitution under a mayor, 2 aldermen, 24 capital burgesses and a high steward. In 1684 Charles II. issued a new charter, under which the borough was governed until the Municipal Reform Act 1835. The earliest mention of a market is in a grant by James I. to Charles, prince of Wales and earl of Chester, in 1617. In the charter of 1666 a market is included among the privileges confirmed to the borough as those which had been granted in 1605, or by any previous kings and queens of England. The charter of Elizabeth in 1595 granted an annual fair in June, and this was supplemented by Charles II. in 1684 by a grant of fairs in April and September. Except during the three winter months fairs are now held monthly, the chief being "Barnaby" in June, when the town keeps a week's holiday. Macclesfield borough sent two members to parliament in 1832 for the first time. In 1880 it was disfranchised for bribery, and in 1885 the borough was merged in the county division of Macclesfield. The manufacture of silk-covered buttons began in the 16th century, and flourished until the early 18th. The first silk mill was erected about 1755, and silk manufacture on a large scale was introduced about 1790. The manufacture of cotton began in Macclesfield about 1785.

See J. Corry, *History of Macclesfield* (1817).

M‘CLINTOCK, SIR FRANCIS LEOPOLD (1819–1907), British naval officer and Arctic explorer, was born at Dundalk, Ireland, on the 8th of July 1819, of a family of Scottish origin. In 1831 he entered the royal navy, joining the "Samarang" frigate, Captain Charles Paget. In 1843 he passed his examination for lieutenancy and joined the "Gorgon" steamship, Captain Charles Hotham, which was driven ashore at Montevideo and salved, a feat of seamanship on the part of her captain and officers which attracted much attention. Hitherto, and until 1847, M‘Clintock's service was almost wholly on the American coasts, but in 1848 he joined the Arctic expedition under Sir James Ross in search of Sir John Franklin's ships, as second lieutenant of the "Enterprise." In the second search expedition (1850) he was first lieutenant of the "Assistance," and in the third (1854) he commanded the "Intrepid." On all these expeditions M‘Clintock carried out brilliant sleigh journeys, and gained recognition as one of the highest authorities on Arctic travel. The direction which the search should follow had at last been learnt from the Eskimo, and M‘Clintock accepted the command of the expedition on board the "Fox," fitted out by Lady Franklin in 1857, which succeeded in its object in 1859 (see FRANKLIN, SIR JOHN). For this expedition M‘Clintock had obtained leave of absence, but the time occupied was afterwards counted in his service. He was knighted and received many other honours on his return. Active service now occupied him in various tasks, including the important one of sounding in the north Atlantic, in connexion with a scheme for a north Atlantic cable route, until 1868. In that year he became naval aide-de-camp to Queen Victoria. In 1865 he had been elected a fellow of the Royal Society. He unsuccessfully contested a seat in parliament for the borough of Drogheda, where he made the acquaintance of Annette Elizabeth, daughter of R. F. Dunlop of Monasterboice; he married her in 1870. He became vice-admiral in 1877, and commander-in-chief on the West Indian and North American station in 1879. In 1882 he was elected an Elder Brother of Trinity House, and served actively in that capacity. In 1891 he was created K.C.B. He was one of the principal advisers in the preparations for the Antarctic voyage of the "Discovery" under Captain Scott. His book, *The Voyage of the "Fox" in the Arctic Seas*, was first published in 1859, and passed through several editions. He died on the 17th of November 1907.

See Sir C. R. Markham, *Life of Admiral Sir Leopold M‘Clintock* (1909).

McCLINTOCK, JOHN (1814–1870), American Methodist Episcopal theologian and educationalist, was born in Philadelphia on the 27th of October 1814. He graduated at the university of Pennsylvania in 1835, and was assistant professor of mathematics (1836–1837), professor of mathematics (1837–1840), and professor of Latin and Greek (1840–1848) in Dickinson College, Carlisle, Pennsylvania. He opposed the Mexican War and slavery, and in 1847 was arrested on the charge of instigating a riot, which resulted in the rescue of several fugitive slaves; his trial, in which he was acquitted, attracted wide attention. In 1848–1856 he edited *The Methodist Quarterly Review* (after 1885 *The Methodist Review*); from 1857 to 1860 he was pastor of St Paul's (Methodist Episcopal) Church, New York City; and in 1860–1864 he had charge of the American chapel in Paris, and there and in London did much to turn public opinion in favour of the Northern States. In 1865–1866 he was chairman of the central committee for the celebration of the centenary of American Methodism. He retired from the regular ministry in 1865, but preached in New Brunswick, New Jersey, until the spring of 1867, and in that year, at the wish of its founder, Daniel Drew, became president of the newly established Drew theological seminary at Madison, New Jersey, where he died on the 4th of March 1870. A great preacher, orator and teacher, and a remarkably versatile scholar, McClintock by his editorial and educational work probably did more than any other man to raise the intellectual tone of American Methodism, and, particularly, of the American Methodist clergy. He introduced to his denomination the scholarly methods of the new German theology of the day—not alone by his translation with Charles E. Blumenthal of Neander's *Life of Christ* (1847), and of Bungener's *History of the Council of Trent* (1855), but by his great project, McClintock and Strong's *Cyclopaedia of Biblical, Theological and Ecclesiastical Literature* (10 vols., 1867–1881; Supplement, 2 vols., 1885–1887), in the editing of which he was associated with Dr James Strong (1822–1894), professor of exegetical theology in the Drew Theological Seminary from 1868 to 1893, and the sole editor of the last six volumes of the *Cyclopaedia* and of the supplement. With George Richard Crooks (1822–1897), his colleague at Dickinson College and in 1880–1897 professor of historical theology at Drew Seminary, McClintock edited several elementary textbooks in Latin and Greek (of which some were republished in Spanish), based on the pedagogical principle of "imitation and constant repetition." Among McClintock's other publications are: *Sketches of Eminent Methodist Ministers* (1863); an edition of Richard Watson's *Theological Institutes* (1851); and *The Life and Letters of Rev. Stephen Olin* (1854).

See G. R. Crooks, *Life and Letters of the Rev. Dr John McClintock* (New York, 1876).

McCLOSKEY, JOHN (1810–1885), American cardinal, was born in Brooklyn, New York, on the 20th of March 1810. He graduated at Mt St Mary's College, Emmitsburg, Maryland, in 1827, studied theology there, was ordained a priest in 1834, and in 1837, after two years in the college of the Propaganda at Rome, became rector of St Joseph's, New York City, a charge to which he returned in 1842 after one year's presidency of St John's College (afterwards Fordham University), Fordham, New York, then just opened. In 1844 he was consecrated bishop of Axieren *in partibus*, and was made coadjutor to Bishop Hughes of New York with the right of succession; in 1847 he became bishop of the newly created see of Albany; and in 1864 he succeeded to the archdiocese of New York, then including New York, New Jersey, and New England. In April 1875 he was invested as a cardinal, with the title of Sancta Maria supra Minervam, being the first American citizen to receive this dignity. He attended the conclave of 1878, but was too late to vote for the new pope. In May 1879 he dedicated St Patrick's Cathedral in New York City, whose corner-stone had been laid by Archbishop Hughes in 1858. Archbishop Corrigan became his coadjutor in 1880 because of the failure of McCloskey's always delicate health. The fiftieth anniversary of his ordination to the priesthood was celebrated in 1884. He died in New York City on the 10th of October 1885. He was a scholar, a preacher, and a man of affairs, temperamentally quiet and dignified; and his administration differed radically from that of Archbishop Hughes; he was conciliatory rather than polemic and controversial, and not only built up the Roman Catholic Church materially, but greatly changed the tone of public opinion in his diocese toward the Church.

M‘CLURE, SIR ROBERT JOHN LE MESURIER (1807–1873), English Arctic explorer, born at Wexford, in Ireland, on the 28th of January 1807, was the posthumous son of one of Abercrombie's captains and spent his childhood under the care of his godfather, General Le Mesurier, governor of Alderney, by whom he was educated for the army He entered the navy, however, in 1824, and twelve years later gained his first experience of Arctic exploration as mate of the "Terror" in the expedition (1836–1837) commanded by Captain (afterwards Sir) George Back. On his return he obtained his commission as lieutenant, and from 1838 to 1839 served on the Canadian lakes, being subsequently attached to the North American and West Indian naval stations, where he remained till 1846 Two years later he joined the Franklin search expedition (1848–1849) under Sir J C Ross as first lieutenant of the "Enterprise," and on the return of this expedition was given the command of the "Investigator" in the new search expedition (1850–1854) which was sent out by way of Bering Strait to co-operate with another from the north-west. In the course of this voyage he achieved the distinction of completing (1850) the work connected with the discovery of a North-West Passage (see Polar Regions) On his return to England, M'Clure was awarded gold medals by the English and French geographical societies, was knighted and promoted to post-rank, his commission being dated back four years in recognition of his special services From 1856 to 1861 he served in Eastern waters, commanding the division of the naval brigade before Canton in 1858, for which he received a C.B in the following year His latter years were spent in a quiet country life, he attained the rank of rear-admiral in 1867, and of vice-admiral in 1873.

See Admiral Sherard Osborn, *The Discovery of a North-West Passage* (1856).

MacCOLL, MALCOLM (*c.* 1838–1907), British clergyman and publicist, was the son of a Scottish farmer He was educated at Trinity College, Glenalmond, for the Scotch Episcopal ministry, and after further study at the university of Naples was ordained in 1859, and entered on a succession of curacies in the Church of England, in London and at Addington, Bucks. He quickly became known as a political and ecclesiastical controversialist, wielding an active pen in support of W E. Gladstone, who rewarded him with the living of St George's, Botolph Lane, in 1871, and with a canonry of Ripon in 1884. The living was practically a sinecure, and he devoted himself to political pamphleteering and newspaper correspondence, the result of extensive European travel, a wide acquaintance with the leading personages of the day, strong views on ecclesiastical subjects from a high-church standpoint, and particularly on the politics of the Eastern Question and Mahommedanism. He took a leading part in ventilating the Bulgarian and Armenian "atrocities," and his combative personality was constantly to the fore in support of the campaigns of Gladstonian Liberalism. He died in London on the 5th of April 1907

McCOMBIE, WILLIAM (1805–1880), Scottish agriculturist, was born at Tillyfour, Aberdeenshire, where he founded the herd of black-polled cattle with which his name is associated. He was the first tenant farmer to represent a Scottish constituency, and was returned to parliament, unopposed, as Liberal member for the western division of Aberdeen in 1868. He died unmarried in February 1880. His work *Cattle and Cattle-breeders* (1867) passed into a fourth edition in 1886.

McCOOK, ALEXANDER McDOWELL (1831–1903), American soldier, was born in Columbiana county, Ohio, on the 22nd of April 1831. He graduated at the U. S. military academy in 1852, served against the Apaches and Utes in New Mexico in 1853–57, was assistant instructor of infantry tactics at the military academy in 1858–1861, and in April 1861 became colonel of the 1st Ohio Volunteers. He served in the first battle of Bull Run; commanded a brigade in Kentucky in the winter of 1861, a division in Tennessee and Mississippi early in 1862, and the 1st Corps in Kentucky in October of the same year; was in command of Nashville in November and December of that year; and was then engaged in Tennessee until after the battle of Chickamauga, after which he saw no active service at the front during the Civil War. He was promoted to be brigadier-general of volunteers in September 1861, and to be major-general of volunteers in July 1862, earned the brevet of lieutenant-colonel in the regular army at the capture of Nashville, Tennessee, that of colonel at Shiloh, and that of brigadier-general at Perryville, and in March 1865 was breveted major-general for his services during the war In February–May 1865 he commanded the district of Eastern Arkansas. He resigned from the volunteer service in October 1865, was commissioned lieutenant-colonel of the 26th Infantry in March 1867, served in Texas, mostly in garrison duty, until 1874, and in 1886–1890 (except for brief terms of absence) commanded Fort Leavenworth, Kansas, and the infantry and cavalry school there. He became a brigadier-general in 1890, and a major-general in 1894, retired in 1895; and in 1898–1899 served on a commission to investigate the United States department of war as administered during the war with Spain

His father, Daniel McCook (1798–1863), killed at Buffington's Island during General John H. Morgan's raid in Ohio, and seven of his eight brothers (three of whom were killed in battle) all served in the Civil War, this family and that of John McCook (1806–1865), Daniel's brother, a physician, who served as a volunteer surgeon in the Civil War, are known as the "fighting McCooks"—four of John's sons served in the Union army and one in the Union navy

John James McCook (b 1845), the youngest brother of Alexander McDowell McCook, served in the West and afterwards in the army of the Potomac, was wounded at Shady Grove, Virginia, in 1864, and in 1865 was breveted lieutenant-colonel of volunteers, he graduated at Kenyon College in 1866, subsequently practised law in New York City, where he became head of the firm Alexander & Green; was a prominent member of the Presbyterian Church, and was a member of the prosecuting committee in the Briggs heresy trial in 1892–1893.

His cousin, Anson George McCook (b. 1835), a son of John, was admitted to the Ohio bar in 1861, served throughout the Civil War in the Union Army, and was breveted brigadier-general of volunteers; he was a Republican representative in Congress from New York in 1877–1883; and in 1884–1893 was secretary of the United States Senate.

Another son of John McCook, Edward Moody McCook (1833–1909), was an efficient cavalry officer in the Union army, was breveted brigadier-general in the regular army and major-general of volunteers in 1865, was United States minister to Hawaii in 1866–1869, and was governor of Colorado Territory in 1869–1873, and in 1874–1875

His brother, Henry Christopher McCook (b. 1837), was first lieutenant and afterwards chaplain of the 41st Illinois, was long pastor of the Tabernacle Presbyterian Church in Philadelphia, and was president of the American Presbyterian Historical Society, but is best known for his popular and excellent works on entomology, which include. *The Mound-making Ants of the Alleghanies* (1877); *The Natural History of the Agricultural Ants of Texas* (1879); *Tenants of an Old Farm* (1884), *American Spiders and their Spinning-work* (3 vols., 1889–1893), *Nature's Craftsmen* (1907) and *Ant Communities* (1909).

Another brother, John James McCook (b. 1843), a cousin of the lawyer of the same name, was a 2nd lieutenant of volunteers in the Union army in 1861; graduated at Trinity College, Hartford, Connecticut, in 1863, and at the Berkeley divinity school in 1866; entered the Protestant Episcopal ministry in 1867, and in 1869 became rector of St John's, East Hartford, Connecticut; became professor of modern languages in Trinity College, Hartford, in 1883; in 1895–1897 was president of the board of directors of the Connecticut reformatory; and wrote on prison reform and kindred topics.

MacCORMAC, SIR WILLIAM, Bart. (1836–1901), Irish surgeon, was born at Belfast on the 17th of January 1836, being the son of Dr Henry MacCormac. He studied medicine and surgery at Belfast, Dublin and Paris, and graduated in arts, medicine and surgery at the Queen's University of Ireland, in which he afterwards became an examiner in surgery. He began practice in Belfast, where he became surgeon to the General Hospital, but left it for London on his marriage in 1861 to Miss Katherine M. Charters. In the Franco-German War of 1870 he was surgeon-in-chief to the Anglo-American Ambulance, and was present at Sedan, and he also went through the Turco-Servian War of 1876. He became in this way an authority on gun-shot wounds, and besides being highly successful as a surgeon was very popular in society, his magnificent physique and Irish temperament making him a notable and attractive personality. In 1881 he was appointed assistant-surgeon at St Thomas's Hospital, London, and for twenty years continued his work there as surgeon, lecturer and consulting surgeon. In 1881 he acted as honorary secretary-general of the International Medical Congress in London, and was knighted for his services. In 1883 he was elected member of the council of the College of Surgeons, and in 1887 a member of the court of examiners, in 1893 he delivered the Bradshaw lecture, and in 1896 was elected president, being re-elected to this office in 1897, 1898, 1899, and 1900 (the centenary year of the college), an unprecedented record. In 1897 he was created a baronet, and appointed surgeon-in-ordinary to the prince of Wales. In 1899 he was Hunterian Orator. In the same year he volunteered to go out to South Africa as consulting surgeon to the forces, and from November 1899 to April 1900 he saw much active service both in Cape Colony and Natal, his assistance being cordially acknowledged on his return. In 1901 he was appointed honorary serjeant-surgeon to the king. But during 1898 he had suffered from a prolonged illness, and he had perhaps put too much strain on his strength, for on the 4th of December 1901 he died somewhat suddenly at Bath. Besides treatises on *Surgical Operations* and *Antiseptic Surgery*, and numerous contributions to the medical journals, MacCormac was the author of *Work under the Red Cross* and of an interesting volume commemorating the centenary of the Royal College of Surgeons in 1900. The latter contains biographical notices of all the masters and presidents up to that date.

McCORMICK, CYRUS HALL (1809–1884), American inventor of grain-harvesting machinery, was born at Walnut Grove, in what is now Roane county, W. Va., U.S.A., on the 15th of February 1809. His father was a farmer who had invented numerous labour-saving devices for farmwork, but after repeated efforts had failed in his attempts to construct a successful grain-cutting machine. In 1831, Cyrus, then twenty-two years old, took up the problem, and after careful study constructed a machine which was successfully employed in the late harvest of 1831 and patented in 1834. The McCormick reaper after further improvements proved a complete success; and in 1847 the inventor removed to Chicago, where he established large works for manufacturing his agricultural machines. William H. Seward has said of McCormick's invention, that owing to it "the line of civilization moves westward thirty miles each year." Numerous prizes and medals were awarded for his reaper, and he was elected a corresponding member of the French Academy of Sciences, "as having done more for the cause of agriculture than any other living man." He died in Chicago on the 13th of May 1884.

See Herbert N. Casson, *Cyrus Hall McCormick: his Life and Work* (Chicago, 1909).

McCOSH, JAMES (1811–1894), Scottish philosophical writer, was born of a Covenanting family in Ayrshire, on the 1st of April 1811. He studied at Glasgow and Edinburgh, receiving at the latter university his M.A., at the suggestion of Sir William Hamilton, for an essay on the Stoic philosophy. He became a minister of the Established Church of Scotland, first at Arbroath and then at Brechin, and took part in the Free Church movement of 1843. In 1852 he was appointed professor of logic and metaphysics in Queen's College, Belfast; and in 1868 was chosen president and professor of philosophy of the college of New Jersey, at Princeton. He resigned the presidency in 1888, but continued as lecturer on philosophy till his death on the 16th of November 1894. He was most successful in college administration, a good lecturer and an effective preacher. His general philosophical attitude and method were Hamiltonian; he insisted on severing religious and philosophical data from merely physical, and though he added little to original thought, he clearly restated and vigorously used the conclusions of others. In his controversial writings he often failed to understand the real significance of the views which he attacked, and much of his criticism is superficial.

His chief works are *Method of Divine Government, Physical and Moral* (Edinburgh, 1850, 5th ed., 1856, and frequently republished in New York), *The Typical Forms and Special Ends in Creation* (Edinburgh, 1855, new editions, New York, 1867–1880), *Intuitions of the Mind inductively investigated* (London and New York, 1860; 3rd rev. ed., 1872), *An Examination of Mr J. S. Mill's Philosophy* (London and New York, 1866, enlarged 1871, several eds.), *Philosophical Papers* containing (1) "Examination of Sir W. Hamilton's Logic," (2) "Reply to Mr Mill's third edition," and (3) "Present State of Moral Philosophy in Britain;" *Religious Aspects of Evolution* (New York, 1888, 2nd ed., 1890). For a complete list of his writings see J. H. Dulles, *McCosh Bibliography* (Princeton, 1895).

McCOY, SIR FREDERICK (1823–1899), British palaeontologist, the son of Dr Simon McCoy, was born in Dublin in 1823, and was educated in that city for the medical profession. His interests, however, became early centred in natural history, and especially in geology, and at the age of eighteen he published a *Catalogue of Organic Remains* compiled from specimens exhibited in the Rotunda at Dublin (1841). He assisted Sir R. J. Griffith (*q.v.*) by studying the fossils of the carboniferous and silurian rocks of Ireland, and they prepared a joint *Synopsis of the Silurian Fossils of Ireland* (1846). In 1846 Sedgwick secured his services, and for at least four years he devoted himself to the determination and arrangement of the fossils in the Woodwardian Museum at Cambridge. Sedgwick wrote of him as "an excellent naturalist, an incomparable and most philosophical palaeontologist, and one of the steadiest and quickest workmen that ever undertook the arrangement of a museum" (*Life and Letters of Sedgwick*, ii. 194). Together they prepared the important and now classic work entitled *A Synopsis of the Classification of the British Palaeozoic Rocks, with a Systematic Description of the British Palaeozoic Fossils in the Geological Museum of the University of Cambridge* (1855). Meanwhile McCoy in 1850 had been appointed professor of geology in Queen's College, Belfast, and in 1854 he accepted the newly founded professorship of natural science in the university of Melbourne. There he lectured for upwards of thirty years; he established the National Museum of Natural History and Geology in Melbourne, of which he was director; and becoming associated with the geological survey of Victoria as palaeontologist, he issued a series of decades entitled *Prodromus of the Palaeontology of Victoria*. He also issued the *Prodromus of the Zoology of Victoria*. To local societies he contributed many papers, and he continued his active scientific work for fifty-eight years—his last contribution, "Note on a new Australian Pterygotus," being printed in the *Geological Magazine* for May 1899. He was elected F.R.S. in 1880, and was one of the first to receive the Hon. D.Sc. from the university of Cambridge. In 1886 he was made C.M.G., and in 1891 K.C.M.G. He died in Melbourne on the 16th of May 1899.

Obituary (with bibliography) in *Geol. Mag.* 1899, p. 283.

M'CRIE, THOMAS (1772–1835), Scottish historian and divine, was born at Duns in Berwickshire in November 1772. He studied in Edinburgh University, and in 1796 he was ordained minister of the Second Associate Congregation, Edinburgh. In 1806, however, with some others M'Crie seceded from the "general associate synod," and formed the "constitutional associate presbytery," afterwards merged in the "original seceders." He was consequently deposed by the associate synod, and his congregation withdrew with him and built another place of worship in which he officiated until his death. M'Crie devoted himself to investigations into the history, constitution and polity of the churches of the Reformation; and the first-fruits of his study were given to the public in November 1811 as *The Life of John Knox, containing Illustrations of the History of the Reformation in Scotland*, which procured for the author the degree of D.D. from Edinburgh University, an honour conferred then for the first time upon a Scottish dissenting minister. This work, of great learning and value, exercised an important influence on public opinion at the time.

At the solicitation of his friend Andrew Thomson, M'Crie became a contributor to *The Edinburgh Christian Instructor*, and in 1817 he subjected some of Sir W. Scott's works to a criticism which took the form of a vindication of the Covenanters. Preserving the continuity of his historical studies, he followed up his first work with *The Life of Andrew Melville* (1819). In 1827 he published a *History of the Progress and Suppression of the Reformation in Italy*, and in 1829 a *History of the Progress and Suppression of the Reformation in Spain*.

His latest literary undertaking was a life of John Calvin. Only three chapters were completed when the writer died on the 5th of August 1835, leaving four sons and one daughter.

See Thomas M'Crie (1797–1875), *Life of T. M'Crie* (1840), and Hugh Miller, *My Schools and Schoolmasters* (1869).

MACCULLAGH, JAMES (1809–1847), Irish mathematician and physicist, was born in 1809, near Strabane, Ireland. After a brilliant career at Trinity College, Dublin, he was elected fellow in 1832. From 1832 to 1843 he held the chair of mathematics; and during his tenure of this post he improved in a most marked manner the position of his university as a mathematical centre. In 1843 he was transferred to the chair of natural philosophy. Overwork, mainly on subjects beyond the natural range of his powers, induced mental disease; and he died by his own hand in October 1847.

His *Works* were published in 1880. Their distinguishing feature is the geometry—which has rarely been applied either to pure space problems or to known physical questions such as the rotation of a rigid solid or the properties of Fresnel's wave-surface with such singular elegance; in this respect his work takes rank with that of Louis Poinsot. One specially remarkable geometrical discovery of MacCullagh's is that of the "modular generation of surfaces of the second degree"; and a noteworthy contribution to physical optics is his "theorem of the polar plane." But his methods, which, in less known subjects, were almost entirely tentative, were altogether inadequate to the solution of the more profound physical problems to which his attention was mainly devoted, such as the theory of double refraction, &c. See G. G. Stokes's "Report on Double Refraction" (*B. A. Report*, 1862).

MACCULLOCH, HORATIO (1805–1867), Scottish landscape painter, was born in Glasgow. He studied for a year under John Knox, a Glasgow landscapist of some repute, was then engaged at Cumnock, painting the ornamental lids of snuff-boxes, and afterwards employed in Edinburgh by Lizars, the engraver, to colour the illustrations in Selby's *British Birds* and similar works. Meanwhile he was working unweariedly from nature, greatly influenced in his early practice by the water-colours of H. W. Williams. Returning to Glasgow in some four or five years, he was employed on several large pictures for the decoration of a public hall in St George's Place, and he did a little as a theatrical scene-painter. About this time he was greatly impressed with a picture by Thomson of Duddingston. Gradually MacCulloch asserted his individuality, and formed his own style on a close study of nature; his works form an interesting link between the old world of Scottish landscape and the new. In 1829 MacCulloch first figured in the Royal Scottish Academy's exhibition, and year by year, till his death on the 24th of June 1867, he was a regular exhibitor. In 1838 he was elected a member of the Scottish Academy. The subjects of his numerous landscapes were taken almost exclusively from Scottish scenery

Several works by MacCulloch were engraved by William Miller and William Forrest, and a volume of photographs from his landscapes, with an excellent biographical notice of the artist by Alexander Fraser, R.S.A., was published in Edinburgh in 1872.

McCULLOCH, HUGH (1808–1895), American financier, was born at Kennebunk, Maine, on the 7th of December 1808. He was educated at Bowdoin College, studied law in Boston, and in 1833 began practice at Fort Wayne, Indiana. He was cashier and manager of the Fort Wayne branch of the old state bank of Indiana from 1835 to 1857, and president of the new state bank from 1857 to 1863. Notwithstanding his opposition to the National Banking Act of 1862, he was selected by Secretary Chase as comptroller of the currency in 1863 to put the new system into operation. His work was so successful that he was appointed secretary of the treasury by President Lincoln in 1865, and was continued in office by President Johnson until the close of his administration in 1869. In his first annual report, issued on the 4th of December 1865, he strongly urged the retirement of the legal tenders or greenbacks as a preliminary to the resumption of specie payments. In accordance with this suggestion an act was passed, on the 12th of March 1866, authorizing the retirement of not more than $10,000,000 in six months and not more than $4,000,000 per month thereafter, but it met with strong opposition and was repealed on the 4th of February 1868, after only $48,000,000 had been retired. He was much disappointed by the decision of the United States Supreme Court upholding the constitutionality of the legal tenders (12 Wallace 457). Soon after the close of his term of office McCulloch went to England, and spent six years (1870–1876) as a member of the banking firm of Jay Cooke, McCulloch & Co. From October 1884 until the close of President Arthur's term of office in March 1885 he was again secretary of the treasury. He died at his home near Washington, D.C., on the 24th of May 1895.

The chief authority for the life of McCulloch is his own book, *Men and Measures of Half a Century* (New York, 1888).

M'CULLOCH, SIR JAMES (1819–1893), Australian statesman, was born in Glasgow. He entered the house of Dennistoun Brothers, became a partner, and went to Melbourne to open a branch. In 1854, shortly after his arrival in Victoria, he was appointed a nominee member of the Legislative Council, and in the first Legislative Assembly under the new constitution was returned for the electorate of the Wimmera. In 1857 he was appointed minister of trade and customs in the second ministry of Haines, which lasted till 1858, and subsequently he became treasurer in the Nicholson administration, which held office from October 1859 to November 1860. In June 1862 the third O'Shanassy ministry was defeated by a combination between a section of its supporters led by M'Culloch and the opposition proper under Heales, and M'Culloch became premier and chief secretary. Hitherto he had been regarded as a supporter of the landed, squatting and importing interests, but the coalition ministry introduced a number of measures which at the time were regarded by the propertied classes in the colony as revolutionary. In addition to passing a Land Bill, which extended the principle of free selection and deferred payments, the ministry announced their intention of reducing the duties on the export of gold and the import duties upon tea and sugar, and of supplying the deficiency by the imposition of duties ranging from 5 to 10% upon a number of articles which entered into competition with the local industries, thus introducing protection. The mercantile community took alarm at the proposal, and at the general election of 1864 the ministerial policy was warmly opposed. But a majority was returned in its favour, and a new tariff was carried through the popular branch of the legislature. There was no probability of its being assented to by the Council, which, under the constitution, had the power of rejecting, although it could not amend, any money Bill. The government therefore decided upon tacking the tariff to the Appropriation Bill, and compelling the Council either to agree to the new fiscal proposals or to refuse to pay the public creditors and the civil servants. The Council accepted the challenge, and rejected the Appropriation Bill. But M'Culloch and his colleagues would not give way. They continued to collect the new duties under the authority of the Assembly, and took advantage of a clause in the Audit Act which directed the governor to sign the necessary warrants for the payment of any sum awarded by verdicts in the supreme court in favour of persons who had sued the government. M'Culloch borrowed £40,000 from the London Chartered Bank, of which he was a director, to meet pressing payments, and the bank at his instigation sued the government for the amount of the advance. The attorney-general at once accepted judgment, and the governor, who had placed himself unreservedly in the hands of his ministers, signed the necessary warrant, and the Treasury repaid to the bank the amount of its advance, plus interest and costs. In the next session the tariff was again sent up to the Council, which promptly rejected it, whereupon the ministry dissolved the assembly and appealed to the country. The result of the general election was to increase M'Culloch's majority, and the tariff was again sent to the Council, only to be again rejected. M'Culloch resigned, but no member of the opposition was willing to form a ministry, and he resumed office. Eventually a conference between the two houses was held, and the Council passed the tariff, after a few modifications in it had been agreed to by the Assembly. Just at the moment that peace was restored, the governor, Sir Charles Darling, was recalled by the home government, on the ground that he had displayed partisanship by assisting M'Culloch's government and their majority in the Assembly to coerce the Council. In order to show their gratitude to the dismissed governor, the Assembly decided to grant a sum of £20,000 to Lady Darling. The home government intimated that Sir Charles Darling must retire from the Colonial service if this gift were accepted by his wife, but M'Culloch included the money in the annual Appropriation Bill, with the result that it was rejected by the Council. The new governor, Viscount Canterbury, was less complaisant than his predecessor, but after an unsuccessful attempt to obtain other advisers, he agreed to recommend the Council to pass the Appropriation Bill with the £20,000 grant included. The Upper House declined to adopt this course, and again rejected the Bill. A long and bitter struggle between the two Chambers ended in another general election in 1868, which still further increased the ministerial majority; but Lord Canterbury, in obedience to instructions from the colonial office, declined to do anything to facilitate the passage of the Darling grant. M'Culloch resigned, and after protracted negotiations Sir Charles Sladen formed from the minority in the Assembly a ministry which only lasted two months. The deadlock seemed likely to become more stringent than ever, when a communication was received from Sir Charles Darling, that neither he nor his wife could receive anything like a donation from the people of Victoria. The attempt to pass the grant was therefore abandoned, and in July 1868 M'Culloch resumed office with different colleagues, but resigned in the following year, when he was knighted. He formed a third ministry in 1870. During this third administration he passed a measure through both Houses which secured a life annuity of £1000 per annum to Lady Darling. Additional taxation being necessary, Sir James M'Culloch was urged by his protectionist supporters to increase the import duties, but he refused, and proposed to provide for the deficit by levying a tax upon town, suburban and country property. This proposal was defeated in the Assembly; Sir James resigned in June 1871, and was appointed agent-general for Victoria in London. He held that appointment till 1873, was created K.C.M.G. in 1874, returned to the colony the same year, and in 1875 formed his fourth and last ministry, which kept power till May 1877, when his party was defeated at the general election. During his eighteen months of office he had to encounter a persistent opposition from Berry and his followers, who systematically obstructed the business of the Assembly, on the ground that the acting-governor, Sir William Stawell, had improperly refused a dissolution. Sir James M'Culloch, to counteract this obstruction, invented the closure, which was afterwards introduced with some modifications into the house of commons. After his defeat in 1877 Sir James retired from public life and returned to England, where he died on the 30th of January 1893 at Ewell, Surrey. He was twice married—first, in 1841, to Susan, daughter of the Rev. James Renwick, of Muirton, Scotland; secondly, in 1867, to Margaret, daughter of William Inglis, of Walflat, Dumbartonshire. He left the house of Dennistoun Brothers in 1862, and founded a new firm at Melbourne in conjunction with Leishman, Inglis & Co. of London, under the title of M'Culloch, Sellars & Co. He held several important commercial positions, and was president of the Melbourne Chamber of Commerce. (G. C. L.)

MACCULLOCH, JOHN (1773–1835), Scottish geologist, descended from the Maccullochs of Nether Ardwell in Galloway, was born in Guernsey, on the 6th of October 1773, his mother being a native of that island. Having displayed remarkable powers as a boy, he was sent to study medicine in the university of Edinburgh, where he qualified as M.D in 1793, and then entered the army as assistant surgeon. Attaching himself to the artillery, he became chemist to the board of ordnance (1803) He still continued, however, to practise for a time as a physician, and during the years 1807–1811 he resided at Blackheath. In 1811 he communicated his first papers to the Geological Society. They were devoted to an elucidation of the geological structure of Guernsey, of the Channel Islands, and of Heligoland. The evidence they afforded of his capacity, and the fact that he already had received a scientific appointment, probably led to his being selected in the same year to make some geological and mineralogical investigations in Scotland. He was asked to report upon stones adapted for use in powder-mills, upon the suitability of the chief Scottish mountains for a repetition of the pendulum experiments previously conducted by Maskelyne and Playfair at Schiehallion, and on the deviations of the plumb-line along the meridian of the Trigonometrical Survey. In the course of the explorations necessary for the purposes of these reports he made extensive observations on the geology and mineralogy of Scotland. He formed also a collection of the mineral productions and rocks of that country, which he presented to the Geological Society in 1814. In that year he was appointed geologist to the Trigonometrical Survey; and in 1816–1817 he was president of the Geological Society. Comparatively little had been done in the investigation of Scottish geology, and finding the field so full of promise, he devoted himself to its cultivation with great ardour. One of his most important labours was the examination of the whole range of islands along the west of Scotland, at that time not easily visited, and presenting many obstacles to a scientific explorer. The results of this survey appeared (1819) in the form of his *Description of the Western Islands of Scotland, including the Isle of Man* (2 vols. 8vo, with an atlas of plates in 4to), which forms one of the classical treatises on British geology. He was elected F.R.S. in 1820. He continued to write papers, chiefly on the rocks and minerals of Scotland, and had at last gathered so large an amount of information that the government was prevailed upon in the year 1826 to employ him in the preparation of a geological map of Scotland. From that date up to the time of his death he returned each summer to Scotland and traversed every district of the kingdom, inserting the geological features upon Arrowsmith's map, the only one then available for his purpose. He completed the field-work in 1832, and in 1834 his map and memoir were ready for publication, but these were not issued until 1836, the year after he died. Among his other works the following may be mentioned: *A Geological Classification of Rocks with Descriptive Synopses of the Species and Varieties, comprising the Elements of Practical Geology* (1821); *The Highlands and Western Isles of Scotland*, in a series of letters to Sir Walter Scott (4 vols. 1824); *A System of Geology, with a Theory of the Earth and an Examination of its Connexion with the Sacred Records* (2 vols. 1831). During a visit to Cornwall he was killed by being dragged along in the wheel of his carriage, on the 21st of August 1835.

In penning an obituary notice, C. Lyell in 1836 (*Proc. Geol. Soc.* ii. 357) acknowledged "with gratitude" that he had "received more instruction from Macculloch's labours in geology than from those of any living writer"

M'CULLOCH, JOHN RAMSAY (1789–1864), British economist and statistician, was born on the 1st of March 1789 at Whithorn in Wigtownshire. His family belonged to the class of "statesmen," or small landed proprietors. He was for some time employed at Edinburgh as a clerk in the office of a writer to the signet. But, the *Scotsman* newspaper having been established at the beginning of 1817, M'Culloch sent a contribution to the fourth number, the merit of which was at once recognized; he soon became connected with the management of the paper, and during 1818 and 1819 acted as editor. Most of his articles related to questions of political economy, and he delivered lectures in Edinburgh on that science. He now also began to write on subjects of the same class in the *Edinburgh Review*, his first contribution being an article on Ricardo's *Principles of Political Economy* in 1818. Within the next few years he gave both public lectures and private instruction in London on political economy. In 1823 he was chosen to fill the lectureship established by subscription in honour of the memory of Ricardo A movement was set on foot in 1825 by Jeffrey and others to induce the government to found in the university of Edinburgh a chair of political economy, separate from that of moral philosophy, the intention being to obtain the appointment for M'Culloch This project fell to the ground, but in 1828 he was made professor of political economy in London University. He then fixed his residence permanently in London, where he continued his literary work, being now one of the regular writers in the *Edinburgh Review* In 1838 he was appointed comptroller of the stationery office, the duties of this position, which he held till his death, he discharged with conscientious fidelity, and introduced important reforms in the management of the department Sir Robert Peel, in recognition of the services he had rendered to political science, conferred on him a literary pension of £200 per annum. He was elected a foreign associate of the Institute of France (*Académie des sciences morales et politiques*). He died in London, after a short illness, on the 11th of November 1864, in the seventy-sixth year of his age. To his personal character and social qualities very favourable testimony was borne by those who knew him best. In general politics he always remained a Whig pure and simple; though he was in intimate relations with James Mill and his circle, he never shared the Radical opinions of that group.

M'Culloch cannot be regarded as an original thinker on political economy He did not contribute any new ideas to that science, or introduce any noteworthy correction of the views, either as to method or doctrine, generally accepted by the dominant school of his day. But the work he did must be pronounced, in relation to the wants of his time, a very valuable one His name will probably be less permanently associated with anything he has written on economic science, strictly so called, than with his great statistical and other compilations. His *Dictionary of Commerce and Commercial Navigation* (1832) and his *Statistical Account of the British Empire* (1837) remain imposing monuments of his extensive and varied knowledge and his indefatigable industry. Another useful work of reference, also the fruit of wide erudition and much labour, is his *Literature of Political Economy* (1845) Though weak on the side of the foreign literature of the science, it is very valuable as a critical and biographical guide to British writers.

McCULLOUGH, JOHN EDWARD (1837–1885), American actor, was born in Coleraine, Ireland, on the 2nd of November 1837 He went to America at the age of sixteen, and made his first appearance on the stage at the Arch Street Theatre, Philadelphia, in 1857 In support of Edwin Forrest and Edwin Booth he played second rôles in Shakespearian and other tragedies, and Forrest left him by will all his prompt books. Virginius was his greatest success, although even in this part and as Othello he was coldly received in England (1881) In 1884 he broke down physically and mentally, and he died in an asylum at Philadelphia on the 8th of November 1885.

MACCUNN, HAMISH (1868–), Scottish musical composer, was born at Greenock, the son of a shipowner, and was educated at the Royal College of Music. His first success was with the overture *Land of the Mountain and Flood* in 1887 at the Crystal Palace, and this was followed by other compositions. with a characteristic Scottish colouring. From 1888 to 1894 he was a professor at the Royal College of Music, and this latter year saw both his marriage to a daughter of John Pettie, R.A., and the production of his opera *Jeanie Deans* at Edinburgh. He was for some years conductor to the Carl Rosa Opera company, and subsequently to other companies. His opera *Diarmid* was produced at Covent Garden in 1897, and his other music includes cantatas, overtures, part-songs, instrumental pieces, and songs, all markedly Scottish in type.

MACDONALD, FLORA (1722–1790), Jacobite heroine, was the daughter of Ranald Macdonald of Milton in the island of South Uist in the Hebrides, and his wife Marion the daughter of Angus Macdonald, minister of South Uist Her father died when she was a child, and her mother was abducted and married by Hugh Macdonald of Armadale. She was brought up under the care of the chief of her clan, Macdonald of Clanranald, and was partly educated in Edinburgh. In June 1746 she was living in Benbecula in the Hebrides when Prince Charles Edward (*q.v.*) took refuge there after the battle of Culloden. The prince's companion, Captain O'Neill, sought her help. The island was held for the government by the local militia, but the secret sympathies of the Macdonalds were with the Jacobite cause. After some hesitation Flora promised to help. At a later period she told the duke of Cumberland, son of George III. and commander-in-chief in Scotland, that she acted from charity and would have helped him also if he had been defeated and in distress, a statement which need not be accepted as quite literally true. The commander of the militia in the island, a Macdonald, who was probably admitted into the secret, gave her a pass to the mainland for herself, a manservant, an Irish spinning maid, Betty Burke, and a boat's crew of six men. The prince was disguised as Betty Burke. After a first repulse at Waternish, the party landed at Portree. The prince was hidden in a cave while Flora Macdonald found help for him in the neighbourhood, and was finally able to escape. He had left Benbecula on the 27th of June. The talk of the boatmen brought suspicion on Flora Macdonald, and she was arrested and brought to London. After a short imprisonment in the Tower, she was allowed to live outside of it, under the guard of a "messenger" or gaoler. When the Act of Indemnity was passed in 1747 she was left at liberty. Her courage and loyalty had gained her general sympathy, which was increased by her good manners and gentle character. Dr Johnson, who saw her in 1773, describes her as "a woman of soft features, gentle manners and elegant presence." In 1750 she married Allen Macdonald of Kingsburgh, and in 1773 they emigrated to America. In the War of Independence he served the British government and was taken prisoner. In 1779 his wife returned home in a merchant ship which was attacked by a privateer She refused to leave the deck during the action, and was wounded in the arm. She died on the 5th of March 1790. There is a statue to her memory in Inverness. Flora Macdonald had a large family of sons, who mostly entered the army or navy, and two daughters.

See A. C Ewald, *Life and Times of Prince Charles Edward* (1886). The so-called *Autobiography* of Flora Macdonald, published by her grand-daughter F. F. Walde (1870) is of small value.

MACDONALD, GEORGE (1824–1905), Scottish novelist and poet, was born at Huntly, Aberdeenshire. His father, a farmer. was one of the Macdonalds of Glencoe, and a direct descendant of one of the families that suffered in the massacre Macdonald's youth was passed in his native town, under the immediate influence of the Congregational Church, and in an atmosphere strongly impregnated with Calvinism. He took his degree at Aberdeen University, and migrated thence to London, studying at Highbury College for the Congregational ministry In 1850 he was appointed pastor of Trinity Congregational Church, Arundel, and, after resigning his cure there, was engaged in ministerial work in Manchester His health, however, was unequal to the strain, and after a short sojourn in Algiers he settled in London and adopted the profession of literature. In 1856 he published his first book, *Within and Without*, a dramatic poem, following it in 1857 with a volume of *Poems*, and in 1858 by the delightful "faerie romance" *Phantastes*. His first conspicuous success was achieved in 1862 with *David Elginbrod*, the forerunner of a number of popular novels, which include *Alec Forbes of Howglen* (1865), *Annals of a Quiet Neighbourhood* (1866), *Robert Falconer* (1868), *Malcolm* (1875), *The Marquis of Lossie* (1877), and *Donal Grant* (1883) He was for a time editor of *Good Words for the Young*, and lectured successfully in America in 1872–1873 He wrote admirable stories for the young, and published some volumes of sermons. In 1877 he was given a civil list pension. He died on the 18th of September 1905.

Both as preacher and as lecturer on literary topics George Macdonald's sincerity and moral enthusiasm exercised great influence upon thoughtful minds. His verse is homely and direct, and marked by religious fervour and simplicity. As a portrayer of Scottish peasant-life in fiction he was the precursor of a large school, which has benefited by his example and surpassed its original leader in popularity The religious tone of his novels is relieved by tolerance and a broad spirit of humour, and the simpler emotions of humble life are sympathetically treated.

MACDONALD, SIR HECTOR ARCHIBALD (1852–1903), British soldier, was born of humble parentage at Muir of Allan-Grange, Ross-shire, Scotland, in 1852. As a boy he was employed in a draper's shop at Dingwall, but in 1870 he enlisted in the 92nd (Gordon) Highlanders. He rose rapidly through the non-commissioned ranks, and had already been a colour-sergeant for some years when, in the Afghan War of 1879, he distinguished himself in the presence of the enemy so much as to be promoted to commissioned rank, his advancement being equally acceptable to his brother officers and popular with the rank and file. As a subaltern he served in the first Boer War of 1880–81, and at Majuba, where he was made prisoner, his bravery was so conspicuous that General Joubert gave him back his sword. In 1885 he served under Sir Evelyn Wood in the reorganization of the Egyptian army, and he took part in the Nile Expedition of that year. In 1888 he became a regimental captain in the British service, but continued to serve in the Egyptian army, being particularly occupied with the training of the Sudanese battalions. In 1889 he received the D.S.O. for his conduct at Toski and in 1891, after the action at Tokar, he was promoted substantive major. In 1896 he commanded a brigade of the Egyptian army in the Dongola Expedition, and during the following campaigns he distinguished himself in every engagement, above all in the final battle of Omdurman (1898) at the crisis of which Macdonald's Sudanese brigade, manœuvring as a unit with the coolness and precision of the parade ground, repulsed the most determined attack of the Mahdists. After this great service Macdonald's name became famous in England and Scotland, the popular sobriquet of "Fighting Mac" testifying the interest aroused in the public mind by his career and his soldierly personality He was promoted colonel in the army and appointed an aide-de-camp to the queen, and in 1899 he was promoted major-general and appointed to a command in India. In December 1899 he was called to South Africa to command the Highland Brigade, which had just suffered very heavily and had lost its commander, Major-General A. G Wauchope, in the battle of Magersfontein. He commanded the brigade throughout Lord Roberts's Paardeberg, Bloemfontein and Pretoria operations, and in 1901 he was made a K.C. B In 1902 he was appointed to command the troops in Ceylon, but early in the following year (March 25, 1903) he committed suicide in Paris. A memorial to this brilliant soldier, in the form of a tower 100 ft. high, was erected at Dingwall and completed in 1907.

MACDONALD, JACQUES ÉTIENNE JOSEPH ALEXANDRE (1765–1840), duke of Taranto and marshal of France, was born at Sedan on the 17th of November 1765. His father came of an old Jacobite family, which had followed James II. to France, and was a near relative of the celebrated Flora Macdonald In 1785 Macdonald joined the legion raised to support the revolutionary party in Holland against the Prussians, and after it was disbanded he received a commission in the regiment of Dillon. On the breaking out of the Revolution, the regiment of Dillon remained eminently loyal, with the exception of Macdonald, who was in love with Mlle Jacob, whose father was enthusiastic for the doctrines of the Revolution. Directly after his marriage he was appointed aide-de-camp to General Dumouriez. He distinguished himself at Jemmapes, and was promoted colonel in 1793 He refused to desert to the Austrians with Dumouriez, and as a reward was made general of brigade, and appointed to command the leading brigade in Pichegru's invasion of Holland. His knowledge of the country proved most useful, and he was instrumental in the capture of the Dutch fleet by French hussars. In 1797, having been made general of division, he served first in the army of the Rhine and then in that of Italy When he reached Italy, the peace of Campo Formio had been signed, and Bonaparte had returned to France; but, under the direction of Berthier, Macdonald first occupied Rome, of which he was made governor, and then in conjunction with Championnet he defeated General Mack, and revolutionized the kingdom of Naples under the title of the Parthenópaean Republic. When Suvarov invaded northern Italy, and was winning back the conquests of Bonaparte, Macdonald collected all the troops in the peninsula and moved northwards. With but 30,000 men he attacked, at the Trebbia, Suvarov with 50,000, and after three days' fighting, during which he held the Russians at bay, and gave time for Moreau to come up, he retired in good order to Genoa. After this gallant behaviour he was made governor of Versailles, and acquiesced, if he did not co-operate, in the events of the 18th Brumaire. In 1800 he received the command of the army in Switzerland which was to maintain the communications between the armies of Germany and of Italy. He carried out his orders to the letter, and at last, in the winter of 1800–1, he was ordered to march over the Splügen Pass. This achievement is fully described by Mathieu Dumas, who was chief of his staff, and is at least as noteworthy as Bonaparte's famous passage of the St Bernard before Marengo, though followed by no such successful battle. On his return to Paris Macdonald married the widow of General Joubert, and was appointed French plenipotentiary in Denmark. Returning in 1805 he associated himself with Moreau and incurred the dislike of Napoleon, who did not include him in his first creation of marshals. Till 1809 he remained without employment, but in that year Napoleon gave him the command of a corps and the duties of military adviser to the young prince Eugène Beauharnais, viceroy of Italy. He led the army from Italy till its junction with Napoleon, and at Wagram commanded the celebrated column of attack which broke the Austrian centre and won the victory. Napoleon made him marshal of France on the field of battle, and presently created him duke of Taranto. In 1810 he served in Spain, and in 1812 he commanded the left wing of the grand army for the invasion of Russia. In 1813, after sharing in the battles of Lützen and Bautzen, he was ordered to invade Silesia, where Blücher defeated him with great loss at the Katzbach (see NAPOLEONIC CAMPAIGNS) After the terrible battle of Leipzig he was ordered with Prince Poniatowski to cover the evacuation of Leipzig, after the blowing up of the bridge, he managed to swim the Elster, while Poniatowksi was drowned. During the defensive campaign of 1814 Macdonald again distinguished himself; he was one of the marshals sent by Napoleon to take his abdication in favour of his son to Paris. When all were deserting their old master, Macdonald remained faithful to him. He was directed by Napoleon to give in his adherence to the new régime, and was presented by him with the sabre of Murad Bey for his fidelity At the Restoration he was made a peer of France and knight grand cross of the order of St Louis, he remained faithful to the new order of things during the Hundred Days. In 1815 he became chancellor of the Legion of Honour (a post he held till 1831), in 1816 major-general of the royal bodyguard, and he took a great part in the discussions in the House of Peers, voting consistently as a moderate Liberal. In 1823 he married Mlle de Bourgony, by whom he had a son, Alexander, who succeeded on his death in 1840 as duke of Taranto. From 1830 his life was spent in retirement at his country place Courcelles-le-Roi (Seine et Oise), where he died on the 7th of September 1840.

Macdonald had none of that military genius which distinguished Davout, Masséna and Lannes, nor of that military science conspicuous in Marmont and St Cyr, but nevertheless his campaign in Switzerland gives him a rank far superior to such mere generals of division as Oudinot and Dupont This capacity for independent command made Napoleon, in spite of his defeats at the Trebbia and the Katzbach, trust him with large commands till the end of his career. As a man, his character cannot be spoken of too highly, no stain of cruelty or faithlessness rests on him.

Macdonald was especially fortunate in the accounts of his military exploits, Mathieu Dumas and Ségur having been on his staff in Switzerland. See Dumas, *Événements militaires*, and Ségur's rare tract, *Lettre sur la campagne du Général Macdonald dans les Grisons en 1800 et 1801* (1802), and *Éloge* (1842) His memoirs were published in 1892 (Eng. trans., *Recollections of Marshal Macdonald*), but are brief and wanting in balance.

MACDONALD, SIR JOHN ALEXANDER (1815–1891), first premier of the dominion of Canada, was born in Glasgow on the 11th of January 1815, the third child of Hugh Macdonald (d. 1841), a native of Sutherlandshire. The family emigrated to Canada in 1820, settling first at Kingston, Ontario. At the age of fifteen Macdonald entered a law office; he was called to the bar in 1836, and began practice in Kingston, with immediate success. Macdonald entered upon his active career at a critical period in the history of Canada, and the circumstances of the time were calculated to stimulate political thought. It was the year before the rebellion of 1837; the condition of the whole country was very unsettled; and it seemed well-nigh impossible to reconcile differences arising from racial and political antagonisms. During the rebellion young Macdonald volunteered for active service, but his military career never went farther than drilling and marching. The mission of Lord Durham; the publication of his famous report; the union of the two Canadas; the administrations of Lord Sydenham, Sir Charles Bagot, and Sir Charles Metcalfe, filled the years immediately succeeding 1837 with intense political interest, and in their results have profoundly influenced the constitution of the British Empire.

Macdonald made his first acquaintance with public business as an alderman of Kingston. In 1844 Sir Charles Metcalfe, in his contest with the Reform party led by Baldwin and Lafontaine, appealed to the electors, and Macdonald was elected to the provincial assembly as Conservative member for Kingston. A sentence in his first address to the electors strikes the dominant note of his public career: "I therefore need scarcely state my firm belief that the prosperity of Canada depends upon its permanent connexion with the mother country, and that I shall resist to the utmost any attempt (from whatever quarter it may come) which may tend to weaken that union." He took his seat on the 28th of November as a supporter of the Draper government. During the first three or four years he spoke little, but devoted himself with assiduity to mastering parliamentary forms and the business of the house. His capacity soon attracted attention, and in 1847 he was made receiver-general with a seat in the executive council, an office soon exchanged for the more important one of commissioner of Crown-lands. Although the government of which he thus became a member held office for only ten months, being placed in a hopeless minority on making an appeal to the country, Macdonald from this time forward took a position of constantly increasing weight in his party.

One of the first acts of the Reform government which succeeded that of which Macdonald was a member was to pass the Rebellion Losses Bill, made famous in colonial history by the fact that it brought to a crucial test the principle of responsible government. The assent of Lord Elgin to the bill provoked in Montreal a riot which ended in the burning of the houses of parliament, and so great was the indignation of the hitherto ultra-loyal Conservative party that many of its most prominent members signed a document favouring annexation to the United States; Macdonald on the other hand took steps, in conjunction with others, to form a British-American league, having for its object the confederation of all the provinces, the strengthening of the connexion with the mother country, and the adoption of a national commercial policy. He remained in opposition from 1848 till 1854, holding together under difficult circumstances an unpopular party with which he was not entirely in sympathy. The two great political issues of the time were the secularization of the clergy reserves in Ontario, and the abolition of seigniorial tenure in Quebec. Both of these reforms Macdonald long opposed, but when successive elections had proved that they were supported by public opinion, he brought about a coalition of Conservatives and moderate reformers for the purpose of carrying them.

Out of this coalition was gradually developed the Liberal-conservative party, of which until his death Macdonald continued to be the most considerable figure, and which for more than forty years largely moulded the history of Canada. From 1854 to 1857 he was attorney-general of Upper Canada, and then, on the retirement of Colonel Taché, he became prime minister This first coalition had now accomplished its temporary purpose, but so closely were parties divided at this period, that the defeat and reinstatement of governments followed each other in rapid succession.

The experiment of applying responsible government on party lines to the two Canadian provinces at last seemed to have come to a deadlock. Two general elections and the defeat of four ministries within three years had done nothing to solve the difficulties of the situation. At this critical period a proposal was made for a coalition of parties in order to carry out a broad scheme of British-American confederation. The immediate proposal is said to have come from George Brown; the large political idea had long been advocated by Macdonald and Alexander Galt in Upper Canada—by Joseph Howe and others in the maritime provinces. The close of the American Civil War, the Fenian raids across the American border, and the dangers incident to the international situation, gave a decisive impulse to the movement. Macdonald, at the head of a representative delegation from Ontario and Quebec, met the public men of the maritime provinces in conference at Charlottetown in 1864, and the outline of confederation then agreed upon was filled out in detail at a conference held at Quebec soon afterwards. The actual framing of the British North America Act, into which the resolutions of these two conferences were consolidated, was carried out at the Westminster Palace Hotel in London, during December 1866 and January 1867, by delegates from all the provinces working in co-operation with the law officers of the Crown, under the presidency of Lord Carnarvon, then secretary of state for the colonies. Macdonald took the leading part in all these discussions, and he thus naturally became the first premier of the Dominion. He was made a K.C.B. in recognition of his services to the empire.

The difficulties of organizing the new Dominion, the questions arising from diverse claims and the various conditions of the country, called for infinite tact and resource on the part of the premier. Federal rights were to be safeguarded against the provincial governments, always jealous of their privileges. The people of Nova Scotia in particular, dissatisfied with the way in which their province had been drawn into the Union, maintained a fierce opposition to the Ottawa government, until their leader, Joseph Howe, fearing an armed rising, came to an agreement with Macdonald and accepted a seat in his cabinet. The establishment of a supreme court also occupied the attention of Sir John, who had a strong sense of the necessity of maintaining the purity and dignity of the judicial office. The act creating this court was finally passed during the administration of Alexander Mackenzie. The pledge made at confederation with regard to the building of the Intercolonial railway to connect the maritime provinces with those of the St Lawrence was fulfilled. The North-West Territories were secured as a part of confederated Canada by the purchase of the rights of the Hudson's Bay Company, and the establishment of Manitoba as a province in 1870. Canada's interests were protected during the negotiations which ended in the treaty of Washington in 1871, and in which Sir John took a leading part as one of the British delegates. In this year British Columbia entered the confederation, one of the provisions of union being that a transcontinental railroad should be built within ten years. This was declared by the opposition to be impossible. It was possible only to a leader of indomitable will. Charges of bribery against the government in connexion with the contract for the building of this line led to the resignation of the cabinet in 1874, and for four years Sir John was in opposition. But he was by no means inactive. During the summer of 1876 he travelled through Ontario addressing the people on the subject of a commercial system looking to the protection of native industries. This was the celebrated "National Policy," which had been in his thoughts as long ago as the formation of the British-American League in 1850 The government of Alexander Mackenzie refused to consider a protection policy, and determined to adhere to Free Trade, with a tariff for revenue only On these strongly defined issues the two parties appealed to the people in 1878 The Liberal party was almost swept away, and Sir John, on his return to power, put his policy into effect with a thoroughness that commanded the admiration even of his opponents, who, after long resistance, adopted it on their accession to office in 1896. He also undertook the immediate construction of the Canadian Pacific railway, which had been postponed by the former government The line was begun late in 1880, and finished in November 1885—an achievement which Sir John ranked among his greatest triumphs. "The faith of Sir John," says one of his biographers, "did more to build the road than the money of Mount-Stephen."

During the remaining years of his life his efforts at administration were directed mainly towards the organization and development of the great North-West. From 1878 until his death in 1891 Sir John retained his position as premier of Canada, and his history is practically that of Canada (*q v*) For forty-six years of a stormy political life he remained true to the cardinal policy that he had announced to the electors of Kingston in 1844. "A British subject I was born; a British subject I will die," says his last political manifesto to the people of the Dominion. At his advanced age the anxiety and excitement of the contested election of 1891 proved too great On the 29th of May he suffered a stroke of paralysis, which caused his death eight days later (June 6)

The career of Sir John Macdonald must be considered in connexion with the political history of Canada and the conditions of its government during the latter half of the 19th century Trained in a school where the principles of responsible government were still in an embryonic state, where the adroit management of coalitions and cabals was essential to the life of a political party, and where plots and counterplots were looked upon as a regular part of the political game, he acquired a dexterity and skill in managing men that finally gave him an almost autocratic power among his political followers But great personal qualities supplemented his political dexterity and sagacity A strong will enabled him to overcome the passionate temper which marked his youth, and later in his career a habit of intemperance, which he at first shared with many public men of his time. He was a man of strong ambitions, but these were curbed by a shrewd foresight, which led him for a long time to submit to the nominal leadership of other and smaller men. Politics he made his business, and to this he devoted all his energies. He had the gift of living for the work in hand without feeling the distraction of other interests. He had a singular faculty for reading the minds and the motives of men, and to this insight he perhaps owed the power of adaptability (called by his opponents shiftiness) which characterized his whole career. To this power the successful guidance of the Dominion through its critical formative period must be ascribed Few political leaders have ever had such a number of antagonistic elements to reconcile as presented themselves in the first Canadian parliament after confederation. The man who could manage to rule a congeries of jealous factions, including Irish Catholics and Orangemen, French and English anti-federationists and agitators for independence, Conservatives and Reformers, careful economists and prodigal expansionists, was manifestly a man of unusual power, superior to small prejudices, and without strong bias towards any creed or section. Such a man Macdonald proved himself to be. His personality stands out at this period as the central power in which each faction chiefly reposed trust, and under which it could join hands with the others in the service of the state. His singleness of purpose, personal independence and indomitable energy enabled him to achieve triumphs that to others seemed impossible. His methods cannot always be defended, and were explained by himself only on grounds of necessity and the character of the electorate with which he had to deal. After the "Pacific scandal" of 1874 the leader of the opposite party declared that "John A." (as he was generally called) "has fallen, never to rise again." Yet he not only cleared his own character from the charges laid against him, but succeeded four years later in achieving his most signal party triumph. His natural urbanity allowed him to rule without seeming to rule. When baffled in minor objects he gave way with a good-natured flexibility which brought upon him at times charges of inconsistency Yet Canada has seen statesmen of more contracted view insist on such small points, fall, and drag down their party with them. He lived at a time when the exigencies of state seemed to require the peculiar talents which he possessed Entering politics at the dreariest and least profitable stage in Canadian history, he took the foremost part in the movement which made of Canada a nation, he guided that nation through the nebulous stages of its existence, and left it united, strong and vigorous, a monument to his patriotic and far-sighted statesmanship. His statue adorns the squares of the principal Canadian towns. In the crypt of St Paul's Cathedral a memorial has rightly been placed to him as a statesman, not merely of Canada, but of the empire. In unveiling that memorial Lord Rosebery fitly epitomized the meaning of his life and work when he said "We recognize only this, that Sir John Macdonald had grasped the central idea that the British Empire is the greatest secular agency for good now known to mankind, that that was the secret of his success, and that he determined to die under it, and strove that Canada should live under it." Macdonald became a member of the Imperial Privy Council in 1879, and in 1884 he received the Grand Cross of the Bath. His first wife was his cousin, Miss Isabella Clark, who died in 1858, leaving one surviving son, the Hon. Hugh John Macdonald, at one time premier of the province of Manitoba. By his second marriage, to Miss Bernard in 1867, Macdonald left an only daughter. On his death in 1891 his widow was created Baroness Macdonald of Earnscliffe.

The authorized and fullest biography of Sir John A. Macdonald is one written by his private secretary, Joseph Pope. Others have been written by his nephew, Colonel J Pennington Macpherson, and by J E. Collins. A bright and amusing anecdotal life has been compiled by E. D. Biggar. A condensed biography by G. R. Parkin forms one of the "Makers of Canada" series (Toronto, 1907; new ed., 1909). (G. R. P.)

MACDONALD, JOHN SANDFIELD (1812–1872), Canadian statesman, was born at St Raphael, Glengarry county, Ontario, on the 12th of December 1812. He was admitted to the bar in 1840, and settled in Cornwall. In the same year he married Miss Waggaman, the daughter of an American senator from Louisiana. In 1841 he was elected to the Canadian parliament for Glengarry, which seat he held for sixteen years. In 1842 he joined the Reformers in the cry for constitutional government, and from 1852 to 1854 was Speaker of the house. He was always uncertain in his party allegiance, and often attacked George Brown, the Liberal leader. Indeed, he well described himself as "the Ishmael of parliament" In 1862 he was called on by Lord Monck, the governor-general, to form a ministry, which by manifold shifts held office till February 1864. In the debates on federation he opposed the measure, but on its passage was in 1867 entrusted by the Conservatives with the task of organizing the provincial government of Ontario. He ruled the province with economy and efficiency, but was defeated in December 1871 by the Liberals, resigned the premiership, and died on the 1st of June 1872.

MACDONALD, LAWRENCE (1799–1878), British sculptor, was born at Findo-Gask, Perthshire, Scotland. In early life he served as a mason's apprentice. Having shown an aptitude for stone carving, he became an art student at the Trustees' Academy, Edinburgh. By the help of friends he was enabled to visit Rome, where together with other artists he helped to found the British Academy of Arts. He returned to Edinburgh in 1826. In 1829 he was elected a member of the Scottish Academy. From 1832 until his death his home was in Rome. Among his ideal works may be mentioned "Ulysses and his Dog Argos," "Andromeda chained to the Rock," "Eurydice," "Hyacinth," a "Siren," and a "Bacchante."

MACDONELL, JAMES (1841–1879), British journalist, was born at Dyce, Aberdeenshire. In 1858, after his father's death, he became clerk in a merchant's office. He began writing in the *Aberdeen Free Press*; in 1862 he was appointed to the staff of the *Daily Review* at Edinburgh, and at twenty-two he became editor of the *Northern Daily Express*. In 1865 he went to London to accept a position on the staff of the *Daily Telegraph*, which he retained until 1875, being special correspondent in France in 1870 and 1871. In 1873 he became a leader-writer on *The Times*. He died in London on the 2nd of March 1879. His posthumous *France since the First Empire*, though incomplete, gave a clever and accurate account of the French politics of his time.

MACDONNELL (or MACDONELL), **ALESTAIR** (*i.e.* Alexander) **RUADH** (*c.* 1725–1761), chief of Glengarry, a Scottish Jacobite who has been identified by Andrew Lang as the secret agent "Pickle," who acted as a spy on Prince Charles Edward after 1750. The family were a branch of the clan Macdonald, but spelt their name Macdonnell or Macdonell. His father was John, 12th chief of Glengarry, a violent and brutal man, who is said to have starved his first wife, Alestair's mother, to death on an island in the Hebrides. Alestair ran away to France while a mere boy in 1738, and there entered the Royal Scots, a regiment in the French service. In 1743 he commanded a company in it, and in 1744 was sent to Scotland as a Jacobite agent. In January 1745 he was sent back with messages, and was in France when Prince Charles Edward landed in Scotland. Late in 1745 he was captured at sea while bringing a picquet of the Royal Scots to help the prince. He remained a prisoner in the Tower for twenty-two months, and when released went abroad. In 1744 his father had made a transfer to him of the family estates, which were ruined. Alestair, who still affected to be a Jacobite, lived for a time in great poverty. In 1749 he was in London, and there is good reason to believe that he then offered his services as a spy to the British government, with which he communicated under the name of Pickle. His information enabled British ministers to keep a close watch on the prince and on the Jacobite conspiracies. Though he was denounced by a Mrs Cameron, whose husband he betrayed to death in 1752, he never lost the confidence of the Jacobite leaders. On the death of his father, in 1754, he succeeded to the estates, and proved himself a greedy landlord. He died on the 23rd of December 1761.

See Andrew Lang, *Pickle the Spy* (1897) and *The Companions of Pickle* (1898).

MACDONNELL, SORLEY BOY (*c.* 1505–1590), Scoto-Irish chieftain, son of Alexander Macdonnell, lord of Islay and Kintyre (Cantire), was born at Ballycastle, Co. Antrim. From an ancestor who about a hundred years earlier had married Margaret Bisset, heiress of the district on the Antrim coast known as the Glynns (or Glens), he inherited a claim to the lordship of that territory; and he was one of the most powerful of the Scottish settlers in Ulster whom the English government in the 16th century found difficulty in bringing into subjection. Many attempts were made to drive them out of Ireland, in one of which, about 1550, Sorley Boy Macdonnell was taken prisoner and conveyed to Dublin Castle, where, however, his confinement was brief. The chief rivals of the Macdonnells were the Mac Quillins who dominated the northern portion of Antrim, known as the Route, and whose stronghold was Dunluce Castle, near the mouth of the Bush. Sorley Boy Macdonnell took an active part in the tribal warfare between his own clan and the Mac Quillins; and in 1558, when the latter had been to a great extent overcome, his elder brother James committed to him the lordship of the Route, his hold on which he made good by decisively defeating the Mac Quillins in Glenshesk. Sorley Boy was now too powerful and turbulent to be neglected by Queen Elizabeth and her ministers, who were also being troubled by his great contemporary, Shane O'Neill, and the history of Ulster for the next twenty years consists for the most part of alternating conflict and alliance between Macdonnells and O'Neills, and attempts on the part of the English government to subdue them both. With this object Elizabeth aimed at fomenting the rivalry between the two clans; and she came to terms sometimes with the one and sometimes with the other. Sorley Boy's wife was an illegitimate half-sister of Shane O'Neill; but this did not deter him from leaguing himself with the government against the O'Neills, if by so doing he could obtain a formal recognition of his title to the lands of which he was in actual possession. In 1562 Shane O'Neill paid his celebrated visit to London, where he obtained recognition by Elizabeth of his claims as head of the O'Neills; and on his return to Ireland he attacked the Macdonnells, ostensibly in the English interest. He defeated Sorley Boy near Coleraine in the summer of 1564, in 1565 he invaded the Glynns, and at Ballycastle won a decisive victory, in which James Macdonnell and Sorley Boy were taken prisoners. James soon afterwards died, but Sorley Boy remained O'Neill's captive till 1567, when Shane was murdered by the Macdonnells at Cushendun (see O'NEILL). Sorley Boy then went to Scotland to enlist support, and he spent the next few years in striving to frustrate the schemes of Sir Thomas Smith, and later of the earl of Essex, for colonizing Ulster with English settlers. Sorley Boy was willing to come to terms with the government provided his claims to his lands were allowed, but Essex determined to reduce him to unconditional submission. John Norris was ordered to proceed by sea from Carrickfergus to Rathlin Island, where Sorley Boy's children and valuables, together with the families of his principal retainers, had been lodged for safety; and while the chieftain was himself at Ballycastle, within sight of the island, the women and children were massacred by the English. Sorley Boy retaliated by a successful raid on Carrickfergus and by re-establishing his power in the Glynns and the Route, which the Mac Quillins made ineffectual attempts to recover. Macdonnell's position was still further strengthened by an alliance with Turlough Luineach O'Neill, and by a formidable immigration of followers from the Scottish islands. In 1584 Sir John Perrot determined to make a further effort to subdue the turbulent chieftain. After another expedition to Scotland seeking help, Sorley Boy landed at Cushendun in January 1585, and his followers regained possession of Dunluce Castle. In these circumstances Sir John Perrot opened negotiations with Sorley Boy, who in the summer of 1586 repaired to Dublin and made submission to Elizabeth's representative. He obtained a grant to himself and his heirs of all the Route country between the rivers Bann and Bush, with certain other lands to the east, and was made constable of Dunluce Castle. For the rest of his life Sorley Boy gave no trouble to the English government. He died in 1590, and was buried in Bonamairgy Abbey, at Ballycastle. He is said to have married when over eighty years of age, as his second wife, a daughter of Turlough Luineach O'Neill, a kinswoman of his first wife; and two of his five daughters married members of the O'Neill family. Sorley Boy had several sons by his first marriage, one of whom, Randal, was created earl of Antrim (*q.v.*), and was ancestor of the present holder of that title.

See G. Hill, *An Historical Account of the Macdonnells of Antrim* (London, 1873); Richard Bagwell, *Ireland under the Tudors* (3 vols., London, 1885–1890); *Calendar of State Papers: Carew MSS.* i., ii., (6 vols., 1867–1873); Donald Gregory, *History of the Western Highlands and Isles of Scotland 1493–1625* (London, 1881); Sir J. T. Gilbert, *History of the Viceroys of Ireland* (Dublin, 1865). (R. J. M.)

MACDONOUGH, THOMAS (1786–1825), American sailor, was born in the state of Delaware, his father being an officer of the Continental Army, and entered the United States navy in 1800. During his long service as a lieutenant he took part in the bombardment of Tripoli, and on a subsequent occasion showed great firmness in resisting the seizure of a seaman as an alleged deserter from the British navy, his ship at the time lying under the guns of Gibraltar. When war with England broke out, in 1812, he was ordered to cruise in the lakes between Canada and the United States, with his headquarters on lake Champlain. He was instrumental in saving New York and Vermont from invasion by his brilliant victory of lake Champlain gained, on the 11th of September 1814, with a flotilla of 14 vessels carrying 86 guns, over Captain George Downie's 16 vessels and 92 guns. For this important achievement New York and Vermont granted him estates, whilst Congress gave him a gold medal.

MacDOWELL, EDWARD ALEXANDER (1861–1908), American musical composer, was born in New York City on the 18th of December 1861. His father, an Irishman of Belfast, had emigrated to America shortly before the boy's birth. He had a varied education in music, first under Spanish-American teachers, and then in Europe, at Paris (Debussy being a fellow pupil). Stuttgart, Wiesbaden and Weimar, where he was chiefly influenced by Joachim, Raff and Liszt. From 1879 to 1887 he lived in Germany, teaching and studying, and also appearing as solo pianist at important concerts. In 1884 he married Marian Nevins, of New York. In 1888 he returned to America, and settled in Boston till in 1896 he was made professor of music at Columbia University, New York. He resigned this post in 1904, and in 1905 overwork and insomnia resulted in a complete cerebral collapse. He died on the 24th of January 1908. MacDowell's work gives him perhaps the highest place among American composers. Deeply influenced by modern French models and by German romanticism, full of poetry and "atmosphere," and founded on the "programme," idea of composition, it is essentially creative in the spirit of a searcher after delicate truths of artistic expression. His employment of touches of American folk-song, suggested by Indian themes, is characteristic. This is notably the case with his orchestral *Indian Suite* (1896) and *Woodland Sketches* for the piano. His first concerto, in A minor, for piano and orchestra, and first pianoforte suite, were performed at Weimar in 1882. His works include orchestral suites and "poems," songs, choruses, and various pieces for pianoforte, his own instrument; they are numbered from *op.* 9 to *op.* 62, his first eight numbered works being destroyed by him.

See Lawrence Gilman, *Edward MacDowell* (1906).

McDOWELL, IRVIN (1818–1885), American soldier, was born in Columbus, Ohio, on the 15th of October 1818. He was educated in France, and graduated at the U. S. military academy in 1838. From 1841 to 1845 he was instructor, and later adjutant, at West Point. He won the brevet of captain in the Mexican War, at the battle of Buena Vista, and served as adjutant-general, chiefly at Washington, until 1861, being promoted major in 1856. In 1858–1859 he visited Europe. Whilst occupied in mustering volunteers at the capital, he was made brigadier-general in May 1861, and placed in command during the premature Virginian campaign of July, which ended in the defeat at Bull Run. Under McClellan he became a corps commander and major-general of volunteers (March 1862). When the Peninsular campaign began McDowell's corps was detained against McClellan's wishes, sent away to join in the fruitless chase of "Stonewall" Jackson in the Shenandoah Valley, and eventually came under the command of General Pope, taking part in the disastrous campaign of Second Bull Run. Involved in Pope's disgrace, McDowell was relieved of duty in the field (Sept. 1862), and served on the Pacific coast 1864–68. He became, on Meade's death in November 1872, major-general of regulars (a rank which he already held by brevet), and commanded successively the department of the east, the division of the south, and the division of the Pacific until his retirement in 1882. The latter years of his life were spent in California, and he died at San Francisco on the 4th of May 1885. As a commander he was uniformly unfortunate. Undoubtedly he was a faithful, unselfish and energetic soldier, in patriotic sympathy with the administration, and capable of great achievements. It was his misfortune to be associated with the first great disaster to the Union cause, to play the part of D'Erlon at Quatre-Bras between the armies of Banks and McClellan, and finally to be involved in the catastrophe of Pope's campaign. That he was perhaps too ready to accept great risks at the instance of his superiors is the only just criticism to which his military character was open.

MACDUFF, a police burgh and seaport of Banffshire, Scotland. Pop. (1901), 3431. It lies on the right bank of the mouth of the Deveron, 1 m. E. of Banff and 50¼ m. N.W. of Aberdeen by the Great North of Scotland railway. The site was originally occupied by the fishing village of Doune, but after its purchase by the 1st earl of Fife, about 1732, the name was altered to Macduff by the 2nd earl, who also procured for it in 1783 a royal charter constituting it a burgh. In honour of the occasion he rebuilt the market cross, in front of the parish church. The harbour, safer and more accessible than that of Banff, was constructed by the duke of Fife, and transferred to the burgh in 1898. The inhabitants are chiefly employed in the herring fishery, but there is some boat-building, besides rope-and-sail making, manure works, saw-mills and oilcake mills. A stone bridge across the Deveron communicates with Banff. Good bathing facilities, a bracing climate and a mineral well attract numerous visitors to Macduff every summer. The burgh unites with Banff, Cullen, Elgin, Inverurie, Kintore and Peterhead (the Elgin burghs) in returning one member to parliament.

McDUFFIE, GEORGE (1788–1851), American political leader, was born in Columbia county, Georgia. He was admitted to the bar in 1814, and served in the South Carolina General Assembly in 1818–1821, and in the national House of Representatives in 1821–1834. In 1821 he published a pamphlet in which strict construction and states' rights were strongly denounced; yet in 1832 there were few more uncompromising nullificationists. The change seems to have been gradual, and to have been determined in part by the influence of John C. Calhoun. When, after 1824, the old Democratic-Republican party split into factions, he followed Andrew Jackson and Martin Van Buren in opposing the Panama Congress and the policy of making Federal appropriations for internal improvements. He did not hesitate, however, to differ from Jackson on the two chief issues of his administration: the Bank and nullification. In 1832 he was a prominent member of the South Carolina Nullification Convention, and drafted its address to the people of the United States. He served as governor in 1834–1836, during which time he helped to reorganize South Carolina College. From January 1843 until January 1846 he was a member of the United States Senate. The leading Democratic measures of those years all received his hearty support. McDuffie, like Calhoun, became an eloquent champion of state sovereignty; but while Calhoun emphasized state action as the only means of redressing a grievance, McDuffie paid more attention to the grievance itself. Influenced in large measure by Thomas Cooper, he made it his special work to convince the people of the South that the downfall of protection was essential to their material progress. His argument that it is the producer who really pays the duty of imports has been called the economic basis of nullification. He died at Cherry Hill, Sumter district, South Carolina, on the 11th of March 1851.

MACE (Fr. *masse*, O. Fr. *mace*, connected with Lat. *mateola*, a mallet), originally a weapon of offence, made of iron, steel or latten, capable of breaking through the strongest armour.[1] The earliest *ceremonial* maces, as they afterwards became, though at first intended to protect the king's person, were those borne by the serjeants-at-arms, a royal body-guard established in France by Philip II., and in England probably by Richard I. By the 14th century a tendency towards a more decorative serjeant's mace, encased with precious metals, is noticeable. The history of the civic mace (carried by the serjeants-at-mace) begins about the middle of the 13th century, though no examples of that period are in existence to-day. Ornamented civic maces were considered an infringement of one of the privileges of the king's serjeants, who, according to the Commons' petition in 1344, were alone deemed worthy of having maces enriched with costly metals. This privilege was, however, granted to the serjeants of London, and later to those of York (in 1396), Norwich (in 1403/4) and Chester (in 1506). Maces covered with silver are known to have been used at Exeter in 1387/8; two were bought at Norwich in 1435, and others for Launceston in 1467/8. Several other cities and towns had silver maces in the next century, and in the 16th they were almost universally used. Early in the 15th century the flanged end of the mace, *i.e.* the head of the war mace, was borne uppermost, and the small button with the royal arms in the base. By the beginning of the Tudor period, however, these blade-like flanges, originally made for offence, degenerated into mere ornaments, while the greater importance of the end with the royal arms (afterwards enriched with a cresting) resulted in the reversal of the position. The custom of carrying the flanged end upward did not die out at once: a few maces were made to carry both ways, such as the beautiful pair of Winchcombe silver maces, dating from the end of the 15th century. The Guildford mace is one of the finest of the fifteen specimens of the 15th century. The flanged ends of the maces of this period were often beautifully pierced and decorated. These flanges gradually became smaller, and later (in the 16th and early 17th centuries) developed into pretty projecting scroll-brackets and other ornaments, which remained in vogue till about 1640. The next development in the embellishment of the shaft was the reappearance of these small scroll-brackets on the top, immediately under the head of the mace. They disappear altogether from the foot in the last half of the 17th century, and are found only under the heads, or, in rarer instances, on a knob on the shaft. The silver mace-heads were mostly plain, with a cresting of leaves or flowers in the 15th and 16th centuries. In the reign of James I. they began to be engraved and decorated with heraldic devices, &c. As the custom of having serjeants' maces ceased (about 1650), the large maces, borne before the mayor or bailiffs, came into general use. Thomas Maundy was the chief maker of maces during the Commonwealth. He made the mace for the House of Commons in 1649, which is the one at present in use there, though without the original head with the non-regal symbols, the latter having been replaced by one with regal symbols at the Restoration. There are two maces in the House of Lords, the earliest dating from the reign of William III. The dates of the eight large and massive silver-gilt maces of the serjeants-at-arms, kept in the jewel-house at the Tower of London, are as follows: two of Charles II., two of James II., three of William and Mary, and one of Queen Anne (the cypher of George I. was subsequently added to the latter). All the foregoing are of the type which was almost universally adopted, with slight differences, at the Restoration. The civic maces of the 18th century follow this type, with some modifications in shape and ornamentation. The historic English silver maces of the 18th century include the one of 1753 at Norfolk, Virginia, and that of 1756 of the state of South Carolina, both in the United States of America; two, made in 1753 and 1787, at Jamaica; that of 1791 belonging to the colony of Grenada, and the Speaker's mace at Barbados, dating from 1812; and the silver mace of the old Irish House of Commons, 1765–1766, now in the possession of Lord Massereene and Ferrard.

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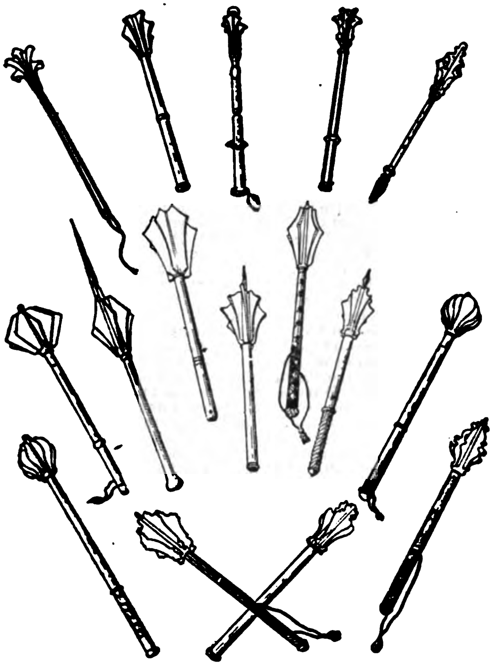
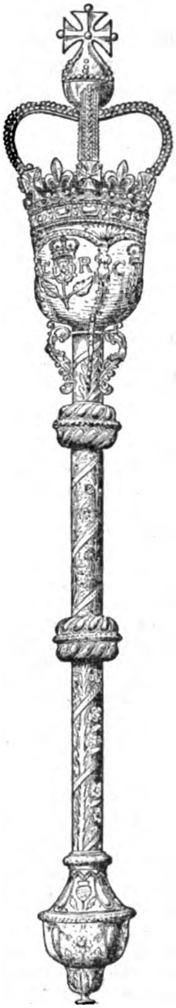
[1] The mace was carried in battle by medieval bishops (Odo of Bayeux is represented on the Bayeux tapestry as wielding one) instead of the sword, so as to conform to the canonical rule which forbade priests to shed blood.—[Ed.]



From Jewitt and Hope's *Corporation Plate and Insignia* (1895), by permission of Bemrose & Co.

FIG. 1.—Group of War Maces of the 15th and 16th centuries.



From Jewitt and Hope's *Corporation Plate and Insignia* (1895), by permission of Bemrose & Co.

FIG. 2.—Mace of the House of Commons.

Among other maces, more correctly described as staves, in use at the present time, are those carried before ecclesiastical dignitaries and clergy in cathedrals and parish churches and the maces of the universities. At Oxford there are three of the second half of the 16th century and six of 1723–1724, while at Cambridge there are three of 1626 and one of 1628, but altered at the Commonwealth and again at the Restoration. The silver mace with crystal globe of the lord high treasurer of Scotland, at Holyrood Palace, was made about 1690 by Francis Garthorne. The remarkable mace or sceptre of the lord mayor of London is of crystal and gold and set with pearls; the head dates from the 15th century, while the mounts of the shaft are early medieval. A mace of an unusual form is that of the Tower ward of London, which has a head resembling the White Tower in the Tower of London, and which was made in the reign of Charles II. The beautiful mace of the Cork gilds, made by Robert Goble of Cork in 1696 for the associated gilds, of which he had been master, is in the Victoria and Albert Museum, where there is also a large silver mace of the middle of the 18th century, with the arms of Pope Benedict XIV., which is said to have been used at the coronation of Napoleon as king of Italy at Milan in 1805.

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MACEDO, JOSÉ AGOSTINHO DE (1761–1831), Portuguese poet and prose writer, was born at Beja of plebeian family, and studied Latin and rhetoric with the Oratorians in Lisbon. He became professed as an Augustinian in 1778, but owing to his turbulent character he spent a great part of his time in prison, and was constantly being transferred from one convent to another, finally giving up the monastic habit to live licentiously in the capital. In 1792 he was unfrocked, but by the aid of powerful friends he obtained a papal brief which secularized him and permitted him to retain his ecclesiastical status. Taking to journalism and preaching he now made for himself a substantial living and a unique position. In a short time he was recognized as the leading pulpit orator of the day, and in 1802 he became one of the royal preachers. Macedo was the first to introduce from abroad and to cultivate didactic and descriptive poetry, the best example of which is his notable transcendental poem *Meditation* (1813). His colossal egotism made him attempt to supersede Camoens as Portugal's greatest poet, and in 1814 he produced *Oriente*, an insipid epic notwithstanding its correct and vigorous verse, dealing with the same subject as the *Lusiads*—Gama's discovery of the sea route to India. This amended paraphrase met with a cold reception, whereupon Macedo published his *Censura dos Lusiadas*, containing a minute examination and virulent indictment of Camoens. Macedo founded and wrote for a large number of journals, and the tone and temper of these and his political pamphlets induced his leading biographer to name him the "chief libeller" of Portugal, though at the time his jocular and satirical style gained him popular favour. An extreme adherent of absolutism, he expended all his brilliant powers of invective against the Constitutionalists, and advocated a general massacre of the opponents of the Miguelite régime. Notwithstanding his priestly office and old age, he continued his aggressive journalistic campaign, until his own party, feeling that he was damaging the cause by his excesses, threatened him with proceedings, which caused him in 1829 to resign the post of censor of books for the Ordinary, to which he had been appointed in 1824. Though his ingratitude was proverbial, and his moral character of the worst, when he died in 1831 he left behind him many friends, a host of admirers, and a great but ephemeral literary reputation. His ambition to rank as the king of letters led to his famous conflict with Bocage (*q.v.*), whose poem *Pena de Talião* was perhaps the hardest blow Macedo ever received. His malignity reached its height in a satirical poem in six cantos, *Os Burros* (1812–1814), in which he pilloried by name men and women of all grades of society, living and dead, with the utmost licence of expression. His translation of the *Odes* of Horace, and his dramatic attempts, are only of value as evidence of the extraordinary versatility of the man, but his treatise, if his it be, *A Demonstration of the Existence of God*, at least proves his possession of very high mental powers. As a poet, his odes on Wellington and the emperor Alexander show true inspiration, and the poems of the same nature in his *Lyra anacreontica*, addressed to his mistress, have considerable merit.

See *Memorias para la vida intima de José Agostinho de Macedo* (ed. Th. Braga, 1899); *Cartas e opusculos* (1900); *Censuras á diversas obras* (1901). (E. Pr.)

MACEDONIA, the name generally given to that portion of European Turkey which is bounded on the N. by the Kara-Dagh mountain range and the frontier of Bulgaria, on the E. by the river Mesta, on the S. by the Aegean Sea and the frontier of Greece, and on the W. by an ill-defined line coinciding with the mountain chains of Shar (ancient *Scardus*) Grammus and Pindus. The Macedonia of antiquity was originally confined to the inland region west of the Axius, between that river and the Scardus range, and did not include the northern portion, known as Paeonia, or the coast-land, which, with the eastern districts, was inhabited by Thracian tribes; the people of the country were not Hellenic. In modern Macedonia are included the vilayet of Salonica (Turk. *Selanik*), the eastern and greater portion of the vilayet of Monastir (sanjaks of Monastir, Servia [Turk. *Selfije*], and part of that of Kortcha), and the south-eastern portion of the vilayet of Kossovo (sanjak of Uskūb). The greater part of Macedonia is inhabited by a Slavonic population, mainly Bulgarian in its characteristics; the coast-line and the southern districts west of the Gulf of Salonica by Greeks, while Turkish, Vlach and Albanian settlements exist sporadically, or in groups, in many parts of the country.

Geographical Features.—The coast-line is broken by the remarkable peninsula of Chalcidice, with its three promontories of Athos (ancient *Acte*), Longus (*Sithonia*) and Cassandra (*Pallene*). The country is divided into two almost equal portions by the river Vardar (*Axius*), the valley of which has always constituted the principal route from Central Europe to the Aegean. Rising in the Shar mountains near Gostivar (Bulgarian *Kostovo*), the Vardar, flowing to the N.E., drains the rich elevated plain of Tetovo (Turk. *Kalkandelen*) and, turning to the S.E. at the foot of Mt Liubotrn, traverses the town and plain of Uskūb, leaving to the left the high plateau of Ovchepolye ("the sheep-plain"); then flowing through the town of Veles, it receives on its right, near the ruins of the ancient Stobi, the waters of its principal tributary, the Tcherna (*Erigon*), which drains the basin of Monastir and the mountainous region of Morichovo, and after passing through the picturesque gorge of Demir-Kapu (the Iron Gate) finds its way to the Gulf of Salonica through the alluvial tract known as the Campania, extending to the west of that town. The other important rivers are the Struma (*Strymon*) and Mesta (*Nestus*) to the east, running almost parallel to the Vardar, and the Bistritza in the south, all falling into the Aegean. (The Black Drin, issuing from Lake Ochrida and flowing N.W. to the Adriatic, is for the greater part of its course an Albanian river.) The Struma, which rises in Mt Vitosha in Bulgaria, runs through a narrow defile till, within a short distance of the sea, it expands into Lake Tachino, and falls into the Aegean near the site of the ancient Amphipolis. The Mesta, rising in the Rhodope range, drains the valley of Razlog and forms a delta at its entrance into the Aegean opposite the island of Thasos. The Bistritza, which has its source in the eastern slope of Mt Grammus, receives early in its course the outflow from Lake Castoria on the left; it flows to the S.E. towards the frontier of Greece, where its course is arrested by the Cambunian mountains; then turning sharply to the N.E., and passing through the districts of Serfije and Verria, it reaches the Campania and enters the Gulf of Salonica at a point a few miles to the S.W. of the mouth of the Vardar. The valleys of most of the rivers and their tributaries broaden here and there into fertile upland basins, which were formerly lakes. Of these the extensive plateau of Monastir, the ancient plain of Pelagonia, about 1500 ft. above the sea, is the most remarkable; the basins of Tetovo, Uskūb, Kotchané, Strumnitza, Nevrokop, Melnik, Serres and Drama furnish other examples. The principal lakes are Ochrida (*Lychnitis*) on the confines of Albania; Prespa, separated from Ochrida by the Galinitza mountains, and supposed to be connected with it by a subterranean channel; Castoria, to the S.E. of Prespa; Ostrovo, midway between Prespa and the Vardar; Tachino (*Cercinitis*) on the lower course of the Struma; Beshik (*Bolbe*), separating the Chalcidian peninsula from the mainland, and Doiran (probably *Prasias*), beneath the southern declivity of the Belasitza mountains; the smaller lakes of Amatovo and Yenije are in the alluvial plain on either side of the lower Vardar. Lake Ochrida (*q.v.*) finds egress into the Black Drin (*Drilon*) at Struga, where there are productive fisheries. The lacustrine habitations of the Paeonians on Lake Prasias described by Herodotus (v. 16) find a modern counterpart in the huts of the fishing population on Lake Doiran. The surface of the country is generally mountainous; the various mountain-groups present little uniformity in their geographical contour. The great chain of Rhodope, continued to the N.W. by the Rilska and Osogovska Planina, forms a natural boundary on the north; the principal summit, Musallá (9031 ft.), is just over the Bulgarian frontier. The adjoining Dospat range culminates in Belmeken (8562 ft.), also just over the Bulgarian frontier. Between the upper courses of the Mesta and Struma is the Perim Dagh or Pirin Planina (*Orbelos*) with Elin (8794 ft.), continued to the south by the Bozo Dagh (6081 ft.); still further south, overlooking the bay of Kavala, are the Bunar Dagh and Mt Pangaeus, famous in antiquity for its gold and silver mines. Between the Struma and the Vardar are the Belasitza, Krusha and other ranges. West of the Vardar is the lofty Shar chain (*Scardus*) overlooking the plain of Tetovo and terminating at its eastern extremity in the pyramidal Liubotrn (according to some authorities, 10,007 ft., and consequently the highest mountain in the Peninsula; according to others 8989, 8856, or 8200 ft.). The Shar range, with the Kara Dagh to the east, forms the natural boundary of Macedonia on the N.W; this is prolonged on the west by the Yaina-Bistra and Yablanitza mountains with several summits exceeding 7000 ft. in height, the Odonishta Planina overlooking Lake Ochrida on the west, the Morova Planina, the Grammus range, and Pindus with Smolika (8546 ft.). The series of heights is broken by the valleys of the Black Drin and Devol, which flow to the Adriatic. Between the Vardar and the plain of Monastir the Nija range culminates in Kaimakchalan (8255 ft.); south-west of Monastir is Mt Peristeri (7720 ft.) overlooking Lake Prespa on the east; on the west is the Galinitza range separating it from Lake Ochrida. Between Lake Ostrovo and the lower Bistritza are the Bermius and Kitarion ranges with Doxa (5240 ft.) and Turla (about 3280 ft.). South of the Bistritza are the Cambunian mountains forming the boundary of Thessaly and terminating to the east in the imposing mass of Elymbos, or Olympus (9794 ft.). Lastly, Mt Athos, at the extremity of the peninsula of that name, reaches the height of 6350 ft. The general aspect of the country is bare and desolate, especially in the neighbourhood of the principal routes; the trees have been destroyed, and large tracts of land remain uncultivated. Magnificent forests, however, still clothe the slopes of Rhodope, Pirin and Pindus. The well-wooded and cultivated districts of Grevena and Castoria, which are mainly inhabited by a Vlach population, are remarkably beautiful, and the scenery around Lakes Ochrida and Prespa is exceedingly picturesque. For the principal geological formations see BALKAN PENINSULA.

The climate is severe; the spring is often rainy, and the melted snows from the encircling mountains produce inundations in the plains. The natural products are in general similar to those of southern Bulgaria and Servia—the fig, olive and orange, however, appear on the shores of the Aegean and in the sheltered valleys of the southern region. The best tobacco in Europe is grown in the Drama and Kavala districts; rice and cotton are cultivated in the southern plains.

Population.—The population of Macedonia may perhaps be estimated at 2,200,000. About 1,300,000 are Christians of various churches and nationalities; more than 800,000 are Mahommedans, and about 75,000 are Jews. Of the Christians, the great majority profess the Eastern Orthodox faith, owning allegiance either to the Greek patriarchate or the Bulgarian exarchate. Among the Orthodox Christians are reckoned some 4000 Turks. The small Catholic minority is composed chiefly of Uniate Bulgarians (about 3600), occupying the districts of Kukush and Doiran; there are also some 2000 Bulgarian Protestants, principally inhabiting the valley of Razlog. The Mahommedan population is mainly composed of Turks (about 500,000). In addition to these there are some 130,000 Bulgars, 120,000 Albanians, 35,000 gipsies and 14,000 Greeks, together with a smaller number of Vlachs, Jews and Circassians, who profess the creed of Islam. The untrustworthy Turkish statistics take religion, not nationality, as the basis of classification. All Moslems are included in the *millet*, or nation, of Islam. The *Rûm*, or Roman (*i.e.* Greek) *millet* comprises all those who acknowledge the authority of the Oecumenical patriarch, and consequently includes, in addition to the Greeks, the Servians, the Vlachs, and a certain number of Bulgarians; the Bulgar *millet* comprises the Bulgarians who accept the rule of the exarchate; the other *millets* are the *Katolik* (Catholics), *Ermeni* (Gregorian Armenians), *Musevi* (Jews) and *Prodesdan* (Protestants). The population of Macedonia, at all times scanty, has undoubtedly diminished in recent years. There has been a continual outflow of the Christian population in the direction of Bulgaria, Servia and Greece, and a corresponding emigration of the Turkish peasantry to Asia Minor. Many of the smaller villages are being abandoned by their inhabitants, who migrate for safety to the more considerable towns—usually situated at some point where a mountain pass descends to the outskirts of the plains. In the agricultural districts the Christian peasants, or *rayas*, are either small proprietors or cultivate holdings on the estates of Turkish landowners. The upland districts are thinly inhabited by a nomad pastoral population.

Towns.—The principal towns are Salonica (pop. in 1910, about 130,000), Monastir (60,000), each the capital of a vilayet, and Usküb (32,000), capital of the vilayet of Kossovo. In the Salonica vilayet are Serres (28,000), pleasantly situated in a fertile valley near Lake Tachino; Nevrokop (6200), Mehomia (5000), and Bansko (6500), in the valley of the Upper Mesta; Drama (9000), at the foot of the Bozo Dagh, with its port Kavala (9500); Djumaia (6440), Melnik (4300) and Demir Hissar (5840) in the valley of the Struma, with Strumnitza (10,160) and Petrich (7100) in the valley of its tributary, the Strumnitza; Veles (Turk. *Koprūlū*) on the Vardar (19,700); Doiran (6780) and Kukush (7750); and, to the west of the Vardar, Verria (Slav. *Ber*, anc. *Beroea*, Turk. *Karaferia*, 10,500), Yenijé-Vardar (9599) and Vodena (anc. *Edessa*, *q.v.*, 11,000). In the portion of the Kossovo vilayet included in Macedonia are Kalkandelen (Slav. *Tetovo*, 19,200), Kumanovo (14,500) and Shtip (Turk. *Istib*, 21,000). In the Monastir vilayet are Prilep (24,000) at the northern end of the Pelagonian plain, Krushevo (9350), mainly inhabited by Vlachs, Resen (4450) north of Lake Prespa, Florina (Slav. *Lerin*, 9824); Ochrida (14,860), with a picturesque fortress of Tsar Samuel, and Struga (4570), both on the north shore of Lake Ochrida; Dibra (Slav. *Debr*) on the confines of Albania (15,500), Castoria (Slav. *Kostur*), on the lake of that name (6190), and Kozhané (6100). (Dibra, Kavala, Monastir, Ochrida, Salonica, Serres, Usküb and Vodena are described in separate articles.)

The Turks.

Races.—Macedonia is the principal theatre of the struggle of nationalities in Eastern Europe. All the races which dispute the reversion of the Turkish possessions in Europe are represented within its borders. The Macedonian probably may therefore be described as the quintessence of the Near Eastern Question. The Turks, the ruling race, form less than a quarter of the entire population, and their numbers are steadily declining. The first Turkish immigration from Asia Minor took place under the Byzantine emperors before the conquest of the country. The first purely Turkish town, Yenijé-Vardar, was founded on the ruins of Vardar in 1362. After the capture of Salonica (1430), a strong Turkish population was settled in the city, and similar colonies were founded in Monastir, Ochrida, Serres, Drama and other important places. In many of these towns half or more of the population is still Turkish. A series of military colonies were subsequently established at various points of strategic importance along the principal lines of communication. Before 1360 large numbers of nomad shepherds, or Yuruks, from the district of Konia, in Asia Minor, had settled in the country; their descendants are still known as Konariotes. Further immigration from this region took place from time to time up to the middle of the 18th century. After the establishment of the feudal system in 1397 many of the Seljuk noble families came over from Asia Minor; their descendants may be recognized among the beys or Moslem landowners in southern Macedonia. At the beginning of the 18th century the Turkish population was very considerable, but since that time it has continuously decreased. A low birth-rate, the exhaustion of the male population by military service, and great mortality from epidemics, against which Moslem fatalism takes no precautions, have brought about a decline which has latterly been hastened by emigration. On the other hand, there has been a considerable Moslem immigration from Bosnia, Servia, Bulgaria and Greece, but the newcomers, *mohajirs*, do not form a permanent colonizing element. The Turkish rural population is found in three principal groups: the most easterly extends from the Mesta to Drama, Pravishta and Orfano, reaching the sea-coast on either side of Kavala, which is partly Turkish, partly Greek. The second, or central, group begins on the sea-coast, a little west of the mouth of the Strymon, where a Greek population intervenes, and extends to the north-west along the Kara-Dagh and Belasitza ranges in the direction of Strumnitza, Veles, Shtip and Radovisht. The third, or southern, group is centred around Kaïlar, an entirely Turkish town, and extends from Lake Ostrovo to Selfijé (Servia). The second and third groups are mainly composed of Konariot shepherds. Besides these fairly compact settlements there are numerous isolated Turkish colonies in various parts of the country. The Turkish rural population is quiet, sober and orderly, presenting some of the best characteristics of the race. The urban population, on the other hand, has become much demoralized, while the official classes, under the rule of Abdul Hamid II. and his predecessors, were corrupt and avaricious, and seemed to have parted with all scruple in their dealings with the Christian peasantry. The Turks, though still numerically and politically strong, fall behind the other nationalities in point of intellectual culture, and the contrast is daily becoming more marked owing to the educational activity of the Christians.

The Greeks and Vlachs.

The Greek and Vlach populations are not always easily distinguished, as a considerable proportion of the Vlachs have been hellenized. Both show a remarkable aptitude for commerce; the Greeks have maintained their language and religion, and the Vlachs their religion, with greater tenacity than any of the other races. From the date of the Ottoman conquest until comparatively recent times, the Greeks occupied an exceptional position in Macedonia, as elsewhere in the Turkish Empire, owing to the privileges conferred on the patriarchate of Constantinople, and the influence subsequently acquired by the great Phanariot families. All the Christian population belonged to the Greek *millet* and called itself Greek; the bishops and higher clergy were exclusively Greek; Greek was the language of the upper classes, of commerce, literature and religion, and Greek alone was taught in the schools. The supremacy of the patriarchate was consummated by the suppression of the autocephalous Slavonic churches of Ipek in 1766 and Ochrida in 1767. In the latter half of the 18th century Greek ascendancy in Macedonia was at its zenith; its decline began with the War of Independence, the establishment of the Hellenic kingdom, and the extinction of the Phanariot power in Constantinople. The patriarchate, nevertheless, maintained its exclusive jurisdiction over all the Orthodox population till 1870, when the Bulgarian exarchate was established, and the Greek clergy continued to labour with undiminished zeal for the spread of Hellenism. Notwithstanding their venality and intolerance, their merits as the only diffusers of culture and enlightenment in the past should not be overlooked. The process of hellenization made greater progress in the towns than in the rural districts of the interior, where the non-Hellenic populations preserved their languages, which alone saved the several nationalities from extinction. The typical Greek, with his superior education, his love of politics and commerce, and his distaste for laborious occupations, has always been a dweller in cities. In Salonica, Serres, Kavala, Castoria, and other towns in southern Macedonia the Hellenic element is strong; in the northern towns it is insignificant, except at Melnik, which is almost exclusively Greek. The Greek rural population extends from the Thessalian frontier to Castoria and Verria (*Beroea*); it occupies the whole Chalcidian peninsula and both banks of the lower Strymon from Serres to the sea, and from Nigrita on the west to Pravishta on the east; there are also numerous Greek villages in the Kavala district. The Mahommedan Greeks, known as *Valachides*, occupy a considerable tract in the upper Bistritza valley near Grevena and Liapsista. The purely Greek population of Macedonia may possibly be estimated at a quarter of a million. The Vlachs, or Rumans, who call themselves *Aromuni* or *Aromâni* (*i.e.* Romans), are also known as *Kutzovlachs* and *Tsintzars:* the last two appellations are, in fact, nicknames, "Kutzovlach" meaning "lame Vlach," while "Tzintzar" denotes their inability to pronounce the Rumanian *cinci* (five). The Vlachs are styled by some writers "Macedo-Rumans," in contradistinction to the "Daco-Rumans," who inhabit the country north of the Danube. They are, in all probability, the descendants of the Thracian branch of the aboriginal Thraco-Illyrian population of the Balkan Peninsula, the Illyrians being represented by the Albanians. This early native population, which was apparently hellenized to some extent under the Macedonian empire, seems to have been latinized in the period succeeding the Roman conquest, and probably received a considerable infusion of Italian blood. The Vlachs are for the most part either highland shepherds or wandering owners of horses and mules. Their settlements are scattered all over the mountains of Macedonia: some of these consist of permanent dwellings, others of huts occupied only in the summer. The compactest groups are found in the Pindus and Agrapha mountains (extending into Albania and Thessaly), in the neighbourhood of Monastir, Grevena and Castoria, and in the district of Meglen. The Vlachs who settle in the lowland districts are excellent husbandmen. The urban population is considerable; the Vlachs of Salonica, Monastir, Serres and other large towns are, for the most part, descended from refugees from Moschopolis, once the principal centre of Macedonian commerce. The towns of Metzovo, on the confines of Albania, and Klisura, in the Bistritza valley, are almost exclusively Vlach. The urban and most of the rural Vlachs are bilingual, speaking Greek as well as Rumanian; a great number of the former have been completely hellenized, partly in consequence of mixed marriages, and many of the wealthiest commercial families of Vlach origin are now devoted to the Greek cause. The Vlachs of Macedonia possibly number 90,000, of whom only some 3000 are Mahommedans. The Macedonian dialect of the Rumanian language differs mainly from that spoken north of the Danube in its vocabulary and certain phonetic peculiarities; it contains a number of Greek works which are often replaced in the northern speech by Slavonic or Latin synonyms.

The Albanians, Circassians, &c.

The Albanians, called by the Turks and Slavs *Arnauts*, by the Greeks *'Αρβανῖται*, and by themselves *Shkyipetar*, have always been the scourge of western Macedonia. After the first Turkish invasion of Albania many of the chiefs or beys adopted Mahommedanism, but the conversion of the great bulk of the people took place in the 16th and 17th centuries. Professing the creed of the dominant power and entitled to bear arms, the Albanians were enabled to push forward their limits at the expense of the defenceless population around them, and their encroachments have continued to the present day. They have not only advanced themselves, but have driven to the eastward numbers of their Christian compatriots and a great portion of the once-prosperous Vlach population of Albania. Albanian revolts and disturbances have been frequent along the western confines of Macedonia, especially in the neighbourhood of Dibra: the Slavonic peasants have been the principal sufferers from these troubles, while the Porte, in pursuance of the "Islamic policy" adopted by the sultan Abdul Hamid II., dealt tenderly with the recalcitrant believers. In southern Macedonia the Albanians of the Tosk race extend over the upper Bistritza valley as far west as Castoria, and reach the southern and western shores of Lakes Prespa and Ochrida: they are also numerous in the neighbourhood of Monastir. In northern Macedonia the Albanians are of the Gheg stock: they have advanced in large numbers over the districts of Dibra, Kalkandelen and Usküb, driving the Slavonic population before them. The total number of Albanians in Macedonia may be estimated at about 120,000, of whom some 10,000 are Christians (chiefly orthodox Tosks). The Circassians, who occupy some villages in the neighbourhood of Serres, now scarcely number 3000: their predatory instincts may be compared with those of the Albanians. The Jews had colonies in Macedonia in the time of St Paul, but no trace remains of these early settlements. The Jews now found in the country descend from refugees who fled from Spain during the persecutions at the end of the 15th century: they speak a dialect of Spanish, which they write with Hebrew characters. They form a flourishing community at Salonica, which numbers more than half the population: their colonies at Monastir, Serres and other towns are poor. A small proportion of the Jews, known as *Deunmé* by the Turks, have embraced Mahommedanism.

The Slavonic Population.

With the exception of the southern and western districts already specified, the principal towns, and certain isolated tracts, the whole of Macedonia is inhabited by a race or races speaking a Slavonic dialect. If language is adopted as a test, the great bulk of the rural population must be described as Slavonic. The Slavs first crossed the Danube at the beginning of the 3rd century, but their great immigration took place in the 6th and 7th centuries. They overran the entire peninsula, driving the Greeks to the shores of the Aegean, the Albanians into the Mirdite country, and the latinized population of Macedonia into the highland districts, such as Pindus, Agrapha and Olympus. The Slavs, a primitive agricultural and pastoral people, were often unsuccessful in their attacks on the fortified towns, which remained centres of Hellenism. In the outlying parts of the peninsula they were absorbed, or eventually driven back, by the original populations, but in the central region they probably assimilated a considerable proportion of the latinized races. The western portions of the peninsula were occupied by Serb and Slovene tribes: the Slavs of the eastern and central portions were conquered at the end of the 7th century by the Bulgarians, a Ugro-Finnish horde, who established a despotic political organization, but being less numerous than the subjected race were eventually absorbed by it. The Mongolian physical type, which prevails in the districts between the Balkans and the Danube, is also found in central Macedonia, and may be recognized as far west as Ochrida and Dibra. In general, however, the Macedonian Slavs differ somewhat both in appearance and character from their neighbours beyond the Bulgarian and Servian frontiers: the peculiar type which they present is probably due to a considerable admixture of Vlach, Hellenic, Albanian and Turkish blood, and to the influence of the surrounding races. Almost all independent authorities, however, agree that the bulk of the Slavonic population of Macedonia is Bulgarian. The principal indication is furnished by the language, which, though resembling Servian in some respects (*e.g.* the case-endings, which are occasionally retained), presents most of the characteristic features of Bulgarian (see BULGARIA: *Language*). Among these may be mentioned the suffix-article, the nasal vowels (retained in the neighbourhood of Salonica and Castoria, but modified elsewhere as in Bulgarian), the retention of *l* (*e.g. vulk* "wolf," *bel* "white"; Servian *vuk*, *beo*), and the loss of the infinitive. There are at least four Slavonic dialects in Macedonia, but the suffix-article, though varying in form, is a constant feature in all. The Slavs of western Macedonia are of a lively, enterprising character, and share the commercial aptitude of the Vlachs: those of the eastern and southern regions are a quiet, sober, hardworking agricultural race, more obviously homogeneous with the population of Bulgaria. In upper Macedonia large family communities, resembling the Servian and Bulgarian *zadruga*, are commonly found: they sometimes number over 50 members. The whole Slavonic population of Macedonia may be estimated at about 1,150,000, of whom about 1,000,000 are Christians of the Orthodox faith. The majority of these own allegiance to the Bulgarian exarchate, but a certain minority still remains faithful to the Greek patriarchate. The Moslem Bulgarians form a considerable element: they are found principally in the valley of the upper Mesta and the Rhodope district, where they are known as *Pomaks* or "helpers," *i.e.* auxiliaries to the Turkish army.

The Racial Propaganda.—The embittered struggle of the rival nationalities in Macedonia dates from the middle of the 19th century. Until that period the Greeks, owing to their superior culture and their privileged position, exercised an exclusive influence over the whole population professing the Orthodox faith. All Macedonia was either Moslem or Orthodox Christian, without distinction of nationalities, the Catholic or Protestant *millets* being inconsiderable. The first opposition to Greek ecclesiastical ascendancy came from the Bulgarians. The Bulgarian literary revival, which took place in the earlier part of the 19th century, was the precursor of the ecclesiastical and national movement which resulted in the establishment of the exarchate in 1870 (see BULGARIA). In the course of the struggle some of the Bulgarian leaders entered into negotiations with Rome; a Bulgarian Uniate church was recognized by the Porte, and the pope nominated a bishop, who, however, was mysteriously deported to Russia a few days after his consecration (1861). The first exarch, who was elected in 1871, was excommunicated with all his followers by the patriarch, and a considerable number of Bulgarians in Macedonia—the so-called "Bulgarophone Greeks"—fearing the reproach of schism, or influenced by other considerations, refrained from acknowledging the new spiritual power. Many of the recently converted uniates, on the other hand, offered their allegiance to the exarch. The firman of the 28th of February 1870 specified a number of districts within the present boundaries of Bulgaria and Servia, as well as in Macedonia, to which Bulgarian bishops might be appointed; other districts might be subjected to the exarchate should two-thirds of the inhabitants so desire. In virtue of the latter provision the districts of Veles, Ochrida and Usküb declared for the exarchate, but the Turkish government refrained from sanctioning the nomination of Bulgarian bishops to these dioceses. It was not till 1891 that the Porte, at the instance of Stamboloff, the Bulgarian prime minister, whose demands were supported by the Triple Alliance and Great Britain, issued the *berat*, or exequatur, for Bulgarian bishops at Ochrida and Usküb; the sees of Veles and Nevrokop received Bulgarian prelates in 1894, and those of Monastir, Strumnitza and Dibra in 1898. The Bulgarian position was further strengthened in the latter year by the establishment of "commercial agents" representing the principality at Salonica, Usküb, Monastir and Serres. During this period (1891–1898) the Bulgarian propaganda, entirely controlled by the spiritual power and conducted within the bounds of legality, made rapid and surprising progress. Subsequently the interference of the Macedonian committee at Sofia, in which the advocates of physical force predominated, and the rivalry of factions did much to injure the movement; the hostility of the Porte was provoked and the sympathy of the powers alienated by a series of assassinations and other crimes. According to the official figures, the Bulgarian schools, which in 1893 were 554, with 30,267 pupils and 853 teachers, in 1900 numbered 785 (including 5 gymnasia and 58 secondary schools), with 39,892 pupils and 1250 teachers. A great number of the schools were closed by the Turkish authorities after the insurrection of 1903 and many had not been reopened in 1909; the teachers were imprisoned or had fled into exile.

The Rumanian movement comes next to the Bulgarian in order of time. The Vlachs had shown greater susceptibility to Greek influence than any of the other non-Hellenic populations of Macedonia, and, though efforts to create a Rumanian propaganda were made as early as 1855, it was not till after the union of the principalities of Wallachia and Moldavia in 1861 that any indications of a national sentiment appeared amongst them. In 1886 the principal apostle of the Rumanian cause, a priest named Apostol Margaritis, founded a gymnasium at Monastir, and the movement, countenanced by the Porte, supported by the French Catholic missions, and to some extent encouraged by Austria, has made no inconsiderable progress since that time. There are now about forty Rumanian schools in Macedonia, including two gymnasia, and large sums are devoted to their maintenance by the ministry of education at Bucharest, which also provides qualified teachers. The Rumanian and Servian movements are at a disadvantage compared with the Bulgarian, owing to their want of a separate ecclesiastical organization, the orthodox Vlachs and Serbs in Turkey owning allegiance to the Greek patriarchate. The governments of Bucharest and Belgrade therefore endeavoured to obtain the recognition of Vlach and Servian *millets*, demanding respectively the establishment of a Rumanian bishopric at Monastir and the restoration of the patriarchate of Ipek with the appointment of a Servian metropolitan at Usküb. The Vlach *millet* was recognized by the Porte by iradé on the 23rd of May 1905, but the aims of the Servians, whose active interference in Macedonia is of comparatively recent date, have not been realized. Previously to 1878 the hopes of the Servians were centred on Bosnia, Herzegovina and the vilayet of Kossovo; but when the Berlin Treaty assigned Bosnia and Herzegovina to Austria, the national aspirations were directed to Macedonia, the Slavonic population of which was declared to be Servian. The strained relations existing between Russia and Bulgaria from 1886 to 1895 were to the advantage of the Servian propaganda, which after 1890 made remarkable progress. Great expenditure has been incurred by the Servian government in the opening and maintenance of schools. At the beginning of 1899 there were stated to be 178 Servian schools in the vilayets of Usküb, Salonica and Monastir (including fifteen gymnasia), with 321 teachers and 7200 pupils.

The Albanian movement is still in an inceptive stage; owing to the persistent prohibition of Albanian schools by the Turks, a literary propaganda, the usual precursor of a national revival, was rendered impossible till the outbreak of the Young Turk revolution in July 1908. After that date numerous schools were founded and an Albanian committee, meeting in November 1908, fixed the national alphabet and decided on the adoption of the Latin character. The educational movement is most conspicuous among the Tosks, or southern Albanians. Notwithstanding the encroachments of their rivals, the impoverishment of the patriarchate, and the injury inflicted on their cause by the Greco-Turkish War of 1897, the Greeks still maintain a large number of schools; according to statistics prepared at Athens there were in 1901, 927 Greek schools in the vilayets of Salonica and Monastir (including five gymnasia), with 1397 teachers and 57,607 pupils. The great educational activity displayed by the proselytizing movements in Macedonia, while tending to the artificial creation of parties, daily widens the contrast between the progressive Christian and the backward Moslem populations.

Antiquities.—Macedonia, like the neighbouring Balkan countries, still awaited exploration at the beginning of the 20th century, and little had been learned of the earlier development of civilization in these regions. The ancient indigenous population has left many traces of its presence in the tumuli which occur on the plains, and more especially along the valley of the Vardar. The unquiet state of the country went far to prevent any systematic investigation of these remains; excavations, however, were made by Körte and Franke at Niausta and near Salonica (see Kretschner, *Einleitung in die Geschichte der griechischen Sprache*, pp. 176, 421), and fragments of primitive pottery, with peculiar characteristics, were found by Perdrizet at Tchepelje, on the left bank of Lake Tachino. The oldest archaeological monuments of Macedonia are its coins, for which the mines of Crenides (the later Philippi), at the foot of Mt Pangaeus, of Chalcidice, of the island of Thasos, and of the mountains between Lake Prasias and the ancient Macedonian kingdom (Herod. v. 17), furnished abundance of metal. From the reign of Alexander I., in the epoch of the Persian wars (502–479 B.C.), the Macedonian dynasty issued silver coins of a purely Greek style. The Thracian communities around Mt Pangaeus also produced a variety of coins, especially at the beginning of the 5th century. The great octodrachms of this period were perhaps struck for the purpose of paying tribute to the Persians when the country between the Strymon and the Nestos was in their possession; most of the specimens have been found in Asia Minor. These large pieces present many characteristics of the Ionian style; it is evident that the Thracians derived the arts of minting and engraving from the neighbouring Thasos, itself a colony from the Ionian Paros. The monarchs of Pella were enthusiastic admirers of Hellenic culture, and their court was doubtless frequented by Greek sculptors as well as men of letters, such as Herodotus and Euripides. At Pella has been found a funerary *stele* of the late 5th or early 4th century representing a Macedonian *hetaerus*—a beautiful specimen of the best Greek art, now preserved in the Imperial Ottoman Museum at Constantinople. To the Hellenic period belong the vaulted tombs under tumuli discovered at Pella, Pydna, Palatitza, and other places; the dead were laid in marble couches ornamented with sculptures, like those of the so-called sarcophagus of Alexander at Constantinople. These tombs doubtless received the remains of the Macedonian nobles and *hetaeri*: in one of them a fresco representing a conflict between a horseman and a warrior on foot has been brought to light by Kinch. Similarly constructed places of sepulture have been found at Eretria and elsewhere in Greece. At Palatitza the ruins of a remarkable structure, perhaps a palace, have been laid bare by Heuzey and Daumet. Unlike Greece, where each independent city had its acropolis, Macedonia offers few remnants of ancient fortification; most of the country towns appear to have been nothing more than open market-centres. The most interesting ruins in the country are those of the Roman and Byzantine epochs, especially those at Salonica (*q.v.*). The Byzantine fortifications and aqueduct of Kavala are also remarkable. At Verria (*Beroea*) may be seen some Christian remains, at Melnik a palace of the age of the Comneni, at Serres a fortress built by the Servian tsar Stephen Dushan (1336–1356). The remains at Filibejik (*Philippi*) are principally of the Roman and Byzantine periods; the numerous *ex voto* rock-tablets of the acropolis are especially interesting. The Roman inscriptions found in Macedonia are mainly funerary, but include several ephebic lists. The funerary tablets afford convincing proof of the persistence of the Thracian element, notwithstanding hellenization and latinization; many of them, for instance, represent the well-known Thracian horseman hunting the wild boar. The monastic communities on the promontory of Athos (*q.v.*), with their treasures of Byzantine art and their rich collections of manuscripts, are of the highest antiquarian interest.

History.—For the history of ancient Macedonia see Macedonian Empire.[1] After its subjugation by the Romans the country was divided into four districts separated by rigid political and social limitations. Before long it was constituted a province, which in the time of Augustus was assigned to the senate. Thenceforward it followed the fortunes of the Roman empire, and, after the partition of that dominion, of its eastern branch. Its Thraco-Illyrian inhabitants had already been largely latinized when Constantine the Great made Byzantium the imperial residence in A.D. 330; they called themselves Romans and spoke Latin. Towards the close of the 4th century the country was devastated by the Goths and Avars, whose incursions possessed no lasting significance. It was otherwise with the great Slavonic immigration, which took place at intervals from the 3rd to the 7th century. An important ethnographic change was brought about, and the greater part of Macedonia was colonized by the invaders (see Balkan Peninsula).

The Slavs were in their turn conquered by the Bulgarians (see Bulgaria: *History*) whose chief Krum (802–815) included central Macedonia in his dominions. The Byzantines retained the southern regions and Salonica, which temporarily fell into the hands of the Saracens in 904. With the exception of the maritime districts, the whole of Macedonia formed a portion of the empire of the Bulgarian tsar Simeon (893–927); the Bulgarian power declined after his death, but was revived in western Macedonia under the Shishman dynasty at Ochrida; Tsar Samuel (976–1014), the third ruler of that family, included in his dominions Usküb, Veles, Vodena and Melnik. After his defeat by the emperor Basil II. in 1014 Greek domination was established for a century and a half. The Byzantine emperors endeavoured to confirm their positions by Asiatic colonization; Turkish immigrants, afterwards known as Vardariotes, the first of their race who appeared in Macedonia, were settled in the neighbourhood of Salonica in the 9th century; colonies of Uzes, Petchenegs and Kumans were introduced at various periods from the 11th to the 13th century. While Greeks and Bulgarians disputed the mastery of Macedonia the Vlachs, in the 10th century, established an independent state in the Pindus region, which, afterwards known as Great Walachia, continued to exist till the beginning of the 14th century. In 1185 southern Macedonia was exposed to a raid of the Normans under William of Sicily, who captured Salonica and massacred its inhabitants. After the taking of Constantinople in 1204 by the Franks of the fourth crusade, the Latin empire of Romania was formed and the feudal kingdom of Thessalonica was bestowed on Boniface, marquis of Montferrat; this was overthrown in 1222 by Theodore, despot of Epirus, a descendant of the imperial house of the Comneni, who styled himself emperor of Thessalonica and for some years ruled over all Macedonia. He was defeated and captured by the Bulgarians in 1230 and the remnant of his possessions, to which his son John succeeded, was absorbed in the empire of Nicaea in 1234. Bulgarian rule was now once more established in Macedonia under the powerful monarch Ivan Asen II. (1218–1241) whose dynasty, of Vlach origin, had been founded at Trnovo in 1186 after a revolt of the Vlachs and Bulgars against the Greeks. A period of decadence followed the extinction of the Asen dynasty in 1257; the Bulgarian power was overthrown by the Servians at Velbuzhd (1330), and Macedonia was included in the realm of the great Servian tsar Dushan (1331–1355) who fixed his capital at Usküb. Dushan's empire fell to pieces after his death, and the anarchy which followed prepared the way for the advance of the Turks, to whom not only contending factions at Constantinople but Servian and Bulgarian princes alike made overtures.

Byzantine and Bulgarian Domination.

Turkish Rule.

Macedonia and Thrace were soon desolated by Turkish raids; when it was too late the Slavonic states combined against the invaders, but their forces, under the Servian tsar Lazar, were routed at Kossovo in 1389 by the sultan Murad I. Salonica and Larissa were captured in 1395 by Murad's son Bayezid, whose victory over Sigismund of Hungary at Nicopolis in 1396 sealed the fate of the peninsula. The towns in the Struma valley were yielded to the Turks by John VII. Palaeologus in 1424; Salonica was taken for the last time in 1428 by Murad II. and its inhabitants were massacred. Large tracts of land were distributed among the Ottoman chiefs; a system of feudal tenure was developed by Mahommed II. (1451–1481), each fief furnishing a certain number of armed warriors. The Christian peasant owners remained on the lands assigned to the Moslem feudal lords, to whom they paid a tithe. The condition of the subject population was deplorable from the first, and became worse during the period of anarchy which coincided with the decadence of the central power in the 17th and 18th centuries; in the latter half of the 17th century efforts to improve it were made by the grand viziers Mehemet and Mustafa of the eminent house of Koprülü. The country was policed by the janissaries (*q.v.*). Numbers of the peasant proprietors were ultimately reduced to serfdom, working as labourers on the farms or *tchifliks* of the Moslem beys. Towards the end of the 18th century many of the local governors became practically independent; western Macedonia fell under the sway of Ali Pasha of Iannina; at Serres Ismail Bey maintained an army of 10,000 men and exercised a beneficent despotism. For more than two centuries Albanian incursions, often resulting in permanent settlements, added to the troubles of the Christian population. The reforms embodied in the Hatt-i-Sherif of Gulhané (1839) and in the Hatt-i-humayun (1856), in both of which the perfect equality of races and religions was proclaimed, remained a dead letter; the first "Law of the Vilayets" (1864), reforming the local administration, brought no relief, while depriving the Christian communities of certain rights which they had hitherto possessed.

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[1] Also Alexander, Perdiccas, Philip, &c.

European Intervention. Treaties of San Stefano and Berlin.

In 1876 a conference of the powers at Constantinople proposed the reorganization of the Bulgarian provinces of Turkey in two vilayets under Christian governors-general aided by popular assemblies. The "western" vilayet, of which Sofia was to be the capital, included northern, central and western Macedonia, extending south as far as Castoria. The *projet de règlement* elaborated by the conference was rejected by the Turkish parliament convoked under the constitution proclaimed on the 23rd of December 1876; the constitution, which was little more than a device for eluding European intervention, was shortly afterwards suspended. Under the treaty of San Stefano (March 3, 1878) the whole of Macedonia, except Salonica and the Chalcidic peninsula, was included in the newly formed principality of Bulgaria; this arrangement was reversed by the Treaty of Berlin (July 13) which left Macedonia under Turkish administration but provided (Art. xxiii.) for the introduction of reforms analogous to those of the Cretan Organic Statute of 1868. These reforms were to be drawn up by special commissions, on which the native element should be largely represented, and the opinion of the European commission for eastern Rumelia was to be taken before their promulgation. The Porte, however, prepared a project of its own, and the commission, taking this as a basis, drew up the elaborate "Law of the Vilayets" (Aug. 23, 1880). The law never received the sultan's sanction, and European diplomacy proved unequal to the task of securing its adoption.

The Macedonian Question.

The Berlin Treaty, by its artificial division of the Bulgarian race, created the difficult and perplexing "Macedonian Question." The population handed back to Turkish rule never acquiesced in its fate; its discontent was aggravated by the deplorable misgovernment which characterized the reign of Abdul Hamid II., and its efforts to assert itself, stimulated by the sympathy of the enfranchised portion of the race, provoked rival movements on the part of the other Christian nationalities, each receiving encouragement and material aid from the adjacent and kindred states. Some insignificant risings took place in Macedonia after the signature of the Berlin Treaty, but in the interval between 1878 and 1893 the population remained comparatively tranquil, awaiting the fulfilment of the promised reforms.

Bulgarian Conspiracies.

In 1893, however, a number of secret revolutionary societies (*druzhestva*) were set on foot in Macedonia, and in 1894 similar bodies were organized as legal corporations in Bulgaria. The fall of Stamboloff in that year and the reconciliation of Bulgaria with Russia encouraged the revolutionaries in the mistaken belief that Russia would take steps to revive the provisions of the San Stefano treaty. In 1895 the "Supreme Macedo-Adrianopolitan Committee" (*Vrkhoven Makedoni-Odrinski Komitet*) was formed at Sofia and forthwith despatched armed bands into northern Macedonia; the town of Melnik was occupied for a short time by the revolutionaries under Boris Sarafoff, but the enterprise ended in failure. Dispirited by this result, the "Vrkhovists," as the revolutionaries in Bulgaria were generally styled, refrained from any serious effort for the next five years; the movement was paralysed by dissensions among the chiefs, and rival parties were formed under Sarafoff and General Tzoncheff. Meanwhile the "Centralist" or local Macedonian societies were welded by two remarkable men, Damian Grueff and Gotzé Delcheff, into a formidable power known as the "Internal Organization," founded in 1893, which maintained its own police, held its own tribunals, assessed and collected contributions, and otherwise exercised an *imperium in imperio* throughout the country, which was divided into rayons or districts, and subdivided into departments and communes, each with its special staff of functionaries. The Internal Organization, as a rule, avoided co-operation with the revolutionaries in Bulgaria; it aimed at the attainment of Macedonian autonomy, and at first endeavoured, but unsuccessfully, to enlist the sympathies of the Greeks and Servians for the programme of "Macedonia for the Macedonians."

Greek Action.

The principle of autonomy was suspected at Athens and Belgrade as calculated to ensure Bulgarian predominance and to delay or preclude the ultimate partition of the country. At Athens, especially, the progress of the Bulgarian movement was viewed with much alarm; it was feared that Macedonia would be lost to Hellenism, and in 1896 the *Ethnikè Hetaerea* (see GREECE and CRETE) sent numerous bands into the southern districts of the country. The Hetaerea aimed at bringing about a war between Greece and Turkey, and the outbreak of trouble in Crete enabled it to accomplish its purpose. During the Greco-Turkish War (*q.v.*) Macedonia remained quiet, Bulgaria and Servia refraining from interference under pressure from Austria, Russia and the other great powers. The reverses of the Greeks were to the advantage of the Bulgarian movement, which continued to gain strength, but after the discovery of a hidden dépôt of arms at Vinitza in 1897 the Turkish authorities changed their attitude towards the Bulgarian element; extreme and often barbarous methods of repression were adopted, and arms were distributed among the Moslem population. The capture of an American missionary, Miss Stone, by a Bulgarian band under Sandansky in the autumn of 1901 proved a windfall to the revolutionaries, who expended her ransom of £T16,000 in the purchase of arms and ammunition.

Troubles in 1902: Intervention of the Powers.

In 1902 the Servians, after a prolonged conflict with the Greeks, succeeded with Russian aid in obtaining the nomination of Mgr. Firmilian, a Servian, to the archbishopric of Usküb. Contemporaneously with a series of Russo-Bulgarian celebrations in the Shipka pass in September of that year, an effort was made to provoke a rising in the Monastir district by Colonel Yankoff, the lieutenant of General Tzoncheff; in November a number of bands entered the Razlog district under the general's personal direction. These movements, which were not supported by the Internal Organization, ended in failure, and merciless repression followed. The state of the country now became such as to necessitate the intervention of the powers, and the Austrian and Russian governments, which had acted in concert since April 1897, drew up an elaborate scheme of reforms. The Porte, as usual, endeavoured to forestall foreign interference by producing a project of its own, which was promulgated in November 1902, and Hilmi Pasha was appointed Inspector General of the Rumelian vilayets and charged with its application. The two powers, however, persevered in their intention and on the 21st of February 1903 presented to the Porte an identic memorandum proposing a series of reforms in the administration, police and finance, including the employment of "foreign specialists" for the reorganization of the gendarmerie.

Bulgarian Insurrection in 1903.

At the same time the Bulgarian government, under pressure from Russia, arrested the revolutionary leaders in the principality, suppressed the committees, and confiscated their funds. The Internal Organization, however, was beyond reach, and preparations for an insurrection went rapidly forward. In March a serious Albanian revolt complicated the situation. At the end of April a number of dynamite outrages took place at Salonica; public opinion in Europe turned against the revolutionaries and the Turks seized the opportunity to wreak a terrible vengeance on the Bulgarian population. On the 2nd of August, the feast of St Elias, a general insurrection broke out in the Monastir vilayet, followed by sporadic revolts in other districts. The insurgents achieved some temporary successes and occupied the towns of Krushevo, Klisura and Neveska, but by the end of September their resistance was overcome; more than 100 villages were burned by the troops and bashi-bazouks, 8400 houses were destroyed and 60,000 peasants remained homeless in the mountains at the approach of winter.

The "Mürzsteg Programme."

The Austrian and Russian governments then drew up a further series of reforms known as the "Mürzsteg programme" (Oct. 9, 1903) to which the Porte assented in principle, though many difficulties were raised over details. Two officials, an Austrian and a Russian, styled "civil agents" and charged with the supervision of the local authorities in the application of reforms, were placed by the side of the inspector-general while the reorganization of the gendarmerie was entrusted to a foreign general in the Turkish service aided by a certain number of officers from the armies of the great powers. The latter task was entrusted to the Italian General de Giorgis (April 1904), the country being divided into sections under the supervision of the officers of each power. The reforms proved a failure, mainly owing to the tacit opposition of the Turkish authorities, the insufficient powers attributed to the European officials, the racial feuds and the deplorable financial situation. In 1905 the powers agreed on the establishment of a financial commission on which the representatives of Great Britain, France, Germany and Italy would sit as colleagues of the civil agents. The Porte offered an obstinate resistance to the project and only yielded (Dec. 5) when the fleets of the powers appeared near the Dardanelles. Some improvement was now effected in the financial administration, but the general state of the country continued to grow worse; large funds were collected abroad by the committees at Athens, which despatched numerous bands largely composed of Cretans into the southern districts, the Servians displayed renewed activity in the north, while the Bulgarians offered a dogged resistance to all their foes.

The "Reval Programme."

The Austro-Russian *entente* came to an end in the beginning of 1908 owing to the Austrian project of connecting the Bosnian and Macedonian railway systems, and Great Britain and Russia now took the foremost place in the demand for reforms. After a meeting between King Edward VII. and the emperor Nicholas II. at Reval in the early summer of 1908 an Anglo-Russian scheme, known as the "Reval programme," was announced; the project aimed at more effective European supervision and dealt especially with the administration of justice. Its appearance was almost immediately followed by the military revolt of the Young Turk or constitutional party, which began in the Monastir district under two junior officers, Enver Bey and Niazi Bey, in July. The restoration of the constitution of 1876 was proclaimed (July 24, 1908), and the powers, anticipating the spontaneous adoption of reforms on the part of regenerated Turkey, decided to suspend the Reval programme and to withdraw their military officers from Macedonia.

See Lejean, *Ethnographie de la Turquie d'Europe* (Gotha, 1861); Hahn, *Reise von Belgrad nach Salonik* (Vienna, 1868); Yastreboff, *Obichai i pesni turetskikh Serbov* (St Petersburg, 1886); "Ofeicoff" (Shopoff), *La Macédoine au point de vue ethnographique, historique et philologique* (Philippopolis, 1888); Gopchevitch, *Makedonien und Alt-Serbien* (Vienna, 1889); Verkovitch, *Topografichesko-ethnographicheskii ocherk Makedonii* (St Petersburg, 1889); Burada, *Cercetari despre scoalele Romanesci din Turcia* (Bucharest, 1890); Tomaschek, *Die heutigen Bewohner Macedoniens* (Sonderabdruck aus den Verhandlungen des IX. D. Geographen-Tages in Wien, 1891) (Berlin, 1891); *Die alten Thräker* (Vienna, 1893); Berard, *La Turquie et l'Hellénisme contemporain*, (Paris, 1893); *La Macédoine* (Paris, 1900); Shopoff, *Iz zhivota i polozhenieto na Bulgarite v vilayetite* (Philippopolis, 1894); Weigand, *Die Aromunen* (Leipzig, 1895); *Die nationalen Bestrebungen der Balkanvölker* (Leipzig, 1898); Nikolaides, *La Macédoine* (Berlin, 1899); "Odysseus," *Turkey in Europe* (London, 1900); Kunchoff, *Makedonia: etnografia i statistika* (Sofia, 1900); *La Macédoine et la Vilayet d'Andrinople* (Sofia, 1904), anonymous; L. Villari, *The Balkan Question* (London, 1905); H. N. Brailsford, *Macedonia: its Races and their Future* (London, 1906); J. Cvijić, *Grundlinien der Geographie und Geologie von Mazedonien und Altserbien* (Gotha, 1908). For the antiquities, see Texier and Pullan, *Byzantine Architecture* (London, 1864); Heuzey and Daumet, *Mission archéologique en Macédoine* (Paris, 1865); Duchesne and Bayet, *Mémoire sur une mission en Macédoine et au Mont Athos* (Paris, 1876); Barclay V. Head, *Catalogue of Greek Coins*; Macedonia (London, 1879); Kinch, *L'Arc de triomphe de Salonique* (Paris, 1890); *Beretnung om en archaeologisk Reise i Makedonien* (Copenhagen, 1893); Mommsen, Suppl. to vol. iii. *Corpus inscript. latinarum* (Berlin, 1893); Perdrizet, Articles on Macedonian archaeology and epigraphy in *Bulletin de correspondance hellénique*, since 1894.

(J. D. B.)

MACEDONIAN EMPIRE, the name generally given to the empire founded by Alexander the Great of Macedon in the countries now represented by Greece and European Turkey, Asia Minor, Egypt, Syria, Persia and eastwards as far as northern India.[1] The present article contains a general account of the empire in its various aspects. It falls naturally into two main divisions:—I. The reign of Alexander. II. The period of his successors, the "Diadochi" and their dynasties.

1. Greeks and Persians.

I. *The Reign of Alexander.*—At the beginning of the 4th century B.C. two types of political association confronted each other in the lands of the Eastern Mediterranean,—the Persian monarchy with its huge agglomeration of subject peoples, and the Greek city-state. Each had a different principle of strength. The Persian monarchy was strong in its size, in the mere amount of men and treasure it could dispose of under a single hand; the Greek state was strong in its *morale*, in the energy and discipline of its soldiery. But the smallness of the single city-states and their unwillingness to combine prevented this superiority in quality from telling destructively upon the bulk of the Persian empire. The future belonged to any power that could combine the advantages of both systems, could make a state larger than the Greek *polis*, and animated by a spirit equal to that of the Greek soldier. This was achieved by the kings of Macedonia. The work, begun by his predecessors, of consolidating the kingdom internally and making its army a fighting-machine of high power was completed by the genius of Philip II. (359–336 B.C.), who at the same time by war and diplomacy brought the Greek states of the Balkan peninsula generally to recognize his single predominance. At the synod of Corinth (338) Philip was solemnly declared the captain-general (στρατηγὸς αὐτοκράτωρ) of the Hellenes against the Great King. The attack on Persia was delayed by the assassination of Philip in 336, and it needed some fighting before the young Alexander had made his position secure in Macedonia and Greece. The recognition as captain-general he had obtained at another synod in Corinth, by an imposing military demonstration in Greece immediately upon his accession. Then came the invasion of the Persian empire by Alexander in 334 at the head of an army composed both of Macedonians and contingents from the allied Greek states. Before this force the Persian monarchy went down, and when Alexander died eleven years later (323) a Macedonian empire which covered all the territory of the old Persian empire, and even more, was a realized fact.

2. Extent of the Empire.

The empire outside of Macedonia itself consisted of 22 provinces. *In Europe*, (1) Thrace; *in Asia Minor*, (2) Phrygia on the Hellespont, (3) Lydia, (4) Caria, (5) Lycia and Pamphylia, (6) Great Phrygia, (7) Paphlagonia and Cappadocia; *between the Taurus and Iran*, (8) Cilicia, (9) Syria, (10) Mesopotamia, (11) Babylonia, (12) Susiana; *in Africa*, (13) Egypt; *in Iran*, (14) Persis, (15) Media, (16) Parthia and Hyrcania, (17) Bactria and Sogdiana, (18) Areia and Drangiana, (19) Carmania, (20) Arachosia and Gedrosia; lastly *the Indian provinces*, (21) the Paropanisidae (the Kabul valley), and (22) the province assigned to Pithon, the son of Agenor, upon the Indus (J. Beloch, *Griech. Gesch.* III. [ii.], p. 236 seq.; for the Indian provinces cf. B. Niese, *Gesch. der griech. und maked. Staaten*, I. p. 500 seq.). Hardly provinces proper, but rather client principalities, were the two native kingdoms to which Alexander had left the conquered land beyond the Indus—the kingdoms of Taxiles and Porus.

3. System of Government.

The conquered empire presented Alexander with a system of government ready-made, which it was natural for the new masters to take over. For the Asiatic provinces and Egypt, the old Persian name of *satrapy* (see SATRAP) was still retained, but the governor seems to have been styled officially in Greek *strategos*, although the term *satrap* certainly continued current in common parlance. The governors appointed by Alexander were, in the west of the empire, exclusively Macedonians; in the east, members of the Old Persian nobility were still among the satraps at Alexander's death, Atropates in Media, Phrataphernes in Parthia and Hyrcania, and Alexander's father-in-law Oxyartes in the Paropanisidae. Alexander had at first trusted Persian grandees more freely in this capacity; in Babylonia, Bactria, Carmania, Susiana he had set Persian governors, till the ingrained Oriental tradition of misgovernment so declared itself that to the three latter provinces certainly Macedonians had been appointed before his death. Otherwise the only eastern satrapy whose governor was not a Macedonian, was Areia, under Stasanor, a Cypriote Greek. In the case of certain provinces, possibly in the empire generally, Alexander established a double control. The financial administration was entrusted to separate officials; we hear of such in Lydia (Arr. i. 17, 7), Babylonia (id. iii. 16, 4), and notably in Egypt (id. iii. 5, 4). Higher financial controllers seem to have been over groups of provinces (Philoxenus over Asia Minor, Arr. i. 17, 7; see Beloch, *Gr. Gesch.* III. [i] p. 14), and Harpalus over the whole finances of the empire, with his seat in Babylon. Again the garrisons in the chief cities, such as Sardis, Babylon, Memphis Pelusium and Susa, were under commands distinct from those of the provinces. The old Greek cities of the motherland were not formally subjects of the empire, but sovereign states, which assembled at Corinth as members of a great alliance, in which the Macedonian king was included as a member and held the office of captain-general. The Greek cities of Asia Minor stood to him in a similar relation, though not included in the Corinthian alliance, but in federations of their own (Kaerst, *Gesch, d. hellenist. Zeitalt:* i. 261 seq.). Their territory was not part of the king's country (*Inscr. in the Brit. Mus.* No. 400). Of course, in fact, the power of the king was so vastly superior that the Greek cities were in reality subject to his dictation, even in so intimate a matter as the readmission of their exiles, and might be obliged to receive his garrisons. Within the empire itself, the various communities were allowed, subject to the interference of the king or his officials, to manage their own affairs. Alexander is said to have granted the Lydians to be "free" and "to use the laws of the ancient Lydians," whatever exactly these expressions may mean (Arr. i. 17, 4). So too in Egypt, the native monarchs were left as the local authorities (Arr. iii. 5, 4). Especially to the gods of the conquered people Alexander showed respect. In Egypt and in Babylon he appeared as the restorer of the native religions to honour after the unsympathetic rule of the Persians. The temple of Marduk in Babylon which had fallen began to rise again at his command. It is possible that he offered sacrifice to Yahweh in Jerusalem. In Persia, the native aristocracy retained their power, and the Macedonian governor adopted Persian dress and manners (Diod. xix. 48, 5; Arr. vi. 30). A new factor introduced by Alexander was the foundation of Greek cities at all critical points of intercourse in the conquered lands. These, no doubt, possessed municipal autonomy with the ordinary organization of the Greek state; to what extent they were formally and regularly controlled by the provincial authorities we do not know; Pithon, the satrap of the Indian province is specially described as sent "in colonias in Indis conditas" (Just. xiii. 4, 21). The empire included large tracts of mountain or desert, inhabited by tribes, which the Persian government had never subdued. The subjugation of such districts could only be by a system of effective military occupation and would be a work of time; but Alexander made a beginning by punitive expeditions, as occasion offered, calculated to reduce the free tribes to temporary quiet; we hear of such expeditions in the case of the Pisidians, the tribes of the Lebanon, the Uxii (in Khuzistan), the Tapyri (in the Elburz), the hill-peoples of Bajaor and Swat, the Cossaei (in Kurdistan); an expedition against the Arabs was in preparation when Alexander died.

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[1] For the events which brought this empire into being see ALEXANDER THE GREAT. For the detailed accounts of the separate dynasties into which it was divided after Alexander's death, see SELEUCID DYNASTY, ANTIGONUS, PERGAMUM, &c., and for its effect on the spread of Hellenic culture see HELLENISM.

See A. Köhler, *Reichsverwaltung u. Politik Alexanders des Grossen* in *Klio*, v. 303 seq. (1905).

4. Court. Alexander, who set out as king of the Macedonians and captain-general of the Hellenes, assumed after the death of Darius the character of the Oriental great king. He adopted the Persian garb (Plutarch, *de fort. Al.* i. 8) including a head-dress, the *diadema*, which was suggested by that of the Achaemenian king (*Just.* xii. 3, 8). We hear also of a sceptre as part of his insignia (*Diod.* xviii. 27, 1). The pomps and ceremonies which were traditional in the East were to be continued. To the Greeks and Macedonians such a régime was abhorrent, and the opposition roused by Alexander's attempt to introduce among them the practice of *proskynesis* (prostration before the royal presence), was bitter and effectual. The title of *chiliarch*, by which the Greeks had described the great king's chief minister, in accordance with the Persian title which described him as "commander of a thousand," *i.e.* of the royal body-guard, was conferred by Alexander upon his friend Hephaestion. The Greek Chares held the position of chief usher (εἰσαγγελεύς). Another Greek, Eumenes of Cardia, was chief secretary (ἀρχιγραμματεύς). The figure of the eunuch, so long characteristic of the Oriental court, was as prominent as ever (*e.g.* Bagoas, Plut. *Alex.* 67, &c.; cf. Arr. vii. 24).

Alexander, however, who impressed his contemporaries by his sexual continence, kept no harem of the old sort. The number of his wives did not go beyond two, and the second, the daughter of Darius, he did not take till a year before his death. In closest contact with the king's person were the seven, or latterly eight, body-guards, σωματοφύλακες, Macedonians of high rank, including Ptolemy and Lysimachus, the future kings of Egypt, and Thrace (Arr. vi. 28, 4). The institution, which the Macedonian court before Alexander had borrowed from Persia, of a corps of pages composed of the young sons of the nobility (παῖδες βασίλειοι or βασιλικοί) continued to hold an important place in the system of the court and in Alexander's campaigns (see Arr. iv. 13, 1; Curt. viii. 6, 6; Suid. βασίλειοι παῖδες; cf. the παῖδες of Eumenes, Diod. xix. 28, 3).

See Spiecker, *Der Hof und die Hofordnung Alex. d. Grossen* (1904).

5. Army. The army of Alexander was an instrument which he inherited from his father Philip. Its core was composed of the Macedonian peasantry who served on foot in heavy armour ("the Foot-companions") πεζεταῖροι). They formed the phalanx, and were divided into 6 brigades (τάξεις), probably on the territorial system. Their distinctive arm was the great Macedonian pike (*sarissa*), some 14 ft. long, of further reach than the ordinary Greek spear. They were normally drawn up in more open order than the heavy Greek phalanx, and possessed thereby a mobility and elasticity in which the latter was fatally deficient. Reckoning 1,500 to each brigade, we got a total for the phalanx of 9,000 men. Of higher rank than the *pezetaeri* were the royal foot-guards (βασιλικοὶ ὑπασπισταί), some 3,000 in number, more lightly armed, and distinguished (at any rate at the time of Alexander's death) by silver shields. Of these 1,000 constituted the royal corps (τὸ ἄγημα τὸ βασιλικόν). The Macedonian cavalry was recruited from a higher grade of society than the infantry, the *petite noblesse* of the nation. They bore by old custom the name of the king's Companions (ἑταῖροι), and were distributed into 8 territorial squadrons (ἶλαι) of probably some 250 men each, making a normal total of 2,000. In the cavalry also the most privileged squadron bore the name of the *agema*. The ruder peoples which were neighbors to the Macedonians (Paeonians, Agrianes, Thracians) furnished contingents of light cavalry and javelineers (ἀκοντισταί). From the Thessalians the Macedonian king, as overlord, drew some thousand excellent troopers. The rest of Alexander's army was composed of Greeks, not formally his subjects. These served partly as mercenaries, partly in contingents contributed by the states in virtue of their alliance. According to Diodorus (xvii. 17, 3) at the time of Alexander's passage into Asia, the mercenaries numbered 5,000, and the troops of the alliance 7,000 foot and 600 horse. All these numbers take no account of the troops left behind in Macedonia, 12,000 foot and 1,500 horse, according to Diodorus. When Alexander was lord of Asia, innovations followed in the army. Already in 330 at Persepolis, the command went forth that 30,000 young Asiatics were to be trained as Macedonian soldiers (the *epigoni*, Arr. vii., 6, 1). Contingents of the fine Bactrian cavalry followed Alexander into India. Persian nobles were admitted into the *agema* of the Macedonian cavalry. A far more radical remodelling of the army was undertaken at Babylon in 323, by which the old phalanx system was to be given up for one in which the unit was to be composed of Macedonians with pikes and Asiatics with missile arms in combination—a change calculated to be momentous both from a military point of view in the coming wars, and from a political, in the close fusion of Europeans and Asiatics. The death of Alexander interrupted the scheme, and his successors reverted to the older system. In the wars of Alexander the phalanx was never the most active arm; Alexander delivered his telling attacks with his cavalry, whereas the slow-moving phalanx held rather the position of a reserve, and was brought up to complete a victory when the cavalry charges had already taken effect. Apart from the pitched battles, the warfare of Alexander was largely hill-fighting, in which the *hypaspistae* took the principal part, and the contingents of light-armed hillmen from the Balkan region did excellent service.

For Alexander's army and tactics, beside the regular histories (Droysen, Niese, Beloch, Kaerst), see D. G. Hogarth, *Journal of Philol.*, xvii. 1 seq. (corrected at some points in his *Philip and Alexander*).

6. Fusion of Greeks and Asiatics.

The modifications in the army system were closely connected with Alexander's general policy, in which the fusion of Greeks and Asiatics held so prominent a place. He had himself, as we have seen, assumed to some extent the guise of a Persian king. The Macedonian Peucestas received special marks of his favour for adopting the Persian dress. The most striking declaration of his ideals was the marriage feast at Susa in 324, when a large number of the Macedonian nobles were induced to marry Persian princesses, and the rank and file were encouraged by special rewards to take Eastern wives. We are told that among the schemes registered in the state papers and disclosed after Alexander's death was one for transplanting large bodies of Asiatics into Europe and Europeans into Asia, for blending the peoples of the empire by intermarriage into a single whole (Diod. xviii. 4, 4). How far did Alexander intend that in such a fusion Hellenic culture should retain its pre-eminence? How far could it have done so, had the scheme been realized? It is not impossible that the question may yet be raised again whether the Eurasian after all is the heir of the ages.

7. Divine Honours.

High above all the medley of kindreds and tongues, untrammelled by national traditions, for he had outgrown the compass of any one nation, invested with the glory of achievements in which the old bounds of the possible seemed to fall away, stood in 324 the man Alexander. Was he a man? The question was explicitly suggested by the report that the Egyptian priest in the Oasis had hailed him in the god's name as the son of Ammon. The Egyptians had, of course, ascribed deity by old custom to their kings, and were ready enough to add Alexander to the list. The Persians, on the other hand, had a different conception of the godhead, and we have no proof that from them Alexander either required or received divine honours. From the Greeks he certainly received such honours; the ambassadors from the Greek states came in 323 with the character of *theori*, as if approaching a deity (Arr. vii. 23, 2). It has been supposed that in offering such worship the Greeks showed the effect of "Oriental" influence, but indeed we have not to look outside the Greek circle of ideas to explain it. As early as Aeschylus (*Supp.* 991) the proffering of divine honours was a form of expression for intense feelings of reverence or gratitude towards men which naturally suggested itself—as a figure of speech in Aeschylus, but the figure had been translated into action before Alexander not in the well-known case of Lysander only (cf. the case of Dion, Plut. *Dio*, 29). Among the educated Greeks rationalistic views of the old mythology had become so current that they could assimilate Alexander to Dionysus without supposing him to be supernatural, and to this temper the divine honours were a mere form, an elaborate sort of flattery. Did Alexander merely receive such honours? Or did he claim them himself? It would seem that he did. Many of the assertions as to his action in this line do not stand the light of criticism (see Hogarth, *Eng. Hist. Rev.* ii., 1887, p. 317 seq.; Niese, *Historische Zeitschrift*, lxxix., 1897, p. 1, seq.); even the explicit statement in Arrian as to Alexander and the Arabians is given as a mere report; but we have well-authenticated utterances of Attic orators when the question of the cult of Alexander came up for debate, which seem to prove that an intimation of the king's pleasure had been conveyed to Athens.

8. Intercourse and Discovery.

A new life entered the lands conquered by Alexander. Human intercourse was increased and quickened to a degree not before known. Commercial enterprise now found open roads between the Aegean and India; the new Greek cities made stations in what had been for the earlier Greek traders unknown lands; an immense quantity of precious metal had been put into circulation which the Persian kings had kept locked up in their treasuries (cf. Athen. vi. 231 e). At the same time Alexander himself made it a principal concern to win fresh geographical knowledge, to open new ways. The voyage of Nearchus from the Indus to the Euphrates was intended to link India by a waterway with the Mediterranean lands. So too Heraclides was sent to explore the Caspian; the survey, and possible circumnavigation, of the Arabian coasts was the last enterprise which occupied Alexander. The improvement of waterways in the interior of the empire was not neglected, the Babylonian canal system was repaired, the obstructions in the Tigris removed. A canal was attempted across the Mimas promontory (Plin. *N.H.* v. 116). The reports of the βηματισταί, Baeton and Diognetus, who accompanied the march of Alexander's army, gave an exacter knowledge of the geographical conformation of the empire, and were accessible for later investigators (Susemihl, *Gesch. d. griech. Litt.*, I. p. 544). Greek natural science was enriched with a mass of new material from the observations of the philosophers who went with Alexander through the strange lands (H. Bretzl, *Botanische Forschungen d. Alexanderzuges*, 1903); whilst on the other hand attempts were made to acclimatize the plants of the motherland in the foreign soil (Theophr., *Hist. Plant.* iv. 4, 1).

9. Coinage.

The accession of Alexander brought about a change in the monetary system of the kingdom. Philip's bimetallic system, which had attempted artificially to fix the value of silver in spite of the great depreciation of gold consequent upon the working of the Pangaean mines, was abandoned. Alexander's gold coinage, indeed (possibly not struck till after the invasion of Asia), follows in weight that of Philip's staters; but he seems at once to have adopted for his silver coins (of a smaller denomination than the tetradrachm) the Euboic-Attic standard, instead of the Phoenician, which had been Philip's. With the conquest of Asia, Alexander conceived the plan of issuing a uniform coinage for the empire. Gold had fallen still further from the diffusion of the Persian treasure, and Alexander struck in both metals on the Attic standard, leaving their relation to adjust itself by the state of the market. This imperial coinage was designed to break down the monetary predominance of Athens (Beloch, *Gr. Gesch.* iii. [i.], 42). None of the coins with Alexander's own image can be shown to have been issued during his reign; the traditional gods of the Greeks still admitted no living man to share their prerogative in this sphere. Athena and Nike alone figured upon Alexander's gold; Heracles and Zeus upon his silver.

See L. Müller, *Numismatique d'Alexandre le Grand* (1855); also NUMISMATICS: § I. "Greek Coins, Macedonian."

1. History of the "Successors."

II. *After Alexander.*—The external fortunes of the Macedonian Empire after Alexander's death must be briefly traced before its inner developments be touched upon.[1] There was, at first, when Alexander suddenly died in 323, no overt disruption of the empire. The dispute between the Macedonian infantry and the cavalry (*i.e.* the commonalty and the nobles) was as to the person who should be chosen to be the king, although it is true that either candidate, the half-witted son of Philip II., Philip Arrhidaeus, or the posthumous son of Alexander by Roxana, opened the prospect of a long regency exercised by one or more of the Macedonian lords. The compromise, by which both the candidates should be kings together, was, of course, succeeded by a struggle for power among those who wished to rule in their name. The resettlement of dignities made in Babylon in 323, while it left the eastern commands practically undisturbed as well as that of Antipater in Europe, placed Perdiccas (whether as regent or as chiliarch) in possession of the kings' persons, and this was a position which the other Macedonian lords could not suffer. Hence the first intestine war among the Macedonians, in which Antipater, Antigonus, the satrap of Phrygia, and Ptolemy, the satrap of Egypt, were allied against Perdiccas, who was ultimately murdered in 321 on the Egyptian frontier (see PERDICCAS [4], EUMENES). A second settlement, made at Triparadisus in Syria in 321, constituted Antipater regent and increased the power of Antigonus in Asia. When Antipater died, in 319, a second war broke out, the wrecks of the party of Perdiccas, led by Eumenes, combining with Polyperchon, the new regent, and later on (318) with the eastern satraps who were in arms against Pithon, the satrap of Media. Cassander, the son of Antipater, disappointed of the regency, had joined the party of Antigonus. In 316 Antigonus had defeated and killed Eumenes and made himself supreme from the Aegean to Iran, and Cassander had ousted Polyperchon from Macedonia. But now a third war began, the old associates of Antigonus, alarmed by his overgrown power, combining against him—Cassander, Ptolemy, Lysimachus, the governor of Thrace, and Seleucus, who had fled before Antigonus from his satrapy of Babylonia. From 315 to 301 the war of Antigonus against these four went on, with one short truce in 311. Antigonus never succeeded in reaching Macedonia, although his son Demetrius won Athens and Megara in 307 and again (304–302) wrested almost all Greece from Cassander; nor did Antigonus succeed in expelling Ptolemy from Egypt, although he led an army to its frontier in 306; and after the battle of Gaza in 312, in which Ptolemy and Seleucus defeated Demetrius, he had to see Seleucus not only recover Babylonia but bring all the eastern provinces under his authority as far as India. Meanwhile the struggle changed its character in an important respect. King Philip had been murdered by Olympias in 317; the young Alexander by Cassander in 310; Heracles, the illegitimate son of Alexander the Great, by Polyperchon in 309. Thus the old royal house became extinct in the male line, and in 306 Antigonus assumed the title of king. His four adversaries answered this challenge by immediately doing the same. Even in appearance the empire was no longer a unity. In 301 the coalition triumphed over Antigonus in the battle of Ipsus (in Phrygia) and he himself was slain. Of the four kings who now divided the Macedonian Empire amongst them, two were not destined to found durable dynasties, while the house of Antigonus, represented by Demetrius, was after all to do so. The house of Antipater came to an end in the male line in 294, when Demetrius killed the son of Cassander and established himself on the throne of Macedonia. He was however expelled by Lysimachus and Pyrrhus in 288; and in 285 Lysimachus took possession of all the European part of the Macedonian Empire. Except indeed for Egypt and Palestine under Ptolemy, Lysimachus and Seleucus now divided the empire between them, with the Taurus in Asia Minor for their frontier. These two survivors of the forty years' conflict soon entered upon the crowning fight, and in 281 Lysimachus fell in the battle of Corupedion (in Lydia), leaving Seleucus virtually master of the empire. Seleucus' assassination by Ptolemy Ceraunus in the same year brought back confusion.

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[1] For details see separate articles on the chief generals.

Ptolemy Ceraunus (the son of the first Ptolemy, and half-brother of the reigning king of Egypt) seized the Macedonian throne, whilst Antiochus, the son of Seleucus, succeeded in holding together the Asiatic dominions of his father. The confusion was aggravated by the incursion of the Gauls into the Balkan Peninsula in 279; Ptolemy Ceraunus perished, and a period of complete anarchy succeeded in Macedonia. In 276 Antigonus Gonatas, the son of Demetrius, after inflicting a crushing defeat on the Gauls near Lysimachia, at last won Macedonia definitively for his house. Three solid kingdoms had thus emerged from all the fighting since Alexander's death: the kingdom of the Antigonids in the original land of the race, the kingdom of the Ptolemies in Egypt, and that of the Seleucids, extending from the Aegean to India. For the next 100 years these are the three great powers of the eastern Mediterranean. But already parts of the empire of Alexander had passed from Macedonian rule altogether. In Asia Minor, Philetaerus a Greek of Tios (Tieium) in Paphlagonia, had established himself in a position of practical independence at Pergamum, and his nephew, Attalus, was the father of the line of kings who reigned in Pergamum till 133—antagonistic to the Seleucid house, till in 189 they took over the Seleucid possessions west of the Taurus. In Bithynia a native dynasty assumed the style of kings in 297. In Cappadocia two Persian houses, relics of the old aristocracy of Achaemenian days had carved out principalities, one of which became the kingdom of Pontus and the other the kingdom of Cappadocia (in the narrower sense); the former regarding Mithradates (281–266) as its founder, the latter being the creation of the second Ariarathes (?302–?281). Armenia, never effectively conquered by the Macedonians, was left in the hands of native princes, tributary only when the Seleucid court was strong enough to compel. In India, Seleucus had in 302 ceded large districts on the west of the Indus to Chandragupta, who had arisen to found a native empire which annexed the Macedonian provinces in the Panjab.

Whilst the Antigonid kingdom remained practically whole till the Roman conquest ended it in 168 B.C., and the house of Ptolemy ruled in Egypt till the death of Cleopatra in 30 B.C., the Seleucid Empire perished by a slow process of disruption. The eastern provinces of Iran went in 240 or thereabouts, when the Greek Diodotus made himself an independent king in Bactria (*q.v.*) and Sogdiana, and Tiridates, brother of Arsaces, a "Scythian" chieftain, conquered Parthia (so Arrian, but see PARTHIA). Armenia was finally lost in 190, when Artaxias founded a new native dynasty there. Native princes probably ruled in Persis before 166, though the district was at least nominally subject to Antiochus IV. Epiphanes till his death in 164 (see PERSIS). In southern Syria, which had been won by the house of Seleucus from the house of Ptolemy in 198, the independent Jewish principality was set up in 143. About the same time Media was totally relinquished to the Parthians. Babylonia was Parthian from 129. Before 88 the Parthians had conquered Mesopotamia. Commagene was independent under a king, Mithradates Callinicus, in the earlier part of the last century B.C. Syria itself in the last days of the Seleucid dynasty is seen to be breaking up into petty principalities, Greek or native. From 83 to 69 is the transient episode of Armenian conquest, and in 64 the last shadow of Seleucid rule vanished, when Syria was made a Roman province by Pompey. From this time Rome formally entered upon the heritage of Alexander as far as the Euphrates, but many of the dynasties which had arisen in the days of Macedonian supremacy were allowed to go on for a time as client states. One of them, the royal house of Commagene, not deposed by the Romans till A.D. 72, had Seleucid blood in its veins through the marriage of a Seleucid princess with Mithradates Callinicus, and regarded itself as being a continuation of the Seleucid dynasty. Its kings bore the name of Antiochus, and were as proud of their Macedonian, as of their Persian, descent (see the Inscription of Nimrud Dagh, Michel, No. 735)

2. Constitution of the Macedonian Kingdom.

The Macedonians of Alexander were not mistaken in seeing an essential transformation of their national monarchy when Alexander adopted the guise of an Oriental great king. Transplanted into this foreign soil, the monarchy became an absolute despotism, unchecked by a proud territorial nobility and a hardy peasantry on familiar terms with their king. The principle which Seleucus is reported to have enunciated, that the king's command was the supreme law (App. *Syr.* 61), was literally the principle of the new Hellenistic monarchies in the East. But the rights belonging to the Macedonian army as Alexander inherited it did not altogether disappear. Like the old Roman people, the Macedonian people under arms had acted especially in the transference of the royal authority, conferring or confirming the right of the new chief, and in cases of the capital trials of Macedonians. In the latter respect the army came regularly into function under Alexander, and in the wars which followed his death (Diod. xviii. 4, 3; 36, 7; 37, 2, 39, 2; xix. 61, 3), and in Macedonia; although the power of life and death came *de facto* into the hands of the Antigonid king, the old right of the army to act as judge was not legally abrogated, and friction was sometimes caused by its assertion (Polyb. v. 27, 5). The right of the army to confer the royal power was still symbolized in the popular acclamation required on the accession of a new king, and at Alexandria in troubled times we hear of "the people" making its will effective in filling the throne, although it is here hard to distinguish mob-rule from the exercise of a legitimate function. Thus the people put Euergetes II. on the throne when Philometor was captured (Polyb. xxix. 23, 4); the people compelled Cleopatra III. to choose Soter II. as her associate (Just. xxxiv. 3, 2). In Syria, the usurper Tryphon bases his right upon an election by the "people" (Just. xxxvi. 1, 7) or "the army" (Jos. *Ant.* xiii. § 219). Where it is a case of delegating some part of the supreme authority, as when Seleucus I. made his son Antiochus king for the eastern provinces, we find the army convoked to ratify the appointment (App. *Syr.* 61). So too the people is spoken of as appointing the guardians of a king during his minority (Just. xxxiv. 3, 6). Nor was the power of the army a fiction. The Hellenistic monarchies rested, as all government in the last resort must, upon the loyalty of those who wielded the brute force of the state, and however unlimited the powers of the king might be in theory, he could not alienate the goodwill of the army with impunity. The right of primogeniture in succession was recognized as a general principle; a woman, however, might succeed only so long as there were no male agnates. Illegitimate children had no rights of succession. In disturbed times, of course, right yielded to might or to practical necessities.

The practice by which the king associated a son with himself, as secondary king, dates from the very beginning of the kingdoms of the Successors; Antigonus on assuming the diadem in 306 caused Demetrius also to bear the title of king. Some ten years later Seleucus appointed Antiochus as king for the eastern provinces. Thenceforth the practice is a common one. But the cases of it fall into two classes. Sometimes the subordinate or joint kingship implies real functions. In the Seleucid kingdom the territorial expanse of the realm made the creation of a distinct subordinate government for part of it a measure of practical convenience. Sometimes the joint-king is merely titular, an infant of tender years, as for instance Antiochus Eupator, the son of Antiochus Epiphanes, or Ptolemy Eupator, the son of Ptolemy Philometor. The object here is to secure the succession in the event of the supreme king's dying whilst his heir is an infant. The king's government was carried on by officials appointed by him and responsible to him alone. Government at the same time, as an Oriental despotism understands it, often has little in view but the gathering in of the tribute and compulsion of the subjects to personal service in the army or in royal works, and if satisfied in these respects will leave much independence to the local authorities. In the loosely-knit Seleucid realm it is plain that a great deal more independence was left to the various communities,—cities or native tribes,—than in Egypt, where the conditions made a bureaucratic system so easy to carry through. In their outlying possessions the Ptolemies may have suffered as much local independence as the Seleucids; the internal government of Jerusalem, for instance, was left to the high priests. In so far as the older Greek cities fell within their sphere of power, the successors of Alexander were forced to the same ambiguous policy as Alexander had been, between recognizing the cities' unabated claim to sovereign independence and the necessity of attaching them securely. In Asia Minor, the "enslavement" and liberation of cities alternated with the circumstances of the hour, while the kings all through professed themselves the champions of Hellenic freedom, and were ready on occasion to display munificence toward the city temples or in public works, such as might reconcile republicans to a position of dependence. Antiochus III. went so far as to write on one occasion to the subject Greek cities that if any royal mandate clashed with the civic laws it was to be disregarded (Plut. *Imp. et duc. apophth.*). But it was the old cry of the "autonomy of the Hellenes," raised by Smyrna and Lampsacus, which ultimately brought Antiochus III. into collision with Rome. How anxious the Pergamene kings, with their ardent Hellenism, were to avoid offence is shown by the elaborate forms by which, in their own capital, they sought to give their real control the appearance of popular freedom (Cardinali, *Regno di Pergamo*, p. 281 seq.). A similar problem confronted the Antigonid dynasty in the cities of Greece itself, for to maintain a predominant influence in Greece was a ground-principle of their policy. Demetrius had presented himself in 307 as the liberator, and driven the Macedonian garrison from the Peiraeus; but his own garrisons held Athens thirteen years later, when he was king of Macedonia, and the Antigonid dynasty clung to the points of vantage in Greece, especially Chalcis and Corinth, till their garrisons were finally expelled by the Romans in the name of Hellenic liberty.

3. Commerce.

The new movement of commerce initiated by the conquest of Alexander continued under his successors, though the break-up of the Macedonian Empire in Asia in the 3rd century and the distractions of the Seleucid court must have withheld many advantages from the Greek merchants which a strong central government might have afforded them. It was along the great trade-routes between India and the West that the main stream of riches flowed then as in later centuries. One of these routes was by sea to south-west Arabia (Yemen), and thence up the Red Sea to Alexandria. This was the route controlled and developed by the Ptolemaic kings. Between Yemen and India the traffic till Roman times was mainly in the hands of Arabians or Indians; between Alexandria and Yemen it was carried by Greeks (Strabo ii. 118). The west coast of the Red Sea was dotted with commercial stations of royal foundation from Arsinoë north of Suez to Arsinoë in the south near the straits of Bab-el-Mandeb. From Berenice on the Red Sea a land-route struck across to the Nile at Coptos; this route the kings furnished with watering stations. That there might also be a waterway between Alexandria and the Red Sea, they cut a canal between the Delta and the northern Arsinoë. It was Alexandria into which this stream of traffic poured and made it the commercial metropolis of the world. We hear of direct diplomatic intercourse between the courts of Alexandria and Pataliputra, *i.e.* Patna (Plin. vi. § 58). An alternative route went from the Indian ports to the Persian Gulf, and thence found the Mediterranean by caravan across Arabia from the country of Gerrha to Gaza; and to control it was no doubt a motive in the long struggle of the Ptolemaic and Seleucid houses for Palestine, as well as in the attempt of Antiochus III. to subjugate the Gerrhaeans. Or from the Persian Gulf wares might be taken up the Euphrates and carried across to Antioch; this route lay altogether in the Seleucid sphere. With Iran Antioch was connected most directly by the road which crossed the Euphrates at the Zeugma and went through Edessa and Antioch-Nisibis to the Tigris. The trade from India which went down the Oxus and then to the Caspian does not seem to have been considerable (Tarn, *Journ. of Hell. Stud.* xxi. 10 seq.). From Antioch to the Aegean the land high-road went across Asia Minor by the Cilician Gates and the Phrygian Apamea.

4. Finance.

Of the financial organization of the Macedonian kingdoms we know practically nothing, except in the case of Egypt. Here the papyri and ostraca have put a large material at our disposal, but the circumstances in Egypt[1] were too peculiar for us to generalize upon these data as to the Seleucid and Antigonid realms. That the Seleucid kings drew in a principal part of their revenues from tribute levied upon the various native races, distributed in their village communities as tillers of the soil goes without saying.[2] In districts left in the hands of native chiefs these chiefs would themselves exploit their villages and pay the Seleucid court and tribute. To exact tribute from Greek cities was invidious, but both Antigonid and Seleucid kings often did so (Antigonid, Diog. Laërt. II., 140; Plut. *Dem.* 27; Seleucid, Michel, No. 37; Polyb. xxi. 43, 2). Sometimes, no doubt, this tribute was demanded under a fairer name, as the contribution of any ally (σύνταξις, not φόρος), like the Γαλατικά levied by Antiochus I. (Michel, No. 37; cf. Polyb. xxii. 27, 2). The royal domains, again, and royal monopolies, such as salt-mines, were a source of revenue.[3] As to indirect taxes, like customs and harbour dues, while their existence is a matter of course (cf. Polyb. v. 89, 8), their scale, nature and amount is quite unknown to us. Whatever the financial system of the Antigonid and Seleucid kingdoms may have been, it is clear that they were far from enjoying the affluence of the Ptolemaic. During the first Seleucid reigns indeed the revenues of Asia may have filled its treasuries (see Just. xvii. 2, 13), but Antiochus III. already at his accession found them depleted (Polyb. v. 50, 1), and from his reign financial embarrassment, coupled with extravagant expenditure, was here the usual condition of things. Perseus, the last of the Antigonid house, amassed a substantial treasure for the expenses of the supreme struggle with Rome (Polyb. xviii. 35, 4; Liv. xlv, 40), but it was by means of almost miserly economies.

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[1] For Ptolemaic Egypt, see PTOLEMIES and EGYPT.

[2] A *tenth* of the produce is suggested to have been the normal tax by what the Romans found obtaining in the Attalid kingdom. The references given by Beloch (*Griech. Gesch.* iii. [i.], p. 343) to prove it for the Seleucid kingdom are questionable. Beloch refers (1) to the letter of Demetrius II. to Lasthenes in which αἱ δεκαταὶ καὶ τὰ τέλη are mentioned, 1 Macc. 11, 35 (Beloch, by an oversight, refers to the paraphrase of the documents in Joseph. *Ant.* xiii. 4, § 126 seq., in which the mention of the δεκαταὶ is omitted!). The authenticity of this document is, however, very doubtful. He refers (2) to Dittenb. 171 (1st ed.), line 101; but here the tax seems to be, not an imperial one, but one paid to the city of Smyrna.

[3] The salt monopoly is mentioned in 1 Macc. 10, 29: 11, 35, a suspected source, but supported in this detail by the analogy of Ptolemaic Egypt and Rome. For domains in Antigonid, Attalid and Bithynian realms, see Cic. *De leg. agr.* ii. 19, 50.

Special officials were naturally attached to the service of the finances. Over the whole department in the Seleucid realm there presided a single chief (*ὁ ἐπὶ τῶν προσόδων*, App. *Syr.* 45). How far the financial administration was removed from the competence of the provincial governors, as it seems to have been in Alexander's system, we cannot say. Seleucus at any rate, as satrap of Babylonia, controlled the finances of the province (Diod. xix. 55, 3), and so, in the Ptolemaic system, did the governor of Cyprus (Polyb. xxvii. 13). The fact that provincial officials *ἐπὶ τῶν προσόδων* (in Eriza, *Bull. corr. hell.* xv. 556) are found does not prove anything, since it leaves open the question of their being subordinate to the governor.

5. Coinage.

With the exception of Ptolemaic Egypt, the Macedonian kingdoms followed in their coinage that of Alexander. Money was for a long while largely struck with Alexander's own image and superscription; the gold and silver coined in the names of Antigonid and Seleucid kings and by the minor principalities of Asia, kept to the Attic standard which Alexander had established. Only in Egypt Ptolemy I. adopted, at first the Rhodian, and afterwards the Phoenician, standard, and on this latter standard the Ptolemaic money was struck during the subsequent centuries. Money was also struck in their own name by the cities in the several dynasties' spheres of power, but in most cases only bronze or small silver for local use. Corinth, however, was allowed to go on striking staters under Antigonus Gonatas; Ephesus, Cos and the greater cities of Phoenicia retained their right of coinage under Seleucid or Ptolemaic supremacy.

6. The Court.

In language and manners the courts of Alexander's successors were Greek. Even the Macedonian dialect, which it was considered proper for the kings to use on occasion, was often forgotten (Plut. *Ant.* 27). The Oriental features which Alexander had introduced were not copied. There was no *proskynesis* (or certainly not in the case of Greeks and Macedonians), and the king did not wear an Oriental dress. The symbol of royalty, it is true, the *diadem*, was suggested by the head-band of the old Persian kings (Just. xii. 3, 8); but, whereas, that had been an imposing erection, the Hellenistic diadem was a simple riband. The king's state dress was the same in principle as that worn by the Macedonian or Thessalian horsemen, as the uniform of his own cavalry officers, Its features were the broad-brimmed hat (*kausia*), the cloak (*chlamys*) and the high-laced boots (*krepides*) (Plut. *Ant.* 54; Frontinus, iii. 2, 11). These, in the case of the king, would be of richer material, colour and adornment. The diadem could be worn round the kausia; the chlamys offered scope for gorgeous embroidery; and the boots might be crimson felt (see the description of Demetrius' chlamys and boots, Plut. *Dem.* 41). There were other traces in the Hellenistic courts of the old Macedonian tradition besides in dress. One was the honour given to prowess in the chase (Polyb. xxii. 3, 8; Diod. xxxiv. 34). Another was the fashion for the king to hold wassail with his courtiers, in which he unbent to an extent scandalous to the Greeks, dancing or indulging in routs and practical jokes.[1]

The prominent part taken by the women of the royal house was a Macedonian characteristic. The history of these kingdoms furnishes a long list of queens and princesses who were ambitious and masterful politicians, of which the great Cleopatra is the last and the most famous. The kings after Alexander, with the exception of Demetrius Poliorcetes and Pyrrhus, are not found to have more than one legitimate wife at a time, although they show unstinted freedom in divorce and the number of their mistresses. The custom of marriages between brothers and sisters, agreeable to old Persian as to old Egyptian ethics, was instituted in Egypt by the second Ptolemy when he married his full sister Arsinoë Philadelphus. It was henceforth common, though not invariable, among the Ptolemies. At the Seleucid court there seems to be an instance of it in 195, when the heir-apparent, Antiochus, married his sister Laodice. The style of "sister" was given in both courts to the queen, even when she was not the king's sister in reality (Strack, *Dynastie*, Nos. 38, 40, 43; *Archiv. f. Papyr*, i. 205). The "Friends" of the king are often mentioned. It is usual for him to confer with a council (*συνέδριον*) of his "Friends" before important decisions, administrative, military or judicial (*e.g.* Polyb. v. 16, 5; 22, 8). They form a definite body about the king's person (*φίλων σύνταγμα*, Polyb. xxxi. 3, 7; cf. *οἱ φίλοι* in contrast with *αἱ δυνάμεις*, id. v. 50, 9), admission into which depends upon his favour alone, and is accorded, not only to his subjects, but to aliens, such as the Greek refugee politicians (*e.g.* Hegesianax, Athen. iv. 155b; Hannibal and the Aetolian Thoas take part in the councils of Antiochus III). A similar body, with a title corresponding to *φίλοι*, is found in ancient Egypt (Erman, *Ancient Egypt*, Eng. trans., p. 72) and in Persia (Spiegel. *Eran. Alt.* iii. 626); but some such support is so obviously required by the necessities of a despot's position that we need not suppose it derived from any particular precedent. The Friends (at any rate under the later Seleucid and Ptolemaic reigns) were distinguished by a special dress and badge of gold analogous to the stars and crosses of modern orders. The dress was of crimson (*πορφύρα*); this and the badges were the king's gift, and except by royal grant neither crimson nor gold might, apparently, be worn at court (1 Macc. 10, 20; 62; 89; 11, 58; Athen. v. 211b). The order of Friends was organized in a hierarchy of ranks, which were multiplied as time went on. In Egypt we find them classified as *συγγενεῖς*, *ὁμότιμοι τοῖς συγγενέσιν*, *ἀρχισωματοφύλακες*, *πρῶτοι φίλοι*, *φίλοι* (in the narrower sense), *διάδοχοι*. For the Seleucid kingdom *συγγενεῖς*, *πρῶτοι φίλοι* and *φίλοι* are mentioned. These classes do not appear in Egypt before the 2nd century; Strack conjectures that they were created in imitation of the Seleucid court. We have no direct evidence as to the institutions of the Seleucid court in the 3rd century. Certain *σωματοφύλακες* of Antiochus I. are mentioned, but we do not know whether the name was not then used in its natural sense (Strack, *Rhein. Mus.* LV., 1900, p. 161 seq.; Wilamowitz, *Archiv f. Pap.* I., p. 225; Beloch, *Gr. Gesch.* iii (i), p. 391). As to Macedonia, whatever may have been the constitution of the court, it is implied that it offered in its externals a sober plainness in comparison with the vain display and ceremonious frivolities of Antioch and Alexandria (Polyb. xvi, 22, 5; Plut. *Cleom.* 31; *Arat*, 15). The position of a Friend did not carry with it necessarily any functions; it was in itself purely honorary. The ministers and high officials were, on the other hand, regularly invested with one or other of the ranks specified. The chief of these ministers is denoted *ὁ ἐπὶ τῶν πραγμάτων*, and he corresponds to the *vizier* of the later East. All departments of government are under his supervision, and he regularly holds the highest rank of a kinsman. When the king is a minor, he acts as guardian or regent (*ἐπίτροπος*). Over different departments of state we find a state secretary (*ἐπιστολογράφος* or *ὑπομνηματογράφος*: Seleucid, Polyb. xxxi, 3, 16; Ptolemaic, Strack, *Inschriften* 103) and a minister of finance (*ὁ ἐπὶ τῶν προσόδων* in the Seleucid kingdom; App. *Syr.* 45; *διοικητής* in Egypt, Lumbroso, *Econ. Pol.* p. 339). Under each of these great heads of departments was a host of lower officials, those, for instance, who held to the province a relation analogous to that of the head of the department of the realm. Such a provincial authority is described as *ἐπὶ τῶν προσόδων* in the inscription of Eriza (*Bull. corr. hell.*

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[1] Antiochus Epiphanes was an extreme case. For the Antigonid court see Diog. Laërt. vii. 13; Plut. *Arat.* 17; for the Seleucid, Athen. iv. 155b; v. 211a; for the Ptolemaic, Diog. L. vii. 177; Athen. vi. 246c; Plut. *Cleom.* 33; Just. xxx. 1.

xv. 556). Beside the officials concerned with the work of government we have those of the royal household: (1) the chief-physician, *ἀρχιατρός* (for the Seleucid see App. *Syr.* 59; Polyb. v. 56, 1; Michel, No. 1158; for the Pontic, *Bull. corr. hell.* vii. 354 seq.); (2) the chief-huntsman, *ἀρχικυνηγός* (Dittenb. *Orient. Graec.* 99); (3) the maître-d'hôtel *ἀρχεδέατρος* (Dittenb. *Orient. Graec.* 169) (4) the lord of the queen's bedchamber, *ὁ επὶ τοῦ κοιτῶνος τῆς βασιλίσσης* (Dittenb. *Orient. Graec.* 256). As in the older Oriental courts, the high positions were often filled by eunuchs (*e.g.* Craterus, in last mentioned inscription).

It was customary, as in Persia and in old Macedonia, for the great men of the realm to send their children to court to be brought up with the children of the royal house. Those who had been so brought up with the king were styled his *σύντροφοι* (for the Seleucid, Polyb. v. 82, 8 and xxxi. 21, 2; *Bull. corr. hell.* i. 285; 2 Macc. ix. 29; for the Ptolemaic *σύντροφοι παιδίσκαι* of the queen, Polyb. xv. 33, 11; for the Pontic, *Bull. corr. hell.* vii. 355; for the Pergamene. Polyb. xxxii. 27, 10, &c.; for the Herodian, Acts 13). It is perfectly gratuitous to suppose with Deissmann that "the fundamental meaning had given place to the general meaning of intimate friend." With this custom we may perhaps bring into connexion the office of *τροφεύς* (Polyb. xxxi. 20, 3; Michel, No. 1158). As under Alexander, so under his successors, we find a corps of *βασιλικοί παῖδες*. They appear as a corps, 600 strong, in a triumphal procession at Antioch (Polyb. xxxi. 3, 17; cf. v. 82, 13; Antigonid, Livy, xlv. 6; cf. Curtius, viii. 6, 6).

7. Hellenic Culture.

All the Hellenistic courts felt it a great part of prestige to be filled with the light of Hellenic culture. A distinguished philosopher or man of letters would find them bidding for his presence, and most of the great names are associated with one or other of the contemporary kings. Antigonus Gonatas, bluff soldier-spirit that he was, heard the Stoic philosophers gladly, and, though he failed to induce Zeno to come to Macedonia, persuaded Zeno's disciple, Persaeus of Citium, to enter his service. Nor was it philosophers only who made his court illustrious, but poets like Aratus. The Ptolemaic court, with the museum attached to it, is so prominent in the literary and scientific history of the age that it is unnecessary to give a list of the philosophers, the men of letters and science, who at one time or other ate at King Ptolemy's table. One may notice that the first Ptolemy himself made a contribution of some value to historical literature in his account of Alexander's campaigns; the fourth Ptolemy not only instituted a cult of Homer but himself published tragedies; and even Ptolemy Euergetes II. issued a book of memoirs. The Pergamene court was in no degree behind the Ptolemaic in its literary and artistic zeal. The notable school of sculpture connected with it is treated elsewhere (see GREEK ART); to its literary school we probably owe in great part the preservation of the masterpieces of Attic prose (Susemihl I., p. 4), and two of its kings (Eumenes I. and Attalus III.) were themselves authors. The Seleucid court did not rival either of the last named in brilliance of culture; and yet some names of distinction were associated with it. Under Antiochus I. Aratus carried out a recension of the *Odyssey*, and Berossus composed a Babylonian history in Greek; under Antiochus III. Euphorion was made keeper of the library at Antioch. Antiochus IV., of course, the enthusiastic Hellenist, filled Antioch with Greek artists and gave a royal welcome to Athenian philosophers. Even in the degenerate days of the dynasty, Antiochus Grypus, who had been brought up at Athens, aspired to shine as a poet. The values recognized in the great Hellenistic courts and the Greek world generally imposed their authority upon the dynasties of barbarian origin. The Cappadocian court admitted the full stream of Hellenistic culture under Ariarathes V. (Diod. xxxi. 19, 8). One of the kings called Nicomedes in Bithynia offered immense sums to acquire the Aphrodite of Praxiteles from the Cnidians (Plin. *N.H.* xxxvi. 21), and to a king Nicomedes the geographical poem of the Pseudo-Scymnus is dedicated. Even Iranian kings in the last century B.C. found pleasure in composing, or listening to, Greek tragedies, and Herod the Great kept Greek men of letters beside him and had spasmodic ambitions to make his mark as an orator or author (Nicol. Dam. frag. 4; *F.H.G.* III. p. 350).

8. Divine Honours.

The offering of divine honours to the king, which we saw begin under Alexander, became stereotyped in the institutions of the succeeding Hellenistic kingdoms. Alexander himself was after his death the object of various local cults, like that which centred in the shrine near Erythrae (Strabo, xiv. 644). His successors in the first years after his death recognized him officially as a divinity, except Antipater (Suidas, *s.v. Ἀντίπατρος*), and coins began to be issued with his image. At Alexandria the state cult of him seems to have been instituted by the second Ptolemy, when his body was laid in the *Sema* (Otto, *Priester u. Tempel*, i. 139 seq.). The successors themselves received divine honours. Such worship might be the spontaneous homage of a particular Greek community, like that offered to Antigonus by Scepsis in 311 (*Journ. of Hell. Stud.* xix. 335 seq.), the Antigonus and Demetrius by Athens in 307, to Ptolemy I. by the Rhodians in 304, or by Cassandrea to Cassander, as the city's founder (Ditt. 2nd ed. 178); or it might be organized and maintained by royal authority. The first proved instance of a cult of the latter kind is that instituted at Alexandria by the second Ptolemy for his father soon after the latter's death in 283/2, in which, some time after, 279/8, he associated his mother Berenice also, the two being worshipped together as *θεοὶ σωτῆρες* (Theoc. xvii. 121 seq.). Antiochus I. followed the Ptolemaic precedent by instituting at Seleucia-in-Pieria a cult for his father as Seleucus Zeus Nicator. So far we can point to no instance of a cult of the living sovereign (though the cities might institute such locally) being established by the court for the realm. This step was taken in Egypt after the death of Arsinoë Philadelphus (271) when she and her still-living brother-husband, Ptolemy II., began to be worshipped together as *θεοὶ ἀδελφοί*. After this the cult of the reigning king and queen was regularly maintained in Greek Egypt, side by side with that of the dead Ptolemies. Under Antiochus II. (261–246) a document shows us a cult of the reigning king in full working for the Seleucid realm, with a high priest in each province, appointed by the king himself; the document declares that the Queen Laodice is now to be associated with the king. The official surname of Antiochus II., Theos, suggests that he himself had here been the innovator. Thenceforward, in the Hellenistic kingdoms of the East the worship of the living sovereign became the rule, although it appears to have been regarded as given in anticipation of an apotheosis which did not become actual till death. In the Pergamene kingdom at any rate, though the living king was worshipped with sacrifice, the title *θεός* was only given to those who were dead (Cardinali, *Regno di Pergamo*, p. 153). The Antigonid dynasty, simpler and saner in its manners, had no official cult of this sort. The divine honours offered on occasion by the Greek cities were the independent acts of the cities.

See Plut. *Arat.* 45; *Cleom.* 16; Kornemann, "Zur Gesch. d. antiken Herrscherkulte" in *Beiträge z. alt. Gesch.* i. 51 sqq.; Otto, *Priester u. Tempel*, pp. 138 seq.

9. Surnames.

There does not seem any clear proof that the surnames which the Hellenistic kings in Asia and Egypt bore were necessarily connected with the cult, even if they were used to describe the various kings in religious ceremonies. Some had doubtless a religious colour, *Theos*, *Epiphanes*, *Soter*; others a dynastic, *Philopator*, *Philometor*, *Philadelphus*. Under what circumstances, and by whose selection, the surname was attached to a king, is obscure. It is noteworthy that while modern books commonly speak of the surnames as *assumed*, the explanations given by our ancient authorities almost invariably suppose them to be given as marks of homage or gratitude (*English Historical Review*, xvi. 629 (1901). The official surnames must not, of course, be confused with the popular nicknames which were naturally not recognized by the court, *e.g.* *Ceraunus* ("Thunder"), *Hierax* ("Hawk"), *Physcon* ("Pot-belly"), *Lathyrus* ("Chick-pea").

10. Armies.

The armies of Alexander's successors were still in the main principles of their organization similar to the army with which Alexander had conquered Asia. During the years immediately after Alexander the very Macedonians who had fought under Alexander were ranged against each other under the banners of the several chiefs. The most noted corps of veterans, Argyraspides (*i.e.* the royal Hypaspistae) played a great part in the first wars of the successors, and covered themselves with infamy by their betrayal of Eumenes. As the soldiers of Alexander died off, fresh levies of home-born Macedonians could be raised only by the chief who held the motherland. The other chiefs had to supply themselves with Macedonians from the numerous colonies planted before the break-up of the empire in Asia or Egypt, and from such Macedonians they continued for the next two centuries to form their phalanx. The breed—at least if the statement which Livy puts into the mouth of a Roman general can be relied on—degenerated greatly under Asiatic and Egyptian skies (Liv. xxxviii. 17, 10); but still old names like that of *pezetaeri* attached to the phalangites (Plut. *Tib.* 17), and they still wielded the national *sarissa*. The latter weapon in the interval between Alexander and the time of Polybius had been increased to a length of 21 ft. (Polyb. xviii. 12), a proportion inconsistent with any degree of mobility; once more indeed the phalanx of the 2nd century seems to have become a body effective by sheer weight only and disordered by unevenness of ground. The Antigonid kings were never able from Macedonian levies to put in the field a phalanx of more than 20,000 at the utmost (Liv. xlii. 51); Antigonus Doson takes with him to Greece (in 222) one of 10,000 only. The phalanx of Antiochus III. at Raphia numbered 20,000, and Ptolemy Philopator was able at the same time to form one of 25,000 men (Polyb. v. 4). As these phalangites are distinguished both from the Greek mercenaries and the native Egyptian levies, it looks (although such a fact would be staggering) as if more Macedonians could be raised for military service in Egypt than in Macedonia itself (but see Beloch, p. 353). The royal foot-guards are still described in Macedonia in 171 as the *agema* (Polyb. v. 25, 1; 27, 3; Liv. xlii. 51), when they number 2000; at the Ptolemaic court in 217 the *agema* had numbered 3000 (Polyb. v. 65, 2); and a similar corps of *hypaspistae* is indicated in the Seleucid army (Polyb. vii. 16,2; xvi. 18,7). So too the old name of "Companions" was kept up in the Seleucid kingdom for the Macedonian cavalry (see Polyb. v. 53, 4, &c.), and divisions of rank in it are still indicated by the terms *agema* and royal squadron (βασιλικὴ ἴλη, see Bevan, *House of Seleucus*, ii. 288). The Antigonid and Seleucid courts had much valuable material at hand for their armies in the barbarian races under their sway. The Balkan hill-peoples of Illyrian or Thracian stock, the hill-peoples of Asia Minor and Iran, the chivalry of Media and Bactria, the mounted bowmen of the Caspian steppes, the camel-riders of the Arabian desert, could all be turned to account. Iranian troops seem to have been employed on a large scale by the earlier Seleucids. At Raphia, Antiochus III. had 10,000 men drawn from the provinces, armed and drilled as Macedonians, and another corps of Iranians numbering 5000 under a native commander (Polyb. v. 79). The experiment of arming the native Egyptians on a large scale does not seem to have been made before the campaign of 217, when Ptolemy IV. formed corps of the Macedonian pattern from Egyptians and Libyans (cf. Polyb. v. 107, 2; Ptolemy I. had employed Egyptians in the army, though chiefly as carriers, Diod. xix. 80, 4). From this time native rebellions in Egypt are recurrent. To the troops drawn from their own dominions the mercenaries which the kings procured from abroad were an important supplement. These were mainly the bands of Greek *condottieri*, and even for their home-born troops Greek officers of renown were often engaged. The other class of mercenaries were Gauls, and from the time of the Gallic invasion of Asia Minor in 279 Gauls or Galatians were a regular constituent in all armies. They were a weapon apt to be dangerous to the employer, but the terror they inspired was such that every potentate sought to get hold of them. The elephants which Alexander brought back from India were used in the armies of his successors, and in 302 Seleucus procured a new supply. Thenceforward elephants, either brought fresh from India or bred in the royal stables at Apamea, regularly figured in the Seleucid armies. The Ptolemies supplied themselves with this arm from the southern coasts of the Red Sea, where they established stations for the capture and shipping of elephants, but the African variety was held inferior to the Indian. Scythed chariots such as had figured in the old Persian armies were still used by the Greek masters of Asia (Seleucus I., Diod. xx. 113, 4; Molon, Polyb. v. 53, 10; Antiochus III., Liv. xxxvii. 41), at any rate till the battle of Magnesia. The Hellenistic armies were distinguished by their external magnificence. They made a greater display of brilliant metal and gorgeous colour than the Roman armies, for instance. The description given by Justin of the army which Antiochus Sidetes took to the East in 130 B.C., boot-nails and bridles of gold, gives an idea of their standard of splendour (Just. xxxviii. 10, 1; cf. Polyb. xxxi. 3; Plut. *Eum.* 14; id. *Aemil.* 18; id. *Sulla*, 16).

During the 3rd century B.C. Egypt was the greatest sea power of the eastern Mediterranean, and maintained a large fleet (the figures in App. *Prooem*, 10 are not trustworthy, see Beloch III. [i.], 364). Its control of the Aegean was, however, contested not without success by the Antigonids, who won the two great sea-fights of Cos (*c.* 256) and Andros (227), and wrested the overlordship of the Cyclades from the Ptolemies. Of the numbers and constitution of the Antigonid fleet we know nothing.[1] At the Seleucid court in 222 the admiral (ναύαρχος) appears as a person of high consideration (Polyb. v. 43, 1); in his war with Rome Antiochus III. had 107 decked battleships on the sea at one time. By the Peace of Apamea (188) the Seleucid navy was abolished; Antiochus undertook to keep no more than 10 ships of war.

For the Hellenistic armies and fleets see A. Bauer in L. von Müller's *Handbuch*, vol. iv.; Delbrück, *Gesch. d. Kriegskunst* (1900).

11. Treatment of Subject Peoples.

To their native subjects the Seleucid and Ptolemaic kings were always foreigners. It was considered wonderful in the last Cleopatra that she learnt to speak Egyptian (Plut. *Anton.* 27). Natives were employed, as we have seen, in the army, and Iranians are found under the Seleucids holding high commands, *e.g.* Aspasianus the Mede (Polyb. v. 79, 7), Aribazus, governor of Cilicia (Flinders Petrie, *Papyri*, II., No. 45), Aribazus, governor of Sardis (Polyb. vii. 17, 9), and Omanes (Michel, No. 19, l. 104). Native cults the Hellenistic kings thought it good policy to patronize. Antiochus I. began rebuilding the temple of Nebo at Borsippa (*Keilinschr. Bibl.* iii. 2, 136 seq.) Antiochus III. bestowed favours on the Temple at Jerusalem. Even if the documents in Joseph. *Arch.* xii. §§ 138 seq. are spurious, their general view of the relation of Antiochus III. and Jerusalem is probably true. Even small local worships, like that of the village of Baetocaece, might secure royal patronage (*C.I.G.* No. 4474). Of course, financial straits might drive the kings to lay hands on temple-treasures, as Antiochus III. and Antiochus IV. did, but that was a measure of emergency.

12. Significance of Macedonian Rule.

The Macedonian kingdoms, strained by continual wars, increasingly divided against themselves, falling often under the sway of prodigals and debauchees, were far from realizing the Hellenic idea of sound government as against the crude barbaric despotisms of the older East. Yet, in spite of all corruption, ideas of the intelligent development of the subject lands, visions of the Hellenic king, as the Greek thinkers had come to picture him, haunted the Macedonian rulers, and perhaps fitfully, in the intervals of war or carousal, prompted some degree of action. Treatises "Concerning Kingship" were produced as a regular thing by philosophers, and kings who claimed the fine flower of Hellenism, could not but peruse them. Strabo regards the loss of the eastern provinces to the Parthians as their passage under a government of lower type, beyond the sphere of Hellenic ἐπιμέλεια (Strabo xi. 509). In the organization of the administrative machinery of these kingdoms, the higher power of the Hellene to adapt and combine had been operative; they were organisms of a richer, more complex type than the East had hitherto known. It was thus that when Rome became a world-empire, it found to some extent the forms of government ready made, and took over from the Hellenistic monarchies a tradition which it handed on to the later world.

AUTHORITIES.—For the general history of the Macedonian kingdoms, see Droysen, *Histoire de l'Hellenisme* (the French translation by Bouché-Leclercq, 1883–1885, represents the work in its final revision); A. Holm, *History of Greece*, vol. iv. (1894); B. Niese, *Geschichte der griechischen und makedonischen Staaten* (1893–1903); Kaerst, *Gesch. des hellenist. Zeitalters*, vol. i. (1901). A masterly conspectus of the general character of the Hellenistic kingdoms in their political, economic and social character, their artistic and intellectual culture is given by Beloch, *Griech. Gesch.* iii. (i.), 260–556; see also Kaerst, *Studien zur Entwickelung d. Monarchie*; E. Breccia, *Il Diritto dinastico nelle monarchie dei successori d'Alessandro Magno* (1903). Popular sketches of the history, enlightened by special knowledge and a wide outlook, are given by J. P. Mahaffy, *Alexander's Empire* ("Stories of the Nations Series"); *Progress of Hellenism in Alexander's Empire* (1905); *The Silver Age of the Greek World* (1906). See also HELLENISM; PTOLEMIES; SELEUCID DYNASTY. (E. R. B.)

MACEDONIUS, (1) bishop of Constantinople in succession to Eusebius of Nicomedia, was elected by the Arian bishops in 341, while the orthodox party elected Paul, whom Eusebius had superseded. The partisans of the two rivals involved the city in a tumultuous broil, and were not quelled until the emperor Constantius II. banished Paul. Macedonius was recognized as patriarch in 342. Compelled by the intervention of Constans in 348 to resign the patriarchate in favour of his former opponent, he was reinstalled in 350. He then took vengeance on his opponents by a general persecution of the adherents of the

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[1] For the Antigonid ναύαρχος or admiral, see Polyb. xvi. 6.

Nicene Creed. In 359, on the division of the Arian party into Acacians (or pure Arians) and semi-Arians or Homoiousians, Macedonius adhered to the latter, and in consequence was expelled from his see by the council of Constantinople in 360. He now became avowed leader of the sect of Pneumatomachi, Macedonians or Marathonians, whose distinctive tenet was that the Holy Spirit is but a being similar to the angels, subordinate to and in the service of the Father and the Son, the relation between whom did not admit of a third. He did not long survive his deposition.

See the Church Histories of Socrates and Sozomen; Art. in *Dict. Chr. Biog.*; F. Loofs in Herzog-Hauck's *Realencyk.*; H. M. Gwatkin, *Arianism.*

MACEDONIUS, (2) bishop of Mopsuestia, was present at the councils of Nicaea and Philippopolis, and inclined to the reactionary party who thought the Athanasians had gone too far.

MACEDONIUS, (3) bishop of Constantinople (*fl.* 510), a strict Chalcedonian who vainly opposed the fanaticism of the monophysite Severus and was deposed in 513.

MACEIÓ or MAÇAYÓ, a city and port of Brazil and capital of the state of Alagôas, about 125 m. S.S.W. of Pernambuco, in lat. 9° 39′ 35″ S., long. 35° 44′ 36″ W. Pop. including a large rural district and several villages (1890), 31,498; (1908, estimate), 33,000. The city stands at the foot of low bluffs, about a mile from the shore line. The water-side village of Jaraguá, the port of Maceió, is practically a suburb of the city. South of the port is the shallow entrance to the Lagôa do Norte, or Lagôa Mundahú, a salt-water lake extending inland for some miles. Maceió is attractively situated in the midst of large plantations of coco-nut and *dendê* palms, though the broad sandy beach in front and the open sun-burned plain behind give a barren character to its surroundings. The heat is moderated by the S.E. trade winds, and the city is considered healthful. The public buildings are mostly constructed of broken stone and mortar, plastered outside and covered with red tiles, but the common dwellings are generally constructed of *tapia*—rough trellis-work walls filled in with mud. A light tramway connects the city and port, and a railway—the Alagôas Central—connects the two with various interior towns. The port is formed by a stone reef running parallel with and a half-mile from the shore line, within which vessels of light draft find a safe anchorage, except from southerly gales. Ocean-going steamers anchor outside the reef. The exports consist principally of sugar, cotton, and rum (*aguardiente*). Maceió dates from 1815 when a small settlement there was created a "villa." In 1839 it became the provincial capital and was made a city by the provincial assembly.

McENTEE, JERVIS (1828–1891), American artist, was born at Rondout, New York, on the 14th of July 1828, and was a pupil of Frederick E. Church. He was made an associate of the National Academy of Design, New York, in 1860, and a full academician in 1861. In 1869 he visited Europe, painting much in Italy. He was identified with the Hudson River School, and excelled in pictures of autumn scenery. He died at Rondout, N.Y., on the 27th of January 1891.

MACER, AEMILIUS, of Verona, Roman didactic poet, author of two poems, one on birds (*Ornithogonia*), the other on the antidotes against the poison of serpents (*Theriaca*), imitated from the Greek poet Nicander of Colophon. According to Jerome, he died in 16 B.C. It is possible that he wrote also a botanical work. The extant hexameter poem *De viribus* (or *virtutibus*) *herbarum*, ascribed to Macer, is a medieval production by Odo Magdunensis, a French physician. Aemilius Macer must be distinguished from the Macer called *Iliacus* in the Ovidian catalogue of poets, the author of an epic poem on the events preceding the opening of the Iliad. The fact of his being addressed by Ovid in one of the epistles *Ex Ponto* shows that he was alive long after Aemilius Macer. He had been identified with the son or grandson of Theophanes of Mytilene, the intimate friend of Pompey.

See Ovid, *Tristia*, iv. 10, 43; Quintilian, *Instit.* x. 1, 56, 87; R. Unger, *De Macro Nicandri imitatore* (Friedland, 1845); C. P. Schulze in *Rheinisches Museum* (1898), liii. p. 541; for Macer Iliacus see Ovid, *Ex Ponto*, ii. 10, 13, iv. 16, 6; *Amores*, ii. 18.

MACERATA, a city of the Marches, Italy, the chief town of the province of Macerata and a bishop's see, 44 m. by rail S. of Ancona. Pop. (1901), 6,176 (town), 22,473 (commune). Crowning a hill 919 ft. above sea-level, with a picturesque mass of buildings enclosed by walls and towers, Macerata looks out over the Adriatic. The cathedral is modern, but some of the churches and palaces are not without interest. Besides the university, agricultural school and industrial institute, Macerata has a communal library founded by Leo XII., containing a small but choice collection of early pictures, and in the municipal buildings, a collection of antiquities from Helvia Ricina. There is an enormous amphitheatre or *sferisterio* for *pallone*, a ball game which is very popular in the district. The industries comprise the making of bricks, matches, terra-cotta and chemicals.

Macerata, as well as Recanati, was founded by the inhabitants of Ricina after the destruction of their city by Alaric in 408. During the Lombard period it was a flourishing town; but it was raised from comparative insignificance by Nicholas IV. to be the seat of the governors of the March. It was enclosed in the 13th century by a new line of walls more than 2½ m. in circuit; and in the troubles of the next two hundred years it had frequent occasion to learn their value. For the most part it remained faithful to the popes, and in return it was rewarded by a multitude of privileges. Though in 1797 the inhabitants opened their gates to the French, two years afterwards, when the country people took refuge within the walls, the city was taken by storm and delivered to pillage. The bishopric of Macerata dates from the suppression of the see of Recanati (1320).

MACFARREN, SIR GEORGE ALEXANDER (1813–1887), English composer, was born in London on the 2nd of March 1813, and entered the Royal Academy of Music in 1829. A symphony by him was played at an Academy concert in 1830; for the opening of the Queen's Theatre in Tottenham Street, under the management of his father, in 1831, he wrote an overture. His *Chevy Chase* overture, the orchestral work by which he is perhaps best known, was written as early as 1836, and in a single night. On leaving the Academy in 1836, Macfarren was for about a year a music teacher in the Isle of Man, and wrote two unsuccessful operas. In 1837 he was appointed a professor at the Academy, and wrote his *Romeo and Juliet* overture. In the following year he brought out *The Devil's Opera*, one of his best works. In 1845 he became conductor at Covent Garden, producing the *Antigone* with Mendelssohn's music; his opera on *Don Quixote* was produced under Bunn at Drury Lane in 1846; his subsequent operas include *Charles II.* (1849), *Robin Hood* (1860), *She Stoops to Conquer* (1864), and *Helvellyn* (1864). A gradual failure of his eyesight, which had been defective from boyhood, resulted in total blindness in 1865, but he overcame the difficulties by employing an amanuensis in composition, and made hardly a break in the course of his work. He was made principal of the Royal Academy of Music in succession to Sterndale Bennett in February 1875, and in March of the same year professor of music in Cambridge University. Shortly before this he had begun a series of oratorios: *St John the Baptist* (Bristol, 1873); *Resurrection* (Birmingham, 1876); *Joseph* (Leeds, 1877); and *King David* (Leeds, 1883). In spite of their solid workmanship, and the skill with which the ideas are treated, it is difficult to hear or read them through without smiling at some of the touches of quite unconscious humour often resulting from the way in which the Biblical narratives have been, as it were, dramatized. He delivered many lectures of great and lasting value, and his theoretical works, such as the *Rudiments of Harmony*, and the treatise on counterpoint, will probably be remembered longer than many of his compositions. He was knighted in 1883, and died suddenly in London on the 31st of October 1887.

An excellent memoir by H. C. Banister appeared in 1891.

McGEE, THOMAS D'ARCY (1825–1868), Irish-Canadian politician and writer, second son of James McGee, a coast-guard, was born at Carlingford, Co. Louth, on the 13th of April 1825. He early showed a remarkable aptitude for oratory. At the age of thirteen he delivered a speech at Wexford, and when four years later he emigrated to America he quickly gained a reputation as a writer and public speaker in the city of Boston. He thus attracted the attention of O'Connell, and before he was twenty years of age he returned to London to become parliamentary correspondent of the *Freeman's Journal*, and shortly afterwards London correspondent of the *Nation*, to which he also contributed a number of poems. He married in 1847 Mary Theresa Caffry, by whom he had two children. In 1846 he became one of the moving spirits in the "Young Ireland" party, and in promoting the objects of that organization he contributed two volumes to the "Library of Ireland." On the failure of the movement in 1848 McGee escaped in the disguise of a priest to the United States, where between 1848 and 1853 he established two newspapers, the *New York Nation* and the *American Celt*. His writings at first were exceedingly bitter and anti-English; but as years passed he realized that a greater measure of political freedom was possible under the British constitution than under the American. He had now become well-known as an author, and as a lecturer of unusual ability. In 1857 McGee, driven from the United States by the scurrilous attacks of the extreme Irish revolutionaries, took up his abode in Canada, and was admitted to the bar of the province of Lower Canada in 1861. At the general election in 1858 he was returned to parliament as the member for Montreal, and for four years he was regarded as a powerful factor in the house. On the formation of the Sandfield-Macdonald-Sicotte administration in 1862 he accepted the office of president of the council. When the cabinet was reconstructed a year later the Irish were left without representation, and McGee sought re-election as a member of the opposite party. In 1864 he was appointed minister of agriculture in the administration of Sir E. P. Taché, and he served the country in that capacity until his death. He actively supported the policy of federation and was elected a member of the first Dominion parliament in 1867. On the 7th of April 1868, after having delivered a notable speech in the house, he was shot by an assassin as he was about to enter his house at Ottawa. His utterances against the Fenian invasion are believed to have been the cause of the crime for which P. J. Whelan was executed. McGee's loss was keenly felt by all classes, and within a few weeks of his death parliament granted an annuity to his widow and children. McGee had great faith in the future of Canada as a part of the empire. Speaking at St John, N.B., in 1863, he said: "There are before the public men of British America at this moment but two courses: either to drift with the tide of democracy, or to seize the golden moment and fix for ever the monarchical character of our institutions. I invite every fellow colonist who agrees with me to unite our efforts that we may give our province the aspect of an empire, in order to exercise the influence abroad and at home of a state, and to originate a history which the world will not willingly let die." Sir Charles Gavan Duffy considered that as a poet McGee was not inferior to Davis, and that as an orator he possessed powers rarer than those of T. F Meagher.

McGee's principal works are: *A Popular History of Ireland* (2 vols., New York, 1862; 1 vol., London, 1869); *Irish Writers of the Seventeenth Century* (Dublin, 1846); *Historical Sketches of O'Connell and his Friends* (Boston, 1844); *Memoirs of the Life and Conquests of Art McMurrogh, King of Leinster* (Dublin, 1847); *Memoir of C. G. Duffy* (Dublin, 1849); *A History of the Irish Settlers in North America* (Boston, 1851); *History of the Attempts to establish the Protestant Reformation in Ireland* (Boston, 1853); *Life of Edward Maginn, Coadjutor Bishop of Derry* (New York, 1857); *Catholic History of North America* (Boston, 1854); *Canadian Ballads and Occasional Pieces* (New York, 1858); *Notes on Federal Governments Past and Present* (Montreal, 1865); *Speeches and Addresses, chiefly on the Subject of the British American Union* (London, 1865); *Poems*, edited by Mrs M. A. Sadleir with introductory memoir (New York, 1869). See Fennings Taylor, *The Hon. Thomas D'Arcy McGee* (Montreal, 1867); J. K. Foran, *Thomas D'Arcy McGee as an Empire Builder* (Ottawa, 1904); H. J. O'C. French, *A Sketch of the Life of the Hon. T. D. McGee* (Montreal); Appleton's *Cyclopaedia of American Biography*, iv. 116; N. F. Dvin's *Irishman in Canada* (1887); C. G. Duffy, *Four Years of Irish History* (1883); Alfred Webb, *Compendium of Irish Biography* (Dublin, 1878). (A. G. D.)

McGIFFERT, ARTHUR CUSHMAN (1861–), American theologian, was born in Sauquoit, New York, on the 4th of March 1861, the son of a Presbyterian clergyman of Scotch descent. He graduated at Western Reserve College in 1882 and at Union theological seminary in 1885, studied in Germany (especially under Harnack) in 1885-1887, and in Italy and France in 1888, and in that year received the degree of doctor of philosophy at Marburg. He was instructor (1888–1890) and professor (1890–1893) of church history at Lane theological seminary, and in 1893 became Washburn professor of church history in Union theological seminary, succeeding Dr Philip Schaff. His published work, except occasional critical studies in philosophy, dealt with church history and the history of dogma. His best known publication is a *History of Christianity in the Apostolic Age* (1897). This book, by its independent criticism and departures from traditionalism, aroused the opposition of the General Assembly of the Presbyterian Church; though the charges brought against McGiffert were dismissed by the Presbytery of New York, to which they had been referred, a trial for heresy seemed inevitable, and McGiffert, in 1900, retired from the Presbyterian ministry and entered the Congregational Church, although he retained his position in Union theological seminary. Among his other publications are: *A Dialogue between a Christian and a Jew* (1888); a translation (with introduction and notes) of Eusebius's *Church History* (1890); and *The Apostles' Creed* (1902), in which he attempted to prove that the old Roman creed was formulated as a protest against the dualism of Marcion and his denial of the reality of Jesus's life on earth.

McGILLIVRAY, ALEXANDER (*c.* 1739–1793), American Indian chief, was born near the site of the present Wetumpka, in Alabama. His father was a Scotch merchant and his mother the daughter of a French officer and an Indian "princess." Through his father's relatives in South Carolina, McGillivray received a good education, but at the age of seventeen, after a short experience as a merchant in Savannah and Pensacola, he returned to the Muscogee Indians, who elected him chief. He retained his connexion with business life as a member of the British firm of Panton, Forbes & Leslie of Pensacola. During the War of Independence, as a colonel in the British army, he incited his followers to attack the western frontiers of Georgia and the Carolinas. Georgia confiscated some of his property, and after the peace of 1783 McGillivray remained hostile. Though still retaining his British commission, he accepted one from Spain, and during the remainder of his life used his influence to prevent American settlement in the south-west. So important was he considered that in 1790 President Washington sent an agent who induced him to visit New York. Here he was persuaded to make peace in consideration of a brigadier-general's commission and payment for the property confiscated by Georgia; and with the warriors who accompanied him he signed a formal treaty of peace and friendship on the 7th of August. He then went back to the Indian country, and remained hostile to the Americans until his death. He was one of the ablest Indian leaders of America and at one time wielded great power—having 5000 to 10,000 armed followers. In order to serve Indian interests he played off British, Spanish and American interests against one another, but before he died he saw that he was fighting in a losing cause, and, changing his policy, endeavoured to provide for the training of the Muscogees in the white man's civilization. McGillivray was polished in manners, of cultivated intellect, was a shrewd merchant, and a successful speculator; but he had many savage traits, being noted for his treachery, craftiness and love of barbaric display. (W. L. F.)

MACGILLIVRAY, WILLIAM (1796–1852), Scottish naturalist, was born at Aberdeen on the 25th of January 1796. At King's College, Aberdeen, he graduated in 1815, and also studied medicine, but did not complete the latter course. In 1823 he became assistant to R. Jameson, professor of natural history in Edinburgh University; and in 1831 he was appointed curator of the museum of the Royal College of Surgeons in Edinburgh, a post which he resigned in 1841 to become professor of natural history and lecturer on botany in Marischal College, Aberdeen. He died at Aberdeen on the 4th of September 1852. He possessed a wide and comprehensive knowledge of natural science, gained no less from personal observations in different parts of Scotland than from a study of collections and books. His industry and extensive knowledge are amply shown in his published works. He assisted J. J. Audubon in his classical works on the *Birds of America*, and edited W. Withering's *British Plants*. His larger works include biographies of A. von Humboldt, and of zoologists from Aristotle to Linnaeus, a *History of British Quadrupeds*, a *History of the Molluscous Animals of Aberdeen, Banff and Kincardine*, a *Manual of British Ornithology*, and a *History of British Birds*, in 5 vols. (1837–1852). The last work holds a high rank from the excellent descriptions of the structure, habits and haunts of birds, and from the use in classification of characters afforded by their anatomical structure. His *Natural History of Deeside*, posthumously published by command of Queen Victoria, was the result of a sojourn in the highlands of Aberdeenshire in 1850. He made large collections, alike for the instruction of his students and to illustrate the zoology, botany and geology of the parts of Scotland examined by him, especially around Aberdeen, and a number of his original water-colour drawings are preserved in the British Museum (Natural History).

His eldest son, JOHN MACGILLIVRAY (1822–1867), published an account of the voyage round the world of H.M.S. "Rattlesnake," on board of which he was naturalist. Another son, PAUL, published an *Aberdeen Flora* in 1853.

MACGREGOR, JOHN ["ROB ROY"] (1825–1892), Scottish canoeist, traveller and philanthropist, son of General Sir Duncan MacGregor, K.C.B., was born at Gravesend on the 24th of January 1825. He combined a roving disposition with a natural taste for mechanics and for literature. In 1839 he went to Trinity College, Dublin, and in 1844 to Trinity, Cambridge, where he was a wrangler. He was called to the bar in 1851, but did not pursue his profession. He travelled a great deal in Europe, Egypt, Palestine, Russia, Algeria and America, and between 1853 and 1863 was largely occupied with researches into the history and methods of marine propulsion. He was the pioneer of British canoeing. In 1865 he started on a long canoeing cruise in his "Rob Roy" canoe, and in this way made a prolonged water tour through Europe, a record of which he published in 1866 as *A Thousand Miles in the Rob Roy Canoe*. This book made MacGregor and his canoe famous. He made similar voyages in later years in Norway, Sweden and Denmark, the North Sea and Palestine. Another voyage, in the English Channel and on French waters, was made in a yawl. He published accounts of all these journeys. He did not, however, confine his energies to travelling. He was active in charity and philanthropic work, being one of the founders of the Shoe-black Brigade. In 1870 and again in 1873 he was elected on the London school board. He died at Boscombe on the 16th of July 1892.

MACH, ERNST (1838–), Austrian physicist and psychologist, was born on the 18th of February 1838 at Turas in Moravia, and studied at Vienna. He was professor of mathematics at Gratz (1864–1867), of physics at Prague (1867–1895), and of physics at Vienna (1895–1901). In 1879 and 1880 as *Rector Magnificus* he fought against the introduction of Czech instead of German in the Prague University. In 1901 he was made a member of the Austrian house of peers. In philosophy he began with a strong predilection for the physical side of psychology, and at an early age he came to the conclusion that all existence is sensation, and, after a lapse into noümenalism under the influence of Fechner's *Psychophysics*, finally adopted a universal physical phenomenalism. The Ego he considers not an entity sharply distinguished from the Non-ego, but merely, as it were, a medium of continuity of sensory impressions. His whole theory appears to be vitiated by the confusion of physics and psychology.

WORKS.—*Kompendium der Physik für Medisiner* (Vienna, 1863); *Einleitung in die Helmholtz'sche Musiktheorie* (Gratz, 1866); *Die Gesch. u. d. Wurzel d. Satzes von d. Erhaltung d. Arbeit* (Prague, 1872); *Grundlinien d. Lehre v. d. Bewegungsempfindungen* (Leipzig, 1875); *Die Mechanik in ihrer Entwickelung* (Leipzig, 1883; rev. ed., 1908; Eng. trans., T. J. McCormack, 1902); *Beiträge zur Analyse d. Empfindungen* (Jena, 1886), 5th ed., 1906, entitled *Die Analyse d. Empfindungen*; *Leitfaden d. Physik für Studierende* (Prague, 1881, in collaboration); *Populärwissenschaftliche Vorlesungen* (3rd ed., Leipzig, 1903); *Die Prinzipien d. Wärmelehre* (2nd ed., 1900); *Erkenntnis und Irrtum* (Leipzig, 1905).

MACHAERODUS, or MACHAIRODUS, the typical genus of a group of long-tusked extinct cats, commonly known as sabretooths. Although best regarded as a sub-family (*Machaerodontinae*) of the *Felidae*, they are sometimes referred to a separate family under the name *Nimravidae* (see CARNIVORA). The later forms, as well as some of the earlier ones, are more specialized as regards dentition than the modern *Felidae*, although in several other respects they exhibit more primitive features. The general type of dentition is feline, but in some instances more premolars are retained, as well as a small tubercular molar behind the lower carnassial. The characteristic feature is, however, the great development of the upper canines, which in the more specialized types reach far below the margin of the lower jaw, despite the development of a flange-like expansion of the extremity of the latter for their protection. In these extreme forms it is quite evident that the jaws could not be used in the ordinary manner, and it seems probable that in attacking prey the lower jaw was dropped to a vertical position, and the huge upper tusks used as stabbing instruments. The group is believed to be derived from a creodont allied to the Eocene *Palaeonictis* (see CREODONTA).

Nimravus, of the American Oligocene, with two premolars and two molars in the lower jaw, and comparatively short upper canines, seems to be the least specialized type; next to which comes *Hoplophoneus*, another North American Oligocene genus, in which the tubercular lower molar is lost, and the upper canine is longer. It is noteworthy, however, that this genus retains the third trochanter to the femur, which is lost in *Nimravus*. *Machaerodus*, in the wider sense, includes the larger and more typical forms. In the Pliocene of France and Italy it is represented by *M. megantereon*, a species not larger than a leopard, and allied forms occur in the Pliocene of Greece, Hungary, Samos, Persia, India and China, as well as in the Middle Miocene of France and Germany. Far larger is the Pleistocene *M. cultridens* of the caverns of Europe, with serrated upper tusks several inches in length. From Europe and Asia the sabretoothed tigers may be traced into North and thence into South America, the home of *M.* (*Smilodon*) *neogaeus*, the largest of the whole tribe, whose remains occur in the Brazilian caves and the silt of the Argentine pampas. This animal was as large as a tiger, with tusks projecting seven inches from the jaw and very complex carnassials; the feet were very short, with only four toes to the hind-pair, and the humerus has lost the foramen at the lower end. Very noteworthy is the occurrence of an imperfectly known specialized type—*Eusmilus*—in the Lower Oligocene of Europe and perhaps also North America. Unlike all other cats, it had only two pairs of lower incisors, and the large cheek-teeth were reduced to the carnassial and one premolar in advance of the same. (R. L.*)

MACHALE, JOHN (1791–1881), Irish divine, was born on the 15th of March 1791 at Tuber-na-Fian, Mayo, and was educated at Maynooth, where after graduating in 1814 he was ordained priest and appointed lecturer in theology, succeeding to the professoriate in 1820. In 1825 he became coadjutor bishop of Killala, and in July 1834 archbishop of Tuam and metropolitan. He visited Rome in 1831, and was there again at the proclamation of the dogma of the Immaculate Conception of the Virgin (Dec. 1854) and in 1869–1870 at the Vatican council. Though he did not favour the dogma of Papal Infallibility he submitted as soon as it was defined. Machale was an intensely patriotic Irishman, who fought hard for Catholic Emancipation, for separate Roman Catholic schools, and against the Queen's Colleges. He translated part of the *Iliad* (Dublin, 1861), and made an Irish version of some of Moore's melodies and of the Pentateuch. He died at Tuam on the 7th of November 1881.

MACHAULT D'ARNOUVILLE, JEAN BAPTISTE DE (1701–1794), French statesman, was a son of Louis Charles Machault d'Arnouville, lieutenant of police. In 1721 he was counsel to the parlement of Paris, in 1728 *maître des requêtes*, and ten years later was made president of the Great Council; although he had opposed the court in the *Unigenitus* dispute, he was appointed intendant of Hainaut in 1743. From this position, through the influence at court of his old friend René Louis, Marquis d'Argenson, he was called to succeed Orry de Fulvy as controller-general of the finances in December 1745. He found, on taking office, that in the four years of the War of the Austrian Succession the economies of Cardinal Fleury had been exhausted, and he was forced to develop the system of borrowings which was bringing French finances to bankruptcy. He attempted in 1749 a reform in the levying of direct taxes, which, if carried out, would have done much to prevent the later Revolutionary movement. He proposed to abolish the old tax of a tenth, which was evaded by the clergy and most of the nobility, and substitute a tax of one-twentieth which should be levied on all without exception. The cry for exceptions, however, began at once. The clergy stood in a body by their historical privileges, and the outcry of the nobility was too great for the minister to make headway against. Still he managed to retain his office until July 1754, when he exchanged the controllership for the ministry of marine. Foreseeing the disastrous results of the alliance with Austria, he was drawn to oppose more decidedly the schemes of Mme de Pompadour, whose personal ill-will he had gained. Louis XV. acquiesced in her demand for his disgrace on the 1st of February 1757. Machault lived on his estate at Arnouville until the Revolution broke out, when, after a period of hiding, he was apprehended in 1794 at Rouen and brought to Paris as a suspect. He was imprisoned in the Madelonnettes, where he succumbed in a few weeks, at the age of ninety-three.

His son, LOUIS CHARLES MACHAULT D'ARNOUVILLE (1737–1820), was bishop of Amiens from 1774 until the Revolution. He was famous for his charity; but proved to be a most uncompromising Conservative at the estates general of 1789, where he voted consistently against every reform. He emigrated in 1791, resigned his bishopric in 1801 to facilitate the concordat, and retired to the ancestral château of Arnouville, where he died in 1820.

MACHAUT, GUILLAUME DE (*c.* 1300–1377), French poet and musician, was born in the village of Machault near Réthel in Champagne. Machaut tells us that he served for thirty years the adventurous John of Luxembourg, king of Bohemia. He followed his master to Russia and Poland, and, though of peaceful tastes himself, saw twenty battles and a hundred tourneys. When John was killed at Crécy in 1346 Machaut was received at the court of Normandy, and on the accession of John the Good to the throne of France (1350) he received an office which enabled him to devote himself thenceforth to music and poetry. Machaut wrote about 1348 in honour of Charles III., king of Navarre, a long poem much admired by contemporaries, *Le Jugement du roi de Navarre*. When Charles was thrown into prison by his father-in-law, King John, Machaut addressed him a *Confort d'ami* to console him for his enforced separation from his young wife, then aged fifteen. This was followed about 1370 by a poem of 9000 lines entitled *La Prise d'Alexandrie*, one of the last chronicles cast in this form. Its hero was Pierre de Lusignan, king of Cyprus. Machaut is best known for the strange book telling of the love affair of his old age with a young and noble lady long supposed to be Agnes of Navarre, sister of Charles the Bad; Paulin Paris in his edition of the *Voir dit* (*Historie vraie*) identified her as Perronne d'Armentières, a noble lady of Champagne. In 1362, when Machaut must have been at least sixty-two years of age, he received a rondeau from Perronne, who was then eighteen, expressing her devotion. She no doubt wished to play Laura to his Petrarch, and the *Voir dit* contains the correspondence and the poems which they exchanged. The romance, which ended with Perronne's marriage and Machaut's desire to remain her *doux ami*, has gleams of poetry, especially in Perronne's verses, but its subject and its length are both deterrent to modern readers. But Machaut with Deschamps marks a distinct transition. The *trouvères* had been impersonal. It is difficult to gather any details of their personal history from their work. Machaut and Deschamps wrote of their own affairs, and the next step in development was to be the self-analysis of Villon. Machaut was also a musician. He composed a number of motets, songs and ballads, also a mass supposed to have been sung at the coronation of Charles V. This was translated into modern notation by Perne, who read a notice on it before the Institute of France in 1817.

Machaut's *Oeuvres choisies* were edited by P. Tarbé (Rheims and Paris, 1849); *La Prise d'Alexandrie*, by L. de Mas-Latrie (Geneva, 1877); and *Le Livre du voir-dit*, by Paulin Paris (1875). See also F. G. Fétis, *Biog. universelle des musiciens*.. (Paris, 1862), and a notice on the *Instruments de musique au xiv^e siècle d'après Guillaume de Machaut*, by E. Travers (Paris, 1882).

MACHIAVELLI, NICCOLÒ (1469–1527), Italian statesman and writer, was born at Florence on the 3rd of May 1469. His ancestry claimed blood relationship with the lords of Montespertoli, a fief situated between Val di Pesa and Val d'Elsa, at no great distance from the city. Niccolò's father, Bernardo (b. 1428), followed the profession of a jurist. He held landed property worth something like £250 a year of our money. His son, though not wealthy, was never wholly dependent upon official income.

Of Niccolò's early years and education little is known. His works show wide reading in the Latin and Italian classics, but it is almost certain that he had not mastered the Greek language. To the defects of Machiavelli's education we may, in part at least, ascribe the peculiar vigour of his style and his speculative originality. He is free from the scholastic trifling and learned frivolity which tainted the rhetorical culture of his century. He made the world of men and things his study, learned to write his mother-tongue with idiomatic conciseness, and nourished his imagination on the masterpieces of the Romans.

The year of Charles VIII.'s invasion and of the Medici's expulsion from Florence (1494) saw Machiavelli's first entrance into public life. He was appointed clerk in the second chancery of the commune under his old master, the grammarian, Marcello Virgilio Adriani. Early in 1498 Adriani became chancellor of the republic, and Machiavelli received his vacated office with the rank of second chancellor and secretary. This post he retained till the year 1512. The masters he had to serve were the *dieci di libertà e pace*, who, though subordinate to the *signoria*, exercised a separate control over the departments of war and the interior. They sent their own ambassadors to foreign powers, transacted business with the cities of the Florentine domain, and controlled the military establishment of the commonwealth. The next fourteen years of Machiavelli's life were fully occupied in the voluminous correspondence of his bureau, in diplomatic missions of varying importance, and in the organization of a Florentine militia. It would be tedious to follow him through all his embassies to petty courts of Italy, the first of which took place in 1499, when he was sent to negotiate the continuance of a loan to Catherine Sforza, countess of Forlì and Imola. In 1500 Machiavelli travelled into France, to deal with Louis XII. about the affairs of Pisa. These embassies were the school in which Machiavelli formed his political opinions, and gathered views regarding the state of Europe and the relative strength of nations. They not only introduced him to the subtleties of Italian diplomacy, but also extended his observation over races very different from the Italians. He thus, in the course of his official business, gradually acquired principles and settled ways of thinking which he afterwards expressed in writing.

In 1502 Machiavelli married Marietta Corsini, who bore him several children, with whom, in spite of his own infidelities, he lived on good terms, and who survived him twenty-six years. In the same year Piero Soderini was chosen gonfalonier for life, in accordance with certain changes in the constitution of the state, which were intended to bring Florence closer to the Venetian type of government. Machiavelli became intimately connected with Soderini, assisted him in carrying out his policy, suggested important measures of military reform which Soderini adopted, and finally was involved in ruin by his fall.

The year 1502 was marked by yet another decisive incident in Machiavelli's life. In October he was sent, much against his will, as envoy to the camp of Cesare Borgia, duke of Valentinois. The duke was then in Romagna, and it was Machiavelli's duty to wait upon and watch him. He was able now to observe those intricate intrigues which culminated in Cesare's murder of his disaffected captains. From what remains of Machiavelli's official letters, and from his tract upon the *Modo che tenne il duca Valentino per ammazzar Vitellozzo Vitelli*, we are able to appreciate the actual relations which existed between the two men, and the growth in Machiavelli's mind of a political ideal based upon his study of the duke's character. Machiavelli conceived the strongest admiration for Cesare's combination of audacity with diplomatic prudence, for his adroit use of cruelty and fraud, for his self-reliance, avoidance of half-measures, employment of native troops, and firm administration in conquered provinces. More than once, in letters to his friend Vettori, no less than in the pages of the *Principe*, Machiavelli afterwards expressed his belief that Cesare Borgia's behaviour in the conquest of provinces, the cementing of a new state out of scattered elements, and the dealing with false friends or doubtful allies, was worthy of all commendation and of scrupulous imitation. As he watched Cesare Borgia at this, the most brilliant period of his adventurous career, the man became idealized in his reflective but imaginative mind. Round him, as a hero, he allowed his own conceptions of the perfect prince to cluster. That Machiavelli separated the actual Cesare Borgia, whom he afterwards saw, ruined and contemptible, at Rome, from this radiant creature of his political fancy, is probable. That the Cesare of history does not exactly match the Duca Valentino of Machiavelli's writings is certain. Still the fact remains that henceforth Machiavelli cherished the ideal image of the statesman which he had modelled upon Cesare, and called this by the name of Valentino.

On his return to Florence early in January 1503, Machiavelli began to occupy himself with a project which his recent attendance upon Cesare Borgia had strengthened in his mind. The duties of his office obliged him to study the conditions of military service as they then existed in Italy. He was familiar with the disadvantages under which republics laboured when they engaged professional captains of adventure and levied mercenary troops. The bad faith of the condottiere Paolo Vitelli (beheaded at Florence in 1499) had deeply impressed him. In the war with Pisa he had observed the insubordination and untrustworthiness of soldiers gathered from the dregs of different districts, serving under egotistical and irresponsible commanders. His reading in Livy taught him to admire the Roman system of employing armies raised from the body of the citizens; and Cesare Borgia's method of gradually substituting the troops of his own duchy for aliens and mercenaries showed him that this plan might be adopted with success by the Italians. He was now determined, if possible, to furnish Florence with a national militia. The gonfalonier Soderini entered into his views. But obstacles of no small magnitude arose. The question of money was immediately pressing. Early in 1503 Machiavelli drew up for Soderini a speech, *Discorso sulla provisione del danaro*, in which the duty and necessity of liberal expenditure for the protection of the state were expounded upon principles of sound political philosophy. Between this date and the last month of 1506 Machiavelli laboured at his favourite scheme, working out memorials on the subject for his office, and suggesting the outlines of a new military organization. On the 6th of December 1506 his plan was approved by the signoria, and a special ministry, called the *nove di ordinanza e milizia*, was appointed. Machiavelli immediately became their secretary. The country districts of the Florentine dominion were now divided into departments, and levies of foot soldiers were made in order to secure a standing militia. A commander-in-chief had to be chosen for the new troops. Italian jealousy shrank from conferring this important office on a Florentine, lest one member of the state should acquire a power dangerous to the whole. The choice of Soderini and Machiavelli fell, at this juncture, upon an extremely ineligible person, none other than Don Micheletto, Cesare Borgia's cut-throat and assassin. It is necessary to insist upon this point, since it serves to illustrate a radical infirmity in Machiavelli's genius. While forming and promoting his scheme, he was actuated by principles of political wisdom and by the purest patriotism. But he failed to perceive that such a ruffian as Micheletto could not inspire the troops of Florence with that devotion to their country and that healthy moral tone which should distinguish a patriot army. Here, as elsewhere, he revealed his insensibility to the ethical element in human nature.

Meanwhile Italy had been the scene of memorable events, in most of which Machiavelli took some part. Alexander VI. had died suddenly of fever. Julius II. had ascended the papal chair. The duke of Valentinois had been checked in mid-career of conquest. The collapse of the Borgias threw Central Italy into confusion; and Machiavelli had, in 1505, to visit the Baglioni at Perugia and the Petrucci at Siena. In the following year he accompanied Julius upon his march through Perugia into the province of Emilia, where the fiery pope subdued in person the rebellious cities of the Church. Upon these embassies Machiavelli represented the Florentine *dieci* in quality of envoy. It was his duty to keep the ministry informed by means of frequent despatches and reports. All this while the war for the recovery of Pisa was slowly dragging on, with no success or honour to the Florentines. Machiavelli had to attend the camp and provide for levies amid his many other occupations. And yet he found time for private literary work. In the autumn of 1504 he began his *Decennali*, or *Annals of Italy*, a poem composed in rough terza rima. About the same time he composed a comedy on the model of Aristophanes, which is unfortunately lost. It seems to have been called *Le Maschere*. Giuliano de' Ricci tells us it was marked by stringent satire upon great ecclesiastics and statesmen, no less than by a tendency to "ascribe all human things to natural causes or to fortune." That phrase accurately describes the prevalent bias of its author's mind.

The greater part of 1506 and 1507 was spent in organizing the new militia, corresponding on the subject, and scouring the country on enlistment service. But at the end of the latter year European affairs of no small moment diverted Machiavelli from these humbler duties. Maximilian was planning a journey into Italy in order to be crowned emperor at Rome, and was levying subsidies from the imperial burghs for his expenses. The Florentines thought his demands excessive. Though they already had Francesco Vettori at his court, Soderini judged it advisable to send Machiavelli thither in December. He travelled by Geneva, all through Switzerland, to Botzen, where he found the emperor. This journey was an important moment in his life. It enabled him to study the Swiss and the Germans in their homes; and the report which he wrote on his return is among his most effective political studies. What is most remarkable in it is his concentrated effort to realize the exact political weight of the German nation, and to penetrate the causes of its strength and weakness. He attempts to grasp the national character as a whole, and thence to deduce practical conclusions. The same qualities are noticeable in his *Ritratti delle cose di Francia*, which he drew up after an embassy to Louis XII. at Blois in 1510. These notes upon the French race are more scattered than the report on German affairs. But they reveal no less acumen combined with imaginative penetration into the very essence of national existence.

Michiavelli returned from Germany in June 1508. The rest of that year and a large part of 1509 were spent in the affairs of the militia and the war of Pisa. Chiefly through his exertions the war was terminated by the surrender of Pisa in June 1509. Meanwhile the league of Cambray had disturbed the peace of Italy, and Florence found herself in a perilous position between Spain and France. Soderini's government grew weaker. The Medicean party lifted up its head. To the league of Cambray succeeded the Holy League. The battle of Ravenna was fought, and the French retired from Italy. The Florentines had been spectators rather than actors in these great events. But they were now destined to feel the full effects of them. The cardinal Giovanni de' Medici, who was present at the battle of Ravenna, brought a Spanish army into Tuscany. Prato was sacked in the August of 1512. Florence, in extreme terror, deposed the gonfalonier, and opened her gates to the princes of the house of Medici.

The government on which Machiavelli depended had fallen, never to rise again. The national militia in which he placed unbounded confidence had proved inefficient to protect Florence in the hour of need. He was surrounded by political and personal enemies, who regarded him with jealousy as the ex-gonfalonier's right-hand man. Yet at first it appears that he still hoped to retain his office. He showed no repugnance to a change of masters, and began to make overtures to the Medici. The *nove della milizia* were, however, dissolved; and on the 7th of November 1512 Machiavelli was deprived of his appointments. He was exiled from Florence and confined to the dominion for one year, and on the 17th of November was futher prohibited from setting foot in the Palazzo Pubblico. Ruin stared him in the face; and, to make matters worse, he was implicated in the conspiracy of Pier Paolo Boscoli in February 1513. Machiavelli had taken no share in that feeble attempt against the Medici, but his name was found upon a memorandum dropped by Boscoli. This was enough to ensure his imprisonment. He was racked, and only released upon Giovanni de' Medici's election to the papacy in March 1513. When he left his dungeon he retired to a farm near San Casciano, and faced the fact that his political career was at an end.

Machiavelli now entered upon a period of life to which we owe the great works that have rendered his name immortal. But it was one of prolonged disappointment and annoyance. He had not accustomed himself to economical living; and, when the emoluments of his office were withdrawn, he had barely enough to support his family. The previous years of his manhood had been spent in continual activity. Much as he enjoyed the study of the Latin and Italian classics, literature was not his business; nor had he looked on writing as more than an occasional amusement. He was now driven in upon his books for the employment of a restless temperament; and to this irksomeness of enforced leisure may be ascribed the production of the *Principe*, the *Discorsi*, the *Arte della guerra*, the comedies, and the *Historie fiorentine*. The uneasiness of Machiavelli's mind in the first years of this retirement is brought before us by his private correspondence. The letters to Vettori paint a man of vigorous intellect and feverish activity, dividing his time between studies and vulgar dissipations, seeking at one time distraction in low intrigues and wanton company, at another turning to the great minds of antiquity for solace. It is not easy to understand the spirit in which the author of the *Principe* sat down to exchange obscenities with the author of the *Sommario della storia d'Italia*. At the same time this coarseness of taste did not blunt his intellectual sagacity. His letters on public affairs in Italy and Europe, especially those which he meant Vettori to communicate to the Medici at Rome, are marked by extraordinary fineness of perception, combined, as usual in his case, with philosophical breadth. In retirement at his villa near Percussina, a hamlet of San Casciano, Machiavelli completed the *Principe* before the end of 1513. This famous book is an analysis of the methods whereby an ambitious man may rise to sovereign power. It appears to have grown out of another scarcely less celebrated work, upon which Machiavelli had been engaged before he took the *Principe* in hand, and which he did not finish until some time afterwards. This second treatise is the *Discorsi sopra la prima deca di Tito Livio*.

Cast in the form of comments on the history of Livy, the *Discorsi* are really an inquiry into the genesis and maintenance of states. The *Principe* is an offshoot from the main theme of the *Discorsi*, setting forth Machiavelli's views at large and in detail upon the nature of principalities, the method of cementing them, and the qualities of a successful autocrat. Being more limited in subject and more independent as a work of literary art, this essay detaches itself from the main body of the *Discorsi*, and has attracted far more attention. We feel that the *Principe* is inspired with greater fervency, as though its author had more than a speculative aim in view, and brought it forth to serve a special crisis. The moment of its composition was indeed decisive. Machiavelli judged the case of Italy so desperate that salvation could only be expected from the intervention of a powerful despot. The unification of Italy in a state protected by a national army was the cherished dream of his life; and the peroration of the *Principe* shows that he meant this treatise to have a direct bearing on the problem. We must be careful, however, not to fall into the error of supposing that he wrote it with the sole object of meeting an occasional emergency. Together with the *Discorsi*, the *Principe* contains the speculative fruits of his experience and observation combined with his deductions from Roman history. The two works form one coherent body of opinion, not systematically expressed, it is true, but based on the same principles, involving the same conclusions, and directed to the same philosophical end. That end is the analysis of the conception of the state, studied under two main types, republican and monarchical. Up to the date of Machiavelli, modern political philosophy had always presupposed an ideal. Medieval speculation took the Church and the Empire for granted, as divinely appointed institutions, under which the nations of the earth must flourish for the space of man's probation on this planet. Thinkers differed only as Guelfs and Ghibellines, as leaning on the one side to papal, on the other to imperial supremacy. In the revival of learning, scholarship supplanted scholasticism, and the old ways of medieval thinking were forgotten. But no substantial philosophy of any kind emerged from humanism; the political lucubrations of the scholars were, like their ethical treatises, for the most part rhetorical. Still the humanists effected a delivery of the intellect from what had become the bondage of obsolete ideas, and created a new medium for the speculative faculty. Simultaneously with the revival, Italy had passed into that stage of her existence which has been called the age of despots. The yoke of the Empire had been shaken off. The Church had taken rank among Italian tyrannies. The peninsula was, roughly speaking, divided into principalities and sovereign cities, each of which claimed autocratic jurisdiction. These separate despotisms owned no common social tie, were founded on no common *jus* or right, but were connected in a network of conflicting interests and changeful diplomatic combinations. A keen and positive political intelligence emerged in the Italian race. The reports of Venetian and Florentine ambassadors at this epoch contain the first germs of an attempt to study politics from the point of view of science.

At this moment Machiavelli intervenes. He was conscious of the change which had come over Italy and Europe. He was aware that the old strongholds of medieval thought must be abandoned, and that the decaying ruins of medieval institutions furnished no basis for the erection of solid political edifices. He felt the corruption of his country, and sought to bring the world back to a lively sense of the necessity for reformation. His originality consists in having extended the positive intelligence of his century from the sphere of contemporary politics and special interests to man at large regarded as a political being. He founded the science of politics for the modern world, by concentrating thought upon its fundamental principles. He began to study men, not according to some preconception, but as he found them—men, not in the isolation of one century, but as a whole in history. He drew his conclusions from the nature of mankind itself, "ascribing all things to natural causes or to fortune." In this way he restored the right method of study, a method which had been neglected since the days of Aristotle. He formed a conception of the modern state, which marked the close of the middle ages, and anticipated the next phase of European development. His prince, abating those points which are purely Italian or strongly tinctured with the author's personal peculiarities, prefigured the monarchs of the 16th and 17th centuries, the monarchs whose motto was *L'état c'est moi!* His doctrine of a national militia foreshadowed the system which has given strength in arms to France and Germany. His insight into the causes of Italian decadence was complete; and the remedies which he suggested, in the perorations of the *Principe* and the *Arte della guerra*, have since been applied in the unification of Italy. Lastly, when we once have freed ourselves from the antipathy engendered by his severance of ethics from the field of politics, when we have once made proper allowance for his peculiar use of phrases like *frodi onorevoli* or *scelleratezze gloriose*, nothing is left but admiration for his mental attitude. That is the attitude of a patriot, who saw with open eyes the ruin of his country, who burned above all things to save Italy and set her in her place among the powerful nations, who held the duty of self-sacrifice in the most absolute sense, whose very limitations and mistakes were due to an absorbing passion for the state he dreamed might be reconstituted. It was Machiavelli's intense preoccupation with this problem—what a state is and how to found one in existing circumstances—which caused the many riddles of his speculative writings. Dazzled, as it were, with the brilliancy of his own discovery, concentrated in attention on the one necessity for organizing a powerful coherent nation, he forgot that men are more than political beings. He neglected religion, or regarded it as part of the state machinery. He was by no means indifferent to private virtue, which indeed he judged the basis of all healthy national existence; but in the realm of politics he postponed morals to political expediency. He held that the people, as distinguished from the nobles and the clergy, were the pith and fibre of nations, yet this same people had to become wax in the hands of the politician—their commerce and their comforts, the arts which give a dignity to life and the pleasures which make life liveable, neglected—their very liberty subordinated to the one tyrannical conception. To this point the segregation of politics from every other factor which goes to constitute humanity had brought him; and this it is which makes us feel his world a wilderness, devoid of atmosphere and vegetation. Yet some such isolation of the subject matter of this science was demanded at the moment of its birth, just as political economy, when first started, had to make a rigid severance of wealth from other units. It is only by a gradual process that social science in its whole complexity can be evolved. We have hardly yet discovered that political economy has unavoidable points of contact with ethics.

From the foregoing criticism it will be perceived that all the questions whether Machiavelli meant to corrupt or to instruct the world, to fortify the hands of tyrants or to lead them to their ruin, are now obsolete. He was a man of science—one who by the vigorous study of his subject matter sought from that subject-matter itself to deduce laws. The difficulty which remains in judging him is a difficulty of statement, valuation, allowance. How much shall we allow for his position in Renaissance Italy, for the corruption in the midst of which he lived, for his own personal temperament? How shall we state his point of departure from the middle ages, his sympathy with prevalent classical enthusiasms, his divination of a new period? How shall we estimate the permanent worth of his method, the residuum of value in his maxims?

After finishing the *Principe*, Machiavelli thought of dedicating it to one of the Medicean princes, with the avowed hope that he might thereby regain their favour and find public employment. He wrote to Vettori on the subject, and Giuliano de' Medici, duke of Nemours, seemed to him the proper person. The choice was reasonable. No sooner had Leo been made pope than he formed schemes for the aggrandizement of his family. Giuliano was offered and refused the duchy of Urbino. Later on, Leo designed for him a duchy in Emilia, to be cemented out of Parma, Piacenza, Reggio and Modena. Supported by the power of the papacy, with the goodwill of Florence to back him, Giuliano would have found himself in a position somewhat better than that of Cesare Borgia; and Borgia's creation of the duchy of Romagna might have served as his model. Machiavelli therefore was justified in feeling that here was an opportunity for putting his cherished schemes in practice, and that a prince with such alliances might even advance to the grand end of the unification of Italy. Giuliano, however, died in 1506. Then Machiavelli turned his thoughts towards Lorenzo, duke of Urbino. The choice of this man as a possible Italian liberator reminds us of the choice of Don Micheletto as general of the Florentine militia. To Lorenzo the *Principe* was dedicated, but without result. The Medici, as yet at all events, could not employ Machiavelli, and had not in themselves the stuff to found Italian kingdoms.

Machiavelli, meanwhile, was reading his *Discorsi* to a select audience in the Rucellai gardens, fanning that republican enthusiasm which never lay long dormant among the Florentines. Towards the year 1519 both Leo X. and his cousin, the cardinal Giulio de' Medici, were much perplexed about the management of the republic. It seemed necessary, if possible, in the gradual extinction of their family to give the city at least a semblance of self-government. They applied to several celebrated politicians, among others to Machiavelli, for advice in the emergency. The result was a treatise in which he deduced practical conclusions from the past history and present temper of the city, blending these with his favourite principles of government in general. He earnestly admonished Leo, for his own sake and for Florence, to found a permanent and free state system for the republic, reminding him in terms of noble eloquence how splendid is the glory of the man who shall confer such benefits upon a people. The year 1520 saw the composition of the *Arte della guerra* and the *Vita di Castruccio*.

The first of these is a methodical treatise, setting forth Machiavelli's views on military matters, digesting his theories respecting the superiority of national troops, the inefficiency of fortresses, the necessity of relying upon infantry in war, and the comparative insignificance of artillery. It is strongly coloured with his enthusiasm for ancient Rome; and specially upon the topic of artillery it displays a want of insight into the actualities of modern warfare. We may regard it as a supplement or appendix to the *Principe* and the *Discorsi*, since Machiavelli held it for a fundamental axiom that states are powerless unless completely armed in permanence. The peroration contains a noble appeal to the Italian liberator of his dreams, and a parallel from Macedonian history, which, read by the light of this century, sounds like a prophecy of Piedmont.

The *Vita di Castruccio* was composed at Lucca, whither Machiavelli had been sent on a mission. This so-called biography of the medieval adventurer who raised himself by personal ability and military skill to the tyranny of several Tuscan cities must be regarded in the light of an historical romance. Dealing freely with the outline of Castruccio's career, as he had previously dealt with Cesare Borgia, he sketched his own ideal of the successful prince. Cesare Borgia had entered into the *Principe* as a representative figure rather than an actual personage; so now conversely the theories of the *Principe* assumed the outward form and semblance of Castruccio. In each case history is blent with speculation in nearly the same proportions. But Castruccio, being farther from the writer's own experience, bears weaker traits of personality.

In the same year, 1520, Machiavelli, at the instance of the cardinal Giulio de' Medici, received commission from the officers of the *Studio pubblico* to write a history of Florence. They agreed to pay him an annual allowance of 100 florins while engaged upon the work. The next six years were partly employed in its composition, and he left a portion of it finished, with a dedication to Clement VII., when he died in 1527. In the *Historie fiorentine* Machiavelli quitted the field of political speculation for that of history. But, having already written the *Discorsi* and the *Principe*, he carried with him to this new task of historiography the habit of mind proper to political philosophy. In his hands the history of Florence became a text on which at fitting seasons to deliver lessons in the science he initiated. This gives the work its special character. It is not so much a chronicle of Florentine affairs, from the commencement of modern history to the death of Lorenzo de' Medici in 1492, as a critique of that chronicle from the point of view adopted by Machiavelli in his former writings. Having condensed his doctrines in the *Principe* and the *Discorsi*, he applies their abstract principles to the example of the Florentine republic. But the *History of Florence* is not a mere political pamphlet. It is the first example in Italian literature of a national biography, the first attempt in any literature to trace the vicissitudes of a people's life in their logical sequence, deducing each successive phase from passions or necessities inherent in preceding circumstances, reasoning upon them from general principles, and inferring corollaries for the conduct of the future. In point of form the *Florentine History* is modelled upon Livy. It contains speeches in the antique manner, which may be taken partly as embodying the author's commentary upon situations of importance, partly as expressing what he thought dramatically appropriate to prominent personages. The style of the whole book is nervous, vivid, free from artifice and rhetoric, obeying the writer's thought with absolute plasticity. Machiavelli had formed for himself a prose style, equalled by no one but by Guicciardini in his minor works, which was far removed from the emptiness of the latinizing humanists and the trivialities of the Italian purists. Words in his hands have the substance, the self-evidence of things. It is an athlete's style, all bone and sinew, nude, without superfluous flesh or ornament.

It would seem that from the date of Machiavelli's discourse to Leo on the government of Florence the Medici had taken him into consideration. Writing to Vettori in 1513, he had expressed his eager wish to "roll stones" in their service; and this desire was now gratified. In 1521 he was sent to Carpi to transact a petty matter with the chapter of the Franciscans, the chief known result of the embassy being a burlesque correspondence with Francesco Guicciardini. Four years later, in 1525, he received a rather more important mission to Venice. But Machiavelli's public career was virtually closed; and the interest of his biography still centres in his literary work. We have seen that already, in 1504, he had been engaged upon a comedy in the manner of Aristophanes, which is now unfortunately lost. A translation of the *Andria* and three original comedies from his pen are extant, the precise dates of which are uncertain, though the greatest of them was first printed at Rome in 1524. This is the *Mandragola*, which may be justly called the ripest and most powerful play in the Italian language.

The plot is both improbable and unpleasing. But literary criticism is merged in admiration of the wit, the humour, the vivacity, the satire of a piece which brings before us the old life of Florence in a succession of brilliant scenes. If Machiavelli had any moral object when he composed the *Mandragola*, it was to paint in glaring colours the corruption of Italian society. It shows how a bold and plausible adventurer, aided by the profligacy of a parasite, the avarice and hypocrisy of a confessor, and a mother's complaisant familiarity with vice, achieves the triumph of making a gulled husband bring his own unwilling but too yielding wife to shame. The whole comedy is a study of stupidity and baseness acted on by roguery. About the power with which this picture of domestic immorality is presented there can be no question. But the perusal of the piece obliges us to ask ourselves whether the author's radical conception of human nature was not false. The same suspicion is forced upon us by the *Principe*. Did not Machiavelli leave good habit, as an essential ingredient of character, out of account? Men are not such absolute fools as Nicia, nor such compliant catspaws as Ligurio and Timoteo; women are not such weak instruments as Sostrata and Lucrezia. Somewhere, in actual life, the stress of craft and courage acting on the springs of human vice and weakness fails, unless the hero of the comedy or tragedy, Callimaco or Cesare, allows for the revolt of healthier instincts. Machiavelli does not seem to have calculated the force of this recoil. He speculates a world in which *virtù*, unscrupulous strength of character, shall deal successfully with frailty. This, we submit, was a deep-seated error in his theory of life, an error to which may be ascribed the numerous stumbling-blocks and rocks of offence in his more serious writings.

Some time after the *Mandragola*, he composed a second comedy, entitled *Clizia*, which is even homelier and closer to the life of Florence than its predecessor. It contains incomparable studies of the Florentine housewife and her husband, a grave business-like citizen, who falls into the senile folly of a base intrigue. There remains a short piece without title, the *Commedia in prosa*, which, if it be Machiavelli's, as internal evidence of style sufficiently argues, might be accepted as a study for both the *Clizia* and the *Mandragola*. It seems written to expose the corruption of domestic life in Florence, and especially to satirize the friars in their familar part of go-betweens, tame cats, confessors and adulterers.

Of Machiavelli's minor poems, sonnets, *capitoli* and carnival songs there is not much to say. Powerful as a comic playwright, he was not a poet in the proper sense of the term. The little novel of *Belfagor* claims a passing word, if only because of its celebrity. It is a good-humoured satire upon marriage, the devil being forced to admit that hell itself is preferable to his wife's company. That Machiavelli invented it to express the irritation of his own domestic life is a myth without foundation. The story has a medieval origin, and it was almost simultaneously treated in Italian by Machiavelli, Straparola and Giovanni Brevio.

In the spring of 1526 Machiavelli was employed by Clement VII. to inspect the fortifications of Florence. He presented a report upon the subject, and in the summer of the same year received orders to attend Francesco Guicciardini, the pope's commissary of war in Lombardy. Guicciardini sent him in August to Cremona, to transact business with the Venetian *provveditori*. Later on in the autumn we find him once more with Guicciardini at Bologna. Thus the two great Italian historians of the 16th century, who had been friends for several years, were brought into relations of close intimacy.

After another visit to Guicciardini in the spring of 1527, Machiavelli was sent by him to Civita Vecchia. It seemed that he was destined to be associated in the papal service with Clement's viceroy, and that a new period of diplomatic employment was opening for him. But soon after his return to Florence he fell ill. His son Piero said that he took medicine on the 20th of June which disagreed with him; and on the 22nd he died, having received the last offices of the Church.

There is no foundation for the legend that he expired with profane sarcasms upon his lips. Yet we need not run into the opposite extreme, and try to fancy that Machiavelli, who had professed Paganism in his life, proved himself a believing Christian on his deathbed. That he left an unfavourable opinion among his fellow citizens is very decidedly recorded by the historian Varchi. The *Principe*, it seems, had already begun to prejudice the world against him; and we can readily believe that Varchi sententiously observes, that "it would have been better for him if nature had given him either a less powerful intellect or a mind of a more genial temper." There is in truth a something crude, unsympathetic, cynical in his mental attitude toward human nature, for which, even after the lapse of more than three centuries, we find it difficult to make allowance. The force of his intellect renders this want of geniality repulsive. We cannot help objecting that one who was so powerful could have been kindlier and sounder if he willed. We therefore do him the injustice of mistaking his infirmity for perversity. He was colour-blind to commonplace morality, and we are angry with him because he merged the hues of ethics in one grey monotone of politics.

In person Machiavelli was of middle height, black-haired, with rather a small head, very bright eyes and slightly aquiline nose. His thin, close lips often broke into a smile of sarcasm. His activity was almost feverish. When unemployed in work or study he was not averse to the society of boon companions, gave himself readily to transient amours, and corresponded in a tone of cynical bad taste. At the same time he lived on terms of intimacy with worthy men. Varchi says that "in his conversation he was pleasant, obliging to his intimates, the friend of virtuous persons." Those who care to understand the contradictions of which such a character was capable should study his correspondence with Vettori. It would be unfair to charge what is repulsive in their letters wholly on the habits of the times, for wide familiarity with the published correspondence of similar men at the same epoch brings one acquainted with little that is so disagreeable. (J. A. S.)

Among the many editions of Machiavelli's works the one in 8 vols., dated Italia, 1813, may be mentioned, and the more comprehensive ones published by A. Parenti (Florence, 1843) and by A. Usigli (Florence 1857). P. Fanfani and L. Passerini began another, which promised to be the most complete of all; but only 6 vols. were published (Florence, 1873–1877); the work contains many new and important documents on Machiavelli's life. The best biography is the standard work of Pasquale Villari, *La Storia di Niccolò Machiavelli e de' suoi tempi* (Florence, 1877–1882; latest ed., 1895; Eng. trans. by Linda Villari, London, 1892); in vol. ii. there is an exhaustive criticism of the various authors who have written on Machiavelli. See also T. Mundt, *Niccolò Machiavelli und das System der modernen Politik* (3rd ed., Berlin, 1867); E. Feuerlein, "*Zur Machiavelli-Frage*" in H. von Sybel's *Histor. Zeitschrift* (Munich, 1868); P. S. Mancini, *Prelezioni con un saggio sul Machiavelli*; F. Nitti, *Machiavelli nella vita e nelle opere* (Naples, 1876); O. Tomasini, *La Vita e gli scritti di Niccolò Machiavelli* (Turin, 1883); L. A. Burd, *Il Principe, by Niccolò Machiavelli* (Oxford, 1891); Lord Morley, *Machiavelli* (Romanes lecture, Oxford, 1897). *The Cambridge Modern History*, vol. i. (Cambridge, 1903), contains an essay on Machiavelli by L. A. Burd, with a very full biography.

MACHICOLATION (from Fr. *machicoulis*), an opening between a wall and a parapet, formed by corbelling out the latter, so that the defenders might throw down stones, melted lead, &c., upon assailants below.

MACHINE (through Fr. from Lat. form *machina* of Gr. μηχανή), any device or apparatus for the application or modification of force to a specific purpose. The term "simple machine" is applied to the six so-called mechanical powers—the lever, wedge, wheel and axle, pulley, screw, and inclined plane. For machine-tools see TOOLS. The word machine was formerly applied to vehicles, such as stage-coaches, &c., and is still applied to carriages in Scotland; a survival of this use is in the term "bathing machine." Figuratively, the word is used of persons whose actions seem to be regulated according to a rigid and unchanging system. In politics, especially in America, machine is synonymous with party organization. A stage device of the ancient Greek drama gave rise to the proverbial expression, "the god from the machine," Lat. *deus ex machina*, for the disentangling and conclusion of a plot by supernatural interference or by some accident extraneous to the natural development of the story. When a god had to be brought on the stage he was floated down from above by a γέρανος (crane) or other machine (μηχανή). Euripides has been reproached with an excessive use of the device, but it has been pointed out (A.E. Haigh, *Tragic Drama of the Greeks*, p. 245 seq.) that only in two plays (*Orestes* and *Hippolytus*) is the god brought on for the solution of the plot. In the others the god comes to deliver a kind of epilogue, describing the future story of the characters, or to introduce some account of a legend, institution, &c.

MACHINE-GUN, a weapon designed to deliver a large number of bullets or small shells, either by volleys[1] or in very quick succession, at a high rate of fire. Formerly the mechanism of machine-guns was hand operated, but all modern weapons are automatic in action, the gas of the explosion or the force of recoil being utilized to lock and unlock the breech mechanism, to load the weapon and to eject the fired cartridge cases. The smaller types approximate to the "automatic rifle," which is expected to replace the magazine rifle as the arm of the infantryman. The large types, generically called "pompoms," fire a light artillery projectile, and are considered by many artillery experts as "the gun of the future." The medium type, which takes the ordinary rifle ammunition but is fired from various forms of carriage, is the ordinary machine-gun of to-day, and the present article deals mainly with this.

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[1] The French term *mitrailleuse*, made famous by the War of 1870, reappears in other Latin tongues (*e.g.* Spanish *ametralladora*). It signifies a weapon which delivers a shower of small projectiles *mitraille*—grape or case shot), and has no special reference to its mechanical (hand or automatic) action.

HISTORICAL SKETCH

Machine-guns of a primitive kind are found in the early history of gunpowder artillery, in the form of a grouping or binding of several small-calibre guns for purposes of a volley or a rapid succession of shots. The earliest field artillery (*q.v.*) was indeed chiefly designed to serve the purpose of a modern machine-gun, *i.e.* for a mechanical concentration of musketry. Infantry fire (till the development of the Spanish arquebus, about 1520) was almost ineffective, and the disintegration of the masses of pikes, preparatory to the decisive cavalry charge, had to be effected by guns of one sort or another (see also INFANTRY). Hence the "cart with gonnes," although the prototype of the field gun of to-day was actually a primitive *mitrailleuse*.

Ribaudequins.

"Organs."

Weapons of this sort were freely employed by the Hussites, who fought in laager formation (*Wagenburg*), but the fitting of two or more hand-guns or small culverins to a two-wheeled carriage garnished with spikes and scythe blades (like the ancient war-chariots) was somewhat older, for in 1382 the men of Ghent put into the field 200 "chars de canon" and in 1411 the Burgundian army is said to have had 2000 "ribaudequins" (meaning probably the weapons, not the carts, in this case). These were of course hardly more than carts with hand-gun men; in fact most armies in those days moved about in a hollow square or lozenge of wagons, and it was natural to fill the carts with the available gunners or archers. The method of breaking the enemy's "battles" with these carts was at first, in the ancient manner, to drive into and disorder the hostile ranks with the scythes. But they contained at least the germ of the modern machine-gun, for the tubes (*cannes*, *canons*) were connected by a train of powder and fired in volleys. As however field artillery improved (latter half of 15th century), and a cannon-ball could be fired from a mobile carriage, the ribaudequin ceased to exist, its name being transferred to heavy hand-guns used as rampart pieces. The idea of the machine-gun reappeared however in the 16th century. The weapons were now called "organs" (*orgues*), from the number of pipes or tubes that they contained. At first used (defensively) in the same way as the ribaudequins, *i.e.* as an effective addition to the military equipment of a war-cart, they were developed, in the early part of the 16th century, into a really formidable weapon for breaking the masses of the enemy, not by scythes and spikes but by fire. Fleurange's memoirs assign the credit of this to the famous gunner and engineer Pedro Navarro, who made two hundred weapons of a design of his own for Louis XII. These "were not more than two feet long, and fired fifty shots at a round," but nevertheless "organs" were relatively rare in the armies of the 16th century, for the field artillery, though it grew in size and lost in mobility, had discovered the efficacy of case shot (then called "perdreaux") against uncovered animate targets, and for work that was not sufficiently serious for the guns heavy arquebuses were employed. Infantry fire, too, was growing in power and importance. In 1551 a French army contained 21 guns and 150 arquebuses *à croc* and one *pièce façon d'orgue*. By about 1570 it had been found that when an "organ" was needed all that was necessary was to mount some heavy arquebuses on a cart, and the organ, as a separate weapon, disappeared from the field, although under the name of "mantelet" (from the shield which protected the gunners), it was still used for the defence of breaches in siege warfare. Diego Ufano, who wrote in the early years of the 17th century, describes it as a weapon consisting of five or six barrels fired simultaneously by a common lock, and mentions as a celebrated example the "Triquetraque of Rome" which had five barrels. Another writer, Hanzelet, describes amongst other devices a mitrailleuse of four barrels which was fired from the back of an ass or pony. But such weapons as these were more curious than useful. For work in the open field the musket came more and more to the front, its bullet became at least as formidable as that of an "organ," and when it was necessary to obtain a concentrated fire on a narrow front arquebuses *à croc* were mounted for the nonce in groups of four to six. The "organ" maintained a precarious existence, and is described by Montecucculi a century later, and one of twelve barrels figures in the list of military stores at Hesdin in 1689. But its fatal defect was that it was neither powerful enough to engage nor mobile enough to evade the hostile artillery.

Enthusiastic inventors, of course, produced many models of machine-gun in the strict sense of the word—*i.e.* a gun firing many charges, in volleys or in rapid succession, by a mechanical arrangement of the lock. Wilhelm Calthoff, a German employed by Louis XIII., produced arquebuses and muskets that fired six to eight shots per round, but his invention was a secret, and it seems to have been more of a magazine small arm than a machine-gun (1640). In 1701 a Lorrainer, Beaufort de Mirecourt, proposed a machine-gun which had as its purpose the augmentation of infantry-fire power, so as to place an inferior army on an equality with a superior. At this time inventors were so numerous and so embarrassing that the French grand master of artillery, St Hilaire, in 1703 wrote that he would be glad to have done with "ces sortes de gens à secrets," some of whom demanded a grant of compensation even when their experiments had failed. The machine-gun of the 17th and 18th centuries in fact possessed no advantage over contemporary field artillery, and the battalion gun in particular, which possessed the long ranging and battering power that its rival lacked, and was moreover more efficacious against living targets with its case-shot or grape. As compared with infantry fire, too, it was less effective and slower than the muskets of a well-drilled company. Rapid fire was easily arranged, but the rapid *loading* which would have compensated for other defects was unobtainable in the then existing state of gun-making.

Thus a satisfactory machine-gun was not forthcoming until breech-loading had been, so to speak, rediscovered, that is until about 1860. At that time the tactical conditions of armament were peculiar. As regards artillery, the new (muzzle-loading) long-range rifle sufficed, in the hand of determined infantry, to keep guns out of case-shot range. This made the Napoleonic artillery attack an impossibility. At the same time the infantry rifle was a slow loader, and the augmentation of the volume of infantry fire attracted the attention of several inventors. The French, with their artillery traditions, regarded the machine-gun therefore as a method of restoring the lost superiority of the gunner, while the Americans, equally in accordance with traditions and local circumstances, regarded it as a musketry machine. The representative weapons evolved by each were the *canon à balles*, more commonly called *mitrailleuse*, and the Gatling gun.

The declared purpose of the *canon à balles* was to replace the old artillery case-shot attack. Shrapnel, owing to the defects of the time-fuzes then available, had proved disappointing in the Italian War of 1859, and the gun itself, of the existing model, was not considered satisfactory. Napoleon III., a keen student of artillery, maintained a private arsenal and workshop at the château of Meudon[1] and in 1866, in the alarm following upon

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[1] Meudon Château had long been used for military experiments. The peasantry credited it with mysterious and terrible secrets, asserting even that it contained a tannery of human skins, this tradition perhaps relating to the war balloon constructed there before the battle of Fleurus (1794). Reffye had also many non-military tasks, such as the reproduction of a famous set of bas-reliefs construction of aeroplanes, and the reconstruction of triremes and balistas.

Königgrätz, he ordered Commandant Reffye (1821–1880), the artillery officer he had placed in charge of it, to produce a machine-gun. Reffye held that the work of a mitrailleuse should only begin where that of the infantry rifle ceased. The handbook to his gun issued to the French army in 1870 stated that it was "to carry balls to distances that the infantry, and the artillery firing case, could not reach." The most suitable range was given as 1500–2000 yards against infantry in close order, 2000–2700 against artillery. As the French shrapnel (*obus à balles*) of these days was only used to give its peculiar case-shot effect between 550 and 1350 yards, and even so sparingly and without much confidence in its efficacy, it is clear that the *canon à balles* was intended to do the field-gun's work, except at (what were then) extreme field artillery ranges (2800 and above), in which case the ordinary gun with common shell (time or percussion) alone was used.

The Canon à Balles, 1866-1870.

Constructed to meet these conditions, the Reffye machine-gun in its final form resembled outwardly an ordinary field gun, with wheeled carriage, limber and four-horse team. The gun barrel was in reality a casing for 25 rifle barrels disposed around a common axis (the idea of obtaining sweeping effect by disposing the barrels slightly fan-wise had been tried and abandoned). The barrels were held together at intervals by wrought-iron plates. They were entirely open at the breech, a removable false breech containing the firing mechanism (the cartridge cases were of brass, solid-drawn, like those of the American and unlike those of the British Gatlings). This false breech, held in the firing position by a strong screw—resembling roughly those of contemporary B.L. ordnance such as the Armstrong R. B. L.—consisted of a plate with 25 holes, which allowed the points of the strikers to pass through and reach the cartridges. The plate was turned by hand so that one striker was admitted at a time, the metal of the plate holding back the rest. To avoid any deflection of the bullet by the gases at an adjoining muzzle the barrels were fired in an irregular order. Each gun was provided with four chambers, which were loaded with their 25 cartridges apiece by a charger, and fixed to the breech one after the other as quickly as the manipulation of the powerful retaining screw permitted. The rates of fire were "slow," 3 rounds or 75 shots a minute, and "rapid," 5 rounds or 125 shots per minute. One advantage as against artillery that was claimed for the new weapon was rapidity of ranging. Any ordinary target, such as a hostile gun, would, it was expected, be accurately ranged by the mitrailleuse before it was ready to open fire for effect. The ordinary rifle bullet was employed, but to enhance the case-shot effect a heavy bullet made up in three parts, which broke asunder on discharge, was introduced in 1870 in the proportion of one round in nine. The weapon was sighted to 3000 metres (3300 yds.). The initial velocity was 1558 f.s.; and the weight of the gun 350 kg. (6·45 cwt.), of the carriage 371 kg. (6·86 cwt.); total behind the team, 1,485 kg. (27·1 cwt.).

For an artillery effect, dispersion had to be combined with accuracy. The rifle-barrels when carefully set gave a very close grouping of shots on the target, and dispersion was obtained by traversing the gun during the firing of a round. When this was skilfully performed a front of 18 metres (about 20 yds.) at 1,000 metres range was thoroughly swept by the cone of bullets.

The design and manufacture of these mitrailleuses under the personal orders and at the expense of the emperor enabled the French authorities to keep their new weapon most secret. Even though, after a time, mitrailleuses were constructed by scores, and could therefore no longer be charged to a "sundry" or "petty cash" account in the budget, secrecy was still maintained. The pieces were taken about, muffled in tarpaulins, by by-ways and footpaths. In 1869, two years after the definitive adoption of the weapon, only a few artillery captains were instructed in its mechanism; the non-commissioned officers who had to handle the gun in war were called up for practice in July 1870, when Major Reffye's energies were too much absorbed in turning out the material so urgently demanded to allow him to devote himself to their instruction. The natural consequence was that the mitrailleuses were taken into battle by officers and men of whom nine-tenths had never seen them fire one round of live cartridges. The purpose of this fatal secrecy was the maintenance of prestige. No details were given, but it was confidently announced that war would be revolutionized. One foreign officer only, Major Fosbery, R.A. (see *R.U.S.I. Journal*, v. xiii.), penetrated the secret, and he felt himself bound in honour to keep it to himself, not even communicating it to the War Office. But public attention was only too fully aroused by these mysterious prophecies. "The mitrailleuse paid dearly for its fame." The Prussians, who had examined mitrailleuses of the Gatling or infantry type, were well aware that the artillery machine-gun was at the least a most formidable opponent. They therefore ostentatiously rejected the Gatling gun, taught their troops that the new weapons were in the nature of scientific toys, and secretly made up their minds to turn the whole weight of their guns on to the mitrailleuse whenever and wherever it appeared on the field, and so to overwhelm it at once. This policy they carried into effect in the War of 1870; and although on occasions the new weapon rendered excellent service, in general it cruelly disappointed the over-high hopes of its admirers. And thus, although the Gatling and similar types of gun were employed to a slight extent by both sides in the later stage of the war, machine-guns, as a class of armament for civilized warfare, practically disappeared.

As a good deal of criticism—after the event—has been levelled at the French for their "improper use of the machine-gun as a substitute for artillery," it is necessary to give some summary of the ideas and rules which were inspired by the inventor or dictated by the authorities as to its tactical employment. The first principle laid down was that the gun should not be employed within the zone of the infantry fight. Officers commanding batteries were explicitly warned against infantry divisional generals who would certainly attempt to put the batteries, by sections, amongst the infantry. The second principle was that the mitrailleuses were to share the work of the guns, the latter battering obstacles with common shell, and the former being employed against troops in the open, and especially to cover and support the infantry advance. This tendency to classify the rôles of the artillery and to tell off the batteries each in its special task has reappeared in the French, and to a more limited extent in the British, field artillery of to-day (the Germans alone resolutely opposing the idea of subdivision). The mitrailleuse of 1870 was, in fact, intended to do what the perfected Shrapnel of 1910 does, to transfer the case-shot attack to longer ranges. But, as we have seen, secrecy had prevented any general spread of knowledge as to the uses to which the *canon à balles* was to be put, and consequently, after a few weeks of the war, we find Reffye complaining that the machine-guns were being used by their battery commanders "in a perfectly idiotic fashion. They are only good at a great distance and when used in masses, and they are being employed at close quarters like a rifle." The officers in the field, however, held that it was foolish to pit the mitrailleuse against the gun, which had a longer range, and exerted themselves to use it as an infantry weapon, a concentrated company, for which, unlike the Gatlings of 1870 and the machine-guns of to-day, it was never designed. As to which was right in the controversy it is impossible to dogmatize and needless to argue.

Gatling Gun.

Very different was the Gatling gun, the invention of Richard Jordan Gatling (1818–1903), which came into existence and was to a slight extent used in the field in the latter years of the American Civil War,[1] and also to a still slighter extent by the Bavarians and the French in the latter part of the war of 1870. This was distinctively an infantry type weapon, a sort of revolving rifle, the ten barrels of which were set around an axis, and fired in turn when brought into position by the revolving mechanism. This weapon had a long reign, and was used side by side with the latest automatic machine gun in the Spanish-American War of 1898. The following account of the old British service Gatling (fig. 1), as used in the Egyptian and Sudanese campaigns, is condensed from that in the article "Gun-making," *Ency. Brit.* 9th ed.

A block of ten barrels is secured round an axis, which is fixed in a frame *a a*. On turning the handle *h* (fig. 2) the spindle *g g* causes the worm *f* to act on the pinion *w*, making the axis and barrels revolve. A drum T (figs. 1 and 4) is placed on the top at the breech end of the barrels over a hopper, through a slot in which the cartridges drop into the carrier (fig. 3). The construction of the lock is shown in fig. 4. A A A A is a cam, sloping as in the drawing, which, it must be understood, represents the circular construction opened out and laid flat. As the barrels, carrier and locks revolve the slope of the cam forces the locks forward and backward alternately. At position I. the cartridge has just fallen into the carrier, the lock and bolt are completely withdrawn. At positions II., III., IV., the cam is forcing them forward, so that the bolt pushes the cartridge into the barrel. At IV. the cocking cam R begins to compress the spiral spring, releasing it at V. Position VI. shows the cartridge just after firing; the extractor is clutching the base of the cartridge case, which is withdrawn as the locks retreat down the slope of the cam, till at X it falls through an aperture to the ground. The drum consists of a number of vertical channels radiating from the centre. The cartridges are arranged horizontally, one above the other, in these channels, bullet ends inwards. The drum revolves on the pivot *b* (fig. 3), and the cartridges fall through the aperture B. When all the channels are emptied, a full drum is brought from the limber, and substituted for the empty one. Each barrel fires in turn as it comes to a certain position, so that by turning the handle quickly an almost continuous stream of bullets can be ejected. Experimental Gatlings were constructed which could be made to fire nearly 1000 shots a minute, and an automatic traversing arrangement was also fitted.

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[1] A machine-gun of the artillery or volley type, called the "Requa battery," which had its barrels disposed fan-wise, was also used in the Civil War.

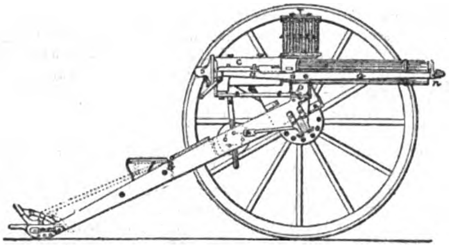

FIG. 1.—Gatling Gun.

As has been said, this weapon had a long reign. It was used with great effect in the Zulu War at Ulundi and in the Sudan.

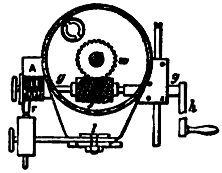

FIG. 2.

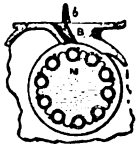

FIG. 3.

But a grave disadvantage of the English pattern was that it had to be used with the Boxer coiled cartridge supplied for the Martini-Henry rifle, and until this was replaced by a solid-drawn cartridge case it was impossible to avoid frequent "jams." The modern, fully automatic, machine gun suffers from this to a considerable extent, and it was an even more serious defect with a hand-operated weapon, as the British troops found in

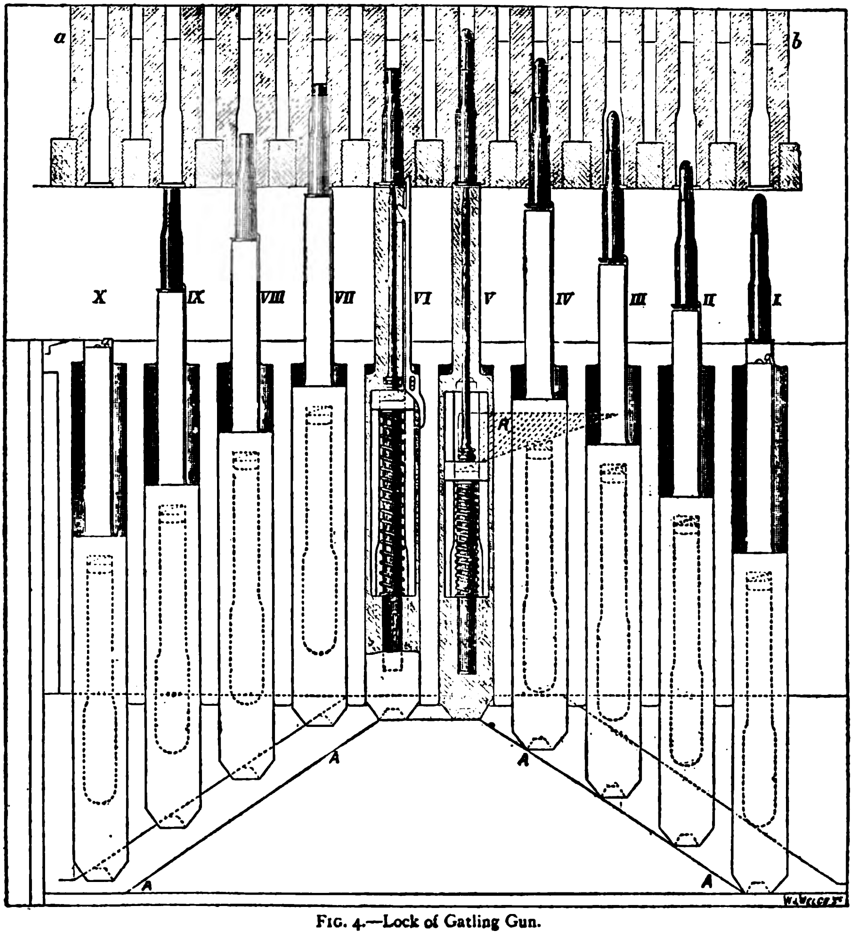

FIG. 4.—Lock of Gatling Gun.

their campaigns against the Mahdists. But the Gatling had many advantages over its newer rivals as regards simplicity and strength. Theodore Roosevelt, who commanded sections of both types in the Spanish-American War, speaks with enthusiasm of the old-fashioned weapon[1] while somewhat disparaging the Colt automatic.

The Gardner was another type which had a certain vogue[2] and was used by the British in savage warfare. But, next to the Gatling, the most important of the hand-operated machine guns was the Nordenfeldt, which was principally designed for naval use about the time when torpedo-boats were beginning to be regarded as dangerous antagonists.

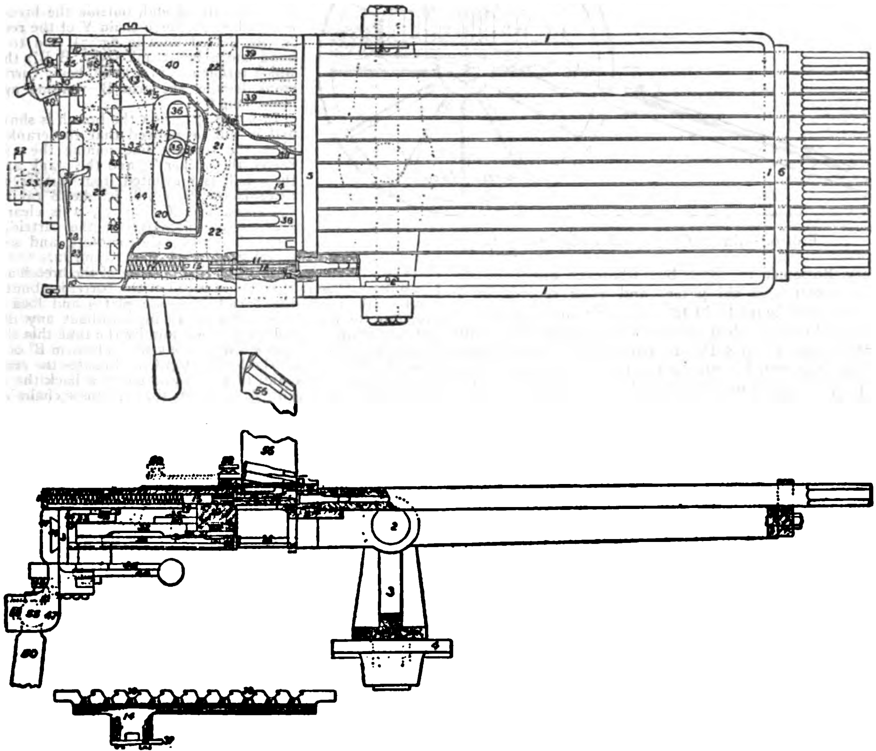

FIG. 5.—Nordenfeldt Machine-Gun.

1–10, Parts of frame;
11, Breech plug;
12, Striker;
13, Extractor;
14, Cartridge receiver;
15–18, 23–31, Lock and trigger parts,
19–22, Locking action;
32–35, Loading action;
36–39, Cartridge receiver;
40, Cover;
41–44, Parts of hand-lever;
45–49, Traversing action;
50–55, Elevating and trailing action;
56, 57, Hopper and slide.

Nordenfeldt Gun.

In this weapon the barrels are placed horizontally, and have no movement. A box containing the locks, bolts, strikers and spiral springs, one of each corresponding to each barrel, moves straight backwards and forwards when worked by the handle of the lever on the right. When the box is drawn back the cartridges fall from the holder on the top into the carriers simultaneously. When the box is pushed forward the bolts push the cartridges into the barrel, cocking-catches compress the spiral springs, the lever releases the catches one after the other at very minute intervals of time, and the cartridges are fired in rapid succession. In this piece, careful aim can be taken from a moving platform, and at the right moment the barrels can be fired at the object almost simultaneously.

PRESENT DAY MACHINE-GUNS

Hitherto we have been dealing with weapons worked by hand-power applied to a lever or winch-handle, the motion of this lever being translated by suitable mechanism into those by which the cartridges are loaded, fired, extracted and ejected—the cycle continuing as long as the lever is worked and there are cartridges in the " hoppers " which feed the gun. In the modern " automatic " machine-gun, moreover, the loading, firing, extracting and ejecting are all performed automatically by the gun itself, either by the recoil of its barrel, or by a small portion of the gases of explosion being allowed to escape through a minute hole in the barrel near the muzzle. The following details of the British Maxim, Hotchkiss and Colt types are reproduced from the article " Machine-guns," *Ency. Brit.* 10th ed.

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[1] The U.S. pattern Gatling hardly differed except in details from the model, above described, of twenty years earlier. The drum had been set horizontally instead of vertically and improved in details, and a " gravity feed," a tall vertical charger, was also used. The barrels were surrounded with a light casing. Tests made of the improved Gatling showed that the use of only one barrel at a time prevented overheating. On one trial 63,000 rounds were fired without a jam, and without stopping to clean the barrels. Smokeless powder and the modern cartridge case were of course used.

[2] The following particulars may be given of the 2-barrelled Gardner and 3-barrelled Nordenfeldt (land service) converted to take the ·303 cartridge: Weight, 92 and 110 lb respectively; parapet mounting in each case 168 lb; rate of fire of Gardner about 250 rounds per minute, of the Nordenfeldt about 350. A few of these guns are still used in fortresses and coast defences.

The idea of using the recoil, or a portion of the gases of explosion, for the working of the breech mechanism is by no means new, the latter system having been proposed and patented (certainly in a very crude and probably unworkable form) by

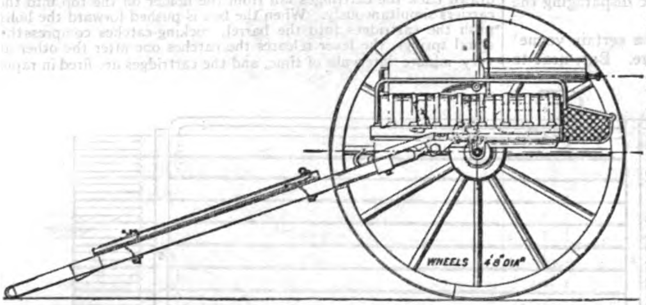
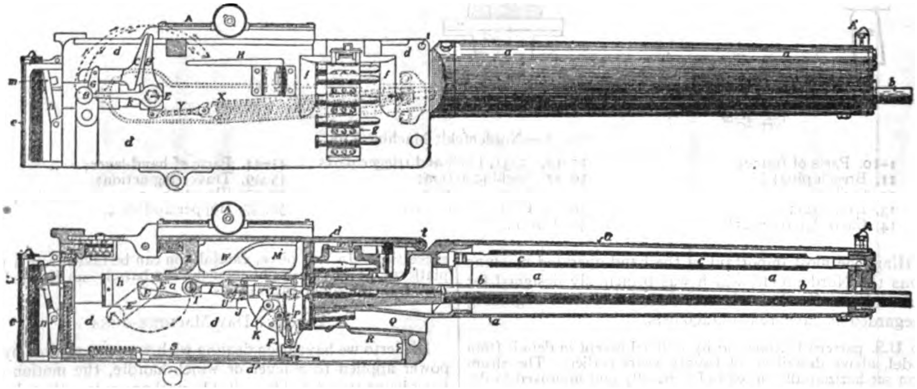


FIG. 6.—Maxim Gun on Wheeled Carriage (1900).

(Sir) Henry Bessemer in 1854; but whatever might be discovered by a search in old patent and other records or in museums, there can be no doubt that (Sir) Hiram S. Maxim was the first to produce a finished automatic gun of practical value. His patents in connexion with this particular class of weapon date back to 1884, and his gun on the recoil system was, after extensive trials, adopted into the British army in 1889 and into the navy in 1892. It is very possible that Bessemer's idea did not bear fruit earlier because the fouling left by the old forms of "black" or smoky powders was apt to clog the moving parts and to choke any small port. With modern smokeless powders this difficulty does not arise.

Maxim Gun.

The Maxim gun,[1] as will be seen from figs. 7 and 8, consists of two parts, the barrel casing (*a*) and breech casing (*d*), secured firmly together. The former (*a*), which is cylindrical in form, contains the barrel (*b*), and the water surrounding it to keep down the very high temperature attained by rapid fire, and the steam tube (*c*), which by the action of a sliding valve allows of the escape of steam but not of water. The barrel has asbestos packings at its front and rear bearings in the casing, which allow of its sliding in recoil without the escape of water. The breech casing (*d*) is a rectangular oblong box, and contains the lock and firing mechanism. At its rear end it has handles (*e*) by which the gun is directed, and the thumb-piece (*m*) by which the trigger is actuated. Its top is closed by a lid, hinged at (*i*). At its front is a recess holding the feed-block (*f*) through which the belt of cartridges (*g*) is fed to the gun.



FIGS. 7 and 8.—Mechanism of Maxim Gun.

Attached to the rear of the barrel (*b*) on either side are two side plates (*h*), between which in guides O works the aggregation of parts D, F, J, K, L, P, T and V, which constitute the lock, and (in bearings) the crank axle E, crank E′, and connecting rod I (see figs. 7 to 11).

The connecting rod I joins the lock and crank, being attached to the side levers J of the former by means of the interrupted screw U; the latter enables the lock to be detached and removed.

The crank axle E extends through both sides of the breech casing (*d*), slots (*k*, fig. 7), allowing it a longitudinal movement of about an inch. To its left-hand end, outside the breech casing, is attached the fusee chain Y of the recoil spring X (see dotted lines in fig. 7), and to its right-hand end a bell trunk lever, B B′; the arm B, which terminates in a knob, being turned by the crank handle, the arm B′ working against the buffer stop C.

In figs. 8, 9 and 11 the breech is shown closed, and it will be noticed that the crank pin I′ is *above* the straight line joining the axis of the barrel, the striker T, and the crank axle E. As the crank is prevented from further movement *upwards* by the crank handle B taking against the check-lever G (fig. 7), it is clear that the pressure on discharge of the cartridge cannot cause the crank axle to rotate, and so open the breech as shown in figs. 10 and 12.

The withdrawal of the lock and opening of the breech are effected as follows: The *total* travel in recoil of the barrel is about one inch, but on discharge the barrel, the side plates and lock all recoil *together* for about a quarter of an inch without any disturbance of the locking as explained above, and by the time this short travel is completed the *bullet has left the muzzle*. The arm B′ of the crank handle then engages the buffer stop C and causes the crank axle E to *rotate* and the crank E′ to *fall* and so draw back the lock from, and open, the breech. At the same time the fusee chain Y is wound up round the left-hand end of the crank axle E and the spring X extended. In the meantime the knob of the buffer handle B swings over, and just as the lock reaches its rearmost position (as in figs. 10 and 12) strikes the flat buffer spring H, and, rebounding, assists the crank in revolving in the reverse direction; the spring X also contracts, and, unwinding the fusee chain, draws back the lock again and closes the breech, a fresh cartridge having been placed in the barrel as explained below.

The gun is fired by means of the trigger F, which is actuated by the projection (*l*) on the trigger bar (S), the latter being drawn back when the button (*m*) on the push lever (*n*) is pressed forwards. If, therefore, the button he kept permanently pressed, the projection (*l*) will always lie in the path of the trigger F just as the lock reaches its forward position and the breech is closed, and the gun will fire automatically, and continue to do so as long as there are cartridges in the belt.

The loading, extraction and ejection of the cartridges are effected as follows: The left-hand side-plate is extended forwards a little beyond the breech, and communicates the reciprocating motion of the barrel to a lever on the feed-block, which causes the cartridges in the belt to be fed forward one by one by a "step-by-step" pawl action, the cartridge which is next to be taken from the belt being arrested exactly above the breech, the ejector-tube Q being below in the same vertical plane.

The extractor D (see figs. 9 to 12) which performs the operations of inserting, extracting and ejecting the cartridges, travels vertically in guides on the face of the lock. Projecting outwards from each side of its top are horns N (figs. 9 and 10). These travel round the edges of the cams M (fig. 8) situated on each side of the breech casing, and in conjunction with the spring W (fig. 8), compel the top of the extractor to take the path shown by the dotted lines and arrows in figs. 9 to 12.

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[1] Modern improvements in mechanical details are only slight, as may be found by reference to the official handbooks of the gun, editions of 1903 and 1907.

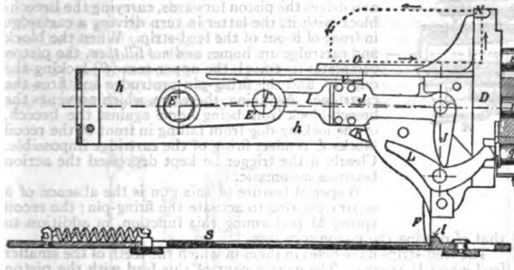


FIG. 9.—Maxim Gun Mechanism.

The extractor (figs. 11 and 12) is recessed to take a movable plate (*u*) termed a "gib," behind which is a spring (*v*). In the face of the gib is a recess (*w*) into which the base of a cartridge can just enter. On either side of the gib the face of the extractor has undercut flanges, open at the top and bottom, between which the base of a cartridge can fit the rim, being held in the undercuts (figs. 9 and 10).

It is clear from this arrangement that the base of the cartridge having been introduced between the flanges at the top of the extractor, can be pushed down, the spring (*v*) yielding, till arrested at the recess (*w*); and, as the lower edges of this recess are slightly sloped, further pressure will make it leave the recess (*w*) and slide over the face of the gib, leave it, and take up a position in front of the hole for the point of the striker (*x*), being now only prevented from slipping out of the extractor by the extractor spring (*y*). If this last be clear of the extractor stop (*z*) it will yield to pressure and the cartridge will be free. This is the action in the gun except that the cartridge is held firm and the extractor pushed against it.

In fig. 10 the extractor holds a cartridge (*r*) and a fired case (*q*) ready to be pushed into the empty breech and ejector-tube Q respectively. In the latter there is already a fired case (*p*), which will be driven by the fired case (*q*) beyond the ejector spring R. As soon as the lock reaches the face of the breech, the cartridge (*r*) and case (*q*) are deposited in the breech and ejector-tube respectively, and the extractor D *rises* under the action of the levers L and J, slides, as already explained, by the bases of the cartridges (*r*) and case (*q*), and then over the base of the cartridge (*s*) in the belt (*g*). Assuming the push-lever (*n*) to be pressed, the gun fires immediately this has occurred, and the bullet of the cartridge (*r*) is expelled. The position is now that shown in fig. 9. The barrel now recoils and the lock is withdrawn, taking with it the fresh cartridge (*s*) from the belt and the now fired case (*r*). The extractor travels horizontally for a time and then drops (as shown by the dotted line and arrows), assuming the position shown in fig. 12, which is exactly similar to that in fig. 10 but with different cartridges; continuing the action, the position shown in fig. 11 is arrived at. It will thus be seen that each cartridge makes two complete journeys with the extractor; the first as a live cartridge from the belt to the breech, the second from the breech to the ejector-tube, the forward journey being always on a lower level than that of the backward one. The sections in figs. 11 and 12 clearly show the cocking and firing mechanism and the safety arrangement. The lock is cocked, after firing, by the arm of the "tumbler" K, being pressed down by the side lever J as it swings down when following the crank E'. Safety against firing before the breech is closed is provided by the projection on the safety lever V, which does not clear the striker T until lifted by the side lever J at the top of its travel, that is, when the crank E' has passed the axial line as already explained.

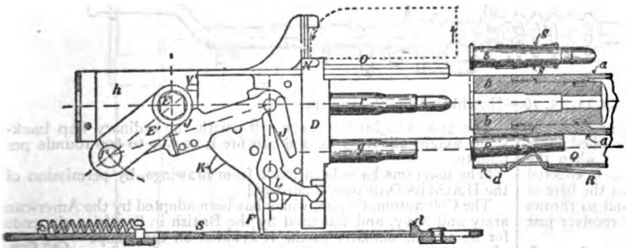


FIG. 10.—Maxim Gun Mechanism.

The lock in its rearmost position is kept in place by the block Z on the under side of the cover of the breech casing. When in this position it is clear of the guides O on the side-plates, and if the cover be opened it can be turned up, unscrewed by a turn through an eighth of a circle (the screw-thread U being interrupted in four places) and removed. To prepare the gun for firing, the crank handle is pushed over by hand to the buffer-spring, thus withdrawing the extractor, and held in this position; the tongue on the end of a filled belt is then pushed through the feed-block from the left and pulled as far as it will go from the opposite side. This places a cartridge above the breech ready to be seized by the extractor. The crank handle is now released and the lock flies forwards. The crank handle is now again pushed over and let go, and the first cartridge thus taken from the belt and placed in the breech. The gun is ready to fire.

To remove a partially filled belt, the crank handle must be pushed over, thus freeing the extractor from the belt, and the latter withdrawn after pressing a spring catch under the feed block which releases the pawls. The gun now has *two* live cartridges in it—both in the extractor. Letting go the crank handle, one of them is deposited in the ejector-tube, and again pushing over and letting go the crank handle does the same with the second.

Fig. 13 shows the feed-block and the cartridge belts. The greatest number usually carried in a belt is 250.

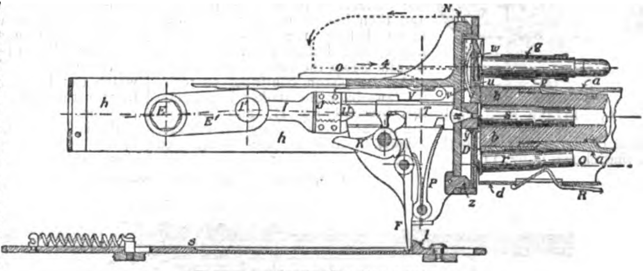


FIG. 11.—Maxim Gun Mechanism.

The gun is sighted to 2,500 yds. and has a folding tangent sight as shown. Its weight varies from 50 to 60 lb, and it can fire about 450 rounds per minute.

[The diagrams have been made from drawings, by permission of Messrs Vickers, Sons & Maxim.]

Hotchkiss Gun.

The Hotchkiss gun, figs. 14 to 16, which has been adopted by the French army and navy and elsewhere, depends for its action on the use of a small portion of the gases of the cartridge itself. The barrel A is firmly attached to the receiver or frame B, the latter containing the breech and firing mechanism. Under the barrel A, and communicating with it by a port (*c*) near the muzzle is a cylinder or tube C. When the gun is fired, and the bullet has passed the port (*c*), a portion of the gases of explosion passes into the cylinder C and drives back the piston F contained in it, a lug on the under part of the piston compressing the spring M, the latter, when the trigger N is pulled, driving back the piston again. The reciprocating motion of the piston performs all the processes of loading and firing the gun, and the action is continuous as long as the trigger is kept pressed back.

The piston F, enlarged and suitably shaped at the rear, actuates the breech-block H and firing pin or striker J; and, by suitable cam grooves (*f*) at about the centre of its length, works the larger feed-wheel U of the feed-box S; the smaller wheel U on the same axis in turn imparting a step-by-step motion to the metal feed-strips, each containing 30 cartridges, so that fresh cartridges are placed one by one before the face of the breech block ready to be pushed into the breech when the fired cartridge has been extracted and ejected.

On the under surface of the piston F, in rear, is a recess or sear (*f*) in which the nose of the trigger N engages, holding back the piston when it has been driven back by the gases. As already stated, a lug on the under surface just in rear of the cam (*f*) engages with the front of the mainspring.

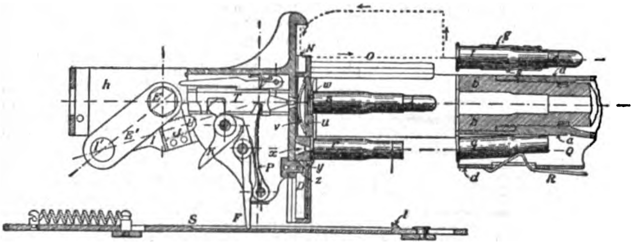


Fig. 12.—Maxim Gun Mechanism.

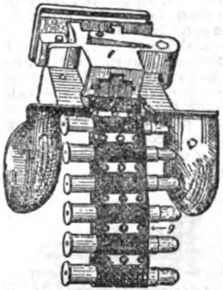
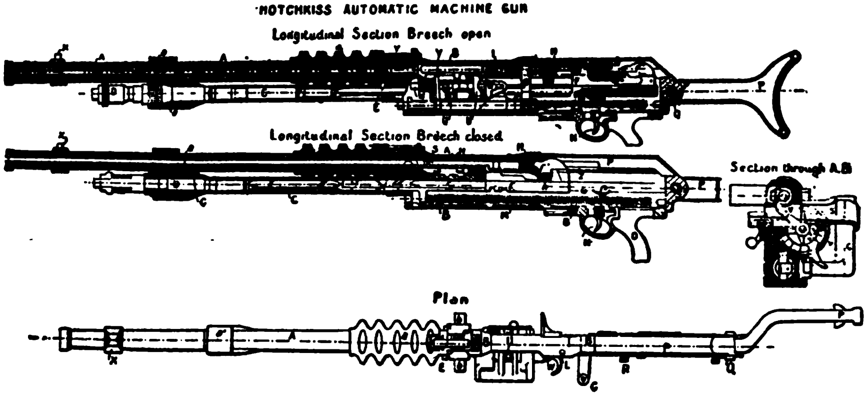


Fig. 13.—Maxim Feed-block.

Taking first the position shown in fig. 15 with the breech closed and locked and the cartridge fired, it will be seen that the breech is locked by the *upper* cam (*f'*), on the end of the piston, F, having caused the movable locking-dog (*h*) to fall and bear against the recoil blocks Z (see fig. 14 also) on the walls of the *receiver* or frame B. Consequently the breech is not unlocked until the piston has moved sufficiently to the rear for the *lower* cam (*f'*) to lift the locking-dog (*h*) clear of the recoil blocks Z. As the piston F is not actuated by the gases until the bullet has passed the port (*c*), and then has to move a short distance before the locking-dog is raised, the bullet is clear of the muzzle *before* the breech is unlocked.

As the piston continues to recoil it draws back the striker J and then the breech-block H, and is then caught and retained by the engagement of the sear (*f*) with the trigger N, and the position assumed is that shown in fig. 14.


HOTCHKISS AUTOMATIC MACHINE GUN
Longitudinal Section Breech open
Longitudinal Section Breech closed
Section through A.B
Plan

Figs. 14, 15, 16.—Hotchkiss Gun Mechanism.

From the head or nose-piece I of the breech-block projects the claw K of a spring extractor which, as the cartridge is pushed home by the breech-block, seizes it, extracting the fired case when the breech-block is withdrawn. Ejection of the fired case is effected by means of the ejector L (fig. 16) which catches against the base of the case, on the opposite side to the extractor claw, and so throws it sideways through the oblong-pointed opening in the receiver just in rear of the breech (see fig. 14).

The platform on the top of the feed-box through which the teeth of the smaller feed-wheel U project, and on which the feed-strips rest, lies *below* the axial line of the breech-block H, so that the face or nose-piece I of the latter only engages a *portion* of the base of the cartridge in the feed-strip as it pushes the cartridge into the breech, the bullet of the cartridge being guided into the breech by the incline at the opening of the latter. This point should be specially noted, the object of the arrangement being to enable the under surface of the breech-block to clear the clips which hold the cartridges in the feed-strips. The cartridge therefore, being extracted in the line of the axis of the block, is ejected through an opening *above* its plane of entry in the feed-strip.

Returning to the position shown in fig. 16, if the trigger be pulled, the compressed spring M reacts and drives the piston forwards, carrying the breech-block with it, the latter in turn driving a cartridge in front of it out of the feed-strip. When the block and cartridge are home, *and not till then*, the piston completes its travel, the upper cam (*f'*) locking the dog (*h*), and the firing-pin protrudes and fires the cartridge. Anything, therefore, which prevents the breech-block from being home against the breech, or the locking-dog from falling in front of the recoil blocks Z, renders firing of the cartridge impossible. Clearly if the trigger be kept depressed the action becomes automatic.

A special feature of this gun is the absence of a separate spring to actuate the firing-pin; the recoil spring M performing this function, in addition to that of driving the piston forwards.

The feed-strips have holes in them in which the teeth of the smaller feed-wheel U engage. The engagement of this feed with the piston F can be released by pulling out the feed arbor W, so that the strips can be removed at any time.

When the last shot in a feed-strip has been fired a stop (V) holds the piston and block ready for a fresh feed-strip to be inserted. As the stop V acts quite independently of the trigger, this action takes place even if the trigger be still depressed after the last cartridge in a strip has been fired.

To cock the gun, when in the locked position, a cocking handle G is provided. This has a long arm projecting to the front with a catch which takes against the front of the lug on the under side of the piston. To prepare the gun for action the gun is cocked, and a feed-strip is pushed into the feed-block.

The pressure of the gas on the piston is regulated by the regulator screw D, by means of which the space in the cylinder C in front of the piston F can be reduced or increased.

A safety lock R is furnished, which is a "half round" pin which can be turned so as to enter the semicircular slot just in front of the sear (*f*), and so hold back the piston when in the cocked position.

Radiation of the heat, generated in the barrel by rapid fire, is facilitated by the radiator (*a*), which consists of rings on the barrel close to the breech, which offer an increased surface to the air.

The gun is sighted to 2000 yds., with the ordinary flap back-sight, weighs about 53 ℔, and can fire from 500 to 600 rounds per minute.

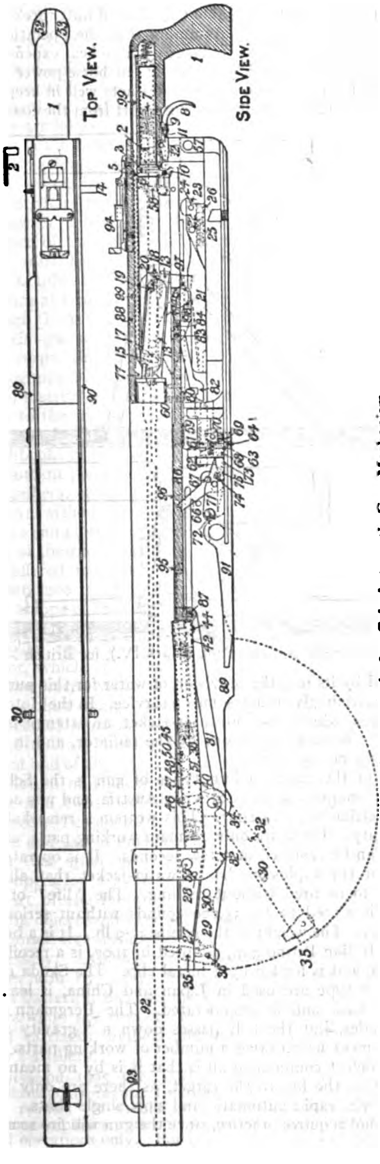
[The diagrams have been made from drawings, by permission of the Hotchkiss Ordnance Company.]

The Colt automatic gun, which has been adopted by the American army and navy, and was used by the British in S. Africa, depends for its action, similarly to the Hotchkiss, on the escape of a small portion of the gases of explosion through a port in the barrel a short distance from the muzzle. Figs. 17 and 18 give a plan, and side elevation with the left side plate removed, respectively. Into the recess in the barrel (92) just below the port fits the piston (35), capable of slight motion round the pivot (36), by which it is attached to the gas lever (29). The latter is a bell-crank lever pivoted at (34), its short arm being attached

Colt Gun.

at (46) by a pivot to a long link with a cross head, termed the retracting connexion (45). This link extends from a point close to the figures (44), where the arms of the cross head bear against the ends of two long spiral retracting springs, (37) and (38), contained in two tubes, (39) and (40), which are slotted for a few inches of their length to allow the cross head to follow up and compress the springs. (Only (38) and (40) are shown, (37) and (39) lying in the same plane of projection.)

When the gun fires, and the bullet has passed the port, the gases drive the piston (35) and gas lever (29) downwards, and the momentum imparted causes them to swing back round the pivot (36), as shown by the dotted circle. The gas lever is brought up now by the bottom plate (91); and the retracting springs, compressed by the cross head of the long link (45) owing to the *forward* motion of the short arm of the gas lever, react and drive the gas lever into its forward position again.



Figs. 17 and 18.—Colt Automatic Gun Mechanism.

The rotary movement of the gas lever is converted into a reciprocating movement of the slide (86) by means of the gas lever connexion rod (31) pivoted at (32) to the gas lever, and at (87) to the slide.

The slide (86) is a nearly flat bar, travelling in guides in the receiver, extending from (14) to (87). It is slotted completely through longitudinally for nearly the whole of its length, this slot affording an opening through which work the cartridge extractor (82) and carrier (21). At its rear end it engages by means of a pin (14) in a cam slot (97) in the bottom rib of the bolt (13), and at (83) it bears the pivot of the cartridge extractor (82). Its rear end is enlarged below to form a cam lug (98), and on its right side are two projections (95) and (96), which work the feed lever (66).

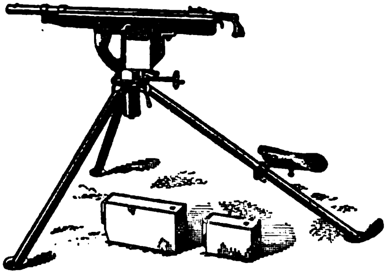


Fig. 19.—Colt Gun mounted.

The feed wheel (61), over which passes the belt containing the cartridges, is actuated by a pawl "step-by-step" gear by means of the feed lever (66).

The carrier (21) is a long trip lever pivoted at (22), and provided with a spring dog (23) pivoted at (24).

The bolt (13) is a cylinder with a guide rib extending from its under surface. It is actuated by the slide by means of the pin (14) and cam slot (97) as already stated, and is bored through to take the striker or firing pin (18). The rear end of the latter projects slightly beyond the rear face of the bolt, being retained in this position by the spring (19). When this projecting end is pushed into the bolt, the point protrudes from the front of the bolt and fires the cartridge. The bolt, when the breech is locked, is held firm by two recoil blocks on the receiver (not shown), as is explained later. At the front of the bolt is an extractor (15) with a spring claw for extracting the fired case. (This is of course quite distinct from the cartridge extractor (82).) Ejection is effected by means of an ejector projecting into the path of the fired case.

The firing of the gun is performed by the cylindrical hammer (6) hollowed out in rear to contain the mainspring (7). When pushed back and cocked as shown in fig. 18, it is held during a *portion* of the operations of the mechanism by *two* detents working independently of each other—the sear (10) and the nose of the trigger (8). The former is automatically released by a trip lever (not shown) as soon as the breech is locked, leaving the hammer held by the trigger only. This is the position shown in fig. 18. The necessity for the two detents is explained later.

The hammer, when cocked, can also be permanently locked by the handle lock (2) actuated by a thumb-piece on the outside of the receiver. The air compressed in rear of the hammer, as the latter is driven back, passes through the tube (99) to the breech; and a puff of air is therefore blown through the barrel after every shot, clearing out fouling and unconsumed powder, and assisting to an appreciable extent to keep down the temperature of the barrel.

Taking the position shown in fig. 18, the hammer is only held back by the trigger nose, the sear (10) having been released as stated above. A belt of cartridges (not shown) has been placed on the feed-wheel, and the cartridge next to be used after the one (not shown) now in the breech has its rim (or base with rimless cartridges) just above the hook on the extractor (82). If now the trigger be pulled, the hammer flies forwards, strikes the protruding end of the firing pin, and the cartridge fires; the gases cause the gas lever to swing round and drive back the slide. The pin (14) working in the cam groove (97) causes the rear of the bolt to *rise* and clear itself from the recoil blocks (not shown) on the receiver, and then to move rearwards horizontally, driving the hammer back until the latter is caught and held by the sear and trigger. In the meantime the extractor (82) has pulled a cartridge from the belt, and, assisted by two spring cartridge guides (80 and 81), of which only (80) is shown, deposits it on the carrier (21); the projection (95) strikes the feed-lever (66), and moves the feed mechanism so as to prepare to revolve the feed-wheel and place a fresh cartridge ready for the next round; and as the slide completes its travel backwards, the cam (98) strikes the dog (23) and slightly depresses it (the spring (25) yielding), the carrier and cartridge on it consequently rising a little and falling again (this latter action is incidental only to the form of the parts, and is not a necessity).

The retracting springs now react and pull the slide forwards; the cam (98) strikes the dog (23), which, as the spring arrangement is of the "non-return" class, does not yield but is depressed, and the front of the carrier and the cartridge on it are therefore raised sharply, and the latter placed in the path of the bolt. The bolt being now pulled forwards, the cartridge is driven off the carrier into the breech, and the bolt locked by the pin (14), causing the bolt to drop in front of the recoil blocks; the carrier is pushed down flat by the advance of the cam lug (98), the trip releases the sear (10), and the projection (96) pushes back the feed lever, completing the action of feeding a fresh cartridge forward. The position shown in fig. 17 is now resumed.

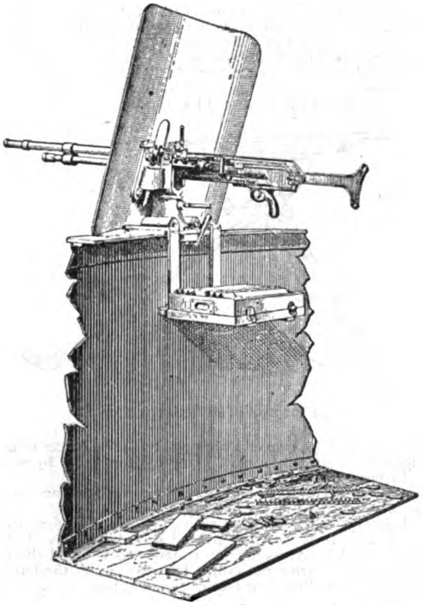


Fig. 20.—Hotchkiss Gun mounted.

It is clear that were the trigger kept permanently pulled the gun would fire immediately the bolt was locked and the sear (10) depressed, and the action would become automatic.

The object of two detents, though now probably obvious, may here be explained. The whole action of the gun depends upon the hammer after it is pushed back by the bolt being *held* back until the bolt has gone completely forwards and locked the breech. If only the trigger detent existed, and that were kept pressed down, the hammer, after being pushed back by the bolt, would immediately *follow up* the latter, and might fire the cartridge prematurely, or fail to fire it at all; hence the use of the sear in addition to the trigger.

To cock the lock, or work the mechanism by hand, the gas lever is pulled round by the pin (30) provided for the purpose, and by this means the gun is prepared for firing. A brass tongue on the end of the belt is pushed through the opening above the feed-wheel and then pulled from the other side of the gun as far as it will go. This places a cartridge in front of the extractor, and if the gas lever be now pulled right back and let go, this cartridge is placed in the breech as already described, and the gun is ready for firing. If it be desired to remove a belt from the feed, a button (68) is pressed and the feed-wheel is then free to revolve backwards.

The gun is sighted with the ordinary rifle-pattern sights, up to 2000 yds. or more if required. It weighs about 40 lb, and can fire about 400 rounds per minute as usually adjusted, though this rate can be increased. There is no means of altering the gas pressure in the field as with the Hotchkiss.

[The diagrams have been made from drawings, by permission of the Colt Arms Company.]

Comparing the principle of employing a recoiling barrel with that of using a portion of the gas, the advantages of the former are that the recoil is made to do useful work instead of straining the gun and mounting in its absorption; the latter system, however, has undoubtedly the advantage in simplicity of mechanism (the Hotchkiss is extraordinarily simple in construction for an automatic gun), and in the large margin of power for working the mechanism with certainty in all conditions of exposure to climate, dust, and dirt. While inferior in this respect, it is nevertheless the fact that the Maxim has proved itself in the field even in savage warfare in the roughest country to be a very efficient and powerful weapon.

The great difficulty which has to be met in all single-barrel machine guns is the heating of the barrel. The 7½ pints of water in the water-jacket of the Maxim gun are raised to boiling point by 600 rounds of rapid fire—*i.e.* in about 1½ minutes—and if firing be continued, about 1½ pints of water are evaporated for every 1000 rounds. Assuming that the operation is continuous, the rate of waste of energy due to heat expended on the water *alone* is equivalent to about 20 horse-power (294 foot tons per minute). The water-jacket acts well in keeping down the temperature of the barrel; but apart from the complications entailed by its use, the provision of water for this purpose is at times exceedingly troublesome on service. In the Hotchkiss and Colt guns, which have no water-jacket, an attempt is made to meet the heating, in the one by the radiator, and in the other by a very heavy barrel.

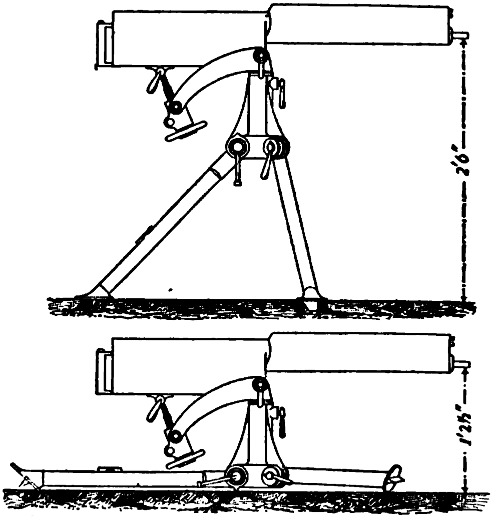


Fig. 21.—Tripod mounting (Mark IV.), for British Maxim.

One of the most modern types of gun is the Schwarzlose, which is manufactured at Steyr in Austria, and was adopted by the Austrian army in 1907. This weapon is remarkable for its simplicity. There are only 10 main working parts, and any of these can be replaced in a few seconds. It is operated by the gases of the explosion, has a water-jacket that allows 3000 rounds to be fired without refilling. The "life" of the gun-barrel is stated to be 35,000 rounds without serious loss of accuracy. The weight of the gun is 37·9 lb. It is a belt loader.

The Italian Perino gun, adopted in 1907, is a recoil-operated weapon, and is loaded by a metal clip. The Skoda gun, some of which type are used in Japan and China, is loaded by a hopper feed, and is gas-operated. The Bergmann gun is a belt loader, but the belt passes down a "gravity feed" an arrangement which saves a number of working parts.

One defect common to all is that it is by no means easy to proportion the fire to the target, as there are only two rates of fire, viz. rapid automatic and slow single shots. To fire a single shot requires practice, since the gun will fire some 7 shots in one *second*, and to press the trigger and remove the finger or thumb instantly, and at the same time be ready to traverse to a fresh target, requires considerable skill. The result of these difficulties is that the target when struck is often riddled with bullets when one would have sufficed. The aiming of the gun, when rapid fire is taking place, may also be difficult even on firmly fixed mountings, owing to vibration. The greater delicacy of the modern machine gun has been alluded to above.[1] Nevertheless the advantages of safety, steadiness and lightness which the automatic weapon possesses, have ensured its victory over the older type of weapon, and although the simple strong and well-tried Gatling still has its advocates, every civilized army has adopted one or more of the automatic types.

Organization and Tactical Employment[2]

Although machine-gun tactics are still somewhat indefinite, at least there are well-marked tendencies which have a close relation to the general tactical scheme or doctrine adopted by each of the various armies as suited to its own purposes and conditions. For many years before the South African and Manchurian wars, the machine-gun had been freely spoken of as "a diabolical weapon before which nothing could live," but this did not contribute much to the science of handling it. Most military powers, indeed, distrusted it—actuated perhaps by the remembrance of the vain hopes excited by the *canon à balles*. It was not until the second half of the war of 1904-05 that the Japanese, taught by the effective handling of the Russian machine-guns at Liao-Yang, introduced it into their field armies, and although Great Britain had provided every regular battalion with a Maxim-gun section some years before the Boer War, and a Volunteer corps, the Central London Rangers (now 12th bn. London Regiment) had maintained a (Nordenfeldt) gun section since 1882, instruction in the tactics of the weapon was confined practically to the simple phrase "the machine-gun is a weapon of opportunity." More than this, at any rate, is attempted in the drill-books of to-day.

One important point is that, whether the guns are used as an arm, in numbers, or as auxiliaries, in sections, they should be free to move without having to maintain their exact position relatively to some other unit. It was in following the infantry firing lines of their own battalion over the open that the British Maxims suffered most heavily in South Africa. Another of equal importance is that the machine guns must co-operate with other troops of their side in the closest possible way; more, in this regard, is demanded of them than of artillery, owing to their mobility and the relative ease of obtaining cover. A third factor, which has been the subject of numerous experiments, is the precise value of a machine-gun, stated in terms of infantry, *i.e.* how many rifles would be required to produce the fire-effect of a machine-gun. A fourth—and on this the teaching of military history is quite definite—is the need of concealment and of evading the enemy's shrapnel. These points, once the datum of efficiency of fire has been settled, resolve themselves into two conclusions—the necessity for combining independence and co-operation, and the desirability of Mercury's winged feet and cap of darkness for the weapon itself. It is on the former that opinions in Europe vary most. Some armies ensure co-operation by making the machine-gun section an integral part of the infantry regimental organization, but in this case the officer commanding it must be taught and allowed to shake himself free from his comrades and immediate superiors when necessary. Others ensure co-operation of the machine-guns as an arm by using them, absolutely free of infantry control, on batteries; but this brings them face to face with the risks of showing, not one or two low-lying gun-barrels, but a number of carriages, limbers and gun teams, within range of the enemy's artillery.

Fire Effect.

Ranging.

French experiments are said to show that the fire-power of a machine-gun is equal to that of 150-200 rifles at exactly known range, and to 60-80 rifles at ranges judged by the French "instantaneous range-finder." The German drill-book gives it as equal approximately to that of 80 rifles on an average. The distinction of known and unknown ranges is due to the fact that the "cone of dispersion" of a large number of bullets in collective infantry fire is deeper than that of machine-gun fire. The latter therefore groups its bullets much more closely about the target if the latter is in the centre of the cone—viz. at known ranges—but if the distance be misjudged not only the close central group of 50% of the shots, but even the outlying rounds may fall well away from the target. At 1500 yards range the "50 per cent. zone" with the Maxim gun is only 34 yards deep as compared with the 60 yards of a half-company of rifles.[3] The accuracy of the gun is more marked when the breadth of the cone of dispersion is taken into account. The "75 per cent." zone is in the case of the machine-gun about as broad at 2000 yards as that of collective rifle fire at 500. At the School of Musketry, South Africa, a trial between 42 picked marksmen and a Maxim at an unknown range at service targets resulted in 408 rounds from the rifles inflicting a loss of 54% on the enemy's firing line represented by the targets, and 228 rounds from the Maxim inflicting one of 64%. Another factor is rapidity of fire. It is doubtful if infantry can keep up a rate of 12 rounds a minute for more than two or three minutes at a time without exhaustion and consequent wild shooting. The machine-gun, with all its limitations in this respect, can probably, taking a period of twenty or thirty minutes, deliver a greater volume of fire than fifty rifles, and assuming that, by one device or another (ranging by observing the strike of the bullets, the use of a telemeter, or the employment of "combined sights") the 75% cone of bullets has been brought on to the target, that fire will be more effective. The serious limiting condition is the need of accurate ranging. If this is unsatisfactory the whole (and not, as with infantry, a part) of the fire effect may be lost, and if the safe expedient of "combined sights"[4] be too freely resorted to, the consumption of ammunition may be out of all proportion.

Vulnerability.

The vulnerability of machine-guns is quite as important as is their accuracy. At a minimum, that is when painted a "service" colour, manœuvred with skill, and mounted on a low tripod—in several armies even the shield has been rejected as tending to make guns more conspicuous—the vulnerability of one gun should be that of one skirmisher lying down. At a maximum, vulnerability is that of a small battery of guns and wagons limbered up.

Mobility.

Mobility comes next. The older patterns of hand-operated guns weighed about 90 lb at least, without carriage, the earlier patterns of Maxims (such as that described in detail above) about 60 lb. But the most modern Maxims weigh no more than 35 lb. Now, such weapons with tripods can be easily carried to and fro by one or two men over ground that is impracticable for wheeled carriages. Nevertheless,

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[1] At San-de-pu 1905 the Japanese machine-guns (Hotchkiss) sustained damage averaging, 1 extractor broken per gun, 1 jam in every 300 rounds. It should be mentioned, however, that the machine-gun companies were only formed shortly before the battle.

[2] In field operations only. For siege warfare see FORTIFICATION AND SIEGECRAFT.

[3] For practical purposes in the field, the "effective" beaten zone, containing 75% of the bullets, is the basis of fire direction both for the machine-gun and the rifle. The depths of these "effective" zones are on an average:—

At	500 yds.	1,000 yds.	1,500 yds.	2,000 yds.
S.L.E. Rifle	220 yds.	120 yds.	100 yds.	—
Maxim Gun	150 yds.	70 yds.	60 yds.	50 yds.

[4] "Combined sights" implies firing with the sights set for two different ranges, the usual difference being 50 yds. With grouped machine guns, "progressive fire" with elevations increasing by 25 yds. is used. This artificially disperses the fire, and therefore lessens the chance of losing the target through ranging errors. One ingenious inventor has produced a two-barrelled automatic, in which the barrels are permanently set to give combined elevations. The British memorandum of August 1909 seems to regard the facility of employing combined sights as the principal advantage of the battery over the section.

wheeled carriages are often used for the ordinary transport of the gun and its equipment, especially with the heavier models. The simplest machine-gun has a number of accessories—tools, spare parts, &c.—that must be conveyed with it, and at the least a pack-animal is indispensable.

Reducing these conditions to a phrase—the fire effect that can be reasonably expected of machine-guns is that of fifty or sixty rifles, the space it takes up in the line can be made to equal that occupied by two men, and it possesses by turns the speed of a mounted man and the freedom of movement of an infantryman.

Machine-Guns as a Reserve of Fire.

Machine-Guns with Cavalry.

The use of the machine-gun (apart from savage warfare) that first commended itself in Europe was its use as a *mobile reserve of fire*. Now, the greatest difficulty attending the employment of a reserve of any sort is the selection of the right moment for its intervention in the struggle, and experience of manœuvres of all arms in Germany, where "machine-gun detachments" began to be formed in 1902, appears to have been that the machine-guns always came into action too late. On the other hand, the conditions of the cavalry *versus* cavalry combat were more favourable. Here there was every inducement to augment fire-power without dismounting whole regiments for the purpose. Moreover, vulnerability was not a fatal defect as against a battery or two of the enemy's horse artillery, whose main task is to fire with effect into the closed squadrons of mounted men on the verge of their charge, and above all to avoid a meaningless duel of projectiles. The use of wheeled carriages was therefore quite admissible (although in fact the equipment was detachable from the carriage) and, given the rapidity and sudden changes of cavalry fighting, both desirable and necessary. Thus, thanks to the machine-gun, the eternal problem of increasing the fire-power of mounted troops is at last partially solved, and the solution has appealed strongly both to armies exceptionally strong in cavalry, as for example the German, and to those exceptionally weak in that arm—Denmark, for instance, having two or three light machine-guns *per squadron*. The object of the weaker cavalry may be to cause the onset of the stronger to dwindle away into a dismounted skirmish, and this is most effectually brought about by a fire concentrated enough and heavy enough to discourage mounted manœuvres; on the other hand, the stronger party desires to avoid dismounting a single squadron that can be kept mounted; and this too may be effected by the machine-guns. What the result of such a policy on both sides may be, it would be hard to prophesy, but it is clear at any rate that, whether on the offensive or on the defensive, skilfully handled machine-guns may enable a cavalry commander to achieve the difficult and longed-for result—to *give the law* to his opponent. The principal difference between the tactics of the stronger and those of the weaker cavalry in this matter is, that it is generally advantageous for the former to act by batteries and for the latter to disperse his machine guns irregularly in pairs.

Machine-Guns in Combined Tactics.

It is not merely in cavalry tactics that the question of "section or battery" arises. It deeply affects the machine-gun tactics in the battle of all arms, and it is therefore decided in each service by the use to which the guns are intended to be put. One powerful current of opinion is in favour of employing them as a mobile reserve of fire. This opinion was responsible for the creation of the German machine-gun batteries or "detachments"; and in the drill regulations issued in 1902 for their guidance it was stated that the proper use of machine-guns required a comprehensive and accurate knowledge of the general situation, and that therefore only the superior leaders could employ them to advantage. Manœuvre experience, as mentioned above, has caused considerable modification in this matter, and while the large machine-gun "detachments" are now definitely told off to the cavalry, new and smaller units have been formed, with the title "companies" to indicate their attachment to the infantry arm. A recent official pronouncement as to the rôle of the "companies" (Amendments to *Exerzierreglement für die Infanterie*, 1909) is to the effect that the companies are an integral part of the infantry, that their mission is to augment directly the fire of the infantry, and that their employment is in the hands of the infantry regimental commander, who keeps the guns at his own disposition or distributes them to the battalions as he sees fit. It must be remembered that the regiment is a large unit, 3000 strong, and the idea of a "mobile reserve of fire" is tacitly maintained, although it has been found necessary to depart from the extreme measure of massing the guns and holding them at the disposal of a general officer. The Japanese regulations state that in principle the machine-gun battery fights as a unit; that although it may be advantageously employed with the advanced guard to assure the possession of supporting points, its true function is to intervene with full effect in the decisive attack, its use in the delaying action being "a serious error." In France, on the other hand, the system of independent sections is most rigidly maintained; when in barracks, the three sections belonging to an infantry regiment are combined for drill, but in the field they seem to be used exclusively as sections. They are not, however, restricted to the positions of their own battalions; taught probably by the experiences of the British in South Africa, they co-operate with instead of following the infantry. In Great Britain, *Field Service Regulations*, part i., 1909, lay down that "machine-guns are best used in pairs[1] in support of the particular body of troops to which they belong" (*i.e.* battalions). "The guns of two or more units may, if required,[2] be placed under a specially selected officer and employed as a special reserve of fire in the hands of a brigade commander" (corresponding to German regimental commander), but "if an overwhelming fire on a particular point is required, it can be obtained by concentrating the fire of dispersed pairs of guns." More explicitly still, "the movements and fire action of these weapons should be *regulated so as to enable them to open fire immediately a favourable opportunity arises.*"

Contrasting the German system with the French and English, we may observe that it is German tactics *as a whole* that impose a method of using machine-guns which the Germans themselves recognize as being in many respects disadvantageous. A German force in action possesses little depth, *i.e.* reserves, except on the flanks where the enveloping attack is intended to be made. Consequently, a German commander needs a reserve of fire in a mechanical, concentrated form more than a British or a French commander, and, further, as regards the decisive attack on the flanks, it is intended not merely to be sudden but even more to be powerful and overwhelming. These considerations tend to impose both the massing and the holding in reserve of machine-guns. The French and British doctrine (see TACTICS) is fundamentally different. Here, whether the guns be massed or not, there is rarely any question of using the machine-guns as a special reserve. In the decisive attack, and especially at the culmination of the decisive attack, when concealment has ceased and power is everything, the machine-guns can render the greatest services when grouped and boldly handled. Above all, they must reach the captured crest in a few minutes, so as to crush the inevitable offensive return of the enemy's reserves. The decisive attack, moreover, is not a prearranged affair, as in Germany, but the culmination, "at a selected point, of gradually increasing pressure relentlessly applied to the enemy at all points" (*F. S. Regulations*). The holding attack, as this "pressure" is called, is not a mere feint. It is launched and developed as a decisive attack, though not completed as such, as it lacks the necessary reserve strength. Here, then, the machine-gun is best employed in enabling relatively small forces to advance—not to assault—without undue loss, that is, in economizing rifles along the non-decisive front.[1]

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[1] The use of single guns facilitates concealment, but this is outweighed by the objection that when a jam or other breakdown occurs the fire ceases altogether. The use of guns in pairs not only obviates this, but admits of each gun in turn ceasing fire to economize ammunition, to cool down, &c. This is the old artillery principle—"one gun is no gun."

[2] In the instructions issued in August 1909 one of the principal advantages of grouped sections is stated to be the neutralization of ranging errors at ranges over 1000 yards. At a less range, it is laid down, grouped guns form too visible a target, unless the ground is very favourable.

Withal, there are certain principles, or rather details of principle, that find general acceptance. One of these is the employment of machine-guns with the advanced guard. In this case the value of the weapon lies in its enabling the advanced guard both to seize favourable ground and points of support without undue effort and to hold the positions gained against the enemy's counter-attack. This applies, further, to the preliminary stages of an action.[2] Another point is that as a rule the most favourable range for the machine-gun is "effective infantry," *i.e.* 600–1400 yards (which is, *mutatis mutandis*, the principle of Reffye's mitrailleuse). Its employment at close infantry range depends entirely on conditions of ground and circumstances—even supposing that the handiest and most inconspicuous type of weapon is employed. Thirdly—and this has a considerable bearing on the other points—the machine-gun both concentrates many rifles on a narrow front, and concentrates the bullets of many rifles on a narrow front. The first clause implies that it can be used where there is no room (physically or tactically) for the fifty or eighty riflemen it represents (as, for instance, in some slight patch of cover whence the gun can give effective cross-fire in support of the infantry attack, or in front of an advanced post, or can watch an exposed flank), and, further, that it can be swung round laterally on to a fresh target far more easily than a line of excited and extended infantry can be made to change front. The second means that the exit of a defile, an exposed turn in a lane or on a bridge, can be beaten by closely grouped fire at greater distances and with greater accuracy than is attainable with riflemen.

Further, the waste of ammunition and the strain on the weapon caused by unnecessarily prolonged firing at the rate for which its mechanism is set—varying between 350 and 700 rounds a minute—have caused it to be laid down as an axiom in all armies that machine-guns shall deliver their fire by "bursts" and only on favourable targets.

Lastly, the reports, both of observers and combatants, are unanimous as to the immense moral effect produced on the combatants by the unmistakable drumming sound of the machine-guns, an effect comparable even at certain stages of the fight to the boom of the artillery itself

Equipments in Use.—Practically all nations have abandoned the simple wheeled carriage for machine-guns, or rather have adopted the tripod or table mounting, reserving the wheeled vehicle for the mere transport of the equipment. Since the Russo-Japanese War the tendency has been to sacrifice the slight protection afforded by the shield in order to reduce visibility. The Japanese, who had unprotected field guns and protected machine-guns in the war, found it advisable to reverse this procedure, for reasons that can easily be guessed in the cases of both weapons.

Great Britain.—The service machine-gun is the Maxim ·303 in., adjusted to a rate of 450 rounds per minute and sighted (except in a few weapons) to 2900 yards. The original patterns weighed 60 lb, and were mounted on wheeled carriages. In the latest pattern, however, the weight of the gun has been reduced to 36 lb. The old Mark I. cavalry Maxim carriage, complete with gun, ammunition, &c., weighed 13 cwt. behind the traces, and the gun was 5 ft. above the ground. It had no limber. The Mark III. cavalry carriage is much lower (3′ 6″ from the ground to the gun), and the gun carriage and limber together only weigh 13 cwt. Of infantry carriages there were various marks, one of which is shown in fig. 6. Now, however, all mountings for infantry are of the tripod type, transported on wheels or on pack animals, but entirely detachable from the travelling mounting, and in action practically never used except on the tripod. The Mark IV tripod mounting, of which a sketch is given in fig. 21, weighs 48 lb. The total weight of the fighting equipment is thus 84 lb only—an important consideration now that in action the gun is man-carried. The gun can be adjusted to fire at heights varying from 2′ 6″ to 1′ 2½″ only from the ground; in its lowest position, then, it is a little lower than the head of a man firing lying. All the later infantry machine-gun equipments are for pack transport and have no shields.

The organization of the machine-gun arm is regimental. Each cavalry regiment and each infantry battalion has a section of 2 guns under an officer.

France.—The guns in use are the Puteaux and the Hotchkiss. The unit is the regimental 2-gun section. Four-horsed carriages with limbers are used with cavalry, tripods with the infantry sections. No shields. Weight of the Hotchkiss in use, 50 lb; of the tripod, 70 lb. The Puteaux was lightened and improved in 1909.

Germany.—As already mentioned the German machine-gun units are classed as cavalry "detachments" and infantry "companies." The "detachment" or battery consists of 6 guns and 4 wagons, the vehicles being of a light artillery pattern and drawn by four horses. The gun (Maxim) weighs 61 lb, and its fighting carriage 110 lb. The "companies" have also 6 guns and 4 wagons, but the equipment is lighter (two-horse), and is not constructed on artillery principles, nor are the guns fired from their carriages as are those of the "detachments." The weight of the gun is 38 lb, and that of the fighting carriage 75 (some accounts give 53 for the latter), the difference between these weights and those of the mounted equipments, affording a good illustration of the difference in the tactical requirements of the cavalry and of the infantry types of gun. The fighting carriage is a sort of sledge, which is provided with four legs for fire in the highest position, but can of course be placed on the ground; the height of the gun, therefore, can be varied from 3′ 6″ to 1′ 6″. The sledges can be dragged across country or carried by men stretcher fashion, and sometimes several sledges are coupled and drawn by a horse.

Japan.—The Japanese Hotchkiss, as modified since the war with Russia, is said to weigh 70 lb, and its tripod mounting 40. Each regiment of infantry has a six-gun battery and each cavalry brigade one of eight guns. Pack transport is used.

Russia.—Since the war eight-gun companies have been formed in the infantry regiments, and each cavalry regiment has been provided with two guns. The war organization is, however, unknown. Both wheel and pack transport are employed for travelling, but the guns are fought from tripods. Early and somewhat heavy patterns of Maxim (with shield) are chiefly used, but a great number of very light guns of the Madsen type have been issued.

The *Austrian* gun is the Schwarzlose, of which some details are given above. Pack transport is used, one mule taking the whole equipment with 1000 rounds. Weight of the gun 37·9 lb, of the tripod 41 lb. The height of the tripod can be varied from 9¾ in. to 2 ft. above the ground. It is proposed that each cavalry regiment should have four guns, and each infantry regiment two. *Switzerland* adopted the Maxim in 1902. It is used principally as a substitute for horse artillery. *Denmark* and other small states have adopted the Madsen or Rexer light-type guns in relatively large numbers, especially for cavalry. In the *United States* the British organization was after many trials adopted, and each infantry and cavalry regiment has a two-gun section of Maxims, with tripod mounting and pack transport.

See P. Azan, *Les premières mitrailleuses* ("Revue d' Histoire de l'Armée," July 1907), *Le Canon à balles, 1870–1871* ("Revue d'Hist. de l'Armée, 1909); Lieut-Colonel E Rogers in "Journal R. United Service Institution" of 1905, Capt R. V. K. Applin, *Machine-gun Tactics* (London, 1910) and paper in "J R. United Service Inst" (1910), War Office Handbook to the Maxim gun (1907); Capt. Cesbron Lavau, *Mitrailleuses de cavalerie*; Lieut. Buttin, *L'emploi des mitrailleuses d'infanterie*; Major J. Goots, *Les Mitrailleuses* (Brussels, 1908); and Merkatz, *Unterrichtsbuch für die Masch.-Gewehrabteilungen* (Berlin, 1906), Korzen & Kühn, *Waffenlehre*, &c.
(C. F A.)

MACÍAS [*O NAMORODO*] (*fl.* 1360–1390), Galician *trovador*, held some position in the household of Enrique de Villena. He is represented by five poems in the *Cancionero de Baena*, and is the reputed author of sixteen others. Macías lives by virtue of the romantic legends which have accumulated round his name. The most popular version of his story is related by Hernán Nuñez. According to this tradition, Macías was enamoured of a great lady, was imprisoned at Arjonilla, and was murdered by the jealous husband while singing the lady's praises. There may be some basis of fact for this narrative, which became a favourite subject with contemporary Spanish poets and later writers Macías is mentioned in Rocaberti's *Gloria de amor* as the Castilian equivalent of Cabestanh; he afforded a theme to Lope de Vega in *Porfiar hasta morir*; in the 19th century, at the outset of the romantic movement in Spain, he inspired Larra (*q.v.*) in the play *Macías* and in the historical novel entitled *El doncel de Don Enrique el doliente.*

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[1] The British instructions of August 1909 direct the grouping of guns in the *decisive* attack (if circumstances and ground favour this course) and their use by sections "if the brigade is deployed on a wide front," *i.e.* on the *non-decisive* front; further, that it is often advisable to disperse the sections of the leading battalions and to group those of units in reserve. In any case, while the 2, 4 or 8 guns must be ready to act independently as a special "arm," their normal work is to give the closest support to the neighbouring infantry (battalion in the holding, brigade in the decisive, attack).

[2] In Germany, however, the tendency is not to make holding attacks but to keep the troops out of harm's way (*i.e.* too far away for the enemy to counter-attack) until they can strike effectively.

See H. A. Rennert, *Macías, o namorado; a Galician trobador* (Philadelphia, 1900); Théodore J. de Puymaigre, *Les vieux auteurs castillans* (1889–1890), i. 54–74; *Cancioneiro Gallego-Castelhano* (New York and London, 1902), ed. H. R. Lang; Christian F. Bellermann, *Die alten Liederbücher der Portugiesen* (Berlin, 1840).

MACINTOSH, CHARLES (1766–1843), Scottish chemist and inventor of waterproof fabrics, was born on the 29th of December 1766 at Glasgow, where he was first employed as a clerk. He devoted all his spare time to science, particularly chemistry, and before he was twenty resigned his clerkship to take up the manufacture of chemicals. In this he was highly successful, inventing various new processes. His experiments with one of the by-products of tar, naphtha, led to his invention of waterproof fabrics, the essence of his patent being the cementing of two thicknesses of india-rubber together, the india-rubber being made soluble by the action of the naphtha. For his various chemical discoveries he was, in 1823, elected F.R.S. He died on the 25th of July 1843.

See George Macintosh, *Memoir of C. Macintosh* (1847).

MACKAY, CHARLES (1814–1889), Scottish writer, was born at Perth, on the 27th of March 1814, and educated at the Caledonian Asylum, London, and in Brussels. In 1830, being then private secretary to a Belgian ironmaster, he began writing verses and articles for local newspapers. Returning to London, he devoted himself to literary and journalistic work, and was attached to the *Morning Chronicle* (1835–1844). He published *Memoirs of Extraordinary Public Delusions* (1841), and gradually made himself known as an industrious and prolific journalist. In 1844 he was made editor of the Glasgow *Argus*. His literary reputation was made by the publication in 1846 of a volume of verses, *Voices from the Crowd*, some of which were set to music by Henry Russell and became very popular. In 1848 Mackay returned to London and worked for the *Illustrated London News*, of which he became editor in 1852. In it he published a number of songs, set to music by Sir Henry Bishop and Henry Russell, and in 1855 they were collected in a volume, they included the popular "Cheer, Boys! Cheer!" After his severance from the *Illustrated London News*, in 1859, Mackay started two unsuccessful periodicals, and acted as special correspondent for *The Times* in America during the Civil War. He edited *A Thousand and One Gems of English Poetry* (1867) Mackay died in London on the 24th of December 1889. Marie Corelli (*q.v.*) was his adopted daughter. His son, Eric Mackay (1851–1899), was known as a writer of verse, particularly by his *Love Letters of a Violinist* (1886).

MACKAY, HUGH (*c.* 1640–1692), Scottish general, was the son of Hugh Mackay of Scourie, Sutherlandshire, and was born there about 1640. He entered Douglas's (Dumbarton's) regiment of the English army (now the Royal Scots) in 1660, accompanied it to France when it was lent by Charles II. to Louis XIV., and though succeeding, through the death of his two elder brothers, to his father's estates, continued to serve abroad. In 1669 he was in the Venetian service at Candia, and in 1672 he was back with his old regiment, Dumbarton's, in the French army, taking part under Turenne in the invasion of Holland. In 1673 he married Clara de Bie of Bommel in Gelderland. Through her influence he became, as Burnet says, "the most pious man that I ever knew in a military way," and, convinced that he was fighting in an unjust cause, resigned his commission to take a captaincy in a Scottish regiment in the Dutch service. He had risen to the rank of major-general in 1685, when the Scots brigade was called to England to assist in the suppression of the Monmouth rebellion. Returning to Holland, Mackay was one of those officers who elected to stay with their men when James II., having again demanded the services of the Scots brigade, and having been met with a refusal, was permitted to invite the officers individually into his service. As major-general commanding the brigade, and also as a privy councillor of Scotland, Mackay was an important and influential person, and James chose to attribute the decision of most of the officers to Mackay's instigation. Soon after this event the Prince of Orange started on his expedition to England, Mackay's division leading the invading corps, and in January 1688–89 Mackay was appointed major-general commanding in chief in Scotland. In this capacity he was called upon to deal with the formidable insurrection headed by Graham of Claverhouse, Viscount Dundee. In the battle of Killiecrankie Mackay was severely defeated, but Dundee was killed, and the English commander, displaying unexpected energy, subdued the Highlands in one summer. In 1690 he founded Fort William at Inverlochy, in 1691 he distinguished himself in the brilliant victory of Aughrim, and in 1692, with the rank of lieutenant-general, he commanded the British division of the allied army in Flanders. At the great battle of Steinkirk Mackay's division bore the brunt of the day unsupported and the general himself was killed.

Mackay was the inventor of the ring bayonet which soon came into general use, the idea of this being suggested to him by the failure of the plug-bayonet to stop the rush of the Highlanders at Killiecrankie. Many of his despatches and papers were published by the Bannatyne Club in 1883.

See *Life* by John Mackay of Rockville (1836); and J. W. Fortescue, *History of the British Army*, vol. i.

MACKAY, JOHN WILLIAM (1831–1902), American capitalist, was born in Dublin, Ireland, on the 28th of November 1831. His parents brought him in 1840 to New York City, where he worked in a ship-yard. In 1851 he went to California and worked in placer gold-mines in Sierra county. In 1852 he went to Virginia City, Nevada, and there, after losing all he had made in California, he formed with James G. Fair, James C. Flood and William S. O'Brien the firm which in 1873 discovered the great Bonanza vein, more than 1200 ft. deep, in the Comstock lode (yielding in March of that year as much as $632 per ton, and in 1877 nearly $19,000,000 altogether); and this firm established the Bank of Nevada in San Francisco. In 1884, with James Gordon Bennett, Mackay formed the Commercial Cable Company—largely to fight Jay Gould and the Western Union Telegraph Company—laid two transatlantic cables, and forced the toll-rate for transatlantic messages down to twenty-five cents a word. In connexion with the Commercial Cable Company he formed the Postal Telegraph Company. Mackay died on the 20th of July 1902 in London. He gave generously, especially to the charities of the Roman Catholic Church, and endowed the Roman Catholic orphan asylum in Virginia City, Nevada. In June 1908 a school of mines was presented to the University of Nevada, as a memorial to him, by his widow and his son, Clarence H. Mackay.

MACKAY, a seaport of Carlisle county, Queensland, Australia, on the Pioneer river, 625 m. direct N.N.W. Pop. (1901), 4091. The harbour is not good. Sugar, tobacco and coffee thrive in the district. There are several important sugar mills, one of which, the largest in Queensland, is capable of an annual output of 8000 tons. Rum is distilled, and there are a brewery and a factory for tinning butter for export. Workable coal is found in the district. This is the port of the Mt Orange and Mt Gotthart copper mines, and the Mt Britten and Eungella gold-fields. It is a calling-station for the Queensland royal mail steamers. The town is named after Captain John Mackay, who discovered the harbour in 1860.

McKEESPORT, a city of Allegheny county, Pennsylvania, U.S.A., at the confluence of the Monongahela and Youghiogheny rivers (both of which are navigable), 14 m. S.E. of Pittsburg. Pop. (1890), 20,741; (1900), 34,227, of whom 9349 were foreign-born and 748 were negroes; (1910 census) 42,694. It is served by the Baltimore & Ohio, the Pittsburg & Lake Erie and the Pennsylvania railways. The city has a Carnegie library a general hospital, and two business schools. Bituminous coal and natural gas abound in the vicinity, and iron, steel, and tin and terne plate are extensively manufactured in the city, the tin-plate plant being one of the most important in the United

States. The total value of the city's factory products was $36,058,447 in 1900 and $23,054,412 in 1905. The municipality owns and operates its water-works. The first white settler was David McKee, who established a ferry here in 1769 In 1795 his son John laid out the town, which was named in his honour, but its growth was very slow until after the discovery of coal in 1830. McKeesport was incorporated as a borough in 1842 and chartered as a city in 1890.

McKEES ROCKS, a borough of Allegheny county, Pennsylvania, U.S.A., on the Ohio river, about 3 m. N.W. of Pittsburg. Pop. (1890) 1687; (1900) 6352 (1264 foreign-born); (1910) 14,702. McKees Rocks is served by the Pittsburg & Lake Erie and the Pittsburg, Chartiers & Youghiogheny railways, the latter a short line extending (13 m.) to Beechmont. Bituminous coal and natural gas are found in the vicinity, and the borough ships coal and lumber, and has various important manufactures. There is an ancient Indian mound here. The first settlement was made in 1830, and the borough incorporated in 1892.

MACKENNAL, ALEXANDER (1835–1904), English Nonconformist divine, was born at Truro in Cornwall, on the 14th of January 1835, the son of Patrick Mackennal, a Scot, who had settled in Cornwall. In 1848 the family removed to London, and at sixteen he went to Glasgow University. In 1854 he entered Hackney College to prepare for the Congregational ministry, and in 1857 he graduated B.A. at London University. After holding pastorates at Burton-on-Trent (1856–1861), Surbiton (1862–1870), Leicester (1870–1876), he finally accepted the pastorate of the Congregational Church at Bowdon, Cheshire, in 1877, in which he remained till his death. In 1886 he was chairman of the Congregational Union, which he represented in 1889 at the triannual national council of the American Congregational churches. The first international council of Congregationalists held in London in 1891 was partly cause, partly consequence, of his visit, and Mackennal acted as secretary. In 1892 he became definitely associated in the public mind with a movement for free church federation which grew out of a series of meetings held to discuss the question of home reunion. When the Lambeth articles put forward as a basis of union were discussed, it was evident that all the free churches were agreed in accepting the three articles dealing with the Bible, the Creed and the Sacraments as a basis of discussion, and were also agreed in rejecting the fourth article, which put the historic episcopate on the same level as the other three. Omitting the Anglicans, the representatives of the remaining churches resolved to develop Christian fellowship by united action and worship wherever possible. Out of this grew the Free Church Federation, which secures a measure of co-operation between the Protestant Evangelical churches throughout England. Mackennal's public action brought him into association with many well-known political and religious leaders. He was a lifelong advocate of international peace, and made a remarkable declaration as to the Christian standard of national action when the Free Church Federation met at Leeds during the South African War in 1900.

Besides a volume of sermons under the title *Christ's Healing Touch*, Mackennal published *The Biblical Scheme of Nature and of Man*, *The Christian Testimony*, the *Letters to the Seven Churches of Asia*, *The Kingdom of the Lord Jesus* and *The Eternal God and the Human Sonship*. These are contributions to exegetical study or to theological and progressive religious thought, and have elements of permanent value. He also made some useful contributions to religious history. In 1893 he published the *Story of the English Separatists*, and later the *Homes and Haunts of the Pilgrim Fathers*; he also wrote the life of Dr J. A. Macfadyen of Manchester. In 1901 he delivered a series of lectures at Hartford Theological Seminary, Connecticut, U.S.A., published under the title *The Evolution of Congregationalism*. He died at Highgate on the 23rd of June 1904.

See D. Macfadyen, *Life and Letters of Alexander Mackennal* (1905). (D. Mn.)

MACKENZIE, SIR ALEXANDER (*c.* 1755–1820), Canadian explorer, was probably a native of Inverness. Emigrating to North America at an early age, he was for several years engaged in the fur trade at Fort Chippewyan, at the head of Lake Athabasca, and it was here that his schemes of travel were formed. His first journey, made in 1789, was from Fort Chippewyan along the Great Slave Lake, and down the river which now bears his name to the Arctic Ocean; and his second, made in 1792 and 1793, from Fort Chippewyan across the Rocky Mountains to the Pacific coast near Cape Menzies. He wrote an account of these journeys, *Voyages on the River St Lawrence and through the Continent of North America to the Frozen and Pacific Oceans* (London, 1801), which is of considerable interest from the information it contains about the native tribes. It is prefaced by an historical dissertation on the Canadian fur trade. Amassing considerable wealth, Mackenzie was knighted in 1802, and later settled in Scotland. He died at Mulnain, near Dunkeld, on the 11th of March 1820.

MACKENZIE, ALEXANDER (1822–1892), Canadian statesman, was born in Perthshire, Scotland, on the 28th of January, 1822. His father was a builder, and young Mackenzie emigrated to Canada in 1842, and worked in Ontario as a stone-mason, setting up for himself later as a builder and contractor at Sarnia with his brother. In 1852 his interest in questions of reform led to his becoming the editor of the *Lambton Shield*, a local Liberal paper This brought him to the front, and in 1861 he became a member of the Canadian parliament, where he at once made his mark and was closely connected with the liberal leader, George Brown. He was elected for Lambton to the first Dominion house of commons in 1867, and soon became the leader of the liberal opposition; from 1871 to 1872 he also sat in the Ontario provincial assembly, and held the position of provincial treasurer. In 1873 the attack on Sir John Macdonald's ministry with regard to the Pacific Railway charter resulted in its defeat, and Mackenzie formed a new government, taking the portfolio of public works and becoming the first liberal premier of Canada. He remained in power till 1878, when industrial depression enabled Macdonald to return to office on a protectionist programme. In 1875 Mackenzie paid a visit to Great Britain, and was received at Windsor by Queen Victoria; he was offered a knighthood, but declined it. After his defeat he suffered from failing health, gradually resulting in almost total paralysis, but though in 1880 he resigned the leadership of the opposition, he retained a seat in parliament till his death at Toronto on the 17th of April 1892. While perhaps too cautious to be the ideal leader of a young and vigorous community, his grasp of detail, indefatigable industry, and unbending integrity won him the respect even of his political opponents.

His *Life and Times* by William Buckingham and the Hon. George W. Ross (Toronto, 1892) contains documents of much interest. See also George Stewart, *Canada under the Administration of the Earl of Dufferin* (Toronto, 1878).

MACKENZIE, SIR ALEXANDER CAMPBELL (1847– British composer, son of an eminent Edinburgh violinist and conductor, was born on the 22nd of August 1847. On the advice of a member of Gung'l's band who had taken up his residence in Edinburgh, Mackenzie was sent for his musical education to Sondershausen, where he entered the conservatorium under Ulrich and Stein, remaining there from 1857 to 1861, when he entered the ducal orchestra as a violinist. At this time he made Liszt's acquaintance. On his return home he won the King's Scholarship at the Royal Academy of Music, and remained the usual three years in the institution, after which he established himself as a teacher of the piano, &c., in Edinburgh. He appeared in public as a violinist, taking part in Chappell's quartette concerts, and starting a set of classical concerts. He was appointed precentor of St George's Church in 1870, and conductor of the Scottish vocal music association in 1873, at the same time getting through a prodigious amount of teaching. He kept in touch with his old friends by playing in the orchestra of the Birmingham Festivals from 1864 to 1873. The most important compositions of this period of Mackenzie's life were the Quartette in E flat for piano and strings, Op. 11, and an overture, *Cervantes*, which owed its first performance to the encouragement and help of von Bülow. On the advice of this great pianist, he gave up his Edinburgh appointments, which had quite worn him out, and settled in Florence in order to compose. The cantatas *The Bride* (Worcester, 1881) and *Jason* (Bristol, 1882) belong to this time, as well as his first opera. This was commissioned for the Carl Rosa Company, and was written to a version of Merimée's *Colomba* prepared by Franz Hueffer. It was produced with great success in 1883, and was the first of a too short series of modern English operas, Mackenzie's second opera, *The Troubadour*, was produced by the same company in 1886, and his third dramatic work was *His Majesty*, an excellent comic opera (Savoy Theatre, 1897). In 1884 his *Rose of Sharon* was given with very great success at the Norwich Festival; in 1885 he was appointed conductor of Novello's oratorio concerts; *The Story of Sayid* came out at the Leeds Festival of 1886, and in 1888 he succeeded Macfarren as principal of the Royal Academy of Music. *The Dream of Jubal* was produced at Liverpool in 1889, and in London very soon afterwards. A fine setting of the hymn "Veni, Creator Spiritus" was given at Birmingham in 1891, and the oratorio *Bethlehem* in 1894. From 1892 to 1899 he conducted the Philharmonic Concerts, and was knighted in 1894. Besides the works mentioned he has written incidental music to plays, as, for instance, to *Ravenswood*, *The Little Minister*, and *Coriolanus*; concertos and other works for violin and orchestra, much orchestral music, and many songs and violin pieces. The romantic side of music appeals to Mackenzie far more strongly than any other, and the cases in which he has conformed to the classical conventions are of the rarest. In the orchestral ballad, *La Belle Dame sans Merci*, he touches the note of weird pathos, and in the nautical overture *Britannia* his sense of humour stands revealed. In the two "Scottish Rhapsodies" for orchestra, in the music to *The Little Minister*, and in a beautiful fantasia for pianoforte and orchestra on Scottish themes, he has seized the essential, not the accidental features of his native music.

MACKENZIE, SIR GEORGE (1636–1691), of Rosehaugh, Scottish lawyer, was the grandson of Kenneth, first Lord Mackenzie of Kintail, and the nephew of Colin and George, first and second earls of Seaforth; his mother was a daughter of Andrew Bruce, principal of St Leonard's College, St Andrews. He was born at Dundee in 1636, educated at the grammar school there and at Aberdeen, and afterwards at St Andrews, graduating at sixteen. He then engaged for three years in the study of the civil law at Bourges; on his return to Scotland he was called to the bar in 1659, and before the Restoration had risen into considerable practice. Immediately after the Restoration he was appointed a "justice-depute," and it is recorded that he and his colleagues in that office were ordained by the parliament in 1661 "to repair, once in the week at least, to Musselburgh and Dalkeith, and to try and judge such persons as are there or thereabouts delate of witchcraft." In the same year he acted as counsel for the marquis of Argyll; soon afterwards he was knighted, and he represented the county of Ross during the four sessions of the parliament which was called in 1669. He succeeded Sir John Nisbet as king's advocate in August 1677, and in the discharge of this office became implicated in all the worst acts of the Scottish administration of Charles II., earning for himself an unenviable distinction as "the bloody Mackenzie." His refusal to concur in the measures for dispensing with the penal laws against Catholics led to his removal from office in 1686, but he was reinstated in February 1688. At the Revolution, being a member of convention, he was one of the minority of five in the division on the forfeiture of the crown. King William was urged to declare him incapacitated for holding any public office, but refused to accede to the proposal. When the death of Dundee (July 1689) had finally destroyed the hopes of his party in Scotland, Mackenzie betook himself to Oxford, where, admitted a student by a grace passed in 1690, he was allowed to spend the rest of his days in the enjoyment of the ample fortune he had acquired, and in the prosecution of his literary labours. One of his last acts before leaving Edinburgh had been to pronounce (March 15, 1689), as dean of the faculty of advocates, the inaugural oration at the foundation of the Advocates' library He died at Westminster on the 8th of May 1691, and was buried in Greyfriars churchyard, Edinburgh.

While still a young man Sir George Mackenzie appears to have aspired to eminence in the domain of pure literature, his earliest publication having been *Aretina, or a Serious Romance* (anon., 1661); it was followed, also anonymously, by *Religio Stoici, a Short Discourse upon Several Divine and Moral Subjects* (1663), *A Moral Essay, preferring Solitude to Public Employment* (1665), and one or two other disquisitions of a similar nature. His most important legal works are entitled *A Discourse upon the Laws and Customs of Scotland in Matters Criminal* (1674), *Observations upon the Laws and Customs of Nations as to Precedency, with the Science of Heraldry* (1680); *Institutions of the Law of Scotland* (1684), and *Observations upon the Acts of Parliament* (1686); of these the last-named is the most important, the *Institutions* being completely overshadowed by the similar work of his great contemporary Stair. In his *Jus Regium: or the Just and Solid Foundations of Monarchy in general, and more especially of the Monarchy of Scotland, maintained* (1684), Mackenzie appears as an uncompromising advocate of the highest doctrines of prerogative. His *Vindication of the Government of Scotland during the reign of Charles II.* (1691) is valuable as a piece of contemporary history The collected *Works* were published at Edinburgh (2 vols. fol.) in 1716–1722; and *Memoirs of the Affairs of Scotland from the Restoration of King Charles II.*, from previously unpublished MSS., in 1821.

See A. Lang, *Sir George Mackenzie of Rosehaugh* (1909).

MACKENZIE, HENRY (1745–1831), Scottish novelist and miscellaneous writer, was born at Edinburgh in August 1745. His father, Joshua Mackenzie, was a distinguished physician, and his mother, Margaret Rose, belonged to an old Nairnshire family. Mackenzie was educated at the high school and the university of Edinburgh, and was then articled to George Inglis of Redhall, who was attorney for the crown in the management of exchequer business. In 1765 he was sent to London to prosecute his legal studies, and on his return to Edinburgh became partner with Inglis, whom he afterwards succeeded as attorney for the crown. His first and most famous work, *The Man of Feeling*, was published anonymously in 1771, and met with instant success. The "Man of Feeling" is a weak creature, dominated by a futile benevolence, who goes up to London and falls into the hands of people who exploit his innocence. The sentimental key in which the book is written shows the author's acquaintance with Sterne and Richardson, but he had neither the humour of Sterne nor the subtle insight into character of Richardson. One Eccles of Bath claimed the authorship of this book, bringing in support of his pretensions a MS. with many ingenious erasures. Mackenzie's name was then officially announced, but Eccles appears to have induced some people to believe in him. In 1773 Mackenzie published a second novel, *The Man of the World*, the hero of which was as consistently bad as the "Man of Feeling" had been "constantly obedient to his moral sense," as Sir Walter Scott says. *Julia de Roubigné* (1777), a story in letters, was preferred to his other novels by "Christopher North," who had a high opinion of Mackenzie (see *Noctes Ambrosianae*, vol. i. p. 155, ed. 1866). The first of his dramatic pieces, *The Prince of Tunis*, was produced in Edinburgh in 1773 with a certain measure of success. The others were failures. At Edinburgh Mackenzie belonged to a literary club, at the meetings of which papers in the manner of the *Spectator* were read. This led to the establishment of a weekly periodical called the *Mirror* (January 23, 1779–May 27, 1780), of which Mackenzie was editor and chief contributor. It was followed in 1785 by a similar paper, the *Lounger*, which ran for nearly two years and had the distinction of containing one of the earliest tributes to the genius of Robert Burns. Mackenzie was an ardent Tory, and wrote many tracts intended to counteract the doctrines of the French Revolution. Most of these remained anonymous, but he acknowledged his *Review of the Principal Proceedings of the Parliament of* 1784, a defence of the policy of William Pitt, written at the desire of Henry Dundas. He was rewarded (1804) by the office of comptroller of the taxes for Scotland. In 1776 Mackenzie married Penuel, daughter of Sir Ludovick Grant of Grant. He was, in his later years, a notable figure in

Edinburgh society. He was nicknamed the "man of feeling," but he was in reality a hard-headed man of affairs with a kindly heart. Some of his literary reminiscences were embodied in his *Account of the Life and Writings of John Home, Esq.* (1822). He also wrote a *Life of Doctor Blacklock*, prefixed to the 1793 edition of the poet's works. He died on the 14th of January 1831.

In 1807 *The Works of Henry Mackenzie* were published surreptitiously, and he then himself superintended the publication of his *Works* (8 vols., 1808). There is an admiring but discriminating criticism of his work in the *Prefatory Memoir* prefixed by Sir Walter Scott to an edition of his novels in Ballantyne's *Novelist's Library* (vol. v., 1823).

McKENZIE, SIR JOHN (1838–1901), New Zealand statesman, was born at Ard-Ross, Scotland, in 1838, the son of a crofter. He emigrated to Otago, New Zealand, in 1860. Beginning as a shepherd, he rose to be farm manager at Puketapu near Palmerston South, and then to be a farmer in a substantial way in Shag Valley. In 1865 he was clerk to the local road board and school committee; in 1871 he entered the provincial council of Otago; and on the 11th of December 1881 was elected member of the House of Representatives, in which he sat till 1900. He was also for some years a member of the education board and of the land board of Otago, and always showed interest in the national elementary school system. In the House of Representatives he soon made good his footing, becoming almost at once a recognized spokesman for the smaller sort of rural settlers and a person of influence in the lobbies. He acted as government whip for the coalition ministry of Sir Robert Stout and Sir Julius Vogel, 1884–1887, and, while still a private member, scored his first success as a land reformer by carrying the "McKenzie clause" in a land act limiting the area which a state tenant might thenceforth obtain on lease. He was still, however, comparatively unknown outside his own province when, in January 1891, his party took office and he aided John Ballance in forming a ministry, in which he himself held the portfolio of lands, immigration and agriculture. From the first he made his hand felt in every matter connected with land settlement and the administration of the vast public estate. Generally his aim was to break up and subdivide the great freehold and leasehold properties which in his time covered four-sevenths of the occupied land of the colony. In his Land Act of 1892 he consolidated, abolished or amended, fifty land acts and ordinances dealing with crown lands, and thereafter amended his own act four times. Though owning to a preference for state tenancy over freehold, he never stopped the selling of crown land, and was satisfied to give would-be settlers the option of choosing freehold or leasehold under tempting terms as their form of tenure. As a compromise he introduced the lease in perpetuity or holding for 999 years at a quit rent fixed at 4%; theoretical objections have since led to its abolition, but for fifteen years much genuine settlement took place under its conditions. Broadly, however, McKenzie's exceptional success as lands minister was due rather to unflinching determination to stimulate the occupation of the soil by working farmers than to the solution of the problems of agrarian controversy. His best-known experiment was in land repurchase. A voluntary law (1892) was displaced by a compulsory act (1894), under which between £5,000,000 and £6,000,000 had by 1910 been spent in buying and subdividing estates for closer settlements, with excellent results. McKenzie also founded and expanded an efficient department of agriculture, in the functions of which inspection, grading, teaching and example are successfully combined. It has aided the development of dairying, fruit-growing, poultry-farming, bee-keeping and flax-milling, and done not a little to keep up the standard of New Zealand products. After 1897 McKenzie had to hold on in the face of failing health. An operation in London in 1899 only postponed the end. He died at his farm on the 6th of August 1901, soon after being called to the legislative council, and receiving a knighthood.

MACKENZIE, SIR MORELL (1837–1892), British physician, son of Stephen Mackenzie, surgeon (d. 1851), was born at Leytonstone, Essex, on the 7th of July 1837. After going through the course at the London Hospital, and becoming M.R.C.S. in 1858, he studied abroad at Paris, Vienna and Pesth; and at Pesth he learnt the use of the newly-invented laryngoscope under J. N. Czermak. Returning to London in 1862, he worked at the London Hospital, and took his degree in medicine. In 1863 he won the Jacksonian prize at the Royal College of Surgeons for an essay on the "Pathology of the Larynx," and he then devoted himself to becoming a specialist in diseases of the throat. In 1863 the Throat Hospital in King Street, Golden Square, was founded, largely owing to his initiative, and by his work there and at the London Hospital (where he was one of the physicians from 1866 to 1873) Morell Mackenzie rapidly became recognized throughout Europe as a leading authority, and acquired an extensive practice. So great was his reputation that in May 1887, when the crown prince of Germany (afterwards the emperor Frederick III.) was attacked by the affection of the throat of which he ultimately died, Morell Mackenzie was specially summoned to attend him. The German physicians who had attended the prince since the beginning of March (Karl Gerhardt, and subsequently Tobold, E. von Bergmann, and others) had diagnosed his ailment on the 18th of May as cancer of the throat; but Morell Mackenzie insisted (basing his opinion on a microscopical examination by R. Virchow of a portion of the tissue) that the disease was not demonstrably cancerous, that an operation for the extirpation of the larynx (planned for the 21st of May) was unjustifiable, and that the growth might well be a benign one and therefore curable by other treatment. The question was one not only of personal but of political importance, since it was doubted whether any one suffering from an incapacitating disease like cancer could, according to the family law of the Hohenzollerns, occupy the German throne; and there was talk of a renunciation of the succession by the crown prince. It was freely hinted, moreover, that some of the doctors themselves were influenced by political considerations. At any rate, Morell Mackenzie's opinion was followed: the crown prince went to England, under his treatment, and was present at the Jubilee celebrations in June. Morell Mackenzie was knighted in September 1887 for his services, and decorated with the Grand Cross of the Hohenzollern Order. In November, however, the German doctors were again called into consultation, and it was ultimately admitted that the disease really was cancer; though Mackenzie, with very questionable judgment, more than hinted that it had become malignant since his first examination, in consequence of the irritating effect of the treatment by the German doctors. The crown prince (see FREDERICK III.) became emperor on the 9th of March 1888, and died on the 15th of June. During all this period a violent quarrel raged between Sir Morell Mackenzie and the German medical world. The German doctors published an account of the illness, to which Mackenzie replied by a work entitled *The Fatal Illness of Frederick the Noble* (1888), the publication of which caused him to be censured by the Royal College of Surgeons. After this sensational episode in his career, the remainder of Sir Morell Mackenzie's life was uneventful, and he died somewhat suddenly in London, on the 3rd of February 1892. He published several books on laryngoscopy and diseases of the throat.

MACKENZIE, WILLIAM LYON (1795–1861), Canadian politician, was born near Dundee, Scotland, on the 12th of March 1795. His father died before he was a month old, and the family were left in poverty. After some six years' work in a shop at Alyth, in April 1820 he emigrated with his mother to Canada. There he became a general merchant, first at York, then at Dundas, and later at Queenston. The discontented condition of Upper Canada drew him into politics, and on the 18th of May 1824 he published at Queenston the first number of the *Colonial Advocate*, in which the ruling oligarchy was attacked with great asperity. Most of the changes which he advocated were wise and have since been adopted; but the violence of Mackenzie's attacks roused great anger among the social and political set at York (Toronto), which was headed by John Beverley Robinson. In November

1824 Mackenzie removed to Toronto, but he had little capital; his paper appeared irregularly, and was on the point of suspending publication when his office was attacked and his type thrown into the bay by a number of the supporters of his opponents. In an action against the chief rioters he was awarded £625 and costs, was thus enabled to set up a much larger and more efficient plant, and the *Colonial Advocate* ran till the 4th of November 1834.

In 1828 he was elected member of parliament for York, but was expelled on the technical ground that he had published in his newspaper the proceedings of the house without authorization. Five times he was expelled and five times re-elected by his constituents, till at last the government refused to issue a writ, and for three years York was without one of its representatives. In May 1832 he visited England, where he was well received by the colonial office. Largely as the result of his representations, many important reforms were ordered by Lord Goderich, afterwards earl of Ripon, the colonial secretary. While in England, he published *Sketches of Canada and the United States*, in which, with some exaggeration, many of the Canadian grievances were exposed. On his return in March 1834 he was elected mayor of Toronto. During his year of office, the heroism with which he worked hand in hand with his old enemy, Bishop Strachan, in fighting an attack of cholera, did not prevent him from winning much unpopularity by his officiousness, and in 1835 he was not re-elected either as mayor or alderman. In October 1834 he was elected member of parliament for York, and took his seat in January 1835, the Reformers being now in the majority. A committee on grievances was appointed, as chairman of which Mackenzie presented the admirable *Seventh Report on Grievances*, largely written by himself, in which the case for the Reformers was presented with force and moderation, and the adoption of responsible government advocated as the remedy.

In the general election of June 1836 the Tory party won a complete victory, Mackenzie and almost all the prominent Reformers being defeated at the polls. This totally unexpected defeat greatly embittered him. On the 4th of July 1836, the anniversary of the adoption of the American Declaration of Independence, he began the publication of the *Constitution*, which openly advocated a republican form of government. Later in the year he was appointed "agent and corresponding secretary" of the extreme wing of the Reform party, and more and more openly, in his speeches throughout the province, advocated armed revolt. He was also in correspondence with Papineau and the other leaders of the Reformers in Lower Canada, who were already planning a rising. Early in December 1837 Mackenzie gathered a mob of his followers, to the number of several hundred, at Gallows Hill, some miles to the north of Toronto, with the intention of seizing the lieutenant-governor and setting up a provisional government. Misunderstandings among the leaders led to the total failure of the revolt, and Mackenzie was forced to fly to the United States with a price on his head. In the town of Buffalo he collected a disorderly rabble, who seized and fortified Navy Island, in the river between the two countries, and for some weeks troubled the Canadian frontier. After the failure of this attempt he was put to the most pitiful shifts to make a living. In June 1839 he was tried in the United States for a breach of the neutrality laws, and sentenced to eighteen months' imprisonment, of which he served over eleven. While in gaol at Rochester he published the *Caroline Almanac*, the tone of which may be judged from its references to "Victoria Guelph, the bloody queen of England," and by the title given to the British cabinet of "Victoria Melbourne's bloody divan." He returned to Canada in consequence of the Amnesty Act 1849. A closer inspection had cured him of his love for republican institutions.

In 1851 he was elected to parliament for Haldimand, defeating George Brown. He at once allied himself with the Radicals (the "Clear Grits"), and, on the leadership of that party being assumed by Brown, became one of his lieutenants. He was still miserably poor, but refused all offers to accept a government position. In 1858 he resigned his seat in the house, owing to incipient softening of the brain, of which he died on the 29th of August 1861.

Turbulent, ungovernable, vain, often the dupe of schemers, Mackenzie united with much that was laughable not a little that was heroic. He could neither be bribed, bullied, nor cajoled. Perhaps the best instance of this is that in 1832 he refused from Lord Goderich an offer of a position which would have given him great influence in Canada and an income of £1,500. He was a born agitator, and as such tended to exaggeration and misrepresentation. But the evils against which he struggled were real and grave; the milder measures of the Constitutional Reformers might have taken long to achieve the results which were due to his hot-headed advocacy.

The *Life and Times* by his son-in-law, Charles Lindsey (Toronto, 2 vols., 1862), is moderate and fair, though tending to smooth over his anti-British gasconnade while in the United States. An abridgment of this work was edited by G. G. S. Lindsey for the "Makers of Canada" series (1909). In *The Story of the Upper Canadian Rebellion* by J. C. Dent (2 vols., Toronto, 1885), a bitter attack is made on him, which drew a savage reply from another son-in-law, John King, K.C., called *The Other Side of the Story*. The best short account of his career is given by J. C. Dent in *The Canadian Portrait Gallery*, vol. ii. (Toronto, 1881). (W. L. G.)

MACKENZIE, a river of the North-West Territories, Canada, discharging the waters of the Great Slave Lake into the Arctic Ocean. It was discovered and first navigated by Sir Alexander Mackenzie in 1789. It has an average width of 1 m., an average fall of 6 in. to the mile; an approximate discharge, at a medium stage, of 500,000 cub. ft. per second; and a total length, including its great tributary the Peace, of 2,350 m. The latter rises, under the name of the Finlay, in the mountains of British Columbia, and flows north-east and then south-east in the great intermontane valley that bounds the Rocky Mountains on the west, to its confluence with the Parsnip. From the confluence the waters of the combined rivers, now called the Peace, flow east through the Rocky Mountains, and then north-east to unite with the river which discharges the waters of Lake Athabasca; thence to Great Slave Lake it is known as Slave river. Excluding the rivers which enter these lakes, the principal tributaries of the Peace are: Omineca, Nation, Parsnip, Halfway, North Pine, South Pine, Smoky, Battle, and Loon rivers; those of the Mackenzie are the Liard (650 m. long), which rises near the sources of the Pelly, west of the Rocky Mountains, and breaks through that range on its way to join the parent stream, Great Bear river, which drains Great Bear Lake, Nahanni, Dahadinni, Arctic Red, and Peel rivers. The Mackenzie enters the Arctic Ocean near 135° W. and 68° 50′ W., after flowing for 70 to 80 m. through a flat delta, not yet fully surveyed. With its continuation, Slave river, it is navigable from the Arctic Ocean to Fort Smith, a distance of over 1,200 m., and between the latter and the head of Lesser Slave Lake, a further distance of 625 m., there is only one obstruction to navigation, the Grand Rapids near Fort McMurray on the Athabasca river. The Peace is navigable from its junction with Slave river for about 220 m. to Vermilion Falls. The Mackenzie is navigable from about the 10th of June to the 20th of October, and Great Slave Lake from about the 1st of July to the end of October. All the waters and lakes of this great system are abundantly stocked with fish, chiefly white fish and trout, the latter attaining to remarkable size.

MACKEREL, pelagic fishes, belonging to a small family, *Scombridae*, of which the tunny, bonito, albacore, and a few other tropical genera are members. Although the species are fewer in number than in most other families of fishes, they are widely spread and extremely abundant, peopling by countless schools the oceans of the tropical and temperate zones, and approaching the coasts only accidentally, occasionally, or periodically.

The mackerel proper (genus *Scomber*) are readily recognized by their elegantly shaped, well-proportioned body, shining in iridescent colours. Small, thin, deciduous scales equally cover nearly the entire body. There are two dorsal fins, the anterior near the head, composed of 11–14 feeble spines, the second near the tail with all the rays soft except the first, and behind the second dorsal five or six finlets. The ventral is immediately below the second dorsal, and is also followed by finlets. The caudal fin is crescent-shaped, strengthened at the base by two short ridges on each side. The mouth is wide, armed above and below with a row of very small fixed teeth.

No other fish shows finer proportions in the shape of its body. Every "line" of its build is designed and eminently adapted for rapid progression through the water; the muscles massed along the vertebral column are enormously developed, especially on the back and the sides of the tail, and impart to the body a certain rigidity which interferes with abruptly sideward motions of the fish. Therefore mackerel generally swim in a straightforward direction, deviating sidewards only when compelled, and rarely turning about in the same spot. They are in almost continuous motion, their power of endurance being equal to the rapidity of their motions. Mackerel, like all fishes of this family, have a firm flesh; that is, the muscles of the several segments are interlaced, and receive a greater supply of blood-vessels and nerves than in other fishes. Therefore the flesh, especially of the larger kinds, is of a red colour; and the energy of their muscular action causes the temperature of their blood to be several degrees higher than in other fishes.

All fishes of the mackerel family are strictly carnivorous; they unceasingly pursue their prey, which consists principally of other fish and pelagic crustaceans. The fry of clupeoids, which likewise swim in schools, are followed by the mackerel until they reach some shallow place, which their enemies dare not enter.

Mackerel are found in almost all tropical and temperate seas, with the exception of the Atlantic shores of temperate South America. European mackerel are of two kinds, of which one, the common mackerel, *Scomber scomber*, lacks, while the other possesses, an air-bladder. The best-known species of the latter kind is *S. colias*, the "Spanish" mackerel;[1] a third, *S. pneumatophorus*, is believed by some ichthyologists to be identical with *S. colias*. Be this as it may, we have strong evidence that the Mediterranean is inhabited by other species different from *S. scomber* and *S. colias*, and well characterized by their dentition and coloration. Also the species from St Helena is distinct. Of extra-Atlantic species the mackerel of the Japanese seas are the most nearly allied to the European, those of New Zealand and Australia, and still more those of the Indian Ocean, differing in many conspicuous points. Two of these species occur in the British seas: *S. scomber*, which is the most common there as well as in other parts of the North Atlantic, crossing the ocean to America, where it abounds; and the Spanish mackerel, *S. colias*, which is distinguished by a somewhat different pattern of coloration, the transverse black bands of the common mackerel being in this species narrower, more irregular or partly broken up into spots, while the scales of the pectoral region are larger, and the snout is longer and more pointed. The Spanish mackerel is, as the name implies, a native of the seas of southern Europe, but single individuals or small schools frequently reach the shores of Great Britain and of the United States.

The home of the common mackerel (to which the following remarks refer) is the North Atlantic, from the Canary Islands to the Orkneys, and from the Mediterranean and the Black Sea and the coasts of Norway to the United States.

Towards the spring large schools approach the coasts. Two causes have been assigned of this migration: first, the instinct of finding a suitable locality for propagating their species; and, secondly, the search and pursuit of food, which in the warmer season is more abundant in the neighbourhood of land than in the open sea. It is probable that the latter is the chief cause.

In the month of February, or in some years as early as the end of January, the first large schools appear at the entrance of the English Channel, and are met by the more adventurous of the drift-net fishers many miles west of the Scilly Islands. These early schools, which consist chiefly of one-year and two-year-old fishes, yield sometimes enormous catches, whilst in other years they escape the drift-nets altogether, passing them, for some hitherto unexplained reason, at a greater depth than that to which the nets reach, viz. 20 ft. As the season advances, the schools penetrate farther northwards into St George's Channel or eastwards into the English Channel. The fishery then assumes proportions which render it next in importance to the herring and cod fisheries. In Plymouth alone a fleet of some two hundred boats assembles; and on the French side of the Channel no less capital and labour are invested in it, the vessels employed being, though less in number, larger in size than on the English side. The chief centre, however, of the fishery in the west of England is at Newlyn, near Penzance, where the small local sailing boats are outnumbered by hundreds of large boats, both sail and steam, which come chiefly from Lowestoft for the season. Simultaneously with the drift-net the deep-sea-seine and shore-seine are used, which towards June almost entirely supersede the drift-net. Towards the end of May the old fish become heavy with spawn and are in the highest condition for the table; and the latter half of June or beginning of July may be regarded as the time at which the greater part of mackerel spawn. Considerable numbers of mackerel are taken off Norfolk and Suffolk in May and June, and also in September and October. There can be no doubt that they enter the North Sea from the English Channel, and return by the same route, but others travel round the north of Scotland and appear in rather small numbers off the east coast of that country. On the Norwegian coast mackerel fishing does not begin before May, whilst on the English coasts large catches are frequently made in March. Large cargoes are annually imported in ice from Norway to the English market.

After the spawning the schools break up into smaller companies which are much scattered, and offer for two or three months employment to the hand-line fishermen. They now begin to disappear from the coasts and return to the open sea. Single individuals or small companies are found, however, on the coast all the year round; they may have become detached from the main bodies, and be seeking for the larger schools which have long left on their return migration.

Although, on the whole, the course and time of the annual migration of mackerel are marked with great regularity, their appearance and abundance at certain localities are subject to great variations. They may pass a spot at such a depth as to evade the nets, and reappear at the surface some days after farther eastwards; they may deviate from their direct line of migration, and even temporarily return westwards. In some years between 1852 and 1867 the old mackerel disappeared off Guernsey from the surface, and were accidentally discovered feeding at the bottom. Many were taken at 10 fathoms and deeper with the line, and all were of exceptionally large size, several measuring 18 in. and weighing nearly 3 lb; these are the largest mackerel on record.

The mackerel most esteemed as food is the common species, and individuals from 10 to 12 in. in length are considered the best flavoured. In more southern latitudes, however, this species seems to deteriorate, specimens from the coast of Portugal, and from the Mediterranean and Black Sea, being stated to be dry and resembling in flavour the Spanish mackerel (*S. colias*), which is not esteemed for the table. (A. C. G.; J. T. C.)

McKIM, CHARLES FOLLEN (1847–1909), American architect, was born in Chester county, Pennsylvania, on the 24th of August 1847. His father, James Miller McKim (1810–1874), originally a Presbyterian minister, was a prominent abolitionist and one of the founders (1865) of the New York *Nation*. The son studied at Harvard (1866–1867) and at Paris in the École des Beaux-Arts (1867–1870), and in 1872 became an architect in New York City, entering the office of H. H. Richardson; in 1877 he formed a partnership with William Rutherford Mead (b. 1846), the firm becoming in 1879 McKim, Mead & White, when Stanford White (1853–1906) became a partner. McKim was one of the founders of the American Academy in Rome; received a gold medal at the Paris exposition of 1900; in 1903, for his services in the promotion of architecture, received the King's Medal of the Royal Institute of British Architects; and in 1907 became a National Academician. He died at St James, Long Island, N.Y., on the 14th of September 1909. McKim's name is especially associated with the University Club in New York, with the Columbia University buildings, with the additions to the White House (1906), and, more particularly, with the Boston Public Library, for which the library of Ste Geneviève in Paris furnished the suggestion.

MACKINAC ISLAND, a small island in the N.W. extremity of Lake Huron and a part of Mackinac county, Michigan, and a city and summer resort of the same name on the island. The city is on the S.E. shore, at the entrance of the Straits of Mackinac, about 7 m. N.E. of Mackinaw City and 6 m. E.S.E. of St Ignace. Pop. (1900), 665; (1904), 736; (1910), 714. During the summer season, when thousands of people come here to enjoy the cool and pure air and the island's beautiful scenery, the city is served by the principal steamboat lines on the Great Lakes and by ferry to Mackinaw city (pop. in 1904, 696), which is served by the Michigan Central, the Grand Rapids & Indiana, and the Duluth, South Shore & Atlantic railways. The island is about 3 m. long by 2 m. wide. From the remarkably clear water of Lake Huron its shores rise for the most part in tall white limestone cliffs; inland there are strangely shaped rocks and forests of cedar, pine, fir, spruce, juniper, maple, oak, birch, and beech. Throughout the island there are numerous glens, ravines, and caverns, some of which are rich in associations with Indian legends. The city is an antiquated fishing and trading village with modern hotels, club-houses, and summer villas. Fort Mackinac and its grounds are included in a state reservation which embraces about one-half of the island.

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[1] The term "Spanish mackerel" is applied in America to *Cybium maculatum*.

The original name of the island was Michilimackinac ("place of the big lame person" or "place of the big wounded person"); the name was apparently derived from an Algonquian tribe, the Mishinimaki or Mishinimakinagog, now extinct. The island was long occupied by Chippewas, the Hurons had a village here for a short time after their expulsion from the East by the Iroquois, and subsequently there was an Ottawa village here. The first white settlement or station was established by the French in 1670 (abandoned in 1701) at Point Saint Ignace on the north side of the strait. In 1761 a fort on the south side (built in 1712) was surrendered to the British. By the treaty of Paris (1783) the right of the United States to this district was acknowledged; but the fort was held by the British until 1796. In July 1812 a British force surprised the garrison, which had not yet learned that war had been declared. In August 1814 an American force under Colonel George Croghan (1791–1849) attempted to recapture the island but was repulsed with considerable loss. By the treaty of Ghent, however, the island was restored, in July 1815, to the United States; Fort Mackinac was maintained by the Federal government until 1895, when it was ceded to the state. From 1820 to 1840 the village was one of the principal stations of the American Fur Company. A Congregational mission was established among the Chippewas on the island in 1827, but was discontinued before 1845. The city of Mackinac Island was chartered in 1899.

See W. C. Richards, "The Fairy Isle of Mackinac," in the *Magazine of American History* (July 1891); and R. G. Thwaites, "The Story of Mackinac," in vol. 14 of the *Collections* of the State Historical Society of Wisconsin (Madison, 1898).

MCKINLEY, WILLIAM (1843–1901), twenty-fifth president of the United States, was born in Niles, Trumbull county, Ohio, on the 29th of January 1843. His ancestors on the paternal side were Scotch-Irish who lived at Dervock, Co. Antrim, and spelled the family name "McKinlay." His great-great-grandfather settled in York county, Pennsylvania, about 1743, and from Chester county, Pennsylvania, his great-grandfather, David McKinley, who served as a private during the War of Independence, moved to Ohio in 1814. David's son James had gone in 1809 to Columbiana county, Ohio. His son William McKinley (b. 1807), like his father an iron manufacturer, was married in 1829 to Nancy Campbell Allison, and to them were born nine children, of whom William, the president, was the seventh. In 1852 the family removed to Poland, Mahoning county, where the younger William was placed at school. At seventeen he entered the junior class of Allegheny College, at Meadville, Pennsylvania; but he studied beyond his strength, and returned to Poland, where for a time he taught in a neighbouring country school. When the Civil War broke out in 1861 he promptly enlisted as a private in the 23rd Ohio Volunteer Infantry. He saw service in West Virginia, at South Mountain, where this regiment lost heavily, and at Antietam, where he brought up hot coffee and provisions to the fighting line; for this he was promoted second lieutenant on the 24th of September 1862. McKinley was promoted first lieutenant in February 1864, and for his services at Winchester was promoted captain on the 25th of July 1864. He was on the staff of General George Crook at the battles of Opequan, Fisher's Hill, and Cedar Creek in the Shenandoah valley, and on the 14th of March 1865 was brevetted major of volunteers for gallant and meritorious services. He also served on the staff of General Rutherford B. Hayes, who spoke highly of his soldierly qualities. He was mustered out with his regiment on the 26th of July 1865. Four years of army life had changed him from a pale and sickly lad into a man of superb figure and health.

After the war McKinley returned to Poland, and bent all his energy upon the study of law. He completed his preparatory reading at the Albany (N.Y.) law school, and was admitted to the bar at Warren, Ohio, in March 1867. On the advice of an elder sister, who had been for several years a teacher in Canton, Stark county, Ohio, he began his law practice in that place, which was to be his permanent home. He identified himself immediately with the Republican party, campaigned in the Democratic county of Stark in favour of negro suffrage in 1867, and took part in the campaign work on behalf of Grant's presidential candidature in 1868. In the following year he was elected prosecuting attorney on the Republican ticket; in 1871 he failed of re-election by 45 votes, and again devoted himself to his profession, while not relaxing his interest in politics.

In 1875 he first became known as an able campaign speaker by his speeches favouring the resumption of specie payments, and in behalf of Rutherford B. Hayes, the Republican candidate for governor of Ohio. In 1876 he was elected by a majority of 3304 to the national House of Representatives. Conditions both in Ohio and in Congress had placed him, and were to keep him for twenty years, in an attitude of aggressive and uncompromising partisanship. His Congressional district was naturally Democratic, and its boundaries were changed two or three times by Democratic legislatures for the purpose of so grouping Democratic strongholds as to cause his defeat. But he overcame what had threatened to be adverse majorities on all occasions from 1876 to 1890, with the single exception of 1882, when, although he received a certificate of election showing that he had been re-elected by a majority of 8, and although he served nearly through the long session of 1883–1884, his seat was contested and taken (May 28, 1884) by his Democratic opponent, Jonathan H. Wallace. McKinley reflected the strong sentiment of his manufacturing constituency in behalf of a high protective tariff, and he soon became known in Congress (where he particularly attracted the attention of James G. Blaine) as one of the most diligent students of industrial policy and question affecting national taxation. In 1878 he took part in the debates over the Wood Tariff Bill, proposing lower import duties; and in the same year he voted for the Bland-Allison Silver Bill. In December 1880 he was appointed a member of the Ways and Means committee, succeeding General James A. Garfield, who had been elected president in the preceding month, and to whose friendship, as to that of Rutherford B. Hayes, McKinley owed much in his earlier years in Congress. He was prominent in the debate which resulted in the defeat of the Democratic Morrison Tariff Bill in 1884, and, as minority leader of the Ways and Means committee, in the defeat of the Mills Bill for the revision of the tariff in 1887–1888. In 1889 he became chairman of the Ways and Means committee and Republican leader in the House of Representatives, after having been defeated by Thomas B. Reed on the third ballot in the Republican caucus for speaker of the House. On the 16th of April 1890 he introduced from the Ways and Means committee the tariff measure known commonly as the McKinley Bill, which passed the House on the 21st of May, passed the Senate (in an amended form, with a reciprocity clause, which McKinley had not been able to get through the House) on the 10th of September, was passed as amended, by the House, and was approved by the president on the 1st of October 1890. The McKinley Bill reduced revenues by its high and in many cases almost prohibitive duties; it put sugar on the free list with a discriminating duty of $\frac{1}{10}$th of one cent a pound on sugar imported from countries giving a bounty for sugar exported, and it gave bounties to American sugar growers; it attempted to protect many "infant" industries such as the manufacture of tin-plate; under its provision for reciprocal trade agreements (a favourite project of James G. Blaine, who opposed many of the "protective" features of the Bill) reciprocity treaties were made with Germany, France, Italy, and Belgium, which secured a market in those countries for American pork. Abroad, where the Bill made McKinley's name known everywhere, there was bitter opposition to it and reprisals were threatened by several European states. In the United States the McKinley Tariff Bill was one of the main causes of the Democratic victory in the Congressional elections of 1890, in which McKinley himself was defeated by an extraordinary Democratic gerrymander of his Congressional district. In November 1891 he was elected governor of Ohio with a plurality of more than 21,000 votes in a total of 795,000 votes cast. He was governor of Ohio in 1892–1895, being re-elected in 1893. His administration was marked by no important events, except that he had on several occasions in his second term to call out the militia of the state to preserve order; but it may be considered important because of the training it gave him in executive as distinguished from legislative work.

McKinley had been prominent in national politics even before the passage of the tariff measure bearing his name. In 1888 in the National Republican Convention in Chicago he was chairman of the committee on resolutions (*i.e.* the platform committee) and was leader of the delegation from Ohio, which had been instructed for John Sherman; after James G. Blaine withdrew his name there was a movement, begun by Republican congressmen, to nominate McKinley, who received 16 votes on the seventh ballot, but passionately refused to be a candidate, considering that his acquiescence would be a breach of faith toward Sherman. In 1892 McKinley was the permanent president of the National Republican Convention which met in Minneapolis and which renominated Benjamin Harrison on the first ballot, on which James G. Blaine received 182 ⅙ votes, and McKinley, in spite of his efforts to the contrary, received 182 votes. In 1894 he made an extended campaign tour before the Congressional elections, and spoke even in the South. In 1896 he seemed for many reasons the most "available" candidate of his party for the presidency: he had no personal enemies in the party; he had carried the crucial state of Ohio by a large majority in 1893; his attitude on the coinage question had never been so pronounced as to make him unpopular either with the radical silver wing or with the conservative "gold-standard" members of the party. The campaign for his nomination was conducted with the greatest adroitness by his friend, Marcus A. Hanna, and in the National Republican Convention held in St Louis in June he was nominated for the presidency on the first ballot by 661 ½ out of a total of 906 votes. The convention adopted a tariff plank drafted by McKinley, and, of far greater immediate importance, a plank, which declared that the Republican party was "opposed to the free coinage of silver, except by international agreement with the leading commercial nations of the world, which we pledge ourselves to promote, and until such agreement can be obtained the existing gold standard must be preserved." This "gold standard" plank drove out of the Republican party the Silver Republicans of the West, headed by Senator Henry M. Teller of Colorado. The Republican convention nominated for the vice-presidency Garrett A. Hobart of New Jersey. The National Democratic Convention declared for the immediate opening of the mints to the free and unlimited coinage of silver at the ratio with gold of 16 to 1; and it nominated for the presidency William Jennings Bryan of Nebraska, who also received the nomination of the People's party and of the National Silver party. There was a secession from the Democratic party of conservatives who called themselves the National Democratic party, who were commonly called Gold Democrats, and who nominated John M. Palmer (1817–1900) of Illinois for president. In this re-alignment of parties McKinley, who had expected to make the campaign on the issue of a high protective tariff, was diverted to the defence of the gold standard as the main issue. While his opponent travelled throughout the country making speeches, McKinley remained in Canton, where he was visited by and addressed many Republican delegations. The campaign was enthusiastic: the Republican candidate was called the "advance agent of prosperity"; "Bill McKinley and the McKinley Bill" became a campaign cry; the panic of 1893 was charged to the repeal of the McKinley tariff measure; and "business men" throughout the states were enlisted in the cause of "sound money" to support McKinley, who was elected in November by a popular vote of 7,106,779 to 6,502,925 for Bryan, and by an electoral vote of 271 to 176.

McKinley was inaugurated president of the United States on the 4th of March 1897. The members of his cabinet were: secretary of state, John Sherman (whose appointment created a vacancy in the Senate to which Marcus A. Hanna was elected), who was succeeded in April 1898 by William R. Day, who in turn was followed in September 1898 by John Hay; secretary of the treasury, Lyman J. Gage, a Gold Democrat; secretary of war, Russell A. Alger, who was succeeded in 1899 by Elihu Root; secretary of the navy, John D. Long; attorney-general, Joseph McKenna, succeeded in January 1898 by John William Griggs; postmaster-general, James A. Gary, succeeded in April 1898 by Charles Emory Smith; secretary of the interior, Cornelius N. Bliss, succeeded in February 1899 by Ethan Allen Hitchcock; and secretary of agriculture, James Wilson. (For the political history of McKinley's administration see UNITED STATES: *History*). Immediately after his inauguration the president summoned Congress to assemble in an extra session on the 15th of March. The Democratic tariff in 1893 had been enacted as part of the general revenue measure, which included an income-tax. The income-tax having been declared unconstitutional by the Supreme Court, the measure had failed to produce a sufficient revenue, and it had been necessary to increase the public debt. McKinley's message to the new Congress dwelt upon the necessity of an immediate revision of the tariff and revenue system of the country, and the so-called Dingley Tariff Bill was accordingly passed through both houses, and was approved by the president on the 24th of July.

The regular session of Congress which opened in December was occupied chiefly with the situation in Cuba. President McKinley showed himself singularly patient and self-controlled in the midst of the popular excitement against Spain and the clamour for intervention by the United States in behalf of the Cubans; but finally, on the 23rd of March, he presented an ultimatum to the Spanish government, and on the 25th of April, on his recommendation, Congress declared war upon Spain. During the war itself he devoted himself with great energy to the mastery of military details; but there was bitter criticism of the war department resulting in the resignation of the secretary of war, Russell A. Alger (*q.v.*). The signing of a peace protocol on the 12th of August was followed by the signature at Paris on the 10th of December of articles of peace between the United States and Spain. After a long discussion the peace treaty was ratified by the United States Senate on the 6th of February 1899; and in accordance with its terms Porto Rico, the Philippine Archipelago, and Guam were transferred by Spain to the United States, and Cuba came under American jurisdiction pending the establishment there of an independent government. Two days before the ratification of the peace treaty, a conflict took place between armed Filipinos under the leadership of Emilio Aguinaldo and the American forces that were in possession of Manila. The six months that had elapsed between the signing of the peace protocol and the ratification of the treaty had constituted a virtual interregnum, Spain's authority having been practically destroyed in the Philippines and that of the United States not having begun. In this period a formidable native Filipino army had been organized and a provisional government created. The warfare waged by these Filipinos against the United States, while having for the most part a desultory and guerilla character, was of a very protracted and troublesome nature. Sovereignty over the Filipinos having been accepted by virtue of the ratification of the Paris treaty, President McKinley was not at liberty to do otherwise than assert the authority of the United States and use every endeavour to suppress the insurrection. But there was bitter protest against this "imperialism," both within the party by such men as Senators George F. Hoar and Eugene Hale, and Thomas B. Reed and Carl Schurz, and, often for purely political reasons, from the leaders of the Democratic party. In the foreign relations of the United States, as directed by President McKinley, the most significant change was the cordial understanding established with the British government, to which much was contributed by his secretary of state, John Hay, appointed to that portfolio when he was ambassador to the court of St James, and which was due to some extent to the friendliness of the British press and even more markedly of the British navy in the Pacific during the Spanish War. Other important foreign events during McKinley's administration were: the annexation of the Hawaiian Islands (see HAWAII) in August 1898, and the formation of the Territory of Hawaii in April 1900; the cessation in 1899 of the tripartite (German, British, and French) government of the Samoan Islands, and the annexation by the United States of those of the islands east of 171°, including the harbour of Pago-Pago; the participation of American troops in the march of the allies on Pekin in August 1900, and the part played by McKinley's secretary of state, John Hay, in securing a guarantee of the integrity of the Chinese empire. In 1900 McKinley was unanimously renominated by the National Republican Convention which met in Philadelphia on the 19th of June, and which nominated Theodore Roosevelt, governor of New York, for the vice-presidency. The Republican convention demanded the maintenance of the gold standard, and pointed to the fulfilment of some of the most important of the pledges given by the Republican party four years earlier. The intervening period had been one of very exceptional prosperity in the United States, foreign commerce having reached an unprecedented volume, and agriculture and manufactures having made greater advancement than in any previous period of the country's history. The tendency towards the concentration of capital in great industrial corporations had been active to an extent previously undreamt of, with incidental consequences that had aroused much apprehension; and the Democrats accused President McKinley and the Republican party of having fostered the "trusts." But the campaign against McKinley and the Republican party was not only "anti-trust" but "anti-imperialistic." William Jennings Bryan, renominated by the Democratic party in July (and in May by the Fusion People's party) on a free silver platform, declared that imperialism was the "paramount issue" and made a second vigorous campaign; and the opposition to McKinley's re-election, whether based on opposition to his economic or to his foreign policy, was not entirely outside of his own party. As the result of the polling in November, 292 Republican presidential electors were chosen, and 155 Democratic electors, elected in Colorado, Idaho, Montana, Nevada, and the Southern states, represented the final strength of the Bryan and Stevenson ticket. The Republican popular vote was 7,207,923, and the Democratic 6,358,133. Since 1872 no president had been re-elected for a second consecutive term.

In the term of Congress immediately following the presidential election it was found possible to reduce materially the war taxes which had been levied on the outbreak of the Spanish-American War. Arrangements were perfected for the termination of the American military occupation of Cuba and the inauguration of a Cuban Republic as a virtual protectorate of the United States, the American government having arranged with the Cuban constitutional convention for the retention of certain naval stations on the Cuban coast. In the Philippines advanced steps had been taken in the substitution of civil government for military occupation, and a governor-general, Judge William H. Taft, had been appointed and sent to Manila. Prosperity at home was great, and foreign relations were free from complications. The problems which had devolved upon McKinley's administration had been far advanced towards final settlement. He retained without change the cabinet of his first administration. After an arduous and anxious term, the president had reached a period that promised to give him comparative repose and freedom from care. He had secured, through the co-operation of Congress, the permanent reorganization of the army and a very considerable development of the navy. In these circumstances, President McKinley, accompanied by the greater part of his cabinet, set forth in the early summer on a tour to visit the Pacific coast, where he was to witness the launching of the battleship "Ohio" at San Francisco. The route chosen was through the Southern states, where many stops were made, and where the president delivered brief addresses. The heartiness of the welcome accorded him seemed to mark the disappearance of the last vestige of sectional feeling that had survived the Civil War, in which McKinley had participated as a young man. After his return he spent a month in a visit at his old home in Canton, Ohio, and at the end of this visit, by previous arrangement, he visited the city of Buffalo, New York, in order to attend the Pan-American exposition and deliver a public address. This address (Sept. 5, 1901) was a public utterance designed by McKinley to affect American opinion and public policy, and apparently to show that he had modified his views upon the tariff. It declared that henceforth the progress of the nations must be through harmony and co-operation, in view of the fast-changing conditions of communication and trade, and it maintained that the time had come for wide-reaching modifications in the tariff policy of the United States, the method preferred by McKinley being that of commercial reciprocity arrangements with various nations. On the following day, the 6th of September 1901, a great reception was held for President McKinley in one of the public buildings of the exposition, all sorts and conditions of men being welcome. Advantage of this opportunity was taken by a young man of Polish parentage, by name Leon Czolgosz, to shoot at the president with a revolver at close range. One of the two bullets fired penetrated the abdomen. After the world had been assured that the patient was doing well and would recover, he collapsed and died on the 14th. The assassin, who, it was for a time supposed, had been inflamed by the editorials and cartoons of the demagogic opposition press, but who professed to hold the views of that branch of anarchists who believe in the assassination of rulers and persons exercising political authority, was promptly seized, and was convicted and executed in October 1901. McKinley's conduct and utterances in his last days revealed a loftiness of personal character that everywhere elicited admiration and praise. Immediately after his death Vice-President Roosevelt took the oath of office, announcing that it would be his purpose to continue McKinley's policy, while also retaining the cabinet and the principal officers of the government. McKinley's funeral took place at Canton, Ohio, on the 19th of September, the occasion being remarkable for the public manifestations of mourning, not only in the United States, but in Great Britain and other countries; in Canton a memorial tomb has been erected.

Though he had not the personal magnetism of James G. Blaine, whom he succeeded as a leader of the Republican party and whose views of reciprocity he formally adopted in his last public address, McKinley had great personal suavity and dignity, and was thoroughly well liked by his party colleagues. As a politician he was always more the people's representative than their leader, and that he "kept his ear to the ground" was the source of much of his power and at the same time was his greatest weakness: his address at Buffalo the day before his assassination seems to voice his appreciation of the change in popular sentiment regarding the tariff laws of the United States and is the more remarkable as coming from the foremost champion for years of a form of tariff legislation devised to stifle international competition. His apparently inconsistent record on the coinage question becomes consistent if considered in the same way, as the expression of the gradually changing views of his constituency. And it may not be fanciful to suggest that the obvious growth of McKinley in breadth and power during his term as president was due to his being the representative of a larger constituency, less local and less narrow-minded. He was an able but far from brilliant campaign speaker. His greatest administrative gift was a fine intuition in choosing men to serve him. McKinley's private life was irreproachable; and very fine was his devotion to his wife, Ida Saxton (d. 1907), whom he had married in Canton in 1871, who was throughout his political career a confirmed invalid. He was from his early manhood a prominent member of the Methodist Episcopal Church.

His *Speeches and Addresses* were printed in two volumes (New York, 1893 and 1901).

McKINNEY, a city and the county-seat of Collin county, Texas, U.S.A., about 30 m. N. by E. of Dallas. Pop. (1890), 2489; (1900), 4342 (917 negroes); (1910) 4714. It is served by the Missouri, Kansas & Texas and the Houston & Texas Central railways, and by the Dallas & Sherman inter-urban (electric) line, the central power plant of which is immediately north of the city. McKinney is in a fine farming region; there are also manufactures. The municipal water supply is obtained from artesian wells. The first settlement in Collin county was made about 10 m. north of what is now McKinney in 1841. McKinney was named, as was the county, in honour of Collin McKinney, a pioneer in the region and a signer of the Declaration of the Independence of Texas. It was settled in 1844, was laid out and became the county-seat in 1846, and was first chartered as a city in 1874.

MACKINTOSH, SIR JAMES (1765–1832), Scottish publicist, was born at Aldourie, 7 m. from Inverness, on the 24th of October 1765. He came of old Highland families on both sides. He went in 1780 to college at Aberdeen, where he made a friend of Robert Hall, afterwards the famous preacher. In 1784 he proceeded for the study of medicine to Edinburgh, where he participated to the full in the intellectual ferment, but did not quite neglect his medical studies, and took his degree in 1787.

In 1788 Mackintosh removed to London, then agitated by the trial of Warren Hastings and the king's first lapse into insanity. He was much more interested in these and other political events than in his professional prospects; and his attention was specially directed to the events and tendencies which caused or preceded the Revolution in France. In 1789 he married his first wife, Catherine Stuart, whose brother Daniel afterwards became editor of the *Morning Post*. His wife's prudence was a corrective to his own unpractical temperament, and his efforts in journalism became fairly profitable. Mackintosh was soon absorbed in the question of the time; and in April 1791, after long meditation, he published his *Vindiciae Gallicae*, a reply to Burke's *Reflections on the French Revolution*. It was the only worthy answer to Burke that appeared. It placed the author in the front rank of European publicists, and won him the friendship of some of the most distinguished men of the time, including Burke himself. The success of the *Vindiciae* finally decided him to give up the medical for the legal profession. He was called to the bar in 1795, and gained a considerable reputation there as well as a tolerable practice. In 1797 his wife died, and next year he married Catherine Allen, sister-in-law of Josiah and John Wedgwood, through whom he introduced Coleridge to the *Morning Post*. As a lawyer his greatest public efforts were his lectures (1799) at Lincoln's Inn on the law of nature and nations, of which the introductory discourse was published, and his eloquent defence (1803) of Jean Gabriel Peltier, a French refugee, tried at the instance of the French government for a libel against the first consul. In 1803 he was knighted, and received the post of recorder at Bombay. The spoilt child of London society was not at home in India, and he was glad to return to England, where he arrived in 1812.

He courteously declined the offer of Perceval to resume political life under the auspices of the dominant Tory party, though tempting prospects of office in connexion with India were opened up. He entered parliament in the Whig interest as member for Nairn. He sat for that county, and afterwards for Knaresborough, till his death. In London society, and in Paris during his occasional visits, he was a recognized favourite for his genial wisdom and his great conversational power. On Mme de Stael's visit to London he was the only Englishman capable of representing his country in talk with her. His parliamentary career was marked by the same wide and candid liberalism as his private life. He opposed the reactionary measures of the Tory government, supported and afterwards succeeded Romilly in his efforts for reforming the criminal code, and took a leading part both in Catholic emancipation and in the Reform Bill. But he was too little of a partisan, too widely sympathetic and candid, as well as too elaborate, to be a telling speaker in parliament, and was consequently surpassed by more practical men whose powers were incomparably inferior. From 1818 to 1824 he was professor of law and general politics in the East India Company's College at Haileybury.

In the midst of the attractions of London society and of his parliamentary avocations Mackintosh felt that the real work of his life was being neglected. His great ambition was to write a history of England. His studies both in English and foreign speculation led him to cherish the design also of making some worthy contribution to philosophy. It was not till 1828 that he set about the first task of his literary ambition. This was the *Dissertation on the Progress of Ethical Philosophy*, prefixed to the seventh edition of the *Encyclopaedia Britannica*. The dissertation, written mostly in ill-health and in snatches of time taken from his parliamentary engagements, was published in 1831. It was severely attacked in 1835 by James Mill in his *Fragment on Mackintosh*. About the same time he wrote for the *Cabinet Cyclopaedia* a "History of England from the Earliest Times to the Final Establishment of the Reformation." His more elaborate *History of the Revolution*, for which he had made great researches and collections, was not published till after his death. Already a privy councillor, Mackintosh was appointed commissioner for the affairs of India under the Whig administration of 1830. He died on the 30th of May 1832.

Mackintosh was undoubtedly one of the most cultured and catholic-minded men of his time. His studies and sympathies embraced almost every human interest, except pure science. But the width of his intellectual sympathies, joined to a constitutional indecision and *vis inertiae*, prevented him from doing more enduring work. *Vindiciae Gallicae* was the verdict of a philosophic Liberal on the development of the French Revolution up to the spring of 1791, and though the excesses of the revolutionists compelled him a few years after to express his entire agreement with the opinions of Burke, its defence of the "rights of man" is a valuable statement of the cultured Whig's point of view at the time. The *History of the Revolution in England*, breaking off at the point where William of Orange is preparing to intervene in the affairs of England, is chiefly interesting because of Macaulay's admiring essay on it and its author.

A *Life*, by his son R. J. Mackintosh, was published in 1836.

MACKLIN, CHARLES (*c.* 1699–1797), Irish actor and playwright, whose real name was McLaughlin, was born in Ireland, and had an adventurous youth before coming to Bristol, where he made his first appearance on the stage as Richmond in *Richard III*. He was at Lincoln's Inn Fields about 1725, and by 1733 was at Drury Lane, where the quarrel between the manager and the principal actors resulted in his getting better parts. When the trouble was over and these were taken from him, he went to the Haymarket, but he returned in 1734 to Drury Lane and acted there almost continuously until 1748. Then for two seasons he and his wife (d. *c.* 1758), an excellent actress, were in Dublin under Sheridan, then back in London at Covent Garden. He played a great number of characters, principally in comedy, although Shylock was his greatest part, and Iago and the Ghost in *Hamlet* were in his repertory. At the end of 1753 Macklin bade farewell to the stage to open a tavern, near the theatre, where he personally supervised the serving of dinner. He also delivered an evening lecture, followed by a debate, which was soon a hopeless subject of ridicule. The tavern failed, and Macklin returned to the stage, and played for a number of years in London and Dublin. His quick temper got him into constant trouble. In a foolish quarrel over a wig in 1735 he killed a fellow actor in the green-room at Drury Lane, and he was constantly at law over his various contracts and quarrels. The bitterest of these arose on account of his appearing as Macbeth at Covent Garden in 1772. The part was usually played there by William Smith, and the public would not brook a change. A few nights later the audience refused to hear Macklin as Shylock, and shouted their wish, in response to the manager's question, to have him discharged. This was done in order to quell the riot. His lawsuit, well conducted by himself, against the leaders of the disturbance resulted in an award of £600 and costs, but Macklin magnanimously elected instead that the defendants should take £100 in tickets at three benefits—for himself, his daughter and the management. He returned to Covent Garden, but his appearances thereafter were less frequent, ending in 1789, when as Shylock, at his benefit, he was only able to begin the play, apologize for his wandering memory, and retire. He lived until the 11th of July 1797, and his last years were provided for by a subscription edition of two of his best plays, *The Man of the World* and *Love in a Maze*. Macklin's daughter, Mary Macklin (*c.* 1734–1781), was a well-known actress in her day.

See Edward A. Parry, *Charles Macklin* (1891).

MACK VON LEIBERICH, KARL, FREIHERR (1752–1828), Austrian soldier, was born at Nenslingen, in Bavaria, on the 25th of August 1752. In 1770 he joined an Austrian cavalry regiment, in which his uncle, Leiberich, was a squadron commander, becoming an officer seven years later. During the brief war of the Bavarian Succession he was selected for service on the staff of Count Kinsky, under whom, and subsequently under the commander-in-chief Field Marshal Count Lacy, he did excellent work. He was promoted first lieutenant in 1778, and captain on the quartermaster-general's staff in 1783. Count Lacy, then the foremost soldier of the Austrian army, had the highest opinion of his young assistant. In 1785 Mack married Katherine Gabrieul, and was ennobled under the name of Mack von Leiberich. In the Turkish war he was employed on the headquarter staff, becoming in 1788 major and personal aide-de-camp to the emperor, and in 1789 lieutenant-colonel. He distinguished himself greatly in the storming of Belgrade. Shortly after this, disagreements between Mack and Loudon, now commander-in-chief, led to the former's demanding a court-martial and leaving the front. He was, however, given a colonelcy (1789) and the order of Maria Theresa, and in 1790 Loudon and Mack, having become reconciled, were again on the field together. During these campaigns Mack received a severe injury to his head, from which he never fully recovered. In 1793 he was made quartermaster-general (chief of staff) to Prince Josias of Saxe-Coburg, commanding in the Netherlands; and he enhanced his reputation by the ensuing campaign. The young Archduke Charles, who won his own first laurels in the action of the 1st of March 1793, wrote after the battle, "Above all we have to thank Colonel Mack for these successes." Mack distinguished himself again on the field of Neerwinden; and had a leading part in the negotiations between Coburg and Dumouriez. He continued to serve as quartermaster-general, and was now made titular chief (*Inhaber*) of a cuirassier regiment. He received a wound at Famars, but in 1794 was once more engaged, having at last been made a major-general. But the failure of the allies, due though it was to political and military factors and ideas, over which Mack had no control, was ascribed to him, as their successes of March–April 1793 had been, and he fell into disfavour in consequence. In 1797 he was promoted lieutenant field marshal, and in the following year he accepted, at the personal request of the emperor, the command of the Neapolitan army. But with the unpromising material of his new command he could do nothing against the French revolutionary troops, and before long, being in actual danger of being murdered by his men, he took refuge in the French camp. He was promised a free pass to his own country, but Napoleon ordered that he should be sent to France as a prisoner of war. Two years later he escaped from Paris in disguise. The allegation that he broke his parole is false. He was not employed for some years, but in 1804, when the war party in the Austrian court needed a general to oppose the peace policy of the Archduke Charles, Mack was made quartermaster-general of the army, with instructions to prepare for a war with France. He did all that was possible within the available time to reform the army, and on the opening of the war of 1805 he was made quartermaster-general to the titular commander-in-chief in Germany, the Archduke Ferdinand. He was the real responsible commander of the army which opposed Napoleon in Bavaria, but his position was ill-defined and his authority treated with slight respect by the other general officers. For the events of the Ulm campaign and an estimate of Mack's responsibility for the disaster, see NAPOLEONIC CAMPAIGNS. After Austerlitz, Mack was tried by a court-martial, sitting from February 1806 to June 1807, and sentenced to be deprived of his rank, his regiment, and the order of Maria Theresa, and to be imprisoned for two years. He was released in 1808, and in 1819, when the ultimate victory of the allies had obliterated the memory of earlier disasters, he was, at the request of Prince Schwarzenberg, reinstated in the army as lieutenant field marshal and a member of the order of Maria Theresa. He died on the 22nd of October 1828 at S. Pölten.

See Schweigerd, *Oesterreichs Helden* (Vienna, 1854); Würzbach, *Biogr. Lexikon d. Kaiserthums Oesterr.* (Vienna, 1867); Ritter von Rittersberg, *Biogr. d. ausgezeichneten Feldherren d. oest. Armee* (Prague, 1828); Raumer's *Hist. Taschenbuch* (1873) contains Mack's vindication. A short critical memoir will be found in *Streffleur* for January 1907.

McLANE, LOUIS (1786–1857), American political leader, was born in Smyrna, Delaware, on the 28th of May 1786, son of Allan McLane (1746–1829), a well-known Revolutionary soldier. He was admitted to the bar in 1807. He entered politics as a Democrat, and served in the Federal House of Representatives in 1817–1827 and in the Senate in 1827–1829. He was minister to England in 1829–1831, and secretary of the treasury in Jackson's cabinet from 1831 (when in his annual report he argued for the United States Bank) until May 1833, when he was transferred to the state department. He retired from the cabinet in June 1834. He was president of the Baltimore & Ohio railway in 1837–1847, minister to England in 1845–1846, and delegate to the Maryland constitutional convention of 1850–1851. He died in Baltimore, Maryland, on the 7th of October 1857.

His son, ROBERT MILLIGAN McLANE (1815–1898), graduated at West Point in 1837, resigned from the army in 1843, and practised law in Baltimore. He was a Democratic representative in Congress in 1847–1851 and again in 1879–1883, governor of Maryland in 1884–1885, U.S. commissioner to China in 1853–1854, and minister to Mexico in 1859–1860 and to France in 1885–1889.

See R. M. McLane's *Reminiscences, 1827–1897* (privately printed, 1897).

MACLAREN, CHARLES (1782–1866), Scottish editor, was born at Ormiston, Haddingtonshire, on the 7th of October 1782, the son of a farmer and cattle-dealer. He was almost entirely self-educated, and when a young man became a clerk in Edinburgh. In 1817, with others, he established the *Scotsman* newspaper in Edinburgh and at first acted as its editor. Offered a post as clerk in the custom house, he resigned his editorial position, resuming it in 1820, and resigning it again in 1845. In 1820 Maclaren was made editor of the sixth edition of the *Encyclopaedia Britannica*. From 1864–1866 he was president of the Geological Society of Edinburgh, in which city he died on the 10th of September 1866.

MACLAREN, IAN, the pseudonym of John Watson (1850–1907), Scottish author and divine. The son of John Watson, a civil servant, he was born at Manningtree, Essex, on the 3rd of November 1850, and was educated at Stirling and at Edinburgh University, afterwards studying theology at New College, Edinburgh, and at Tübingen. In 1874 he entered the ministry of the Free Church of Scotland and became assistant minister of Barclay Church, Edinburgh. Subsequently he was minister at Logiealmond in Perthshire and at Glasgow, and in 1880 he became minister of Sefton Park Presbyterian church, Liverpool, from which he retired in 1905. In 1896 he was Lyman Beecher lecturer at Yale University, and in 1900 he was moderator of the synod of the English Presbyterian church. While travelling in America he died at Mount Pleasant, Iowa, on the 6th of May 1907. Ian Maclaren's first sketches of rural Scottish life, *Beside the Bonnie Briar Bush* (1894), achieved extraordinary popularity and were followed by other successful books, *The Days of Auld Lang Syne* (1895), *Kate Carnegie and those Ministers* (1896) and *Afterwards and other Stories* (1898). Under his own name Watson published several volumes of sermons, among them being *The Upper Room* (1895); *The Mind of the Master* (1896) and *The Potter's Wheel* (1897).

See Sir W. Robertson Nicoll, *Ian Maclaren* (1908).

MACLAURIN, COLIN (1698–1746), Scottish mathematician, was the son of a clergyman, and born at Kilmodan, Argyllshire. In 1709 he entered the university of Glasgow, where he exhibited a decided genius for mathematics, more especially for geometry; it is said that before the end of his sixteenth year he had discovered many of the theorems afterwards published in his *Geometria organica*. In 1717 he was elected professor of mathematics in Marischal College, Aberdeen, as the result of a competitive examination. Two years later he was admitted F.R.S. and made the acquaintance of Sir Isaac Newton. In 1719 he published his *Geometria organica, sive descriptio linearum curvarum universalis*. In it Maclaurin developed several theorems due to Newton, and introduced the method of generating conics which bears his name, and showed that many curves of the third and fourth degrees can be described by the intersection of two movable angles. In 1721 he wrote a supplement to the *Geometria organica*, which he afterwards published, with extensions, in the *Philosophical Transactions* for 1735. This paper is principally based on the following general theorem, which is a remarkable extension of Pascal's hexagram: "If a polygon move so that each of its sides passes through a fixed point, and if all its summits except one describe curves of the degrees m, n, p, &c., respectively, then the free summit moves on a curve of the degree $2mnp$ . . . . which reduces to mnp . . . . when the fixed points all lie on a right line." In 1722 Maclaurin travelled as tutor and companion to the eldest son of Lord Polwarth, and after a short stay in Paris resided for some time in Lorraine, where he wrote an essay on the percussion of bodies, which obtained the prize of the French Academy of Sciences for the year 1724. The following year he was elected professor of mathematics in the university of Edinburgh on the urgent recommendation of Newton. After the death of Newton, in 1728, his nephew, John Conduitt, applied to Maclaurin for his assistance in publishing an account of Newton's life and discoveries. This Maclaurin gladly undertook, but the death of Conduitt put a stop to the project.

In 1740 Maclaurin divided with Leonhard Euler and Daniel Bernoulli the prize offered by the French Academy of Sciences for an essay on tides. His *Treatise on Fluxions* was published at Edinburgh in 1742, in two volumes. In the preface he states that the work was undertaken in consequence of the attack on the method of fluxions made by George Berkeley in 1734. Maclaurin's object was to found the doctrine of fluxions on geometrical demonstration, and thus to answer all objections to its method as being founded on false reasoning and full of mystery. The most valuable part of the work is that devoted to physical applications, in which he embodied his essay on the tides. In this he showed that a homogeneous fluid mass revolving uniformly round an axis under the action of gravity ought to assume the form of an ellipsoid of revolution. The importance of this investigation in connexion with the theory of the tides, the figure of the earth, and other kindred questions, has always caused it to be regarded as one of the great problems of mathematical physics. Maclaurin was the first to introduce into mechanics, in this discussion, the important conception of *surfaces of level*; namely, surfaces at each of whose points the total force acts in the normal direction. He also gave in his *Fluxions*, for the first time, the correct theory for distinguishing between maxima and minima in general, and pointed out the importance of the distinction in the theory of the multiple points of curves. In 1745, when the rebels were marching on Edinburgh, Maclaurin took a most prominent part in preparing trenches and barricades for its defence. The anxiety, fatigue and cold to which he was thus exposed, affecting a constitution naturally weak, laid the foundation of the disease to which he afterwards succumbed. As soon as the rebel army got possession of Edinburgh Maclaurin fled to England, to avoid making submission to the Pretender. He accepted the invitation of T. Herring, then archbishop of York, with whom he remained until it was safe to return to Edinburgh. He died of dropsy on the 14th of June 1746, at Edinburgh. Maclaurin was married in 1733 to Anne, daughter of Walter Stewart, solicitor-general for Scotland. His eldest son John, born in 1734, was distinguished as an advocate, and appointed one of the judges of the Scottish court of session, with the title of Lord Dreghorn. He inherited an attachment to scientific discovery, and was one of the founders of the Royal Society of Edinburgh, in 1782.

After Maclaurin's death his account of Newton's philosophical discoveries was published by Patrick Murdoch, and also his algebra in 1748. As an appendix to the latter appeared his *De linearum geometricarum proprietatibus generalibus tractatus*, a treatise of remarkable elegance. Of the more immediate successors of Newton in Great Britain Maclaurin is probably the only one who can be placed in competition with the great mathematicians of the continent of Europe at the time. (B. W.)

M‘LENNAN, JOHN FERGUSON (1827–1881), Scottish ethnologist, was born at Inverness on the 14th of October 1827. He studied at King's college, Aberdeen, where he graduated with distinction in 1849, thence proceeding to Cambridge, where he remained till 1855 without taking a degree. He was called to the Scottish bar in 1857, and in 1871 was appointed parliamentary draughtsman for Scotland. In 1865 he published *Primitive Marriage*, in which, arguing from the prevalence of the symbolical form of capture in the marriage ceremonies of primitive races, he developed an intelligible picture of the growth of the marriage relation and of systems of kinship (see Family) according to natural laws. In 1866 he wrote in the *Fortnightly Review* (April and May) an essay on "Kinship in Ancient Greece," in which he proposed to test by early Greek facts the theory of the history of kinship set forth in *Primitive Marriage*; and three years later appeared a series of essays on "Totemism" in the same periodical for 1869–1870 (the germ of which had been contained in the paper just named), which mark the second great step in his systematic study of early society. A reprint of *Primitive Marriage*, with "Kinship in Ancient Greece" and some other essays not previously published, appeared in 1876, under the title of *Studies in Ancient History*. The new essays in this volume were mostly critical, but one of them, in which perhaps his guessing talent is seen at its best, "The Divisions of the Irish Family," is an elaborate discussion of a problem which has long puzzled both Celtic scholars and jurists; and in another, "On the Classificatory System of Relationship," he propounded a new explanation of a series of facts which, he thought, might throw light upon the early history of society, at the same time putting to the test of those facts the theories he had set forth in *Primitive Marriage*. Papers on "The Levirate and Polyandry," following up the line of his previous investigations (*Fortnightly Review*, 1877), were the last work he was able to publish. He died of consumption on the 14th of June 1881 at Hayes Common, Kent.

Besides the works already cited, M'Lennan wrote a *Life of Thomas Drummond* (1867). The vast materials which he had accumulated on kinship were edited by his widow and A. Platt, under the title *Studies in Ancient History: Second Series* (1896).

MACLEOD, HENRY DUNNING (1821–1902), Scottish economist, was born in Edinburgh, and educated at Eton, Edinburgh University, and Trinity College, Cambridge, where he graduated in 1843. He travelled in Europe, and in 1849 was called to the English bar. He was employed in Scotland on the work of poor-law reform, and devoted himself to the study of economics. In 1856 he published his *Theory and Practice of Banking*, in 1858 *Elements of Political Economy*, and in 1859 *A Dictionary of Political Economy*. In 1873 appeared his *Principles of Economist Philosophy*, and other books on economics and banking were published later. Between 1868 and 1870 he was employed by the government in digesting and codifying the law of bills of exchange. He died on the 16th of July 1902. Macleod's principal contribution to the study of economics consists in his work on the theory of credit, to which he was the first to give due prominence.

For a judicious discussion of the value of Macleod's writings, see an article on "The Revolt against Orthodox Economics" in the *Quarterly Review* for October 1901 (No. 388).

MACLEOD, NORMAN (1812–1872), Scottish divine, son of Rev. Norman Macleod (1783–1862), and grandson of Rev. Norman Macleod, minister of Morven, Argyllshire, was born at Campbeltown on the 3rd of June 1812. In 1827 he became a student at Glasgow University, and in 1831 went to Edinburgh to study divinity under Dr Thomas Chalmers. On the 18th of March 1838 he became parish minister at Loudoun, Ayrshire. At this time the troubles in the Scottish Church were already gathering to a head (see FREE CHURCH OF SCOTLAND). Macleod, although he had no love for lay patronage, and wished the Church to be free to do its proper work, clung firmly to the idea of a national Established Church, and therefore remained in the Establishment when the disruption took place. He was one of those who took a middle course in the non-intrusion controversy, holding that the fitness of those who were presented to parishes should be judged by the presbyteries—the principle of Lord Aberdeen's Bill. On the secession of 1843 he was offered many different parishes, and having finally settled at Dalkeith, devoted himself to parish work and to questions affecting the Church as a whole. He was largely instrumental in the work of strengthening the Church. In 1847 he became one of the founders of the Evangelical Alliance, and from 1849 edited the *Christian Instructor* (Edinburgh). In 1851 he was called to the Barony church, Glasgow, in which city the rest of his days were passed. There the more liberal theology rapidly made way among a people who judged it more by its fruits than its arguments, and Macleod won many adherents by his practical schemes for the social improvement of the people. He instituted temperance refreshment rooms, a congregational penny savings bank, and held services specially for the poor. In 1860 Macleod was appointed editor of the new monthly magazine *Good Words*. Under his control the magazine, which was mainly of a religious character, became widely popular. His own literary work, nearly all of which originally appeared in its pages—sermons, stories, travels, poems—was only a by-product of a busy life. By far his best work was the spontaneous and delightful *Reminiscences of a Highland Parish* (1867). While *Good Words* made his name known, and helped the cause he had so deeply at heart, his relations with the queen and the royal family strengthened yet further his position in the country. Never since Principal Carstairs had any Scottish clergyman been on such terms with his sovereign. In 1865 he risked an encounter with Scottish Sabbatarian ideas. The presbytery of Glasgow issued a pastoral letter on the subject of Sunday trains and other infringements of the Sabbath. Macleod protested against the grounds on which its strictures were based. For a time, owing partly to a misleading report of his statement, he became "the man in all Scotland most profoundly distrusted." But four years later the Church accorded him the highest honour in her power by choosing him as moderator of her general assembly. In 1867, along with Dr Archibald Watson, he was sent to India, to inquire into the state of the missions. He undertook the journey in spite of failing health, and seems never to have recovered from its effects. He returned resolved to devote the rest of his days to rousing the Church to her duty in the sphere of foreign missions, but his health was now broken, and his old energy flagged. He died on the 16th of June 1872, and was buried at Campsie. He was one of the greatest of Scottish religious leaders, a man of wide sympathy and high ideals. His Glasgow church was named after him the "Macleod Parish Church," and the "Macleod Missionary Institute" was erected by the Barony church in Glasgow. Queen Victoria gave two memorial windows to Crathie church as a testimony of her admiration for his work.

See *Memoir of Norman Macleod*, by his brother, Donald Macleod (1876).

MACLISE, DANIEL (1806–1870), Irish painter, was born at Cork, the son of a Highland soldier. His education was of the plainest kind, but he was eager for culture, fond of reading, and anxious to become an artist. His father, however, placed him, in 1820, in Newenham's Bank, where he remained for two years, and then left to study in the Cork school of art. In 1825 it happened that Sir Walter Scott was travelling in Ireland, and young Maclise, having seen him in a bookseller's shop, made a surreptitious sketch of the great man, which he afterwards lithographed. It was exceedingly popular, and the artist became celebrated enough to receive many commissions for portraits, which he executed, in pencil, with very careful treatment of detail and accessory. Various influential friends perceived the genius and promise of the lad, and were anxious to furnish him with the means of studying in the metropolis; but with rare independence he refused all aid, and by careful economy saved a sufficient sum to enable him to leave for London. There he made a lucky hit by a sketch of the younger Kean, which, like his portrait of Scott, was lithographed and published. He entered the Academy schools in 1828, and carried off the highest prizes open to the students. In 1829 he exhibited for the first time in the Royal Academy. Gradually he began to confine himself more exclusively to subject and historical pictures, varied occasionally by portraits of Campbell, Miss Landon, Dickens, and other of his literary friends. In 1833 he exhibited two pictures which greatly increased his reputation, and in 1835 the "Chivalric Vow of the Ladies and the Peacock" procured his election as associate of the Academy, of which he became full member in 1840. The years that followed were occupied with a long series of figure pictures, deriving their subjects from history and tradition and from the works of Shakespeare, Goldsmith and Le Sage. He also designed illustrations for several of Dickens's Christmas books and other works. Between the years 1830 and 1836 he contributed to *Fraser's Magazine*, under the pseudonym of Alfred Croquis, a remarkable series of portraits of the literary and other celebrities of the time—character studies, etched or lithographed in outline, and touched more or less with the emphasis of the caricaturist, which were afterwards published as the *Maclise Portrait Gallery* (1871). In 1858 Maclise commenced one of the two great monumental works of his life, the "Meeting of Wellington and Blücher," on the walls of Westminster Palace. It was begun in fresco, a process which proved unmanageable. The artist wished to resign the task; but, encouraged by Prince Albert, he studied in Berlin the new method of "water-glass" painting, and carried out the subject and its companion, the "Death of Nelson," in that medium, completing the latter painting in 1864. The intense application which he gave to these great historic works, and various circumstances connected with the commission, had a serious effect on the artist's health. He began to shun the company in which he formerly delighted; his old buoyancy of spirits was gone; and when, in 1865, the presidentship of the Academy was offered to him he declined the honour. He died of acute pneumonia on the 25th of April 1870. His works are distinguished by powerful intellectual and imaginative qualities, but most of them are marred by harsh and dull colouring, by metallic hardness of surface and texture, and by frequent touches of the theatrical in the action and attitudes of the figures. His fame rests most securely on his two greatest works at Westminster.

A memoir of Maclise, by his friend W. J. O'Driscoll, was published in 1871.

MACLURE, WILLIAM (1763–1840), American geologist, was born at Ayr in Scotland in 1763. After a brief visit to New York in 1782 he began active life as a partner in a London firm of American merchants. In 1796 business affairs took him to Virginia, U.S.A., which he thereafter made his home. In 1803 he visited France as one of the commissioners appointed to settle the claims of American citizens on the French government; and during the few years then spent in Europe he applied himself with enthusiasm to the study of geology. On his return home in 1807 he commenced the self-imposed task of making a geological survey of the United States. Almost every state in the Union was traversed and mapped by him, the Alleghany Mountains being crossed and recrossed some fifty times. The results of his unaided labours were submitted to the American Philosophical Society in a memoir entitled *Observations on the Geology of the United States explanatory of a Geological Map*, and published in the Society's *Transactions* (vol. iv. 1809, p. 91) together with the first geological map of that country. This antedates William Smith's geological map of England by six years. In 1817 Maclure brought before the same society a revised edition of his map, and his great geological memoir was issued separately, with some additional matter, under the title *Observations on the Geology of the United States of America*. Subsequent survey has corroborated the general accuracy of Maclure's observations. In 1819 he visited Spain, and attempted, unsuccessfully, to establish an agricultural college near the city of Alicante. Returning to America in 1824, he settled for some years at New Harmony, Indiana, and sought to develop his scheme of the agricultural college. Failing health ultimately constrained him to relinquish the attempt, and to seek (in 1827) a more congenial climate in Mexico. There, at San Angel, he died on the 23rd of March 1840.

See S. G. Morton, "Memoir of William Maclure," *Amer. Journ. Sci.*, vol. xlvii. (1844), p. 1.

MACMAHON, MARIE EDMÉ PATRICE MAURICE DE, duke of Magenta (1808–1893), French marshal and president of the French republic, was born on the 13th of July 1808 at the château of Sully, near Autun. He was descended from an Irish family which went into exile with James II. Educated at the military school of St Cyr, in 1827 he entered the army, and soon saw active service in the first French campaign in Algeria, where his ability and bravery became conspicuous. Being recalled to France, he gained renewed distinction in the expedition to Antwerp in 1832. He became captain in 1833, and in that year returned to Algeria. He led daring cavalry raids across plains infested with Bedouin, and especially distinguished himself at the siege of Constantine in 1837. From then until 1855 he was almost constantly in Algeria, and rose to the rank of general of division. During the Crimean War MacMahon was given the command of a division, and in September 1855 he successfully conducted the assault upon the Malakoff works, which led to the fall of Sebastopol. After his return to France honours were showered upon him, and he was made a senator. Desiring a more active life, however, and declining the highest command in France, he was once more sent out, at his own request, to Algeria, where he completely defeated the Kabyles. After his return to France he voted as a senator against the unconstitutional law for general safety, which was brought forward in consequence of Orsini's abortive attempt on the emperor's life. MacMahon greatly distinguished himself in the Italian campaign of 1859. Partly by good luck and partly by his boldness and sagacity in pushing forward without orders at a critical moment at the battle of Magenta, he enabled the French to secure the victory. For his brilliant services MacMahon received his marshal's baton and was created duke of Magenta. In 1861 he represented France at the coronation of William I. of Prussia, and in 1864 he was nominated governor-general of Algeria. MacMahon's action in this capacity formed the least successful episode of his career. Although he did institute some reforms in the colonies, complaints were so numerous that twice in the early part of 1870 he sent in his resignation to the emperor. When the ill-fated Ollivier cabinet was formed the emperor abandoned his Algerian schemes and MacMahon was recalled.

War being declared between France and Prussia in July 1870, MacMahon was appointed to the command of the Alsace army detachment (see FRANCO-GERMAN WAR). On the 6th of August MacMahon fought the battle of Wörth (*q.v.*). His courage was always conspicuous on the field, but the two-to-one numerical superiority of the Germans triumphed. MacMahon was compelled to fall back upon Saverne, and thence to Toul. Though he suffered further losses in the course of his retreat, his movements were so ably conducted that the emperor confided to him the supreme command of the new levies which he was mustering at Châlons, and he was directed to effect a junction with Bazaine. This operation he undertook against his will. He had an army of 120,000 men, with 324 guns; but large numbers of the troops were disorganized and demoralized. Early on the 1st of September the decisive battle of Sedan began. MacMahon was dangerously wounded in the thigh, whereupon General Ducrot, and soon afterwards General de Wimpffen, took command. MacMahon shared the captivity of his comrades, and resided at Wiesbaden until the conclusion of peace.

In March 1871 MacMahon was appointed by Thiers commander-in-chief of the army of Versailles; and in that capacity he suppressed the Communist insurrection, and successfully conducted the second siege of Paris. In the following December he was invited to become a candidate for Paris in the elections to the National Assembly, but declined nomination. On the resignation of Thiers as president of the Republic, on the 24th of May 1873, MacMahon was elected to the vacant office by an almost unanimous vote, being supported by 390 members out of 392. The duc de Broglie was empowered to form a Conservative administration, but the president also took an early opportunity of showing that he intended to uphold the sovereignty of the National Assembly. On the 5th of November 1873 General Changarnier presented a motion in the Assembly to confirm MacMahon's powers for a period of ten years, and to provide for a commission of thirty to draw up a form of constitutional law. The president consented, but in a message to the Assembly he declared in favour of a confirmation of his own powers for seven years, and expressed his determination to use all his influence in the maintenance of Conservative principles. After prolonged debates the Septennate was adopted on the 19th of November by 378 votes to 310. There was no *coup d'état* in favour of "Henri V.," as had been expected, and the president resolved to abide by "existing institutions." One of his earliest acts was to receive the finding of the court-martial upon his old comrade in arms, Marshal Bazaine, whose death sentence he commuted to one of twenty years' imprisonment in a fortress. Though MacMahon's life as president of the Republic was of the simplest possible character, his term of office was marked by many brilliant displays, while his wife was a leader in all works of charity and benevolence.

The president was very popular in the rural districts of France, through which he made a successful tour shortly after the declaration of the Septennate. But in Paris and other large cities his policy soon caused great dissatisfaction, the Republican party especially being alienated by press prosecutions and the attempted suppression of Republican ideas. Matters were at a comparative deadlock in the National Assembly, until the accession of some Orleanists to the Moderate Republican party in 1875 made it possible to pass various constitutional laws. In May 1877, however, the constitutional crisis became once more acute. A peremptory letter of censure from MacMahon to Jules Simon caused the latter to resign with his colleagues. The duc de Broglie formed a ministry, but Gambetta carried a resolution in the Chamber of Deputies in favour of parliamentary government. The president declined to yield, and being supported by the Senate, he dissolved the Chamber, by decree, on the 25th of June. The prosecution of Gambetta followed for a speech at Lille, in which he had said "the marshal must, if the elections be against him, *se soumettre ou se démettre*." In a manifesto respecting the elections, the president referred to his successful government and observed, "I cannot obey the injunctions of the demagogy; I can neither become the instrument of Radicalism nor abandon the post in which the constitution has placed me." His confidence in the result of the elections was misplaced. Notwithstanding the great pressure put upon the constituencies by the government, the elections in October resulted in the return of 335 Republicans and only 198 anti-Republicans, the latter including 30 MacMahonists, 89 Bonapartists, 41 Legitimists, and 38 Orleanists. The president endeavoured to ignore the significance of the elections, and continued his reactionary policy. As a last resort he called to power an extra-parliamentary cabinet under General Rochebouet, but the Republican majority refused to vote supplies, and after a brief interval the president was compelled to yield, and to accept a new Republican ministry under Dufaure. The prolonged crisis terminated on the 14th of December 1877, and no further constitutional difficulties arose in 1878. But as the senatorial elections, held early in 1879, gave the Republicans an effective working majority in the Upper Chamber, they now called for the removal of the most conspicuous anti-Republicans among the generals and officials. The president refused to supersede them, and declined to sanction the law brought in with this object. Perceiving further resistance to be useless, however, MacMahon resigned the presidency on the 30th of January 1879, and Jules Grévy was elected as his successor.

MacMahon now retired into private life. Relieved from the cares of state, his simple and unostentatious mode of existence enabled him to pass many years of dignified repose. He died at Paris on the 17th of October 1893, in his eighty-sixth year. A fine, tall, soldierly man, of a thoroughly Irish type, in private life MacMahon was universally esteemed as generous and honourable; as a soldier he was brave and able, without decided military genius; as a politician he was patriotic and well-intentioned, but devoid of any real capacity for statecraft. (G. B. S.)

McMASTER, JOHN BACH (1852–), American historian, was born in Brooklyn, New York, on the 29th of June 1852. He graduated from the college of the City of New York in 1872, worked as a civil engineer in 1873–1877, was instructor in civil engineering at Princeton University in 1877–1883, and in 1883 became professor of American history in the university of Pennsylvania. He is best known for his *History of the People of the United States from the Revolution to the Civil War* (1883 sqq.), a valuable supplement to the more purely political writings of Schouler, Von Holst and Henry Adams.

MACMILLAN, the name of a family of English publishers. The founders of the firm were two Scotsmen, Daniel Macmillan (1813–1857) and his younger brother Alexander (1818–1896) Daniel was a native of the Isle of Arran, and Alexander was born in Irvine on the 3rd of October 1818. Daniel was for some time assistant to the bookseller Johnson at Cambridge, but entered the employ of Messrs Seeley in London in 1837; in 1843 he began business in Aldersgate Street, and in the same year the two brothers purchased the business of Newby in Cambridge. They did not confine themselves to bookselling, but published educational works as early as 1844. In 1845 they became the proprietors of the more important business of Stevenson, in Cambridge, the firm being styled Macmillan, Barclay & Macmillan. In 1850 Barclay retired and the firm resumed the name of Macmillan & Co. Daniel Macmillan died at Cambridge on the 27th of June 1857. In that year an impetus was given to the business by the publication of Kingsley's *Two Years Ago*. A branch office was opened in 1858 in Henrietta Street, London, which led to a great extension of trade. These premises were surrendered for larger ones in Bedford Street, and in 1897 the buildings in St Martin's Street were opened. Alexander Macmillan died in January 1896. By his great energy and literary associations, and with the aid of his partners, there had been built up in little over half a century one of the most important publishing houses in the world. Besides the issue of many important series of educational and scientific works, they published the works of Kingsley, Huxley, Maurice, Tennyson, Lightfoot, Westcott, J. R. Green, Lord Roberts, Lewis Carroll, and of many other well-known authors. In 1898 they took over the old-established publishing house of R. Bentley & Son, and with it the works of Mrs Henry Wood, Miss Rhoda Broughton, *The Ingoldsby Legends*, and also *Temple Bar* and the *Argosy*. In 1893 the firm was converted into a limited liability company, its chairman being Frederick Macmillan (b. 1851), who was knighted in 1909. The American firm of the Macmillan Company, of which he was also a director, is a separate business.

See Thomas Hughes, *Memoir of Daniel Macmillan* (1882); *A Bibliographical Catalogue of Macmillan & Co's Publications from 1843 to 1889* (1891), with portraits of the brothers Daniel and Alexander after Lowes Dickinson and Hubert Herkomer; also articles in *Le Livre* (September 1886), *Publishers' Circular* (January 14, 1893), the *Bookman* (May 1901), &c.

MACMONNIES, FREDERICK WILLIAM (1863–), American sculptor and painter, was born at Brooklyn, New York, on the 20th of September 1863. His mother was a niece of Benjamin West. At the age of sixteen MacMonnies was received as an apprentice in the studio of Augustus St Gaudens, the sculptor, where he remained for five years. In 1884 he went to Paris and thence to Munich, where he painted for some months. Returning to Paris next year he became the most prominent pupil of Falguière. His "Diana" brought him a mention at the Salon of 1889. Three life-sized figures of angels for the church of St Paul, New York, were followed by his "Nathan Hale," in the City Hall Park, New York, and a portrait of James S. T. Stranahan, for Brooklyn. This last brought him a "second medal" in the Salon of 1891, the first time an American sculptor had been so honoured. In 1893 he was chosen to design and carry out the Columbian Fountain for the Chicago World's Fair, which placed him instantly in the front rank. His largest work is a decoration for the Memorial Arch to Soldiers and Sailors, in Prospect Park, Brooklyn, consisting of three enormous groups in bronze. In Prospect Park, Brooklyn, MacMonnies has also a large "Horse Tamer," a work of much distinction. A "Winged Victory" at the U.S. military academy at West Point, New York, is of importance; and his "Bacchante," an extraordinary combination of realism and imagination, rejected by the Boston Public Library, is now at the Metropolitan Museum of Art, New York. He also became well known as a painter, mainly of portraits. In 1888 he married Mary Fairchild, a figure painter of distinction, but in 1909 they were divorced and she married Will H. Low.

MACNAGHTEN, SIR WILLIAM HAY, Bart. (1793–1841), Anglo-Indian diplomatist, was the second son of Sir Francis Macnaghten, Bart., judge of the supreme courts of Madras and Calcutta. He was born in August 1793, and educated at Charterhouse. He went out to Madras as a cadet in 1809, but was appointed in 1816 to the Bengal Civil Service. He early displayed a great talent for languages, and also published several treatises on Hindu and Mahommedan law. His political career began in 1830 as secretary to Lord William Bentinck; and in 1837 he became one of the most trusted advisers of the governor-general, Lord Auckland, with whose policy of supporting Shah Shuja against Dost Mahommed, the reigning amir of Kabul, Macnaghten was closely identified. As political agent at Kabul he came into conflict with the military authorities and subsequently with his subordinate Sir Alexander Burnes. Macnaghten attempted to placate the Afghan chiefs with heavy subsidies, but when the drain on the Indian exchequer became too great, and the allowances were reduced, this policy led to an outbreak. Burnes was murdered on the 2nd of November 1841; and owing to the incapacity of the aged General Elphinstone the British army in Kabul degenerated into a leaderless mob. Macnaghten tried to save the situation by negotiating with the Afghan chiefs and, independently of them, with Dost Mahommed's son, Akbar Khan, by whom he was assassinated on the 23rd of December 1841; the disastrous retreat from Kabul and the massacre of the British army in the Kurd Kabul pass followed. These events threw doubt on Macnaghten's capacity for dealing with the problems of Indian diplomacy, though his fearlessness and integrity were unquestioned. He had been created a baronet in 1840, and four months before his death was nominated to the governorship of Bombay.

MACNALLY, LEONARD (1752–1820), Irish informer, was born in Dublin, the son of a merchant. In 1776 he was called to the Irish, and in 1783 to the English bar. He supported himself for some time in London by writing plays and editing the *Public Ledger*. Returning to Dublin, he entered upon a systematic course of informing against the members of the revolutionary party, for whom his house had become the resort. He also betrayed to the government prosecutors political clients whom he defended eloquently in the courts. He made a fine defence for Robert Emmet and cheered him in his last hours, although before appearing in court he had sold, for £200, the contents of his brief to the lawyers for the Crown. After living a professed Protestant all his life, he received absolution on his deathbed from a Roman Catholic priest. He died on the 13th of February 1820.

MACNEE, SIR DANIEL (1806–1882), Scottish portrait painter, was born at Fintry in Stirlingshire. At the age of thirteen he was apprenticed, along with Horatio Macculloch and Leitch the water-colour painter, to John Knox, a landscapist of some repute. He afterwards worked for a year as a lithographer, was employed by the Smiths of Cumnock to paint the ornamental lids of their planewood snuff-boxes, and, having studied in Edinburgh at the "Trustees' Academy," supporting himself meanwhile by designing and colouring book illustrations for Lizars the engraver, he established himself as an artist in Glasgow, where he became a fashionable portrait painter. He was in 1829 admitted a member of the Royal Scottish Academy; and on the death of Sir George Harvey in 1876 he was elected president, and received the honour of knighthood. From this period till his death, on the 18th of January 1882, he resided in Edinburgh, where his genial social qualities and his inimitable powers as a teller of humorous Scottish anecdote rendered him popular.

MACNEIL, HERMON ATKINS (1866–), American sculptor, was born at Chelsea, Massachusetts. He was an instructor in industrial art at Cornell University in 1886–1889, and was then a pupil of Henri M. Chapu and Falguière in Paris. Returning to America, he aided Philip Martiny in the preparation of sketch models for the Columbian exposition, and in 1896 he won the Rinehart scholarship, passing four years (1896–1900) in Rome. In 1906 he became a National Academician. His first important work was "The Moqui Runner," which was followed by "A Primitive Chant," and "The Sun Vow," all figures of the North-American Indian. A "Fountain of Liberty," for the St Louis exposition, and other Indian themes came later; his "Agnese" and his "Beatrice," two fine busts of women, also deserve mention. His principal work is the sculpture for a large memorial arch, at Columbus, Ohio, in honour of President McKinley. In 1909 he won in competition a commission for a large soldiers' and sailors' monument in Albany, New York. His wife, Carol Brooks MacNeil, also a sculptor of distinction, was a pupil of F. W. MacMonnies.

MCNEILE, HUGH (1795–1879), Anglican divine, younger son of Alexander McNeile (or McNeill), was born at Ballycastle, Co. Antrim, on the 15th of July 1795. He graduated at Trinity College, Dublin, in 1810. His handsome presence, and his promise of exceptional gifts of oratory, led a wealthy uncle, Major-General Daniel McNeill, to adopt him as his heir; and he was destined for a parliamentary career. During a stay at Florence, Hugh McNeile became temporarily intimate with Lord Byron and Madame de Staël. On returning home, he determined to abandon the prospect of political distinction for the clerical profession, and was disinherited. In 1820 he was ordained, and after holding the curacy of Stranorlar, Co. Donegal, for two years, was appointed to the living of Albury, Surrey, by Henry Drummond.

Edward Irving endeavoured, not without success at first, to draw McNeile into agreement with his doctrine and aims. Irving's increasing extravagance, however, soon alienated McNeile. His preaching now attracted much attention; in London he frequently was heard by large congregations. In 1834 he accepted the incumbency of St Jude's, Liverpool, where for the next thirty years he wielded great political as well as ecclesiastical influence. He repudiated the notion that a clergyman should be debarred from politics, maintaining at a public meeting that "God when He made the minister did not unmake the citizen." In 1835 McNeile entered upon a long contest, in which he was eventually successful, with the Liverpool corporation, which had been captured by the Whigs, after the passing of the Municipal Reform Act. A proposal was carried that the elementary schools under the control of the corporation should be secularized by the introduction of what was known as the Irish National System. The threatened withdrawal of the Bible as the basis of denominational religious teaching was met by a fierce agitation led by McNeile, who so successfully enlisted public support that before the new system could be introduced every child was provided for in new Church of England schools established by public subscriptions. At the same time he conducted a campaign which gradually reduced the Whig element in the council, till in 1841 it almost entirely disappeared. To his influence was also attributed the defeat of the Liberal parliamentary candidates in the general election of 1837, followed by a long period of Conservative predominance in Liverpool politics. McNeile had the Irish Protestant's horror of Romanism, which he constantly denounced in the pulpit and on the platform; and Macaulay, speaking in the House of Commons on the Maynooth endowment in April 1845, singled him out for attack as the most powerful representative of uncompromising Protestant opinion in the country. As the Tractarian movement in the Church of England developed, he became one of its most zealous opponents and the most conspicuous leader of the evangelical party. In 1840 he published a volume of *Lectures on the Church of England*, and in 1846 (the year after Newman's secession to Rome) *The Church and the Churches*, in which he maintained with much dialectical skill the evangelical doctrine of the "invisible Church" in opposition to the teaching of Newman and Pusey. Hugh McNeile was in close sympathy with the philanthropic work as well as the religious views of the 7th earl of Shaftesbury, who more than once tried to persuade Lord Palmerston to raise him to the episcopal bench. But although Palmerston usually followed the advice of Shaftesbury in the appointment of bishops, he would not consent to the elevation to the House of Lords of so powerful a political opponent as McNeile, whom Lord John Russell had accused of frustrating for thirty years the education policy of the Liberal party. In 1860 he was appointed a canon of Chester; and in 1868 Disraeli appointed him dean of Ripon. This preferment he resigned in 1875, and he lived in retirement at Bournemouth till his death on the 28th of January 1879. McNeile married, in 1822, Anne, daughter of William Magee, archbishop of Dublin, and aunt of William Connor Magee, archbishop of York, by whom he had a large family.

Although a vehement controversialist, Hugh McNeile was a man of simple and sincere piety of character. Sir Edward Russell, an opponent alike of his religious and his political opinions, bears witness to the deep spirituality of his teaching, and describes him as an absolutely unique personality. "He made himself leader of the Liverpool people, and always led with calm and majesty in the most excited times. His eloquence was grave, flowing, emphatic—had a dignity in delivery, a perfection of elocution, that only John Bright equalled in the latter half of the

19th century. Its fire was solemn force. McNeile's voice was probably the finest organ ever heard in public oratory. His action was as graceful as it was expressive. He ruled an audience."

See J. A. Picton, *Memorials of Liverpool*, vol. i. (1873); Sir Edward Russell, "The Religious Life of Liverpool," in the *Sunday Magazine* (June 1905); Charles Bullock, *Hugh McNeile and Reformation Truth*. (R. J. M.)

MACNEILL, HECTOR (1746–1818), Scottish poet, was born near Roslin, Midlothian, on the 22nd of October 1746, the son of an impoverished army captain. He went to Bristol as a clerk at the age of fourteen, and soon afterwards was despatched to the West Indies. From 1780 to 1786 he acted as assistant secretary on board the flagships of Admiral Geary and Sir Richard Bickerton (1727–1792). Most of his later life was spent in Scotland, and it was in the house of a friend at Stirling that he wrote most of his songs and his *Scotland's Skaith, or the History of Will and Jean* (1795), a narrative poem intended to show the deteriorating influences of whisky and pothouse politics. A sequel, *The Waes of War*, appeared next year. In 1800 he published *The Memoirs of Charles Macpherson, Esq.*, a novel understood to be a narrative of his own hardships and adventures. A complete edition of the poems he wished to own appeared in 1812. His songs "Mary of Castlecary," "Come under my plaidy," "My boy Tammy," "O tell me how for to woo," "I lo'ed ne'er a lassie but ane," "The plaid amang the hether," and "Jeanie's black e'e," are notable for their sweetness and simplicity. He died at Edinburgh on the 15th of March 1818.

MACOMB, a city and the county-seat of McDonough county, Illinois, U.S.A., in the W. part of the state, about 60 m. S.W. of Peoria. Pop. (1890), 4052; (1900), 5375 (232 foreign-born); (1910), 5774. Macomb is served by the Chicago, Burlington & Quincy, and the Macomb & Western Illinois railways. The city is the seat of the Western Illinois state normal school (opened in 1902), and has a Carnegie library and a city park. Clay is found in the vicinity, and there are manufactures of pottery, bricks, &c. The city was founded in 1830 as the county-seat of McDonough county, and was called Washington by the settlers, but the charter of incorporation, also granted in 1830, gave it the present name in honour of General Alexander Macomb. Macomb was first chartered as a city in 1856.

MACOMER, a village of Sardinia in the province of Cagliari, from which it is 95 m. N.N.W. by rail, and the same distance S.W. of Golfo degli Aranci. Pop. (1901), 3488. It is situated 1890 ft. above sea-level on the southern ascent to the central plateau (the Campeda) of this part of Sardinia; and it is the junction of narrow-gauge lines branching from the main line eastwards to Nuoro and westwards to Bosa. The old parish church of S. Pantaleone has three Roman mile-stones in front of it, belonging to the Roman high-road from Carales to Turris Libisonis. The modern high-road follows the ancient. The district, especially the Campeda, is well fitted for grazing and horse and cattle breeding, which is carried on to a considerable extent. It is perhaps richer in *nuraghi* than any other part of Sardinia.

MACON, NATHANIEL (1758–1837), American political leader, was born at Macon Manor, Warren county, North Carolina, on the 17th of December 1758. He studied at the college of New Jersey (now Princeton University) from 1774 to 1776, when the institution was closed on account of the outbreak of the War of Independence; served for a short time in a New Jersey militia company; studied law at Bute Court-house, North Carolina, in 1777–1780, at the same time managing his tobacco plantation; was a member of a Warren county militia company in 1780–1782, and served in the North Carolina Senate in 1781–1785. In 1786 he was elected to the Continental Congress, but declined to serve. In 1791–1815 he was a member of the national House of Representatives, and in 1815–1828 of the United States Senate. Macon's point of view was always local rather than national. He was essentially a North Carolinian first, and an American afterwards; and throughout his career he was an aggressive advocate of state sovereignty and an adherent of the doctrines of the "Old Republicans." He at first opposed the adoption of the Federal constitution of 1787, as a member of the faction led by Willie Jones (1731–1801) of Halifax, North Carolina, but later withdrew his opposition. In Congress he denounced Hamilton's financial policy, opposed the Jay Treaty (1795) and the Alien and Sedition Acts, and advocated a continuance of the French alliance of 1778. His party came into power in 1801, and he was Speaker of the house from December 1801 to October 1807. At first he was in accord with Jefferson's administration; he approved the Louisiana Purchase, and as early as 1803 advocated the purchase of Florida. For a number of years, however, he was politically allied with John Randolph.[1] As speaker, in spite of strong opposition, he kept Randolph at the head of the important committee on Ways and Means from 1801 to 1806; and in 1805–1808, with Randolph and Joseph H. Nicholson (1770–1817) of Maryland, he was a leader of the group of about ten independents, called the "Quids," who strongly criticized Jefferson and opposed the presidential candidature of Madison. By 1809, however, Macon was again in accord with his party, and during the next two years he was one of the most influential of its leaders. In December 1809 he introduced resolutions which combined the ideas of Peter Early (1773–1817) of Georgia, David R. Williams (1776–1830) of South Carolina, and Samuel W. Dana (1757–1830) of Connecticut with his own. The resolutions recommended the complete exclusion of foreign war vessels from United States ports and the suppression of illegal trade carried on by foreign merchants under the American flag. The substance of these resolutions was embodied in the "Macon Bill, No. 1," which passed the House but was defeated in the Senate. On the 7th of April 1810 Macon reported from committee the "Macon Bill, No. 2," which had been drawn by John Taylor (1770–1832) of South Carolina, and was not actively supported by him. This measure (amended) became law on the 1st of May, and provided for the repeal of the Non-Intercourse Act of 1809, authorized the president, "in case either Great Britain or France shall before the 3rd day of March next so revoke or modify her edicts as that they shall cease to violate the neutral commerce of the United States," to revive non-intercourse against the other, and prohibited British and French vessels of war from entering American waters. In 1812 Macon voted for the declaration of war against Great Britain, and later was chairman of the Congressional committee which made a report (July 1813) condemning Great Britain's conduct of the war. He opposed the Bank Act of 1816, the "internal improvements" policy of Calhoun (in the early part of his career) and Clay, and the Missouri Compromise, his speech against the last being especially able. In 1824 Macon received the electoral vote of Virginia for the vice-presidency, and in 1826–1828 was president pro tempore of the Senate. He was president of the North Carolina constitutional convention in 1835, and was an elector on the Van Buren ticket in 1836. He died at his home, Buck Springs, Warren county, North Carolina, on the 29th of June 1837.

See William E. Dodd, *The Life of Nathaniel Macon* (Raleigh, N.C., 1903); E. M. Wilson, *The Congressional Career of Nathaniel Macon* (Chapel Hill, N.C., 1900).

MÂCON, a town of east-central France, capital of the department of Saône-et-Loire, 45 m. N. of Lyons on the Paris-Lyon railway. Pop. (1906), 16,151. Mâcon is situated on the right bank of the Saône facing the plain of the Bresse; a bridge of twelve arches connects it with the suburb of St Laurent on the opposite bank. The most prominent building is the modern Romanesque church of St Pierre, a large three-naved basilica, with two fine spires. Of the old cathedral of St Vincent (12th and 13th centuries), destroyed at the Revolution, nothing remains but the Romanesque narthex, now used as a chapel, the façade and its two flanking towers. The hôtel de ville contains a library, a theatre and picture-gallery. Opposite to it stands a statue of the poet Alphonse Lamartine, a native of the town. Mâcon is the seat of a prefecture, and has tribunals of first instance and of commerce, and a chamber of commerce. There are lycées and training colleges. Copper-founding is an important industry; manufactures include casks, mats, rope and utensils for the wine-trade. The town has a large trade in wine of the district, known as Mâcon. It is a railway centre of considerable importance, being the point at which the line from Paris to Marseilles is joined by that from Mont Cenis and Geneva, as well as by a branch from Moulins.

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[1] Their names are associated in Randolph-Macon College, named in their honour in 1830.

Mâcon (*Matisco*) was an important town of the Aedui, but under the Romans it was supplanted by Autun and Lyons. It suffered a succession of disasters at the hands of the Germans, Burgundians, Vandals, Huns, Hungarians and even of the Carolingian kings. In the feudal period it was an important countship which in 1228 was sold to the king of France, but more than once afterwards passed into the possession of the dukes of Burgundy, until the ownership of the French crown was established in the time of Louis XI. In the 16th century Mâcon became a stronghold of the Huguenots, but afterwards fell into the hands of the League, and did not yield to Henry IV. until 1594. The bishopric, created by King Childebert, was suppressed in 1790.

MACON, a city and the county-seat of Bibb county, Georgia, U.S.A., in the central part of the state, on both sides of the Ocmulgee river (at the head of navigation), about 90 m. S.S.E. of Atlanta. Pop. (1900), 23,272, of whom 11,550 were negroes; (1910 census) 40,665. Macon is, next to Atlanta, the most important railway centre in the state, being served by the Southern, the Central of Georgia, the Georgia, the Georgia Southern & Florida, the Macon Dublin & Savannah, and the Macon & Birmingham railways. It was formerly an important river port, especially for the shipment of cotton, but lost this commercial advantage when railway bridges made the river impassable. It is, however, partially regaining the river trade in consequence of the compulsory substitution of drawbridges for the stationary railway bridges. The city is the seat of the Wesleyan female college (1836), which claims to be the first college in the world chartered to grant academic degrees to women; Mercer University (Baptist), which was established in 1833 as Mercer Institute at Penfield, became a university in 1837, was removed to Macon in 1871, and controls Hearn Academy (1839) at Cave Spring and Gibson Mercer Academy (1903) at Bowman; the state academy for the blind (1852), St Stanislaus' College (Jesuit), and Mt de Sales Academy (Roman Catholic) for women. There are four orphan asylums for whites and two for negroes, supported chiefly by the Protestant Episcopal and Methodist Churches, and a public hospital. Immediately east of Macon are two large Indian mounds, and there is a third mound 9 m. south of the city. Situated in the heart of the "Cotton Belt," Macon has a large and lucrative trade; it is one of the most important inland cotton markets of the United States, its annual receipts averaging about 250,000 bales. The city's factory products in 1905 were valued at $7,297,347 (33·8% more than in 1900). In the vicinity are large beds of kaolin, 30 m. wide, reaching nearly across the state, and frequently 35 to 70 ft. in depth. Macon is near the fruit-growing region of Georgia, and large quantities of peaches and of garden products are annually shipped from the city.

Macon (named in honour of Nathaniel Macon) was surveyed in 1823 by order of the Georgia legislature for the county-seat of Bibb county, and received its first charter in 1824. It soon became the centre of trade for Middle Georgia; in 1833 a steamboat line to Darien was opened, and in the following year 69,000 bales of cotton were shipped by this route. During the Civil War the city was a centre for Confederate commissary supplies and the seat of a Treasury depository. In July 1864 General George Stoneman (1822–1894) with 500 men was captured near the city by the Confederate general, Howell Cobb. Macon was finally occupied by Federal troops under General James H. Wilson (b. 1837) on the 20th of April 1865. In 1900–1910 the area of the city was increased by the annexation of several suburbs.

MACPHERSON, SIR DAVID LEWIS (1818–1896), Canadian financier and politician, was born at Castle Leathers, near Inverness, Scotland, on the 12th of September 1818. In 1835 he emigrated to Canada, settling in Montreal, where he built up a large fortune by "forwarding" merchandise. In 1853 he removed to Toronto, and in the same year obtained the contract for building a line of railway from Toronto to Sarnia, a project from which sprang the Grand Trunk railway, in the construction of which line he greatly increased his wealth. In 1864 he was elected to the Canadian parliament as member of the Legislative Council for Saugeen, and on the formation of the Dominion, in 1867, was nominated to the Senate. In the following years he published a number of pamphlets on economic subjects, of which the best-known is *Banking and Currency* (1869). In 1880 he was appointed Speaker of the Senate, and from October 1883 till 1885 was minister of the interior in the Conservative cabinet. In 1884 he was knighted by Queen Victoria. He died on the 16th of August 1896.

MACPHERSON, JAMES (1736–1796), Scottish "translator" of the Ossianic poems, was born at Ruthven in the parish of Kingussie, Inverness, on the 27th of October 1736. He was sent in 1753 to King's College, Aberdeen, removing two years later to Marischal College. He also studied at Edinburgh, but took no degree. He is said to have written over 4000 lines of verse while a student, but though some of this was published, notably *The Highlander* (1758), he afterwards tried to suppress it. On leaving college he taught in the school of his native place. At Moffat he met John Home, the author of *Douglas*, for whom he recited some Gaelic verses from memory. He also showed him MSS. of Gaelic poetry, supposed to have been picked up in the Highlands, and, encouraged by Home and others, he produced a number of pieces translated from the Gaelic, which he was induced to publish at Edinburgh in 1760 as *Fragments of Ancient Poetry collected in the Highlands of Scotland*. Dr Hugh Blair, who was a firm believer in the authenticity of the poems, got up a subscription to allow Macpherson to pursue his Gaelic researches. In the autumn he set out to visit western Inverness, the islands of Skye, North and South Uist and Benbecula. He obtained MSS. which he translated with the assistance of Captain Morrison and the Rev. A. Gallie. Later in the year he made an expedition to Mull, when he obtained other MSS. In 1761 he announced the discovery of an epic on the subject of Fingal, and in December he published *Fingal, an Ancient Epic Poem in Six Books, together with Several Other Poems composed by Ossian, the Son of Fingal, translated from the Gaelic Language*, written in the musical measured prose of which he had made use in his earlier volume. *Temora* followed in 1763, and a collected edition, *The Works of Ossian*, in 1765.

The genuineness of these so-called translations from the works of a 3rd-century bard was immediately challenged in England, and Dr Johnson, after some local investigation, asserted (*Journey to the Western Islands of Scotland*, 1775) that Macpherson had only found fragments of ancient poems and stories, which he had woven into a romance of his own composition. Macpherson is said to have sent Johnson a challenge, to which Johnson replied that he was not to be deterred from detecting what he thought a cheat by the menaces of a ruffian. Macpherson never produced his originals, which he refused to publish on the ground of the expense. In 1764 he was made secretary to General Johnstone at Pensacola, West Florida, and when he returned, two years later, to England, after a quarrel with Johnstone, he was allowed to retain his salary as a pension. He occupied himself with writing several historical works, the most important of which was *Original Papers, containing the Secret History of Great Britain from the Restoration to the Accession of the House of Hanover; to which are prefixed Extracts from the Life of James II., as written by himself* (1775). He enjoyed a salary for defending the policy of Lord North's government, and held the lucrative post of London agent to Mahommed Ali, nabob of Arcot. He entered parliament in 1780, and continued to sit until his death. In his later years he bought an estate, to which he gave the name of Belville, in his native county of Inverness, where he died on the 17th of February 1796.

After Macpherson's death, Malcolm Laing, in an appendix to his *History of Scotland* (1800), propounded the extreme view that the so-called Ossianic poems were altogether modern in origin, and that Macpherson's authorities were practically non-existent. For a discussion of this question see CELT: *Scottish Gaelic Literature*. Much of Macpherson's matter is clearly his own, and he confounds the stories belonging to different cycles. But apart from the doubtful morality of his transactions he must still be regarded as one of the great Scottish writers. The varied sources of his work and its worthlessness as a transcript of actual Celtic poems do not alter the fact that he produced a work of art which by its deep appreciation of natural beauty and the melancholy tenderness of its treatment of the ancient legend did more than any single work to bring about the romantic movement in European, and especially in German, literature. It was speedily translated into many European languages, and Herder and Goethe (in his earlier period) were among its profound admirers. Cesarotti's Italian translation was one of Napoleon's favourite books.

AUTHORITIES.—For Macpherson's life, see *The Life and Letters of James Macpherson* . . . (1894, new ed., 1906), by T. Bailey Saunders, who has laboured to redeem his character from the suspicions generally current with English readers. The antiquity of the Ossianic poems was defended in the introduction by Archibald Clerk to his edition of the *Poems of Ossian* (1870). Materials for arriving at a decision by comparison with undoubtedly genuine fragments of the Ossianic legend are available in *The Book of the Dean of Lismore*, Gaelic verses, collected by J. McGregor, dean of Lismore, in the early 16th century (ed. T. McLauchlan, 1862); the *Leabhar na Feinne* (1871) of F. J. Campbell, who also discusses the subject in *Popular Tales of the Western Highlands*, iv. (1893). See also L. C. Stern, "Die ossianische Heldenlieder "in *Zeitschrift für vergleichende Litteratur-geschichte* (1895; Eng. trans. by J. L. Robertson in *Trans. Gael. Soc. of Inverness*, xxii., 1897–1898); Sir J. Sinclair, *A Dissertation on the Authenticity of the Poems of Ossian* (1806); *Transactions of the Ossianic Society* (Dublin, 1854–1861); *Cours de littérature celtique*, by Arbois de Jubainville, editor of the *Revue celtique* (1883, &c.); A. Nutt, *Ossian and the Ossianic Literature* (1899), with a valuable bibliographical appendix; J. S. Smart, *James Macpherson: an Episode in Literature* (1905).

McPHERSON, JAMES BIRDSEYE (1828–1864), American soldier, was born at Sandusky, Ohio, on the 14th of November 1828. He entered West Point at the age of twenty-one, and graduated (1853) at the head of his class, which included Sheridan, Schofield and Hood. He was employed at the military academy as instructor of practical military engineering (1853). A year later he was sent to engineer duty at New York, and in 1857, after constructing Fort Delaware, he was sent as superintending engineer to San Francisco, becoming 1st lieutenant in 1858. He was promoted captain during the first year of the Civil War, and towards the close of 1861 became lieutenant-colonel and aide-de-camp to General Halleck, who in the spring of 1862 sent him to General Grant as chief engineer. He remained with Grant during the Shiloh campaign, and acted as engineer adviser to Halleck during the siege operations against Corinth in the summer of 1862. In October he distinguished himself in command of an infantry brigade at the battle of Corinth, and on the 8th of this month was made major-general of volunteers and commander of a division. In the second advance on Vicksburg (1863) McPherson commanded the XVII. corps, fought at Port Gibson, Raymond and Jackson, and after the fall of Vicksburg was strongly recommended by Grant for the rank of brigadier-general in the regular army, to which he was promoted on the 1st of August 1863. He commanded at Vicksburg until the following spring. He was about to go on leave of absence in order to be married in Baltimore when he received his nomination to the command of the Army of the Tennessee, Grant's and Sherman's old army, which was to take part under Sherman's supreme command in the campaign against Atlanta (1864). This nomination was made by Sherman and entirely approved by Grant, who had the highest opinion of McPherson's military and personal qualities. He was in command of his army at the actions of Resaca, Dallas, Kenesaw Mountain and the battles about Atlanta. On the 22nd of July, when the Confederates under his old classmate Hood made a sudden and violent attack on the lines held by the Army of the Tennessee, McPherson rode up, in the woods, to the enemy's firing line and was killed. He was one of the most heroic figures of the American Civil War, and Grant is reported to have said when he heard of McPherson's death, "The country has lost one of its best soldiers, and I have lost my best friend."

MACQUARIE, a British island in the South Pacific Ocean, in 54° 49′ S. and 159° 49′ E. It is about 20 m. long, and covered with a grassy vegetation, with some trees or shrubs in the sheltered places which afford food to a parrot of the genus *Cyanorhamphus*, allied to those of the Auckland Islands. Although it has no settled population, Macquarie is constantly visited by sailors in quest of the seals which abound in its waters.

MACRAUCHENIA, a long-necked and long-limbed, three-toed South American ungulate mammal, typifying the suborder *Litopterna* (*q.v.*).

MACREADY, WILLIAM CHARLES (1793–1873), English actor, was born in London on the 3rd of March 1793, and educated at Rugby. It was his intention to go up to Oxford, but in 1809 the embarrassed affairs of his father, the lessee of several provincial theatres, called him to share the responsibilities of theatrical management. On the 7th of June 1810 he made a successful first appearance as Romeo at Birmingham. Other Shakespearian parts followed, but a serious rupture between father and son resulted in the young man's departure for Bath in 1814. Here he remained for two years, with occasional professional visits to other provincial towns. On the 16th of September 1816, Macready made his first London appearance at Covent Garden as Orestes in *The Distressed Mother*, a translation of Racine's *Andromaque* by Ambrose Philips. Macready's choice of characters was at first confined chiefly to the romantic drama. In 1818 he won a permanent success in Isaac Pocock's (1782–1835) adaptation of Scott's *Rob Roy*. He showed his capacity for the highest tragedy when he played Richard III. at Covent Garden on the 25th of October 1819. Transferring his services to Drury Lane, he gradually rose in public favour, his most conspicuous success being in the title-rôle of Sheridan Knowles's *William Tell* (May 11, 1825). In 1826 he completed a successful engagement in America, and in 1828 his performances met with a very flattering reception in Paris. On the 15th of December 1830 he appeared at Drury Lane as Werner, one of his most powerful impersonations. In 1833 he played in *Antony and Cleopatra*, in Byron's *Sardanapalus*, and in *King Lear*. Already Macready had done something to encourage the creation of a modern English drama, and after entering on the management of Covent Garden in 1837 he introduced Robert Browning's *Strafford*, and in the following year Bulwer's *Lady of Lyons* and *Richelieu*, the principal characters in which were among his most effective parts. On the 10th of June 1838 he gave a memorable performance of *Henry V.*, for which Stanfield prepared sketches, and the mounting was superintended by Bulwer, Dickens, Forster, Maclise, W. J. Fox and other friends. The first production of Bulwer's *Money* took place under the artistic direction of Count d'Orsay on the 8th of December 1840, Macready winning unmistakable success in the character of Alfred Evelyn. Both in his management of Covent Garden, which he resigned in 1839, and of Drury Lane, which he held from 1841 to 1843, he found his designs for the elevation of the stage frustrated by the absence of adequate public support. In 1843–1844 he made a prosperous tour in the United States, but his last visit to that country, in 1849, was marred by a riot at the Astor Opera House, New York, arising from the jealousy of the actor Edwin Forrest, and resulting in the death of seventeen persons, who were shot by the military called out to quell the disturbance. Macready took leave of the stage in a farewell performance of Macbeth at Drury Lane on the 26th of February 1851. The remainder of his life was spent in happy retirement, and he died at Cheltenham on the 27th of April 1873. He had married, in 1823, Catherine Frances Atkins (d. 1852). Of a numerous family of children only one son and one daughter survived. In 1860 he married Cecile Louise Frederica Spencer (1827–1908), by whom he had a son.

Macready's performances always displayed fine artistic perceptions developed to a high degree of perfection by very comprehensive culture, and even his least successful personations had the interest resulting from thorough intellectual study. He belonged to the school of Kean rather than of Kemble; but, if his tastes were better disciplined and in some respects more refined than those of Kean, his natural temperament did not permit him to give proper effect to the great tragic parts of Shakespeare, *King Lear* perhaps excepted, which afforded scope for his pathos and tenderness, the qualities in which he specially excelled. With the exception of a voice of good compass and capable of very varied expression, Macready had no especial physical gifts for acting, but the defects of his face and figure cannot be said to have materially affected his success.

See *Macready's Reminiscences*, edited by Sir Frederick Pollock, 2 vols. (1875); *William Charles Macready*, by William Archer (1890).

MACROBIUS, AMBROSIUS THEODOSIUS, Roman grammarian and philosopher, flourished during the reigns of Honorius and Arcadius (395–423). He himself states that he was not a Roman, but there is no certain evidence whether he was of Greek or perhaps African descent. He is generally supposed to have been praetorian praefect in Spain (399), proconsul of Africa (410), and lord chamberlain (422). But the tenure of high office at that date was limited to Christians, and there is no evidence in the writings of Macrobius that he was a Christian. Hence the identification is more than doubtful, unless it be assumed that his conversion to Christianity was subsequent to the composition of his books. It is possible, but by no means certain, that he was the Theodosius to whom Avianus dedicates his fables.

The most important of his works is the *Saturnalia*, containing an account of the discussions held at the house of Vettius Praetextatus (*c.* 325–385) during the holiday of the Saturnalia. It was written by the author for the benefit of his son Eustathius (or Eustachius), and contains a great variety of curious historical, mythological, critical and grammatical disquisitions. There is but little attempt to give any dramatic character to the dialogue; in each book some one of the personages takes the leading part, and the remarks of the others serve only as occasions for calling forth fresh displays of erudition. The first book is devoted to an inquiry as to the origin of the Saturnalia and the festivals of Janus, which leads to a history and discussion of the Roman calendar, and to an attempt to derive all forms of worship from that of the sun. The second book begins with a collection of *bons mots*, to which all present make their contributions, many of them being ascribed to Cicero and Augustus; a discussion of various pleasures, especially of the senses, then seems to have taken place, but almost the whole of this is lost. The third, fourth, fifth and sixth books are devoted to Virgil, dwelling respectively on his learning in religious matters, his rhetorical skill, his debt to Homer (with a comparison of the art of the two) and to other Greek writers, and the nature and extent of his borrowings from the earlier Latin poets. The latter part of the third book is taken up with a dissertation upon luxury and the sumptuary laws intended to check it, which is probably a dislocated portion of the second book. The seventh book consists largely of the discussion of various physiological questions. The value of the work consists solely in the facts and opinions quoted from earlier writers, for it is purely a compilation, and has little in its literary form to recommend it. The form of the *Saturnalia* is copied from Plato's *Symposium* and Gellius's *Noctes atticae*; the chief authorities (whose names, however, are not quoted) are Gellius, Seneca the philosopher, Plutarch (*Quaestiones conviviales*), Athenaeus and the commentaries of Servius (excluded by some) and others on Virgil. We have also two books of a commentary on the *Somnium Scipionis* narrated by Cicero in his *De republica*. The nature of the dream, in which the elder Scipio appears to his (adopted) grandson, and describes the life of the good after death and the constitution of the universe from the Stoic point of view, gives occasion for Macrobius to discourse upon many points of physics in a series of essays interesting as showing the astronomical notions then current. The moral elevation of the fragment of Cicero thus preserved to us gave the work a popularity in the middle ages to which its own merits have little claim. Of a third work, *De differentiis et societatibus graeci latinique verbi*, we only possess an abstract by a certain Johannes, identified with Johannes Scotus Erigena (9th century).

See editions by L. von Jan (1848–1852, with bibliog. of previous editions, and commentary) and F. Eyssenhardt (1893, Teubner text); on the sources of the *Saturnalia* see H. Linke (1880) and G. Wissowa (1880). The grammatical treatise will be found in Jan's edition and H. Keil's *Grammatici latini*, v.; see also G. F. Schömann, *Commentatio macrobiana* (1871).

MACROOM, a market town in the western part of county Cork, Ireland, on the river Sullane, an affluent of the Lee, 24½ m. W. of Cork by the Cork & Macroom railway, of which it is the terminus. Pop. (1901), 3016. Besides a fine Roman Catholic church, a court house and barracks, Macroom possesses a modernized castle, which is said to have been founded by King John, though it is more probably attributable to Norman invaders. It was besieged more than once in the 17th century, and is said to have been the birthplace of Admiral Sir William Penn, whose more famous son founded Pennsylvania. Here some rebels of 1798 were executed and their heads exhibited on the spikes of the castle gate. Macroom has trade in corn-milling, leather-work and dairy produce, and is a good centre for salmon and trout fishing. It is governed by an urban district council.

MACUGNAGA, a village of Piedmont, Italy, in the province of Novara, 20 m. W.S.W. of Piedimulera, which is 7 m. S. of Domodossola by rail. Pop. (1901), 798. It is situated 4047 ft. above sea-level, and is 10 m. N.E. of the highest summit of Monte Rosa. It is frequented as a summer resort.

MACVEAGH, WAYNE (1833–   ), American lawyer and diplomatist, was born near Phoenixville, Chester county, Pa., on the 19th of April 1833. He graduated at Yale in 1853, was admitted to the bar in 1856, and was district attorney of Chester county in 1859–1864. He held commands in militia forces raised to meet threatened Confederate invasions of Pennsylvania (1862–63). He became a leader in the Republican party, and was a prominent opponent of his father-in-law, Simon Cameron, in the fight within the party in 1871. MacVeagh was minister to Turkey in 1870–1871; was a member of the state constitutional convention of 1872–1873; was chairman of the "MacVeagh Commission," sent in 1877 by President Hayes to Louisiana, which secured the settlement of the contest between the two existing state governments and thus made possible the withdrawal of Federal troops from the state; and was attorney-general of the United States in 1881 under President Garfield, but resigned immediately after Garfield's death. In 1892 he supported Grover Cleveland, the Democratic nominee for the presidency, and from 1893 to 1897 was ambassador to Italy. He returned to the Republican party in 1896. In 1903 he was chief counsel of the United States before the Hague tribunal in the case regarding the claims of Germany, Great Britain and Italy against the republic of Venezuela.

MADÁCH, IMRE (1829–1864), Hungarian dramatist, was born at Alsó-Sztregova. He took part in the great revolution of 1848–49 and was imprisoned; on his return to his small estate in the county of Nógrád, he found that his family life had meanwhile been completely wrecked. This only increased his natural tendency to melancholy, and he withdrew from public life till 1861, devoting his time mainly to the composition of his chief work, *Az ember tragoediája* ("The Tragedy of Man"). John Arany, then at the height of his fame as a poet, at once recognized the great merits of that peculiar drama, and Madách enjoyed a short spell of fame before his untimely death of heart-disease in 1864. In *The Tragedy of Man* Madách takes us from the hour when Adam and Eve were innocently walking in the Garden of Eden to the times of the Pharaohs; then to the Athens of Miltiades; to declining Rome; to the period of the crusades; into the study of the astronomer Kepler; thence into the horrors of the French Revolution; into greed-eaten and commerce-ridden modern London; nay, into the ultra-Socialist state of the future, when all the former ideals of man will by scientific formulae be shown up in their hollowness; still further, the poet shows the future of ice-clad earth, when man will be reduced to a degraded brute dragging on the misery of his existence in a cave. In all these scenes, or rather anticipatory dreams, Adam, Eve and the arch-fiend Lucifer are the chief and constantly recurring *personae dramatis*. In the end, Adam, despairing of his race, wants to commit suicide, when at the critical moment Eve tells him that she is going to be a mother. Adam then prostrates himself before God, who encourages him to hope and trust. The diction of the drama is elevated and pure, and although not meant for the stage, it has proved very effective at several public performances.

Concerning Madách there is an ample literature, consisting mostly of elaborate articles by Charles Szász (1862), Augustus Greguss (1872), B. Alexander (1871), M. Palágyi (1890), and others.

MADAGASCAR, an island in the Indian Ocean, and after New Guinea and Borneo the largest island in the world, about 260 m. distant, at the nearest point, from the S.E. coast of Africa, from which it is separated by the Mozambique Channel. Since 1896 Madagascar has been a French colony. It is 995 m. in length from N. to S., and about 250 m. in average breadth, although near the centre it is nearly 360 m. across; its area is about 228,000 sq. m., or not quite four times the extent of England and Wales. It lies mainly between 44° and 50° E. Its northernmost point, Cape Ambro, in 12° S., inclines 16° to the E. from the longitude of Cape St Mary, the southernmost point, in 25° 35′ S., so that the main axis of the island runs from N.N.E. to S.S.W. In its broad structure Madagascar consists of an elevated mountainous region, from 3000 to 5000 ft. in altitude, occupying from two-fifths to a half of the centre and the eastern side of the island, around which are extensive plains at a much less elevation above the sea, and most developed on the western and north-west sides. But this lower region is broken up by masses of hills, with several elevated plateaus, especially in the south-west and south.

Physical Features.—Madagascar has a very regular and compact form, with few indentations considering its great extent of shore-line. In general outline it has a strong resemblance to the impression of a human foot—the left side. Along two-thirds of its eastern side the coast is almost a straight line, without any inlet, Tamatave, the chief port on this side of the island, being only protected by coral reefs. North of this line, however, is Antongil Bay, a deep and wide inlet running northwards for about 50 m.; farther north is Port Louquez, and at almost the extreme point of the island is Diego-Suarez Bay, one of the finest harbours in the world. But the north-western side of Madagascar is broken up by a number of inlets, some of them land-locked and of considerable size. South of Cape St Andrew, the north-west angle of the island, the coast-line is unbroken until the estuary of the river Onilàhy, or St Augustine's Bay, is reached. Rounding the southern end of the island, there is no other inlet save the small bay north of Fort Dauphin, at the southern end of the straight line of coast already mentioned.

The islands around Madagascar are few and unimportant. The largest are Ste Marie, near the eastern coast, a narrow island about 35 m. long, and Nossi-bé (*q.v.*), larger and more compact in form, opposite Ampàsindàva Bay on the N.W. coast. Except the Minnow group, north of Nossi-bé, the rest are merely rocky islets, chiefly of coral.

The shores of the greater portion of the southern half of the island are low and flat, but in the northern half the coast is often bold and precipitous, the high land occasionally approaching the sea. On the eastern side the plains vary from 10 to 50 m. in breadth, but on the western side they exceed in some localities 100 m. From these coast-plains the ground rises by successive ranges of hills to the high interior land. This elevated region is broken in all directions by mountains, from which the crystalline rocks show most frequently as huge bosses, and in certain regions present very varied and picturesque outlines, resembling Titanic castles, cathedrals, domes, pyramids and spires. The highest mountain mass is centrally situated as regards the length of the island, but more to the eastern side. This is the ancient extinct volcano Ankàratra, three of the highest points varying in elevation from 7284 to 8635 ft. above the sea, and from 4000 to 5000 ft. above the general level of the surrounding country. The loftiest of these is named Tsi-àfa-jàvona, *i.e.* "That which the mists cannot climb." It had been supposed that Ankàratra was the highest point in the island, but in 1903 it was found that Ambòro, in the northern province of Antankàrana, is about 9490 ft. in altitude. Besides these highest points there are a considerable number of mountains in the central provinces of Imèrina and Bétsiléo and the intervening and surrounding districts; and in the Bàra country the Isàlo range has been compared to the "Church Buttes" and other striking features of the scenery of Utah. One of the finest of the Madagascar mountains is an isolated mass near the northern point of the island called Ambòhitra. This is 4460 ft. high, and rising from land little above the sea-level, is well seen far out to sea.

In the elevated region of Madagascar are many fertile plains and valleys, the former being the dried-up beds of ancient lakes. Among these are Bètsimitàtatra in Imèrina, and Tsiènimparihy in Bétsiléo, supplying a large proportion of the rice required for the capitals of these two provinces. Still more spacious valleys are the Antsihànaka country and the Ankày district, between the two eastern lines of forest. The extensive coast plains on the western side of the island are chiefly in Ibòina (N.W.) and in Ménabé (S. of the Tsiribihina River); those on the east are widest in the Taifàsy country (S.E.). The water-parting for six-sevenths of the whole length of the island is much nearer the eastern than the western side, averaging from 80 to 90 m. from the sea. There are no arid districts, except in the extreme south-west and towards the southern point of the island. The general surface of the interior highland consists of bare rolling moor-like country, with a great amount of red clay-like soil, while the valleys have a rich humus of bluish-black alluvium.

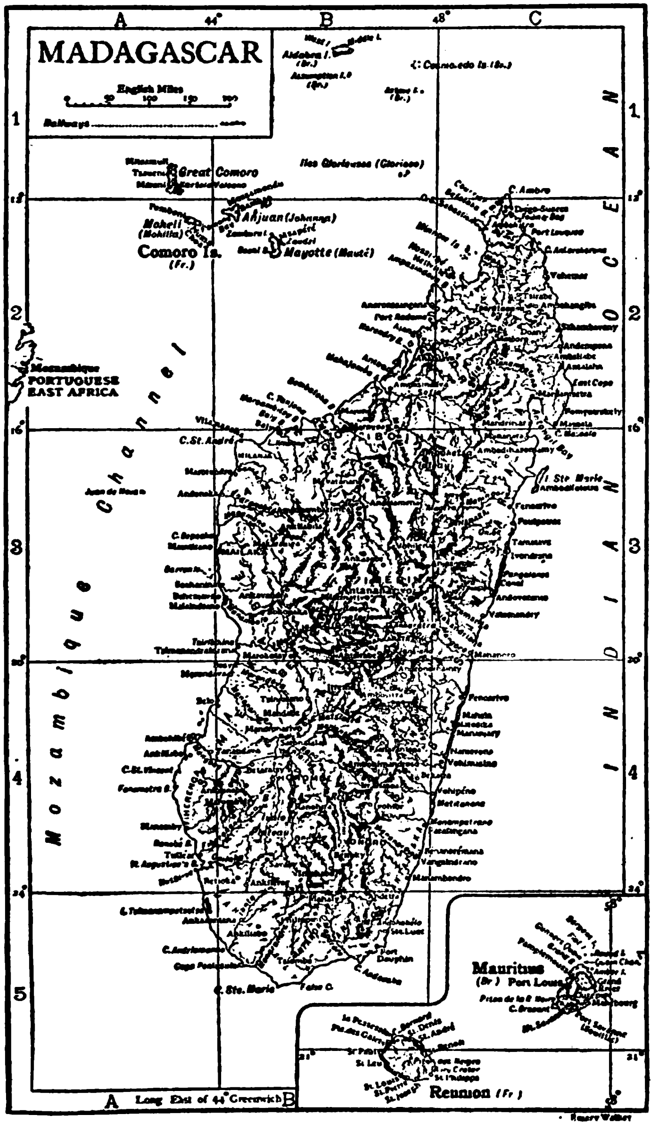
The chief rivers flow to the west and north-west sides of the island. The eastern streams are all less in size, except the Mangòro, which flows parallel with the coast. Few of them therefore are of much service for navigation, except for the light-draught native canoes; and all of them are more or less closed at their outlets by sand-bars. Beginning at the south-eastern point and going northwards, the principal rivers are the Mànanàra, Mànampàtrana, Màtitànana, Mànanjàry, Mangòro, with its great affluent Onivé, Vòhitra, Màniagòry, and the Antànambàlana at the head of Antongil Bay. On the N.W. coast, going southwards, are the Sofià and Màhajàmba, falling into Màhajàmba Bay, the Bètsibòka with the Ikòpa—the great drains of the northern central provinces, forming unitedly the second largest river of the island and falling into Bèmbatòka Bay—the Màhavàry, Mànambòlo, Tsìribìhina or Onimàinty, the third largest river, with its tributaries the Kìtsàmby, Màhajìlo and Manìa, the Mòrondàva, Mangòky, probably the largest river in the country, with its important tributaries the Matsìatra, Mànantànana and Rànomàitso, the Fiherènana and Onilàhy. On the south coast are four considerable streams, the largest of which is the Mènaràndra. Of the western rivers the Bètsibòka can be ascended by small steamers for about 100 m., and the Tsìribìhina is also navigable for a considerable distance. The former is about 300 m. long; the latter somewhat less, but by its affluents spreads over a greater extent of country, as also does the Mangòky. The rivers are all crossed frequently by rocky bars, which often form grand waterfalls. The eastern rivers cut their way through the ramparts of the high land by magnificent gorges amidst dense forest, and descend by a succession of rapids and cataracts. The Màtitànana, whose falls were first seen by the writer in 1876, descends at one plunge some 400 ft.; and on the Vòhitra River, whose valley is followed by the railway, there are also many fine waterfalls.

On the eastern side of Madagascar the contest between the fresh water of the rivers and the sea has caused the formation of a chain of lagoons for nearly 300 m. In many places these look like a river following the coast-line, but frequently they spread out into extensive sheets of water. By cutting about 30 m. of canal to connect them, a continuous waterway could be formed for 270 m. along the coast. This has already been done for about 55 m. between Ivòndrona and Andòvorànto, a service of small steamers forming part of the communication between the coast and the capital. Besides these lagoons, there are few lakes of any size in Madagascar, although there were some very extensive lakes in a recent geological epoch. Of the largest of these, the Alàotra Lake in the Antsihànaka plain is the relic; it is about 25 m. long. Next comes Kinkòny, near Maròambitsy Bay (N.W. coast), about 16 m. long, and then Itàsy, in western Imèrina, about half as large. There is also a salt lake, Tsimànampetsòtsa (S.W. coast), about as large as Alàotra.

There is now no active volcano in Madagascar, but a large number of extinct cones are found, some apparently of very recent formation. Some miles south of Diégo-Suarez is a huge volcanic mountain, Ambòhitra, with scores of subsidiary cones on its slopes and around its base. About 40 m. south-west of Antanànarivo there is a still larger extinct volcano, Ankàratra, with an extensive lava field surrounding it; while near Lake Itàsy are some 200 volcanic cones. Another group of extinct volcanoes is in the Vàkinankàratra district, S.W. of Ankàratra. Many others exist in other parts of the island (see § *Geology*). Slight shocks of earthquake are felt every year, and hot springs occur at many places. Several of these are sulphurous and medicinal, and have been found efficacious in skin diseases and in internal complaints.

Geology.—Madagascar may be divided into two very distinct geological regions, viz. (I.) the Archean Region, which extends over the central and eastern portions of the island and occupies about two-thirds of its whole area, and is composed of crystalline schists; and (II.) the Western Region, of sedimentary rocks, including the remaining third of the island, in the centre of which, however, is an isolated patch of Archean rocks, near Cape St Andrew. There are also found in both regions numerous masses of igneous rocks, both plutonic and volcanic, in some places of considerable extent, which pierce through and overflow the earlier formations.

I. *The Archean Region.*[1]—This region, nearly coincident with the mountainous upper portion of the island, is chiefly composed of the following crystalline rocks: gneiss, which is the most common of them all, quartzite and quartz-schist, with occasional beds of crystalline limestone and mica-schist, although this latter rock is very rare. The gneiss is mostly grey, but occasionally pinkish, its essential constituents (felspar and quartz) being almost always associated with dark mica (biotite) and hornblende in variable quantity. The rock is therefore a hornblende-granitite-gneiss. Granite—more frequently granitite—occurs in several places, as well as pyroxene-granulite, serpentine, argillate, &c.; and gold is found widely disseminated, as well as other metals, but these latter, as far as at present known, except iron, are not abundant. The general strike of the rocks is the same as that of the trend of the island itself (N.N.E. to S.S.W.), but in its western portion the strike is frequently from N.N.W. to S.S.E. In both cases the strike of the rocks is coincident with the direction of several large valleys, which mark huge faults in the crystalline rocks. Almost the whole of this region is covered by a red soil, often of great thickness, which resembles and is often described as "clay," but is really decomposed rock, chiefly gneiss, reddened with oxidized magnetite.



II. *The Sedimentary Region.*—The sedimentary rocks extend continuously along the western side of Madagascar, following the coast-line; in the north these series of strata are only from 20 to 30 m. across, but farther south they reach a breadth of nearly 100 m., while opposite the Bétsiléo province they extend nearly half across the island. A narrow band, of Cretaceous age, occurs also on the east coast, for about 120 m., between Vàtomàndry and Mànanjàry. The following formations are represented:—

1. *Primary.* It is thought that certain beds of slaty rocks, which have been recognized at different places, may belong to some of the Primary strata. Some siliceous schists of the Permian age were discovered in 1908 in the valley of the Sàkamèira, south of the Onilàhy, or Augustine river. (S.W. coast). These contain reptilian remains, and also clear imprints of leaves of the *Glossopteris indica*, as well as other indications of an ancient vegetation. In the same region conglomerates have been found containing enormous blocks, apparently brought by glacial action, and said to be identical in character with those described as existing in the Transvaal. True coal has also been obtained in the same district, the deposits varying from a third to half a metre in thickness.

2. *Secondary.* The lowest members of these rest directly upon the central mass of crystalline rocks, and consist of sandstones, conglomerates and shales, which have been supposed by some to belong to the Trias, without, however, the discovery of any fossil necessary to confirm this supposition, except some silicified trunks of trees. These beds are most probably lower members of the Jurassic series. Westward of and above these strata, the Middle and Upper Jurassic formations are found (Lias, Lower Oolite, Oxfordian, &c.), with well-marked and numerous fossils (*Ammonites*, *Nerinaea*, *Natica*, *Astarte*, *Rhynchonella*, *Echinodermata*, &c.); then the Cretaceous rocks, both these and the Jurassic series being largely developed, the Cretaceous fossils including *Nautilus*, *Belemnites*, *Ostrea*, *Gryphaea*, &c., and some very large Ammonites (*Pachydiscus*). The Secondary strata show generally a very slight dip westwards and are consequently almost horizontal. They do not seem to have been greatly disturbed, although faults occur here and there.

3. *Tertiary.* A small strip of coast of Eocene age is known near Tullear (S.W. coast), and rocks of the same period occur in Nòssi-bé, at Màhajamba Bay, and at Diégo-Suarez, with Nummulites and other foraminifera. Near the latter locality, beds of Oligocene age have been noticed, consisting of coarse limestones.

4. *Quaternary and Recent.* A narrow band of these deposits extends along the west coast, from north of Cape St Andrew nearly to the extreme southern point of the island. But the most noticeable of these are those in the ancient bed of the Alàotra Lake, which formerly extended far southwards along the valley of the Mangòro; also those in the marshes of Antsìrabè and of Ifànja, in the Ikòpa valley (the great rice plain west of the capital), and also in the plain of Tsiénimpàrihy in Bétsiléo, and especially the recent deposits of Ampàsambazìmba, north-west of Lake Itàsy, discovered in 1902. These beds, rich in sub-fossil remains, have yielded important additions to our knowledge of the extinct fauna of the island. (See § *Palaeontology*.)

Igneous Rocks. (1) *Plutonic rocks.*—The ancient or plutonic igneous rocks (including granite, syenite, diorite, gabbro, porphyry, porphyrite, norite and retinite) appear at various points of the two previously described regions. In the Archean region the gneiss is very often found passing into granite, but certain granitic masses have a sufficiently distinct character. In the midst of the sedimentary region are two well-recognized masses of plutonic rocks, belonging to the syenites, sometimes quartziferous in structure. (2) *Volcanic rocks.*—Recent volcanic eruptive rocks (including rhyolite, trachyte, phonolite, andesite and basalt) have been examined at a number of points throughout both the geological regions of the island.

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[1] In the apparent absence of any Cambrian formation above them, there is little doubt that these rocks are Archean, although this cannot be absolutely proved.

the Archean region these are very noticeable near Lake Itàsy, in the *massif* of Ankàratra (an ancient volcano) and in Vàkinankàratra (at Bètàfo, Antsìrabé, &c.); while there are numerous outflows of doleritic rocks, probably from faults, along the eastern side of the island and almost parallel with the coast line. In the sedimentary region volcanic rocks are very numerous; the most extensive of these is a tract of country, more than 80 m. long, on the west coast, where the basalt has overflowed the Cretaceous strata. It must be remembered that the geology of Madagascar is still only known in its broad features.[1]

Minerals and Metals.—The country has considerable mineral wealth. Gold is found almost all over the region of crystalline rocks, except in and around the Antsihànaka province, the richest auriferous districts being a band of country parallel with the east coast and spreading at its southern end into the interior; and another tract, whose centre is about 100 m. N. of the capital (see § *Industries*, &c.). Silver has been detected in certain galenas, and also platinum; copper has been found in various localities, as well as zinc, lead, nickel, antimony and manganese, but none of these metals has yet been discovered in sufficient quantities for profitable working. Iron, on the contrary, especially magnetite, is found abundantly and has for long been worked by the Malagasy with the simple appliances brought by their ancestors from their original home in the Far East. The principal seats of the native industry are on the edge of the upper forest, where charcoal is easily procured. The following precious stones are reported: corundum (rubies and sapphires), beryl, topaz, zircon, garnet, amazon-stone, tourmaline, often in large crystals, and variously coloured quartz, also often found in crystals of great size. Bitumen and petroleum have been found; graphite is plentiful, and sulphur, salt, saltpetre and lime are also procured. On the north-west coast thin beds of lignite occur, and coal has been found in the valley of the Sàkamèira.

Palaeontology.—Researches in various parts of the island have revealed the existence, in a subfossil state, of the bones of numerous birds of the family *Struthidae*. These have been arranged in twelve species, belonging to two genera, *Aepyornis* and *Mullerornis*, which varied in size from that of a bustard to birds much exceeding an ostrich, and rivalling the recently extinct moa of New Zealand, the largest species being about 10 ft. in height. One species of these great wingless birds laid an egg which is the largest known, being 12½ in. by 9½ in. Associated with these remains there have been found those of many other birds, including a hawk, a duck, a darter, a spoonbill, a heron, a rail and a wild-goose, some of these being much larger than any now inhabiting Madagascar. In the same beds the remains of two, if not three, species of hippopotamus have been found, about two-thirds the size of the living South African species; also the bones and carapace, &c., of gigantic tortoises, and the bones of a crocodile, now extinct on the coast and rivers, but still living in the two chief lakes; also the remains of a river-hog, of a species of swine, and of a slender-legged form of zebu-ox. Near the south-west coast the skull of a large lemuroid animal was discovered in 1893, much longer than that of any living lemur, the animal being probably three times the size of any previously known Madagascar lemuroid. Later still, in 1899 and subsequently, the bones of two other creatures of the same suborder have been discovered, one of them indicating an animal much larger than a man. Many of these birds and animals were probably contemporaneous with the earliest human inhabitants of Madagascar. The remains of two species of Edentata have been found, as well as those of several species of small Rodents, also of a Carnivore (*Cryptoprocta*), a larger variety of the species still living in the island.

In the deposits of a much more remote era than those already spoken of—the Jurassic—the bones of some enormous terrestrial lizards have been brought to light, belonging to Sauropodous Dinosaurs of the genera *Bothriospondylus* and *Titanosaurus*, and to a Theropod of the genus *Megalosaurus*. In the beds of the Lower Oolite portions of the skull of a reptile resembling the gavial of the Ganges had been previously discovered, from which a new genus called *Steneosaurus* has been founded. Since the French occupation (1895) considerable additions have been made to our knowledge of the fossil fauna of Madagascar from researches made both on the west and south-west coast (at Bèlo and Ambòlisatrana) and in the interior (at Antsìrabè), especially in the rich deposits near Tsàrazàza (Ampàsambazimba), to the north-west of Lake Itàsy. From these various localities the subfossil remains of thirteen or fourteen extinct species of lemuroid animals (including the gigantic species already mentioned) have been obtained, and have been classified under five new genera viz. *Megaladapis* (3 sp.), *Palaeopropithecus* (3 sp.), *Archaeolemur* (2 sp.), *Bradylemur* (1 sp.) and *Hadropithecus* (1 sp.), together with three new species of lemur. Of these, the *Archaeolemurs* seem to have combined the characteristics of lemuroid animals with those of the monkeys, while *Hadropithecus* is pronounced to be the nearest known link with them. A list of all the fossils of the island known in 1895, but omitting the vertebrates above mentioned, included 140 species,[2] belonging to the Mollusca, Foraminifera, Echinodermata, Actinozoa and Plantae; but the researches of French geologists made the total number of Madagascar fossils known in 1907 to be not fewer than 280 species.

Climate.—In the high interior the climate resembles that of the temperate zones, although six-sevenths of the island are within the tropics, there is no intense heat, and it is quite cold, occasionally touching freezing point, during the nights of the cool season. These parts of the country are tolerably healthy for Europeans. But the coasts are much hotter, especially on the western side, as is also the interior west of the highland region; and from the large amount of marsh and lagoon on the coasts, malarial fever is common and frequently fatal, both to Europeans and to natives from the interior. Epidemics of influenza and fever have been very prevalent of late years in the central provinces. The seasons are two—the hot and rainy season from November to April, and the cool and dry season during the rest of the year; this remark applies chiefly to the interior, for rain falls throughout the year on the eastern coast, which is exposed to the vapour-laden south-east trade winds. The rainfall diminishes as one goes westward and especially south-westward, there being very little rain in the south-west corner of the island. No snow is known, even on the loftiest mountains, but thin ice is occasionally seen; and hail-showers, often very destructive, are frequent in the rainy season. Terrific thunderstorms are also common at that period; waterspouts are sometimes seen; and as the Indian Ocean cyclone region touches the eastern coast, hurricanes occur every few years, at rare intervals ascending into the interior highland. The yearly rainfall of the Imèrina province (Antanànarivo) averages about 54½ in.; accurate statistics as to that of other parts of the island are not available; but on the east coast it appears to be about double that of the interior; in the south-east considerably more than that amount; while at Morondava (west coast) it is given as about 21 in. annually, and at Tullear (south-west coast) as only 10 in. At Tamatave (east coast) the mean annual temperature is given as 76·5°, while at the capital it is about 66°; the temperature of Antanànarivo resembles that of Naples or Palermo.[3] The following table gives the mean of two different sets of government returns of mean rainfall: Antanànarivo, 1369 mm.; Tamatave, E. coast, 1863 mm.; Fàrafangàna, S.E. coast, 2803 mm.; Diégo-Suarez, N. end of island, 1196 mm.; Morondava, W. coast, 543 mm.; Tullear, S.W. coast, 273 mm.; Màrovoày, W. interior, 1413 mm.

Fauna.—The fauna of Madagascar, while deficient in most of the characteristic tropical forms of life, is one of great interest to the naturalist from its remote affinities, much of its animal life having Asiatic rather than African relationships. The central portions of the island, from their generally bare and treeless character, are poor in living creatures, but the lower country, and especially the forests and coast plains, are fairly well stocked. But it is noticeable that many species have a very limited range. Although a continental island, it possesses no large quadrupeds—none of the larger carnivorous, ungulate, proboscoid or quadrumanous animals; but it is the headquarters of the *Lemuroidea*, no fewer than thirty-nine species of which are found in its forests and wooded plains. Some of these creatures are highly specialized, while the curious aye-aye (*Chiromys madagascariensis*), an allied form, is one of the most remarkable animals known, forming a genus and family by itself. Its whole structure is strangely modified to enable it to procure the wood-boring larvae which form its food. Other peculiar animals are twenty-three species of the *Centetidae*, a family of the Insectivora almost confined to Madagascar, while of the *Carnivora* there are several small creatures belonging to the civets (*Viverridae*). The largest of these ferocious animals, also forming a genus and family by itself, is the *Cryptoprocta ferox*; it is a plantigrade animal, 3 ft. long, but very like an enormous weasel, and attacks other animals with the greatest ferocity The island contains twenty-five species of bats, mostly of African, but some of Indian, affinities. African humped cattle were introduced several hundred years ago and now exist in large herds all over the country. The fat-tailed sheep, goats and swine have also been naturalized, as well as all kinds of domestic poultry.

The avi-fauna is much richer than the mammalian, and, although wanting the largest birds as well as the most brilliantly coloured, comprises two hundred and sixty species, half of which are endemic. Many of the birds are remarkable not so much for their shape or colouring as for their distant relationships; many belong to peculiar genera, and some are so isolated that new families have had to be formed for their reception. There is a large variety of perching birds, including several species of brilliant plumage—sun-birds, kingfishers, rollers and flycatchers, &c.; kites, hawks and owls are numerous, and the lakes and marshes abound with water-fowl and herons, ibises, &c.

The island is free from deadly serpents, but contains two or three small species of boa; crocodiles abound in the rivers and lakes; and numerous species of lizard, chameleon and tree-frog inhabit the woods. Madagascar may be considered as one of the headquarters of the *Chamaeleonidae*, for of the fifty known species no fewer than twenty-five have already been described from the island. Many of these are of curious form, with remarkable developments of the plates of the head and projecting horns and spines. There are several peculiar tortoises, but the gigantic species are now found alive only on the little island of Aldabra, to the north. The insect life comprises many brilliantly-coloured beetles, butterflies (about eight hundred species of which are known), moths, locusts, spiders and flies, and also noxious spiders, with scorpions and centipedes. The river fishes belong chiefly to the family *Chromididae*; many of them are of brilliant and bizarre appearance, with strongly contrasted colours in bands and spots. Those found in the coast waters do not differ materially from the widely spread Indian Ocean species.

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[1] For most of the information here given on the geology the writer is indebted to Captain Mouneyres, chef de services des mines, and the Rev R. Baron, F.G.S., F.L.S.

[2] See "On a Collection of Fossils from Madagascar," by R. B. Newton, *Quart. Journ. Geol. Soc.* (Feb. 1895).

[3] The following are figures of mean temperature, kindly supplied by the Rev. E. Colin, S. J., director of the observatory: Diégo-Suarez, N., 79°; Fàrafangàna, S.E. coast, 75°; Màrovoày, W. intr., 81°; Mòrondàva, W. coast, 77°; Tullëar, S.W. coast, 78°.

As a whole, the Madagascar fauna is marked by a strong individuality, which would appear to be the result of long isolation from the other zoological "regions." The Asiatic and Malayan affinities of many of its animals, as well as the physical conditions of the bed of the Indian Ocean, make it highly probable that Madagascar, while once forming part of Africa, is the chief relic of a considerable archipelago formerly connecting that continent with Asia, its other portions being shown by groups of small islands, and by coral atolls and shoals, which are gradually disappearing beneath the waves. These questions have been fully treated by Dr A. R. Wallace in his *Geographical Distribution of Animals* (vol. i. ch. ix., 1876) and *Island Life*, ch. xix. (1880).

Flora.—The flora of Madagascar is one of great interest. One of its most prominent features is the belt of forest round a large part of the island at no great distance from the sea, and generally following the coast-line. This forest is densest on the east side, and for about 120 m. forms a double line, the lower one being much the broader and averaging 30 m. across, but attaining a breadth of 60 or 70 m. on the north-east, near Antongil Bay. The vegetation on the western side of the island is much less dense, often appearing as scattered clumps of trees on savannah-like plains rather than continuous forest; while in the south-west, where the rainfall is very scanty, the vegetation is largely of fleshy-leaved and spiny plants—aloes and cacti (the latter introduced), with several species of Euphorbia, as well as numerous lianas, one of which (*Intisy*) yields india-rubber. It is estimated that there are about 30,000 sq. m. of forest-covered country in Madagascar, or about one-eighth of its whole surface. The vegetation of the forests, the abundant epiphytes, the tree-mosses, the filmy ferns and the viviparous character of many of the ferns, show clearly how abundant the rainfall is in the eastern forest region. This contains a large variety of hard-wooded and valuable timber trees, including species of *Weinmannia* (*Lalòna*[1]), *Elaeocarpus* (*Vodnana*), *Dalbergia* (*Vòambòana*), *Nuxia* (*Vàlanìrana*), *Podocarpus*, a pine, the sole species in the island (*Hètatra*), *Tambourissa* (*Ambòra*), *Neobaronia* (*Hàrahàra*), *Ocotea* (*Varòngy*) and probably ebony, *Diospyros* sp., &c. The following trees are characteristic of Madagascar vegetation, some of them being endemic, and others very prominent features in the landscape: the traveller's-tree (*Urania speciosa*), with its graceful crown of plantain-like leaves growing like an enormous fan at the top of a tall trunk, and affording a supply of pure cool water, every part of the tree being of some service in building; the Raphia (rofia) palm (*Sagus ruffia*); the tall fir-like *Casuarina equisetifolia* or beefwood tree, very prominent on the eastern coast, as well as several species of screw-pine (*Pandanus*); the Madagascar spice (*Ravintsara madagascariensis*), a large forest tree, with fragrant fruit, leaves and bark; a beautiful-leaved species of *Calophyllum*; and the Tangèna (*Tanghinia veneniflua*), formerly employed as a poison ordeal. On the lagoons and lower reaches of the rivers the Viha (*Typhonodorum lindleyanum*), an arum endemic to Madagascar, grows in great profusion to a height of 12 or 13 ft. and has a white spathe more than a foot in length; and on the western coast dense thickets of mangrove line the creeks and rivers. In the interior rivers is found the curious and beautiful lace-leaf plant (*Ouvirandra fenestralis*), with an edible tuberous root. On the western side of the island the baobab, the tamarind, the ròtra (*Eugenia* sp.), the rofia palm, and several species of fan-palm (*Hyphaene*) and of *Ficus* are prominent; and the mango (introduced) grows to a large tree. In the generally bare interior highlands, large trees, species of *Ficus* (*Amòntana*, *Aviàvy*, *Nònoka*, *Adàbo*, &c.), often mark the position of the old towns; and some of these, as Ambòhimànga, Vòhilèna, &c., are surrounded by remnants of the original forest, which formerly covered large portions of the interior. The most prominent tree in the central province is now the Cape-lilac (*Melia azederach*) introduced about 1825; and since the French conquest several species of eucalyptus have been planted in vast numbers by the road sides. These have given quite a new aspect to the vegetation, while bright colour is imparted by species of *Bougainvillea* and *Poinsettia*. In the eastern forests palms, bamboos, lianas and tree-ferns, as well as species of *Dracaena*, are found.

Although flowers growing on the ground or on shrubs are not conspicuous for number or beauty, there are many fine flowering trees, such as *Poinciana regia*, presenting a mass of scarlet flowers; *Colvillia racemosa*, with yellow flowers; *Astrapaea Wallickii*, striking attention from its abundant flowers; and species of *Cryptostegia*, a purple-flowered creeper, and *Strongylodon*, another creeper with cream-coloured blossoms. Among attractive plants are species of *Hibiscus*, *Euphorbia*, *Buddleia*, *Ixora*, *Kitchingia*, *Clematis*, &c. On the east coast two orchids, species of *Angraecum*, with large white waxy flowers, one with an extraordinarily long spur or nectary, attract the attention of every traveller during June and July by their abundance and beauty. Some 320 species of fern have been collected, and there are large numbers of spiny and prickly plants, as well as numerous grasses, reeds and rushes, many of them of great service in the native manufactures of mats, hats, baskets, &c.

The Rev R. Baron divides the flora into three distinctly marked "regions," which run in a longitudinal direction, following approximately the longer axis of the island, and are termed respectively eastern, western and central. The central includes the elevated highland of the interior, while the eastern and western include the forest belts and most of the wooded country and coast plains. Of the 4100 known plants—of which about three-fourths are endemic—composing the Madagascar flora, there are 3492 Dicotyledons, 248 Monocotyledons and 360 Acotyledons. Of these, the orders most largely represented (together with their species) are: Leguminosae, 346, Filices, 318; Compositae, 281; Euphorbiaceae, 228; Orchideae, 170; Cyperaceae, 160; Rubiaceae, 147; Acanthaceae, 131; Gramineae, 130. The number of endemic genera now known is 148. Of the 3178 species of plants whose localities have been determined, 35% are peculiar to the eastern region, 27·5% to the central, and 22% to the western. One natural order, Chlaenaceae, is strictly confined to Madagascar. "A small proportion of the species are Asian, but not African; and the flora of the mountains corresponds closely with that of the great ranges of the tropical zone of Africa." "The general plan of the flora follows thoroughly the same lines as that of the tropical regions of the Old World."

Among the food-giving plants are rice—the staff of life to the majority of the Malagasy—in many varieties, maize, millet, manioc, yams, sweet-potatoes, arrowroot, which is largely used by the western tribes—as well as numerous vegetables, many of them of foreign introduction. The fruits—the majority of which are introduced—are the banana, peach, loquat, pineapple, mango, melon, grape, quince, plum, apple, mulberry, orange, lemon, citron, guava, Chinese-guava, Cape-gooseberry, fig, raspberry, tomato, &c. Several spices are grown, including ginger, capsicum, &c.; sugar-cane, coffee, indigo, vanilla, tobacco, cotton, hemp, gourds, dye-woods, gums, mulberry and other trees and plants for silk-culture, are also among the vegetable productions; gum-copal was formerly, and india-rubber is still, an important article of export.

Provinces and Towns.—The island may be divided into districts or provinces, which in the main indicate tribal divisions. Of these tribal territories the following may be distinguished, taking them in three main divisions, from north to south: (1) *Eastern*: Antankàrana, occupying the northern peninsula; the country of the Bétsimisàraka, who inhabit a long extent of the coast plains, about 500 m. in length; parallel with this for about a third of it, and between the two lines of forest, is the Bézànozàno country. South again are the districts of the Taimbahòaka, the Taimòro, the Taifàsy and the Taisàka; and at the south-eastern corner are the Tanòsy. (2) *Central*: the districts of Tsimihèty and the Sihànaka; Imèrina, the Hova province; the Bétsiléo; the Tanàla or foresters; the Bàra; and the emigrant Tanòsy. (3) *Western*: the people from almost the northern to the southern extremities of the island are known as Sàkalàva, but consist of a number of distinct tribes—the Tibòina, the Màilaka, the Taménabé, and the Fiherènana, &c. South of these last are the Màhafàly, with the Tandròy at the extreme south. There are no distinctly marked boundaries between any of these tribal territories; and west of Imèrina and Bétsiléo there is a considerable extent of country with hardly any population, a kind of "no-man's-land." There are numerous subdivisions of most of the tribes.

The capital, Antanànarìvo (pop. 69,000), in the highlands of Imèrina, and Tamatàve (pop. 4600), on the east coast and the chief seaport, are separately described. Majunga (properly Mojangà, pop. 5300) on the north-west coast, just north of 16° S., and Diégo-Suarez, are important ports for foreign trade, the latter being also a fortified naval and military station. Other ports and towns are Màhanòro, Mànanjàry (S.E. coast, pop. 4500), Tullear (S.W. coast), and Fianàrantsòa (pop. 6200), the chief town of the Bétsiléo. There are very few places besides these with as many as 2000 people.

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[1] The words in parentheses are the native Malagasy names.

Inhabitants.—The population is somewhat under two and three-quarter millions,[1] including some 10,000 or 11,000 Europeans, and a smaller number of Indian, Arab, and other Asiatics, mostly small traders found in the seaports, the Chinese being found in every town of any size. The island, it will be seen, is very sparsely inhabited; the most densely peopled province is that of Imèrina with (1905) 388,000 inhabitants. The natives, collectively known as Malagasy, are divided into a considerable number of tribes, each having its distinct customs. Although geographically an African island, the majority of its inhabitants are derived, the lighter portion of them from the Malayo-Polynesian stock, and the darker races from the Melanesian. This is inferred from their similarity to the peoples of the Indian and Pacific archipelagoes in their physical appearance, mental habits, customs, and, above all, in their language. Their traditions also point in the same direction. There is, however, an undoubted African mixture in the western and some other tribes. There is also an Arab element both on the north-west and south-east coasts; and it appears that most of the families of the ruling classes in all parts of the island are descended from Arabs, who married native women. It is believed that there are traces of an aboriginal people (the Vazimba), who occupied portions of the interior before the advent of the present inhabitants, and these appear to have been a somewhat dwarfish race, and lighter-coloured than the Malagasy generally. The Hòva became the dominant tribe from the beginning of the 19th century; they appear to be the latest immigrants, and are the lightest in colour; and they are also the most intelligent and civilized of all the peoples inhabiting the island.

The most striking proof of the virtual unity of the inhabitants of Madagascar is that substantially but one language is spoken over the whole country. The Malay affinities of Malagasy were noted in the 16th century; indeed, the second and fifth books published upon the country (in 1603 and 1613) were comparative vocabularies of these two languages. Later investigations have confirmed the conclusions thus early arrived at; and Van der Tuuk, Marre de Marin and W. E. Cousins have shown conclusively the close relationships between the language of the Malagasy and those of the Malayo-Polynesian regions; similar connexions exist, especially in grammatical construction, between the Malagasy and Melanesian languages. The Malagasy had never invented for themselves a written character, and had consequently no manuscripts, inscriptions or books, until their language was reduced to writing, and its orthography settled by English missionaries. Their speech nevertheless is very full in many of its verbal and other forms, while it also exhibits some curious deficiencies. It is very soft and musical, full of vowels and liquids, and free from all harsh gutturals. Native oratory abounds in figures, metaphors and parables; and a large number of folk-tales, songs and legends, together with the very numerous proverbs, give ample evidence of the mental ability and imaginative powers of the Malagasy.

Native society in Imèrina among the Hòva was formerly divided into three great classes: the Andrìana, or nobles; the Hòva, freemen or commoners; and the Andèvo, or slaves; but these last became free by a proclamation issued in 1896. The Andrìana are, strictly speaking, royal clans, being descendants of petty kings who were conquered or otherwise lost their authority through the increasing power of the ancestors of the reigning family. Their descendants retained certain honours in virtue of their royal origin, such as special terms of salutation, the use of the smaller scarlet umbrella (the larger one was the mark of royal rank), the right to build a particular kind of tomb, &c.; they also enjoyed exemption from certain government service, and from some punishments for crime. The Hòva[2] or commoners form the mass of the population of Imèrina. They are composed of a large number of tribes, who usually intermarry strictly among themselves, as indeed do families, so that property and land may be kept together. The third great division was the slave population, which since 1896 has become merged in the mass of the people. The Mozambiques or African slaves, who had been brought from the African coast by Arab dhows, were in 1877 formally set free by an agreement with the British government.

Royalty and chieftainship in Madagascar had many peculiar customs. It had a semi-sacred character, the chief was, in heathen tribes, while living, the high priest for his people, and after death, was worshipped as a god; in its modern development among the Hòva sovereigns it gathered round it much state and ceremony. There were many curious examples of the taboo with regard to actions connected with royalty, and also in the words used which relate to Malagasy sovereigns and their surroundings. These were particularly seen in everything having to do with the burial of a monarch. While the foregoing description of native society applied chiefly to the people of the central province of Imèrina, it is applicable, with local modifications, to most of the Malagasy tribes. But on the island becoming a French colony, in 1896, royalty was formally abolished; and little regard is paid to native rank by French officials.

The chief employment of the Malagasy is agriculture. In the cultivation of rice they show very great ingenuity, the *kètsa* grounds, where the rice is sown before transplanting, being formed either on the margins of the streams or in the hollows of the hills in a series of terraces, to which water is often conducted from a considerable distance. In this agricultural engineering no people surpass the Bétsiléo. No plough is used, all work being done by a long-handled spade; and oxen are only employed to tread out the soft mud preparatory to transplanting. The rice is threshed by being beaten in bundles on stones set upright on the threshing-floor; and when beaten out the grain is stored by the Hòva in rice-pits dug in the hard red soil, but by the coast tribes in small timber houses raised on posts. In preparing the rice for use it is pounded in a wooden mortar to remove the husk, this work being almost always done by the women. The manioc root is also largely consumed, together with several other roots and vegetables; but little animal foods (save fish and freshwater *Crustacea*) is taken by the mass of the people except at festival times. Rice is used less by the western tribes than by those of the central and eastern provinces, and the former people are more nomadic in their habits than are the others. Large herds of fine humped cattle are found almost all over the island.

The central and eastern peoples have considerable manual dexterity. The women spin and weave, and with the rudest appliances manufacture a variety of strong and durable cloths of silk, cotton and hemp, and of ròfia palm, aloe and banana fibre, of elegant patterns, and often with much taste in colour. They also make from straw and papyrus peel strong and beautiful mats and baskets in great variety, some of much fineness and delicacy, and also hats resembling those of Panama. The people of the south and south-east make large use of soft rush matting for covering, and they also prepare a rough cloth of bark. Their non-employment of skins for clothing is a marked distinction between the Malagasy and the South African races, and their use of vegetable fibres an equally strong link between them and the Polynesian peoples. The men wear a loin-cloth or *salàka*, the women a *kitàmby* or apron folded round the body from waist to heel, to which a jacket or dress is usually added; both sexes use over these the *làmba*, a large square of cloth folded round the body something like the Roman toga, and which is the characteristic native dress. The Malagasy are skilful in metal-working; with a few rude-looking tools they manufacture silver chains of great fineness, and filagree ornaments both of gold and silver. Their iron-work is of excellent quality, and in copper and brass they can produce copies of anything made by Europeans. They display considerable inventive power, and they are exceedingly quick to adopt new ideas from Europeans.

There is a considerable variety in the houses of the different Malagasy tribes. The majority of Hòva houses were formerly built of layers of the hard red soil of the country, with high-pitched roofs thatched with grass or rush; while the chiefs and wealthy people had houses of framed timber, with massive upright planking, and lofty roofs covered with shingles or tiles. But the introduction of sun-dried and burnt bricks, and of roofing tiles in the central provinces has led to the general use of these materials in the building of houses, large numbers of which are made in two storeys and in European fashion. The forest and coast tribes make their dwellings chiefly of wood framing filled in with the leaf-stalks of the traveller's tree, with the leaves themselves forming the roof covering. The houses of the Bétsiléo and Sàkalàva are very small and dirty, but those of the coast peoples are more cleanly and roomy. Among the Hòva and Bétsiléo the old villages were always built for security on the summits of lofty hills, around which were dug several deep fosses, one within the other. In other districts the villages and homesteads are enclosed within formidable defences of prickly-pear or thorny mimosa.

Apart from the modern influence of religious teaching, the people are very immoral and untruthful, disregardful of human life and suffering, and cruel in war. Until lately polygamy has been common among all the Malagasy tribes, and divorce effected in an absurdly easy fashion. At the same time the position of woman is much higher in Madagascar than in most heathen countries; and, the fact that for nearly seventy years there were (with a few months' exception) only female sovereigns, helped to give women considerable influence in native society. The southern and western peoples still practise infanticide as regards children born on several unlucky days in each month. This was formerly the general practice all over the island. The old laws among the Hòva were very barbarous in their punishments, and death in various cruel forms was inflicted for very trifling offences. Drunkenness is very prevalent in many parts of the island; and it can hardly be said of many of the Malagasy that they are very industrious. But they are courageous and loyal to their chiefs and tribe, and for short periods are capable of much strenuous exertion. They are affectionate and firm in their friendships, kind to their children and their aged and infirm relatives, very respectful to old age, most courteous and polite and very hospitable to strangers. Slavery had a patriarchal and family character, and was seldom exercised in a cruel or oppressive way.

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[1] The census taken in 1905 gives 2,664,000 as the total population, but it is probably a little over that amount, as some localities are still imperfectly known.

[2] This is a special and restricted use of the word, Hòva in its widest sense being a tribal name, including all ranks of people in Imèrina.

The Malagasy have never had any organized religious system or forms of worship; there are no temples, images or stated seasons of devotion, nor is there a priesthood, properly so-called. Yet they have never been without some distinct recognition of a supreme being, whom they call *Andriamànitra*, "The Fragrant One," and *Zànahàry*, "The Creator"—words which are recognized all over the island. They have also retained many ancient sayings, proverbial in their style, which enforce many of the truths of natural religion as to the attributes of God. With all this, however, there has long existed a kind of idolatry, which in its origin is simply fetishism—the belief in charms—as having power to procure various benefits and protect from certain evils. Among the Hòva in modern times four or five of these charms had acquired special sanctity and were each honoured as a kind of national deity, being called "god," and brought out on all public occasions. Together with this idolatry there is also a firm belief in the power of witchcraft and sorcery, in divination, in lucky and unlucky days and times, in ancestor worship, especially that of the sovereign's predecessors, and in several curious ordeals for the detection of crime. The chief of these was the celebrated tangèna poison ordeal, in which there was implicit belief, and by which, until its prohibition by an article in the Anglo-Malagasy treaty of 1865, thousands of persons perished every year. Sacrifices of fowls and sheep are made at many places at sacred stones and altars, both in thanksgiving at times of harvest, &c., and as propitiatory offerings. Blood and fat are used to anoint many of these stones, as well as the tombs of ancestors, and especially those of the Vazimba. In some of the southern districts it is said that human sacrifices were occasionally offered. The chief festival among the Hòva, and almost confined to them, was that of the New Year, at which time a kind of sacrificial killing of oxen took place, and a ceremonial bathing, from which the festival took its name of Fàndròana (the Bath). This festival is now merged in the French national fête of the 14th of July. Another great festival was at circumcision times. This rite was observed by royal command at intervals of a few years; these were occasions of great rejoicing, but also of much drunkenness and licentiousness. Since 1868 circumcision has been observed by each family at any time convenient to itself. It is practised by all the Malagasy tribes. Funerals were also times of much feasting, and at the death of people of rank and wealth numbers of bullocks were and are still killed. Although there was no proper priesthood, the idol-keepers, the diviners, the day-declarers and some others formed a class of people closely connected with heathen customs and interested in their continued observance.

Industries and Commerce.—The rearing of cattle and the dressing of hides, the collection of rubber and bee culture are important industries. The chief food crops grown have been indicated (see *Flora*), and the gold-mining is separately noticed below. Other industries undertaken or developed by Europeans are silk and cotton weaving and raphia-fibre preparation, and ostrich farming. Sugar, rice, soap and other factories have been established. In 1904 the exportation of straw and other fibre hats began; these resemble those of Panama and promise to become an important item. Tanning bark, coffee and guano are also recent exports.

Since 1862, when the country was thrown open to foreign trade, the growth of over-sea commerce has been comparatively slow. In the early days cattle were the chief export. About 1870 india-rubber began to be exported in considerable quantities, and cattle, rubber and hides continue staple products. Other important exports are raphia fibre and beeswax. Since 1900 gold has become a leading export, the value of the gold sent out of the country in the five years 1901–1906 being £1,384,493. The imports consist chiefly of tissues (mostly cotton goods), breadstuffs and rice, liquors, metal-ware and coal. Better means of internal transport and increased production in the island have greatly reduced the import of rice, which came mostly from Saigon.

Before the occupation of Madagascar by France the duty on imports and exports was 10% *ad valorem*, and the foreign trade was very largely in the hands of British and American merchants. In July 1897 the French tariff was applied and increased rates levied on foreign goods, notably cottons. This practically killed the American trade and reduced the British trade to a very small proportion. In 1897 the British imports were valued at £179,000; the next year, with the new tariff in force, they had dropped to £42,000. The only export duties are: cattle 2s. per head and rubber 2d. per lb.

In 1880–1885 the entire foreign trade of Madagascar, imports and exports, was estimated to be about £1,000,000; in 1900–1906 the volume of trade had increased to a little over £2,500,000 a year. But while from 1900 onwards imports had a tendency to decrease (they were £1,841,310 in 1901 and £1,247,936 in 1905), exports steadily increased, owing to the working of gold-mines. The total value of the exports rose from £359,019 in 1901 to £822,470 in 1906.[1] About 90% of the trade is with France or other French colonies. The remaining trade is nearly all British and German.

Banking business is in the hands of French companies. The legal currency is the French 5-franc piece and the smaller French coins. There was no native coinage, the French 5-franc piece or dollar being the standard, and all sums under that amount were obtained by cutting up those coins into all shapes and sizes, which were weighed with small weights and scales into halves, quarters, eighths, twelfths and twenty-fourths of a dollar, and even reckoned down to the seven hundred and twentieth fraction of the same amount.

Gold-mining.—Gold-mining has been carried on regularly since 1897, and by 1900 the value of the ore extracted exceeded £100,000. Reports of rich discoveries attracted considerable attention in South Africa and Europe during 1904–1906, but experts, sent from the Transvaal, came to the conclusion that Madagascar would not become one of the rich goldfields of the world. The chief mining districts have been already indicated (see under *Geology*). Rich finds were reported from the north of the island during 1907, in which year the export of gold was £320,000. The mines afford a lucrative occupation for some thousands of persons, and many of the claim-holders are British. Decrees of 1902 and 1905 regulate the conditions under which mining is carried on. By decree of the 23rd of May 1907, the radius of the circle within which claims may be pegged is 2 kilometres (1¼ m.), and a tax of 5% is levied on the value of the gold extracted.

Communications.—There is regular steamship communication between the chief ports and Marseilles, Zanzibar and India (via Mauritius and Ceylon); and a submarine cable to Mozambique places the island in telegraphic connexion with the rest of the world. The French have built carriage roads from the interior to the principal ports as well as to connect the principal towns. On these roads large use is made of bullock wagons, as well as carts drawn by men, and women also. Tamatave and Antanànarivo are joined by coast canals and lakes and by a railway service. Where other means are not available, goods are carried by canoes, or on the shoulders of bearers along the native footpaths.

There is a well-organized postal service, and all the towns of note are linked by a telegraph system, which has a length of over 4000 miles.

Government, Revenue, &c.—The colony is not represented in the French Chambers, nor has it self-government. At the head of the administration is a governor-general, who is assisted by a nominated council of administration which includes unofficial members. This council must be consulted on matters affecting the budget. In several towns there are *chambres consultatives*, composed of local merchants and planters. The island is divided into *circles*, placed under military officers, and *provinces*, presided over by a civilian. As far as possible in local affairs, each of the native races is granted autonomy, the dominion of the Hòva over the other tribes being abolished. Each province has its native governor and minor officials, the governor being generally selected by popular vote. Each village has an organization (the *Fòkon' òlona*) resembling that

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[1] *Exports:*	1901	1906	*Increase.*
Rubber . .	£26,679	£301,518	£274,839
Hides and skins .	31,548	250,339	218,791
Gold . . .	131,987	270,613	138,626

of a commune; at its head is a chief or *mpiadidy*, who serves for three years.

For Europeans and in suits between Europeans and natives the French judicial code is applicable; suits between natives are tried by native tribunals (established 1898) presided over by a European assisted by two native assessors. These tribunals judge according to native law and usages, except when such customs (*e.g.* polygamy and slavery) have been expressly abolished. Arbitration councils are available everywhere for the settlement of disputes between native workmen and their employers. The native laws respecting land tenure have been improved by the adoption of a method of registration based on the Torrens system.

Revenue is derived from land, house and capitation taxes, from customs, posts and telegraphs, ferries, licences and other indirect imposts. The excess of expenditure over revenue is made good by subventions from France. A considerable portion of the revenue is expended on public works. Revenue and expenditure in 1905 were each just beneath £1,000,000. This is exclusive of the sums spent by France in the island on the army, and for the naval base at Diégo-Suarez. There is a public debt amounting (1907) to £4,055,600. As stated in the French senate (February 1909), everything is taxed in the island; and no sooner has any enterprise become fairly successful than it is so heavily taxed as to be no longer worth carrying on, and certain crops have therefore been destroyed by the colonists who had planted them. This has been the case with tobacco, sugar, rum, and also in butter-making, cattle-breeding and other things. Notwithstanding this taxation, from 1895 to 1908 £12,000,000 was required for Madagascar from the home government, and the demand is constantly increasing.

History.—From the earliest accounts given of the people of Madagascar by European travellers, as well as from what may be inferred from their present condition, they seem for many centuries to have been divided into a number of tribes, often separated from one another by a wide extent of uninhabited country. Each of these was under its own chief, and was often at war with its neighbours. No one tribe seems to have gained any great ascendancy over the rest until about the middle of the 17th century, when a small but warlike people called Sàkalàva, in the south-west of Madagascar, advanced northward, conquered all the inhabitants of the western half of the island, as well as some northern and central tribes, and eventually founded two kingdoms which retained their supremacy until the close of the 18th century. About that time, the Hòva in the central province of Imèrina began to assert their own position under two warlike and energetic chieftains, Andrianimpòina and his son Radàma; they threw off the Sàkalàva authority, and after several wars obtained a nominal allegiance from them; they also conquered the surrounding tribes, and so made themselves virtual kings of Madagascar. From that time until 1895 Hòva authority was retained over a large part of the central and eastern provinces, but it was only nominal over much of the western side of the island, while in the south-west the people were quite independent and governed by their own chiefs.

Arab Intercourse and Influence.

While European intercourse with Madagascar is comparatively recent, the connexion of the Arabs with the island dates from a very remote epoch; and in very early times settlements were formed both on the north-west and south-east coasts. In the latter locality there are still traces of their influence in the knowledge of Arabic possessed by a few of the people. But in these provinces they have become merged in the general mass of the people. It is different, however, in the north-west and west of the island. Here are several large Arab colonies, occupying the ports of Anòrontsànga, Mòjangà, Màrovoày and Mòrondàva, and retaining their distinct nationality. There is also in these districts a Hindu element in the population, for intercourse has also been maintained for some centuries between India and northern Madagascar, and in some towns the Banyan Indian element is as prominent as the Arab element. In the early times of their intercourse with Madagascar, the Arabs had a very powerful influence upon the Malagasy. This is seen in the number of words derived from the Arabic in the native language. Among these are the names of the months and the days of the week, those used in astrology and divination, some forms of salutation, words for dress and bedding, money, musical instruments, books and writings, together with a number of miscellaneous terms.

European Intercourse.

The island is mentioned by several of the early Arabic writers and geographers, but medieval maps show curious ignorance of its size and position. Marco Polo has a chapter upon it, and terms it "Madeigascar," but his accounts are confused with those of the mainland of Africa. The first European voyager who saw Madagascar was a Portuguese named Diogo Diaz, captain of one of the ships of a fleet commanded by Pedro Cabral and bound for India. Separated from his companions by a storm near the Cape, he sighted the eastern coast of the island on the 10th of August 1500. That day being the feast of St Lawrence, Madagascar was named the "Isle of St Lawrence," and retained that name on all maps and charts for a hundred years. The Portuguese gave names to most of the capes, but made no persistent attempts at colonization. After them the Dutch endeavoured, but with little success, to form colonies; and in the time of Charles I. proposals were made to form an English "plantation," but these were never carried into effect, although for a short time there was a settlement formed on the south-west coast. In the latter part of the 17th and during most of the 18th century the French attempted to establish military positions on the east coast. For some time they held the extreme south-east point of the island at Fort Dauphin; but several of their commandants were so incapable and tyrannical that they were frequently involved in war with the people, and more than once their stations were destroyed and the French were massacred. Early in the 19th century all their positions on the mainland were relinquished, and they retained nothing but the island of Ste Marie on the east coast. In 1811 Tamatave had been occupied by British troops, and the Treaty of Paris of 1814 recognized as British the "French settlements in Madagascar," but as a matter of fact France had then no settlements on the mainland. The then governor of Mauritius, Sir Robert Farquhar, endeavoured to prosecute British claims and obtained a cession of Diégo-Suarez Bay. These claims were not backed up by the home government, and a little later the policy was adopted by Great Britain of supporting the Hòva authority.

Radàma I.

The political history of Madagascar as a whole may be said to date from the reign of Radàma I. (1810–1828). He was a man much in advance of his age—shrewd, enterprising, and undeterred by difficulty—a kind of Peter the Great of his time. He saw that it was necessary for his people to be educated and civilized if the country was to progress; and making a treaty with the governor of Mauritius to abolish the export of slaves, he received every year in compensation a subsidy of arms, ammunition, and uniforms, as well as English training for his troops. He was thus enabled to establish his authority over a large portion of the island. For some years a British agent, Mr Hastie, resided at Radàma's court, and exercised a powerful influence over the king, doing much for the material advance of the country.

Introduction of Christianity.

At the same period (1820) Christian teaching was commenced in the capital by the London Missionary Society, and by its missionaries the language was reduced to a systematic written form, and the art of printing introduced; books were prepared, the Scriptures were translated, numerous schools were formed, and several Christian congregations were gathered together. The knowledge of many of the useful arts was also imparted, and many valuable natural productions were discovered. The power of superstition was greatly broken, a result partly due to the keen good sense of the king, but chiefly to the spread of knowledge and religious teaching.

Rànavàlona I.

The bright prospects thus opening up were clouded by the death of Radàma at the age of thirty-six, and the seizure of the royal authority by one of his wives, the Princess Rànavàlona. She looked with much suspicion upon the ideas then gaining power among many of her people, and determined to strike a decisive blow at the new teaching. In 1835 the profession of the Christian religion was declared illegal; all worship was to cease, and all religious books were ordered to be given up. By the middle of 1836 all the English missionaries were obliged to leave the island, and for twenty-five years the most strenuous efforts were made by the queen and her government to suppress all opposition to her commands. This, however, only served to show in a very remarkable manner the courage and faith of the Christian Malagasy, of whom about two hundred suffered death in various cruel forms, while many hundreds were punished more or less severely by fine, degradation, imprisonment and slavery. During the queen's reign the political condition of the country was deplorable; there were frequent rebellions, many of the distant provinces were desolated by barbarous wars; and for some years all Europeans were excluded, and foreign commerce almost ceased. This last circumstance was partly owing to an ill-managed attack upon Tamatàve in 1846 by a combined British and French force, made to redress the wrongs inflicted upon the foreign traders of that port. But for the leaven of Christianity and education which had been introduced into the country it would have reverted to a state of barbarism.

Radàma II.

This reign of terror was brought to a close in 1861 by the death of the queen and the accession of her son Radàma II. The island was reopened to European trade, and missionary efforts were recommenced. A determined attempt was made by some Frenchmen to gain for their country an overwhelming influence by means of a treaty which they induced the king to sign. But this act, as well as the vices and insane follies into which he was led by worthless foreign and native favourites, soon brought his reign and his life to an end. He was put to death in his palace (1863) and his wife was placed on the throne. The new sovereign and her government refused to ratify the agreement which had been illegally obtained, choosing rather to pay a million francs as compensation to the French company. During the five years' reign of Queen Rasohèrina, quiet and steady advances were made in civilization and education, and treaties were concluded with the British, French and American governments.

Rànavàlona II.

At the death of Rasohèrina in 1868, she was succeeded by her cousin, Rànavàlona II. One of the first acts of the new queen was the public recognition of Christianity; and very soon afterwards she and her husband, the prime minister, were baptized, and the erection of a chapel royal was commenced in the palace yard. These acts were followed in the succeeding year by the burning of the royal idols, and immediately afterwards by the destruction of the idols throughout the central provinces, the people generally putting themselves under Christian instruction. From that time education and enlightenment made great progress, chiefly through the labours of missionaries of various societies.

Native Government.

The native Malagasy government, though theoretically despotic, was limited in various ways. Radàma I. and Rànavàlona I. were much more absolute sovereigns than those before or after them, but even they were largely restrained by public opinion. New laws were announced at large assemblies of the people, whose consent was asked, and always given through the headmen of the different divisions of native society; this custom was no doubt a survival from a time when the popular assent was not a merely formal act. The large disciplined army formed by Radàma I. aided much in changing what was formerly a somewhat limited monarchy into an absolute one. The Hòva queen's authority was maintained over the central and eastern portions of Madagascar, and at almost all the ports, by governors appointed by the queen, and supported by small garrisons of Hòva troops. At the same time the chiefs of the various tribes were left in possession of a good deal of their former honours and influence. Rànavàlona II., her predecessor and her successor were successively married to the prime minister, Ràinilaiàrivòny, a man of great ability and sagacity, who, by his position as husband and chief adviser of the sovereign, became virtual ruler of the country. Chiefly owing to his influence, many measures tending to improve the administration were introduced. The Hòva army was estimated at from 30,000 to 40,000 men, several English non-commissioned officers and, latterly, others of higher rank being engaged to train them in European methods. Revenue was derived from customs duties, firstfruits, fines and confiscation of offenders' property, and a money offering called *hàsina*, presented on a great variety of occasions both to the sovereign in person and to her representatives; and these were supplemented by "benevolences" (in the medieval sense of the word) levied upon the people for occasional state necessities. The government also claimed the unpaid service of all classes of the community for every kind of public work.

Foreign Relations.

The Hòva government aspired to have Madagascar recognized as an independent civilized state, and consuls appointed by the British, French and American governments were accredited to the Malagasy sovereign, the queen having a consul in England, and a consular agent at Mauritius. The treaty with Great Britain, concluded in 1865, gave the consuls of that nation jurisdiction over the British subjects in the island. At this period, on the initiative of the 4th earl of Clarendon, then foreign secretary, an understanding was come to between the British and French governments by which it was agreed that each power should respect the independence of Madagascar; and the future of the country appeared to be bound up in the gradual consolidation of the central Hòva authority over the whole island. While this prospect would have satisfied the British interests in the island, it was otherwise with the French. The tradition of their former settlements in and influence over the island was strong; in 1840 they had taken under their protection the Sàkalàva ruler of the small island of Nossi-bé, off the north-west coast, and in virtue of that act claimed a vague protectorate over the adjacent shores of the mainland. A treaty, concluded in 1868, while establishing French consular jurisdiction in Madagascar, recognized Rànavàlona II. as queen of Madagascar, and under the Second Empire attempts to establish French political influence were discouraged, and even as late as 1872 the subsidy enjoyed by the Jesuit missionaries was withdrawn. In 1878 the French consul, Laborde, died, and a dispute arose as to the disposal of his property. This dispute was the occasion of further intervention on the part of the French, for the Paris government supported the claims of Laborde's heirs, and revived their claim to a protectorate over the Sàkalàva of the north-west coast, as based on their agreement with them in 1840, ceding Nossi-bé to France. A policy of colonial expansion generally, and in Africa in particular at this time, was manifest in France, as in other European countries, and the French claims on the Hòva were pressed with vigour.

Franco-Malagasy War of 1883-85.

Towards the middle of 1882 the relations between the native government and that of France became much strained, and to settle, if possible, these causes of dispute, two Hòva officers of high rank were sent to France as ambassadors, but as they were not authorized to concede any territory, their visit accomplished very little. Treaties had been concluded with Great Britain, Germany and America, giving improved facilities for trade with Madagascar, but before the return of the envoys matters had come to a crisis in the island. In May 1883 an ultimatum was sent to the Malagasy queen, requiring immediate compliance with the demands of France; and as these were refused by the Hòva government, Tamatàve was bombarded by a French squadron and then occupied by the marines. The war continued in a desultory fashion for many months; but no serious attempt was made to invade the interior; and in 1885 terms of peace were agreed to. By a treaty signed on the 17th of December it was agreed that the foreign relations of Madagascar should be directed by France; that a resident should live at the capital, with a small guard of French soldiers; and that the Bay of Diégo-Suarez, together with surrounding territory, should be ceded to France. The word "protectorate" was carefully excluded from the treaty, although doubtless the French envoys intended that this should be its practical issue. It was at the same time agreed that there should be no foreign interference with the internal government of the country, and that the queen should retain her former position, with all its honours and dignity. It should be here noticed that the queen, Rànavàlona II., died just at the beginning of the war, on the

13th of July 1883, and was succeeded by her niece, Princess Razàfindrahèty, under the title of Rànavàlona III., who maintained the same policy as her predecessor, and was much beloved by her people and respected by all.

French Protectorate, 1885-1894.

Several French residents successively represented France at Antanànarivo; but these found themselves unable to obtain that influence which the home authorities thought they had a right to demand. Although the British government, in return for concessions in Zanzibar, had consented, in 1890, to recognize a French protectorate over Madagascar, the Malagasy prime minister, Ràinilaiàrivòny, was not disposed to give any advantage to France and continued to arm and train, by the help of British officers, a large body of native soldiers. This state of tension and irritation could not last, and at length, towards the close of 1894, the French government sent an ultimatum to the Malagasy sovereign, demanding such powers as would have made French authority supreme in the island. These demands were refused by the native government, and other conditions were offered; but the French envoy, together with the resident's escort, left the capital, as also did the French traders and others, including the large Jesuit mission.

French Invasion and Conquest, 1895.

As soon as these had left the island, the chief ports were occupied by French troops, and an expeditionary force under General Duchesne was afterwards landed on the north-west coast at Mòjangà—commonly, but incorrectly, written Majunga—with the object of breaking the Hòva authority. Owing to the necessity of making a road for the passage of artillery and military stores, many months were spent on the march into the interior, and there was considerable loss of life by fever and other disease among the invading troops. But no effectual resistance was made by the Malagasy, and at length, on the 30th of September 1895, the French forces appeared on the heights north and east of Antanànarivo, bombarded the city, which surrendered in the afternoon, and on the evening of the same day the French entered the capital.

The result was that the protectorate of France was re-established in the central provinces, but the queen was allowed to retain her position.

Rebellion of 1896, and Gradual Subjection of the Malagasy.

Early in 1896, however, a serious rebellion broke out in several parts of Imèrina. This movement was not only anti-French and anti-foreign, but also distinctly anti-Christian. The French troops gradually broke up the power of the rebellion in the central provinces, but as there appeared to be considerable unrest in many other parts of the island, General Gallieni, an officer with a reputation for vigour and ability in the Sudan and Tongking campaigns, was sent out to relieve the then resident-general.

Administration of General Gallieni.

General Gallieni had a difficult task in establishing the authority of France throughout the island among numbers of tribes who had never submitted to any control from others. Among the first steps he took were to put the country under martial law, to abolish royalty and all semblance of Hòva government, and to declare Madagascar to be henceforth a colony of France. Queen Rànavàlona III. was exiled to Réunion, and subsequently to Algeria. Meanwhile carriage roads were commenced to connect all the chief centres, and the military posts were gradually extended so as to consolidate French rule over all the outlying tribes. French residents and numerous other officials were placed at every important town, and various projects were started for the civilization of the Malagasy in accordance with French ideas. At the close of 1899; General Gallieni was able to report that only portions of the west and south-west remained to be brought into submission. Not long afterwards the authority of France was recognized throughout the island. General Gallieni, whose firm and vigorous administration, and desire to treat the Malagasy justly and kindly, made him liked by the people, retired in 1905, and was succeeded in that office by M. Victor Augagneur, late mayor of Lyons. Since the French occupation the Malagasy have conformed pretty readily to the new order of things, although many of the most intelligent Hòva deeply regret that their country did not retain its independence. Justice is administered, on the whole, with fairness and impartiality; but the taxation seems too heavy for the means of the people, indeed it is affirmed by trustworthy natives that the well-to-do classes are being gradually drained of their property. To an outsider it also appears that the staff of officials is very largely in excess of any real needs of administration; several monopolies, which interfere with the habits of the people, tend to produce discontent; and the taking of their land and houses for public works, roads, &c., while but a mere fraction of their real value is allowed as compensation, does not help to increase their acquiescence in foreign control. But the most serious cause for dislike to government action was the interference by the governor-general, in 1907, with their religious customs, by the suppression of hundreds of their congregational schools, and the closing of numbers of their churches. In July 1910 M. Augagneur was replaced as governor-general by N. Picquié, a prominent official of the Colonial Department, who had previously served with acceptance as deputy governor-general of French Indo-China, and who had a reputation for tact and impartiality.

Christian Missions and Education.—As already noticed, the Malagasy owe to missionaries of the London Missionary Society their first school system and their first literature, in 1820 and subsequent years;[1] and for fifteen years all educational work was carried on by them, some 10,000 to 12,000 children having been instructed in their schools. On the reopening of the country to Europeans in 1862, the L.M.S. mission was resumed and was carried on with vigour for several years, stations being formed in several parts of Imèrina, in the Bétsiléo and Antsihànaka provinces, and at the ports of Tamatave, Majunga and Fàrafangàna (south-east coast). In 1890 the number of their churches was 1220; adherents, 248,000; and scholars, 68,000; so that for long the greater part of the educational work was in their hands, carried on not only in primary schools, but also in high schools and colleges. In 1863 the Church of England began work in the island through the Society for the Propagation of the Gospel and the Church Missionary Society. After some time, however, the latter society withdrew, leaving the field to the S.P.G. A bishop is stationed in the capital, with a theological college in its neighbourhood, but the chief work of the Anglican mission is on the east coast. In 1866 the Norwegian Lutheran Society began work in Madagascar, and was joined in 1888 by an American Lutheran Society. With a representative church at the capital, the chief work of these missions is in the Vàkinankàratra district (south-west of Imèrina), in the Bétsiléo province, and on the south-east and south-west coasts; in these places they have a large number of converts and (until lately) schools. In 1867 a mission was begun by the Society of Friends, who gave great attention to education and literary work, and afterwards took up as their field of labour the western and south-western parts of Imèrina, where they have a large and well-organized mission. Immediately after the island became a French possession the French Protestant Churches began (in 1896) to take part in the evangelizing of their new colony, and about half the area for long occupied by the London Missionary Society was transferred to the Paris Society. The bulk of the Malagasy Christians are Protestants, probably three-fourths or four-fifths of those professing Christianity. A Roman Catholic (Jesuit) mission was begun in 1861, and a large force of priests with a bishop and lay brethren and sisters engaged in education, have been at work in the island since then, except during the two Franco-Malagasy wars.[2] Since the French conquest, the north of the island has been occupied by a mission of priests of the Saint Esprit, and the southern portion by the Lazarist mission, each with a bishop at its head. The following table gives the statistics of the various Protestant missions at the close of 1906:—

Mission	Missionaries	Churches	Adherents	Members	Scholars
Lond. Miss. Soc.	25	630	120,000	32,000	27,000
Soc. Prop. Gospel	15	121	13,000	4,094	7,655
Norweg. Luth.	60	892	84,000	71,500	38,000
Am. Luth.	14	?	?	?	?
Soc. of Friends	27	178	15,000	2,540	7,122
French Prot. Miss.	29	491	110,660	10,500	18,200

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[1] It is true that 200 years earlier than this, persistent efforts were made for nineteen years (1600–1619) by Portuguese Roman Catholic missionaries to propagate their faith among the south-east coast tribes. But although much zeal and self-denial were shown by these men, their efforts were abortive, and the mission was at length abandoned, leaving no fruit of their labours in a single church or convert. Half a dozen small books of devotion are all that remain to show their presence in Madagascar.

[2] The work of the "Frères chrétiens" was, however, almost broken up by the anti-clerical policy of the French government.

Since 1897 high schools, and medical and technical schools, and a few primary schools, have been formed by the French government; and all other schools have been placed under regulations issued by an educational department, the scholars being required to learn the French language; but until the end of 1906 the bulk of the educational work was carried on by the various missions. At that date the anti-clerical movement in France began to affect Madagascar. In all the missions the churches had, in the vast majority of cases, been used as school-houses, but in November 1906 it was strictly forbidden to use churches for educational purposes after two months from that date; and the effect of the decree, with other provisions, was to close hundreds of schools, probably three-fourths of the whole number.

For many years (1862–1896), all medical aid to the sick, the formation of hospitals and dispensaries, the training of native doctors, midwives and nurses, and the production of medical literature was entirely due to the Protestant missionaries, viz. the London Missionary Society, the Friends and the Norwegians. Numbers of young men received a full course of medical and surgical training, and were awarded diplomas after passing strict examinations. This work is now mostly in charge of a government department, and mission medical work is much restricted; but for thirty-five years the Malagasy owed all such help to the benevolence of European Christians. Besides care for the sick in ordinary diseases, asylums for lepers were for many years carried on; two by the London Missionary Society, one, a large one, with 800 or 900 inmates, by the Norwegian Society, and another by the Roman Catholic mission. This last, with one of those of the L.M.S., is now taken over by the government.

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MADAN, MARTIN (1726–1790), English writer, was educated at Westminster School, and at Christ Church, Oxford, where he graduated in 1746. In 1748 he was called to the bar, and for some time lived a very gay life, until he was persuaded to change his ways on hearing a sermon by John Wesley. He took holy orders, and was appointed chaplain to the Lock Hospital, London. He was closely connected with the Calvinistic Methodist movement supported by the countess of Huntingdon, and from time to time acted as an itinerant preacher. He was a first cousin of William Cowper, with whom he had some correspondence on religious matters. In 1767 much adverse comment was aroused by his support of his friend Thomas Haweis in a controversy arising out of the latter's possession of the living of Aldwinkle, Northamptonshire (see *Monthly Review*, xxxvii. 382, 390, 465). In 1780 Madan raised more serious storm of opposition by the publication of his *Thelyphthora, or A Treatise on Female Ruin*, in which he advocated polygamy as the remedy for the evils he deplored. The author was no doubt sincere in his arguments, which he based chiefly on scriptural authority; but his book called forth many angry replies. Nineteen attacks on it are catalogued by Falconer Madan in *Dict. Nat. Biog.* Madan resigned his chaplainship and retired to Epsom, where he produced, among other works, *A New and Literal Translation of Juvenal and Persius* (1789). He died on the 2nd of May 1790.

MADDALONI, a town of Campania, Italy, in the province of Caserta, about 3½ m. S.E. of Caserta, with stations on the railways from Caserta to Benevento and from Caserta to Avellino, 200 ft. above sea-level. Pop. (1901), 19,778 (town); 21,270 (commune). It is prettily situated at the base of one of the Tifata hills, the towers of its medieval castle and the church of San Michele crowning the heights above. The fine old palace of the Caraffa family, once dukes of Maddaloni, the old college now named after Giordano Bruno, and the institute for the sons of soldiers are the chief points of interest. About 2½ m. east of Valle di Maddaloni, the Ponte della Valle, an aqueduct built by the orders of Charles III. of Naples and his son to convey the water of the Tiburno to Caserta (19 m.), is carried across the valley between Monte Longano and Monte Gargano by a threefold series of noble arches rising to a height of 210 ft. The work was designed by Lodovico Vanvitelli, and constructed between 1753 and 1759.

MADDEN, SIR FREDERIC (1801–1873), English palaeographer, the son of an officer of Irish extraction, was born at Portsmouth on the 16th of February 1801. From his earliest years he displayed a strong bent to linguistic and antiquarian studies. In 1826 he was engaged by the British Museum to assist in the preparation of the classified catalogue of printed books then contemplated, and in 1828 he became assistant keeper of manuscripts. In 1833 he was knighted, and in 1837 succeeded Josiah Forshall as keeper of manuscripts. He was not entirely successful in this office, partly owing to want of harmony with his colleagues; he retired in 1866. He edited for the Roxburghe Club *Havelok the Dane* (1828), discovered by himself among the Laudian MSS. in the Bodleian, *William and the Werwolf* (1832) and the old English versions of the *Gesta Romanorum* (1838). In 1839 he edited the ancient metrical romances of *Syr Gawayne* for the Bannatyne Club, and in 1847 Layamon's *Brut*, with a prose translation, for the Society of Antiquaries. In 1850 the magnificent edition, in parallel columns, of what are known as the "Wycliffite" versions of the Bible, from the original MSS., upon which he and his coadjutor, Forshall, had been engaged for twenty years, was published by the university of Oxford. In 1866–1869 he edited the *Historia Minor* of Matthew Paris for the Rolls Series. In 1833 he wrote the text of Henry Shaw's *Illuminated Ornaments of the Middle Ages*; and in 1850 edited the English translation of Silvestre's *Paléographie universelle*. He died on the 8th of March 1873, bequeathing his journals and other private papers to the Bodleian Library, where they were to remain unopened until 1920.

Madden was perhaps the first palaeographer of his day. He was an acute as well as a laborious antiquary, but his ignorance of German prevented his ranking high as a philologist, although he paid much attention to the early dialectical forms of French and English. His minor contributions to antiquarian research were exceedingly numerous: the best known, perhaps, was his dissertation on the orthography of Shakespeare's name, which, mainly on the strength of the Florio autograph, he contended should be "Shakspere."

MADDER, or Dyers' Madder, the root of *Rubia tinctorum* and perhaps also of *R. peregrina*, both European, *R. cordifolia*, a native of the hilly districts of India and of north-east Asia and Java, supplying the Indian madder or *manjit*. *Rubia* is a genus of about thirty-five species of the tribe *Galieae* of the order Rubiaceae, and much resembles the familiar *Galiums*, *e.g.* lady's bedstraw (*G. verum*) and the cleavers (*G. aparine*) of English hedges, having similarly whorled leaves, but the parts of the flowers are in fives and not fours, while the fruit is somewhat fleshy. The only British species is *R. peregrina*, which is found in Wales, the south and west of England, and in east and south Ireland. The use of madder appears to have been known from the earliest times, as cloth dyed with it has been found on the Egyptian mummies. It was the *ἐρευθέδανον* used for dyeing the cloaks of the Libyan women in the days of Herodotus (Herod. iv. 189). It is the *ἐρυθρόδανον* of Dioscorides, who speaks of its cultivation in Caria (iii. 160), and of Hippocrates (*De morb. mul.* i.), and the *Rubia* of Pliny (xix. 17). *R. tinctorum*, a native of western Europe, &c., has been extensively cultivated in south Europe, France, where it is called *garance*, and Holland, and to a small extent in the United States. Large quantities have been imported into England from Smyrna, Trieste, Leghorn, &c. The cultivation, however, decreased after alizarin, the red colouring principle of madder, was made artificially. Madder was employed medicinally by the ancients and in the middle ages. Gerard, in 1597, speaks of it as having been cultivated in many gardens in his day, and describes its supposed many virtues (*Herball*, p.960); but any pharmacological or therapeutic action which madder may possess is unrecognizable. Its most remarkable physiological effect is that of colouring red the bones of animals fed upon it, as also the claws and beaks of birds. This appears to be due to the chemical affinity of phosphate of lime for the colouring matter (Pereira, *Mat. med.*, vol. ii. pt. 2, p. 52). This property has been of much use in enabling physiologists to ascertain the manner in which bones develop, and the functions of the various types of cells found in growing bone. *R. chilensis* has been used for dyeing red from time immemorial. The chay-root, which furnishes a red dye in Coromandel and other parts of India, is the root-bark of *Oldenlandia umbellata*, a low-growing plant of the same family as madder.

MADEC, RENÉ-MARIE (1736–1784)—called Medoc in Anglo-Indian writings—French adventurer in India, was born at Quimper in Brittany on the 7th of February 1736, of poor parents. He went out to India and served under Dupleix and Lally, but being taken prisoner by the British he enlisted in the Bengal army. Deserting with some of his companions shortly before the battle of Buxar (1764), he became military instructor to various native princes, organizing successively the forces of Shuja-ud-Dowlah, nawab of Oudh, and of the Jats and Rohillas. He took service under the emperor Shah Alam in 1772, and when that prince was defeated at Delhi by the Mahrattas, Madec rejoined his own countrymen in Pondicherry, where he took an active part in the defence of the town (1778). After the capitulation of Pondicherry he returned to France with a considerable fortune, and died there in 1784. At one time he formed a scheme for a French alliance with the Mogul emperor against the British, but the project came to nothing.

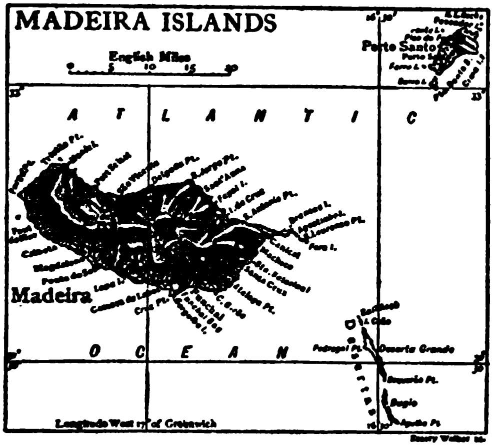
See Émile Barbé, *Le Nabab René Madec* (1894).

MADEIRA, or The Madeiras, a group of islands in the North Atlantic Ocean, which belong to Portugal, and consist of two inhabited islands named Madeira and Porto Santo and two groups of uninhabited rocks named the Desertas and Selvagens. Pop. (1900), 150,574; area, 314 sq. m. Funchal, the capital of the archipelago, is on the south coast of Madeira Island, in 32° 37′ 45″ N. and 16° 54′ W. It is about 360 m. from the coast of Africa, 535 from Lisbon, 1215 from Plymouth, 240 from Teneriffe, and 480 from Santa Maria, the nearest of the Azores.

Madeira (pop. 1900, 148,263), the largest island of the group, has a length of 30 m., an extreme breadth of 12 m., and a coast-line of 80 or 90 m. Its longer axis lies east and west, in which direction it is traversed by a mountain chain, the backbone of the island, having a mean altitude of 4000 ft., up to which many deep ravines penetrate from both coasts and render travel by land very difficult. Pico Ruivo, the highest summit, stands in the centre of the island, and has a height of 6056 ft., while some of the adjacent summits are very little lower. The depth and narrowness of the ravines, the loftiness of the rugged peaks, often covered with snow, that tower above them, the bold precipices of the coast, and the proximity of the sea, afford many scenes of picturesque beauty or striking grandeur. The greater part of the interior is uninhabited, though cultivated, for the towns, villages and scattered huts are usually built either at the mouths of ravines or upon the lower slopes that extend from the mountains to the coast. The ridges between the ravines usually terminate in lofty headlands, one of which, called Cabo Girão, has the height of 1920 ft., and much of the seaboard is bound by precipices of dark basalt. The north coast, having been more exposed to the erosion of the sea, is more precipitous than the south, and presents everywhere a wilder aspect. On the south there is left very little of the indigenous forest which once clothed the whole island and gave it the name it bears (from the Portuguese *madeira*, Lat. *materia*, wood), but on the north some of the valleys still contain native trees of fine growth. A long, narrow and comparatively low rocky promontory forms the eastern extremity of the island; and here is a tract of calcareous sand, known as the Fossil Bed, containing land shells and numerous bodies resembling the roots of trees, probably produced by infiltration.

Porto Santo is about 25 m. N.E. of Madeira. Pop. (1900), 2311. It has a length of 6¼ m. and a width of 3 m. The capital is Porto Santo, called locally the *villa* or town. The island is very unproductive, water being scarce and wood wholly absent. Around the little town there is a considerable tract of pretty level ground covered by calcareous sand containing fossil land-shells. At each end of the island are hills, of which Pico do Facho, the highest, reaches the altitude of 1663 ft. Barley, but little else, is grown here; the limited requirements of the inhabitants being supplied from Funchal.

The Desertas lie about 11 m. S.E. of Madeira, and consist of three islands, Ilheo Chão, Bugio and Deserta Grande, together with Sail Rock off the north end of Ilheo Chão. They present lofty precipices to the sea on all sides. Rabbits and goats abound on them. The archil weed grows on the rocks, and is gathered for exportation. The largest islet (Deserta Grande) is 6¼ m. long, and attains the height of 1610 ft. These rocks are conspicuous objects in the sea-views from Funchal.



The Selvagens or *Salvages* are a group of three islands, 156 m. from Madeira, and between Madeira and the Canary Islands. The largest island is the Great Piton, 3 m. long, and 1 m. broad. The inclusion of the Selvagens in the Madeira Archipelago is due to political rather than to geographical reasons.

Geology.—All the islands of the group are of volcanic origin. They are the summits of very lofty mountains which have their bases in an abyssal ocean. The greater part of what is now visible in Madeira is of subaerial formation, consisting of basaltic and trachytic lavas, beds of tuff and other ejectamenta, the result of a long and complicated series of eruptions from innumerable vents. Besides this building up by the emission of matter from craters and clefts, a certain amount of upheaval in mass has taken place, for at a spot about 1200 ft. above the sea in the northern valley of São Vicente, and again at about the same height in Porto Santo, there have been found fragments of limestone accompanied by tuffs containing marine shells and echinoderms of the Miocene Tertiary epoch. We have here proof that during or since that epoch portions at least of these islands have been bodily uplifted more than 1000 ft. The fossils are sufficiently well preserved to admit of their genera, and in many instances even their species, being made out.

There were pauses of considerable duration whilst the island of Madeira was being increased in height. The leaf bed and the accompanying carbonaceous matter, frequently termed lignite, although it displays no trace of structure, which lie under 1200 ft. of lavas in the valley of São Jorge, afford proof that there had been sufficient time for the growth of a vegetation of high order, many of the leaf impressions belonging to species of trees and shrubs which still exist on the island. Moreover, great alterations and dislocations had taken place in the rocks of various localities before other lavas and tuffs had been thrown upon them.

There are no data for determining when volcanic action began in this locality, but looking at the enormous depth of the surrounding sea it is clear that a vast period of time must have elapsed to allow of a great mountain reaching the surface and then rising several thousand feet. Again, considering the comparatively feeble agents for effecting the work of denudation (neither glaciers nor thick accumulations of alpine snow being found here), and then the enormous erosion that has actually taken place, the inference is inevitable that a very great lapse of time was required to excavate the deep and wide ravines that everywhere intersect the island. Nor is anything known as to the period of the cessation of volcanic action. At the present day there are no live craters or smoking crevices, as at the Canaries and Cape Verdes, nor any hot springs, as at the Azores.

In one of the northern ravines of Madeira by Porto da Cruz some masses of a coarsely crystalline Essexite are exposed to view; this rock is evidently the deep-seated representative of the Trachydoleritic and Nepheline basalt lavas. Fragments of a sodalite-syenite have also been found at Soca in the same neighbourhood.

In the eastern part of the island several small crater rings are to be seen; their rims are formed of spheroidal basalt, while within the craters themselves masses of bauxite are found accompanied by evidences of fumerolic action.

In the sections afforded by the ravines, which strike north and south from the central ridge of Madeira to the sea, the nucleus of the island is seen to consist of a confused mass of more or less stratified rock, upon which rest beds of tuff, scoriae and lava, in the shape of basalt, trap and trachyte, the whole traversed by dykes. These beds are thinnest near the central axis; as they approach the coast they become thicker and less intersected by dykes.

In various parts are elevated tracts of comparatively level ground. These are supposed to have been formed by the meeting of numerous streams of lava flowing from cones and points of eruption in close proximity, various ejectamenta assisting at the same time to fill up inequalities. Deep down in some of the lateral ravines may be seen ancient cones of eruption which have been overwhelmed by streams of melted matter issuing from the central region, and afterwards exposed to view by the same causes that excavated the ravines. These ravines may be regarded as having been formed at first by subterranean movements, both gradual and violent, which dislocated the rocks and cut clefts through which streams flowed to the sea. In course of time the waters, periodically swollen by melted snows and the copious rains of winter, would cut deeper and deeper into the heart of the mountains, and would undermine the lateral cliffs, until the valleys became as large as we now find them. Even the Curral, which from its rounded shape and its position in the centre of the island has been usually deemed the ruins of a crater, is thought to be nothing more than a valley scooped out in the way described. The rarity of crateriform cavities in Madeira is very remarkable. There exists, however, to the east of Funchal, on a tract 2000 ft. high, the Lagoa, a small but perfect crater, 500 ft. in diameter, and with a depth of 150 ft.; and there is another, which is a double one, in the district known as Fanal, in the north-west of Madeira, nearly 5000 ft. above the sea. The basalt, of which much of the outer part of the island is composed, is of a dark colour and a tough texture, with small disseminated crystals of olivine and augite. It is sometimes full of vesicular cavities, formed by the expansion of imprisoned gases. A rudely columnar structure is very often seen in the basalt, but there is nothing so perfect as the columns of Staffa or the Giant's Causeway. The trachytic rocks are small in quantity compared with those of the basaltic class. The tufa is soft and friable, and generally of a yellow colour; but where it has been overflowed by a hot stream of lava it has assumed a red colour. Black ashes and fragments of pumice are sometimes found in the tufaceous strata.

There are no metallic ores, nor has any sulphur been found; but a little iron pyrites and specular iron are occasionally met with. The basalt yields an excellent building-stone, various qualities of which are quarried near Camara de Lobos, five or six miles west of Funchal.

In Porto Santo the trachytic rocks bear a much greater proportion to the basaltic than in Madeira. An adjacent islet is formed of tuffs and calcareous rock, indicating a submarine origin, upon which supramarine lavas have been poured. The older series contains corals and shells (also of the Miocene Tertiary epoch), with water-worn pebbles, cemented together by carbonate of lime, the whole appearing to have been a coral reef near an ancient beach. The calcareous rock is taken in large quantities to Funchal, to be burnt into lime for building purposes.

Climate.—Observations taken at Funchal Observatory (80 ft. above sea-level) in the last twenty years of the 19th century showed that the mean annual temperature is about 65° F. The mean minimum for the coldest part of the year (October to May inclusive) does not fall below 55°, and the average daily variation of temperature in the same period does not exceed 10°. Madeira thus has a remarkably mild climate, though it lies only 10° north of the Tropic of Cancer. This mildness is due to the surrounding ocean, from which the atmosphere obtains a large supply of watery vapour. The mean humidity of the air is about 75 (saturation = 100). The prevalent winds are from the north or from a few points east or west of north, but these winds are much mitigated on the south coast by the central range of mountains. The west wind usually brings rain. That from the east is a dry wind. A hot and dry wind, the *leste* of the natives, occasionally blows from the east-south-east, the direction of the Sahara, and causes the hill region to be hotter than below; but even on the coast the thermometer under its influence sometimes indicates 93°. The *leste* is often accompanied by sandstorms. As the thermometer has never been known to fall as low as 46° at Funchal, frost and snow are there wholly unknown; but snow falls on the mountains once or twice during the winter, very seldom, however, below the altitude of 2000 ft. Thunderstorms are rare, and scarcely ever violent.

Madeira has long had a high reputation as a sanatory resort for persons suffering from diseases of the chest. Notwithstanding the ever-increasing competition of other winter resorts, a considerable number of invalids, especially English and German, winter at Funchal.

Fauna.—No species of land mammal is indigenous to the Madeiras. Some of the early voyagers indeed speak of wild goats and swine, but these animals must have escaped from confinement. The rabbit, black rat, brown rat and mouse have been introduced. The first comers encountered seals, and this amphibious mammal (*Monachus albiventer*) still lingers at the Desertas. Amongst the thirty species of birds which breed in these islands are the kestrel, buzzard and barn owl, the blackbird, robin, wagtail, goldfinch, ring sparrow, linnet, two swifts, three pigeons, the quail, red-legged partridge, woodcock, tern, herring gull, two petrels and three puffins. Only one species is endemic, and that is a wren (*Regulus madeirensis*), but five other species are known elsewhere only at the Canaries. These are the green canary (*Fringilla butyracea*, the parent of the domesticated yellow variety), a chaffinch (*Fringilla tintillon*), a swift (*Cypselus unicolor*), a wood pigeon (*Columba trocaz*) and a petrel (*Thalassidroma Bulwerii*). There is also a local variety of the blackcap, distinguishable from the common kind by the extension in the male of the cap to the shoulder. About seventy other species have been seen from time to time in Madeira, chiefly stragglers from the African coast, many of them coming with the *leste* wind.

The only land reptile is a small lizard (*Lacerta dugesii*), which is abundant and is very destructive to the grape crop. The loggerhead turtle (*Caouana caretta*, Gray) is frequently captured, and is cooked for the table, but the soup is much inferior to that made from the green turtle of the West Indies. A single variety of frog (*Rana esculenta*) has been introduced; there are no other batrachians.

About 250 species of marine fishes taken at Madeira have been scientifically determined, the largest families being *Scombridae* with 35 species, the sharks with 24, the *Sparidae* with 15, the rays with 14, the *Labridae* with 13, the *Gadidae* with 12, the eels with 12 the *Percidae* with 11, and the *Carangidae* with 10. Many kinds, such as the mackerel, horse mackerel, groper, mullet, braise, &c., are caught in abundance, and afford a cheap article of diet to the people. Several species of tunny are taken plentifully in spring and summer, one of them sometimes attaining the weight of 300 lb. The only fresh-water fish is the common eel, which is found in one or two of the streams.

According to T. V. Wollaston (*Testacea atlantica*, 1878), there have been found 158 species of mollusca on the land, 6 inhabiting fresh water and 7 littoral species, making a total of 171. A large majority of the land shells are considered to be peculiar. Many of the species are variable in form or colour, and some have an extraordinary number of varieties. Of the land mollusca 91 species are assigned to the genus *Helix*, 31 to the genus *Pupa*, and 15 to the genus *Achatina* (or *Lovea*). About 43 species are found both living and fossil in superficial deposits of calcareous sand in Madeira or Porto Santo. These deposits were assigned by Lyell to the Newer Pliocene period. Some 12 or 13 species have not been hitherto discovered alive. More than 100 species of *Polyzoa* (*Bryozoa*) have been collected, among them are some highly interesting forms.

The only order of insects which has been thoroughly examined is that of the *Coleoptera*. By the persevering researches of T. V. Wollaston the astonishing number of 695 species of beetles has been brought to light at the Madeiras. The proportion of endemic kinds is very large, and it is remarkable that 200 of them are either wingless or their wings are so poorly developed that they cannot fly, while 23 of the endemic genera have all their species in this condition. With regard to the *Lepidoptera*, 11 or 12 species of butterflies have been seen, all of which belong to European genera. Some of the species are geographical varieties of well-known types. Upward of 100 moths have been collected, the majority of them being of a European stamp, but probably a fourth of the total number are peculiar to the Madeiran group. Thirty-seven species of *Neuroptera* have been observed in Madeira, 12 of them being so far as is known peculiar.

The bristle-footed worms of the coast have been studied by Professor P. Langerhans, who has met with about 200 species, of which a large number were new to science. There are no modern coral reefs, but several species of stony and flexible corals have been collected, though none are of commercial value. There is, however, a white stony coral allied to the red coral of the Mediterranean which would be valuable as an article of trade if it could be obtained in sufficient quantity. Specimens of a rare and handsome red *Paragorgia* are in the British Museum and Liverpool Museum.

Flora.—The vegetation is strongly impressed with a south-European character. Many of the plants in the lower region undoubtedly were introduced and naturalized after the Portuguese colonization. A large number of the remainder are found at the Canaries and the Azores, or in one of these groups, but nowhere else. Lastly, there are about a hundred plants which are peculiarly Madeiran, either as distinct species or as strongly marked varieties. The flowering plants found truly wild belong to about 363 genera and 717 species,—the monocotyledons numbering 70 genera and 128 species, the dicotyledons 293 genera and 589 species. The three largest orders are the *Compositae*, *Leguminosae* and *Graminaceae*. Forty-one species of ferns grow in Madeira, three of which are endemic species and six others belong to the peculiar flora of the North Atlantic islands. About 100 species of moss have been collected, and 47 species of *Hepaticae*. A connexion between the flora of Madeira and that of the West Indies and tropical America has been inferred from the presence in the former of six ferns found nowhere in Europe or North Africa, but existing on the islands of the east coast of America or on the Isthmus of Panama. A further relationship to that continent is to be traced by the presence in Madeira of the beautiful ericaceous tree *Clethra arborea*, belonging to a genus which is otherwise wholly American, and of a *Persea*, a tree laurel, also an American genus. The dragon tree (*Dracaena Draco*) is almost extinct. Amongst the trees most worthy of note are four of the laurel order belonging to separate genera, an *Ardisia*, *Pittosporum*, *Sideroxylon*, *Notelaea*, *Rhamnus* and *Myrica*,—a strange mixture of genera to be found on a small Atlantic island. Two heaths of arborescent growth and a whortleberry cover large tracts on the mountains. In some parts there is a belt of the Spanish chestnut about the height of 1500 ft. There is no indigenous pine tree as at the Canaries; but large tracts on the hills have been planted with *Pinus pinaster*, from which the fuel of the inhabitants is mainly derived. A European juniper (*J Oxycedrus*), growing to the height of 40 or 50 ft., was formerly abundant, but has been almost exterminated, as its scented wood is prized by the cabinet-maker. Several of the native trees and shrubs now grow only in situations which are nearly inaccessible, and some of the indigenous plants are of the greatest rarity. But some plants of foreign origin have spread in a remarkable manner. Among these is the common cactus or prickly pear (*Opuntia Tuna*), which in many spots on the coast is sufficiently abundant to give a character to the landscape. As to *Algae*, the coast is too rocky and the sea too unquiet for a luxuriant marine vegetation, consequently the species are few and poor.

Inhabitants.—The inhabitants are of Portuguese descent, with probably some intermixture of Moorish and negro blood amongst the lower classes. The dress of the peasantry, without being picturesque, is peculiar. Both men and women in the outlying country districts wear the *carapuça*, a small cap made of blue cloth in shape something like a funnel, with the pipe standing upwards. The men have trousers of linen, drawn tight, and terminating at the knees; a coarse shirt enveloping the upper part of their person, covered by a short jacket, completes their attire, with the exception of a pair of rough yellow boots. The women's outer garments consist of a gaudily coloured gown, made from island material, with a small cape of coarse scarlet or blue woollen cloth.) The population tends to increase rapidly. In 1900 it amounted to 150,574, including 890 foreigners, of whom the majority were British. The number of females exceeds that of males by about 6000, partly because many of the able-bodied males emigrate to Brazil or the United States. The density of population (479·5 per sq. m.) is very great for a district containing no large town and chiefly dependent on agriculture and viticulture.

Agriculture.—A large portion of the land was formerly entailed in the families of the landlords (*morgados*), but entails have been abolished by the legislature, and the land is now absolutely free. The deficiency of water is a great obstacle to the proper cultivation of the land, and the rocky nature or steep inclination of the upper parts of the islands is an effectual bar to all tillage. An incredible amount of labour has been expended upon the soil, partly in the erection of walls intended to prevent its being washed away by the rains, and to build up the plots of ground in the form of terraces. Watercourses have been constructed for purposes of irrigation, without which at regular intervals the island would not produce a hundredth part of its present yield. These watercourses originate high up in the ravines, are built of masonry or driven through the rock, and wind about for miles until they reach the cultivated land. Some of them are brought by tunnels from the north side of the island through the central crest of hill. Each occupier takes his turn at the running stream for so many hours in the day or night at a time notified to him beforehand. In this climate flowing water has a saleable value as well as land, which is useless without irrigation.

The agricultural implements employed are of the rudest kind, and the system of cultivation is extremely primitive. Very few of the occupiers own the land they cultivate; but they almost invariably own the walls, cottages and trees standing thereon, the land alone belonging to the landlord. The tenant can sell his share of the property without the consent of the landlord, and if he does not so dispose of it that share passes to his heirs. In this way the tenant practically enjoys fixity of tenure, for the landlord is seldom in a position to pay the price at which the tenant's share is valued. Money rents are rare, the métayer system regulating almost universally the relations between landlord and tenant; that is, the tenant pays to the owner a certain portion of the produce, usually one half or one third. The holdings are as a rule rarely larger than one man can cultivate with a little occasional assistance. There are few meadows and pastures, the cattle being stall-fed when not feeding on the mountains. Horses are never employed for draught, all labour of that kind being done by oxen.

Wine.

The two staple productions of the soil are wine and sugar. The vine was introduced from Cyprus or Crete soon after the discovery of the island by the Portuguese (1420), but it was not actively cultivated until the early part of the 16th century. The vines, after having been totally destroyed by the oidium disease, which made its first appearance in the island in 1852, were replanted, and in a few years wine was again made. The phylloxera also made its way to the island, and every vineyard in Madeira was more or less affected by it. The wine usually termed Madeira is made from a mixture of black and white grapes, which are also made separately into wines called Tinta and Verdelho, after the names of the grapes. Other high-class wines, known as Bual, Sercial and Malmsey, are made from varieties of grapes bearing the same names. (See also WINE.)

Sugar.

The sugar cane is said to have been brought from Sicily about 1452, and in course of time its produce became the sole staple of the island. The cultivation languished, however, as the more abundant produce of tropical countries came into the European market, and sugar had long ceased to be made when the destruction of the vines compelled the peasants to turn their attention to other things. Its cultivation was resumed and sugar machinery imported. A considerable quantity of spirit is made by the distillation of the juice or of the molasses left after extracting the sugar, and this is consumed on the island. The cane does not flourish here as luxuriantly as within the tropics; but in localities below 1000 ft., where there is a good supply of water, it pays the cultivator well.

The grain produced on the island (principally wheat, barley and Indian corn) is not sufficient for the consumption of the people. The common potato, sweet potato and gourds of various kinds are extensively grown, as well as the *Colocasia esculenta*, the *kalo* of the Pacific islanders, the root of which yields an insipid food. Most of the common table vegetables of Europe are plentiful. Besides apples, pears and peaches, all of poor quality, oranges, lemons, guavas, mangoes, loquats, custard-apples, figs, bananas and pineapples are produced, the last two forming articles of export. The date palm is occasionally grown, but its fruit is scarcely edible. On the hills large quantities of the Spanish chestnut afford an item in the food of the common people. A little tobacco is grown, and is made into cigars of inferior quality.

The total foreign trade of Madeira was valued at £628,000 in 1900. The principal exports are wine, sugar, embroidery, vegetables, fruits and wicker goods. Coal is imported for the ships calling at Funchal, which is the headquarters of Madeiran commerce and industry. Spirits, beer, olive oil, soap, butter, linen and woollen goods, straw hats and leather, are manufactured for home consumption, and there are important fisheries.

Chief Towns and Communications.—Funchal (pop. 20,850) is described in a separate article. The other chief towns are Camara de Lobos (7150), Machico (6128), Santa Cruz (5876) Ponta do Sol (5665), São Vicente (4896), Calheta (3475), Sant' Anna (3011) and Porto Santo (2311). Each of these is the capital of a commune (*concelho*), to which it gives its name. Madeira is connected by regular lines of steamships with Great Britain, Germany, Portugal, Cape Colony, Brazil and the United States. There is no railway in the archipelago, and partly owing to the irregularities of the surface of the roads, of which there are some 580 m., are bad, except in the neighbourhood of Funchal. Wheel carriages are rare, and all heavy goods are transported either on the backs of mules or upon rude wooden sledges drawn by bullocks. When horses are not employed, locomotion is effected either by means of hammocks or by bullock cars. The hammock (*rêde*) is a piece of stout canvas gathered up and secured at each end to a long pole carried by a couple of bearers. In place of cabs, curtained cars on sledges, made to hold four persons, and drawn by a pair of bullocks, are employed. They are convenient, but the rate of progress is very slow.

Administration.—The archipelago is officially styled the district of Funchal; it returns members to the Portuguese Cortes, and is regarded as an integral part of the kingdom. The district is subdivided into the eight communes already enumerated, and is administered in accordance with the same laws that regulate local government on the mainland (see PORTUGAL). Funchal is a Roman Catholic bishopric in the archiepiscopal province of Lisbon. Education is compulsory in name only, for less than 2% of the population could read when the census of 1900 was taken. An infantry regiment and a battery of garrison artillery are permanently stationed in Madeira.

History.—It has been conjectured, but on insufficient evidence, that the Phoenicians discovered Madeira at a very early period. Pliny mentions certain Purple or Mauretanian Islands, the position of which with reference to the Fortunate Islands or Canaries might seem to indicate the Madeiras. There is a romantic story, to the effect that two lovers, Robert Machim, à Machin, or Macham, and Anna d'Arfet, fleeing from England to France (*c.* 1370) were driven out of their course by a violent storm and cast on the coast of Madeira at the place subsequently named Machico, in memory of one of them. Both perished here, but some of their crew escaped to the Barbary coast, and were made slaves. Among them was the pilot Pedro Morales of Seville, who is said to have been ransomed and to have communicated his knowledge of Madeira to João Gonçalvez Zarco (or Zargo). How far this story is true cannot now be ascertained. It is, however, certain that Zarco first sighted Porto Santo in 1418, having been driven thither by a storm while he was exploring the coast of West Africa. Madeira itself was discovered in 1420. It is probable that the whole archipelago had been explored at an earlier date by Genoese adventurers, and had been forgotten; for an Italian map dated 1351 (the Laurentian portolano) shows the Madeiras quite clearly, and there is some reason to believe that they were known to the Genoese before 1339. When Zarco visited Madeira in 1420 the islands were uninhabited, but Prince Henry the Navigator at once began their colonization, aided by the knights of the Order of Christ. Sanctioned by the pope and by two charters which the king of Portugal granted in 1430 and 1433, the work proceeded apace; much land was deforested and brought into cultivation, and the Madeiran sugar trade soon became important. For the sixty years 1580–1640 Madeira, with Portugal itself, was united with Spain. Slavery was abolished in Madeira in 1775, by order of Pombal. In 1801 British troops, commanded by General Beresford, occupied the island for a few months, and it was again under the British flag from 1807 to 1814. It shared in the civil disturbances brought about by the accession of Dom Miguel (see PORTUGAL: *History*), but after 1833 its history is a record of peaceful commercial development.

See A. S. Brown, *Madeira, the Canary Islands and the Azores* (1903), a comprehensive study of the three archipelagoes. *The Land of the Wine*, by A. J. D. Biddle (Philadelphia, 1901) is generally valuable, but its history cannot be trusted. See also P. Langerhaus, *Handbuch für Madeira* (1884) and Vahl, *Madeira's Vegetation* (Copenhagen, 1904).

MADELENIAN, a term derived from La Madeleine, a cave in the Vézère, about midway between Moustier and Les Eyzies, France, and given by the French anthropologist Gabriel de Mortillet to the third stage of his system of cave-chronology, synchronous with the fourth or most recent division of the Quaternary Age. The Madelenian epoch was a long one, represented by numerous stations, whose contents show progress in the arts and general culture. It was characterized by a cold and dry climate, the existence of man in association with the reindeer, and the extinction of the mammoth. The use of bone and ivory for various implements, already begun in the preceding Solutrian epoch, was much increased, and the period is essentially a Bone age. The bone instruments are very varied: spear-points, harpoon-heads, borers, hooks and needles. Most remarkable is the evidence La Madeleine affords of prehistoric art. Numbers of bones, reindeer antlers and animals' teeth were found, with rude pictures, carved or etched on them, of seals, fishes, reindeer, mammoths and other creatures. The best of these are a mammoth engraved on a fragment of its own ivory; a dagger of reindeer antler, with handle in form of a reindeer; a cave-bear cut on a flat piece of schist; a seal on a bear's tooth; a fish well drawn on a reindeer antler; and a complete picture, also on reindeer antler, showing horses, an aurochs, trees, and a snake biting a man's leg. The man is naked, and this and the snake suggest a warm climate, in spite of the presence of the reindeer. The fauna of the Madelenian epoch seems, indeed, to have included tigers and other tropical species side by side with reindeer, blue foxes, Arctic hares and other polar creatures. Madelenian man appears to have been of low stature, dolichocephalic, with low retreating forehead and prominent brow ridges. Besides La Madeleine the chief stations of the epoch are Les Eyzies, Laugerie Basse, and Gorge d'Enfer in Dordogne; Grotte du Placard in Charente and others in south-west France.

See G. de Mortillet, *Le Préhistorique* (1900); Edouard Lartet and Henry Christy, *Reliquiae Aquitanicae* (1865–1875); Edouard Dupont, *Le Temps préhistorique en Belgique* (1872); Lord Avebury, *Prehistoric Times* (1900).

MADELEY, a market town in the municipal borough of Wenlock, and the Wellington (Mid) parliamentary division of Shropshire, England, 159 m. N.W. from London, with stations on the London & North Western (Madeley Market) and Great Western railways (Madeley Court). Pop. of civil parish (1901), 8442. There are large ironworks, ironstone and coal are mined, and potter's clay is raised. The church of St Michael (1796) replaced a Norman building. The living was held from 1760 to 1783 by John William Fletcher or de la Flechère, a close friend of the Wesleys. The parish includes a portion of Coalbrookdale (*q.v.*), and the towns of Ironbridge and Coalport. IRONBRIDGE, a town picturesquely situated on the steep left bank of the Severn, adjoins Madeley on the south-west. It takes its name from the iron bridge of one span crossing the river, erected in 1779. This bridge is a remarkable work considering its date; it was probably the first erected, at any rate on so large a scale, and attracted great attention. It is the work of Abraham Darby, the third of the name, one of the famous family of iron-workers in Coalbrookdale. Here are brick and tile works and lime-kilns. There is a station (Ironbridge and Broseley) on the Great Western railway, across the river. COALPORT lies also on the Severn, S. of Madeley and 2 m. S.E. of Ironbridge, with a station on the Great Western railway. It has large china works, founded at the close of the 18th century, which subsequently incorporated those of Caughley, across the Severn, and of Nantgarw in Glamorganshire.

MĀDHAVA ĀCHĀRYA (*fl. c.* 1380), Hindu statesman and philosopher, lived at the court of Vijayanagar (the modern Humpi in the district of Bellary), the vigorous Southern Hindu kingdom that so long withstood Mahommedan influence and aggression. His younger brother Sāyana (d. 1387) was associated with him in the administration and was a famous commentator on the *Rigveda*. Sāyana's commentaries were influenced by and dedicated to Mādhava, who is best known as the author of the *Sarvadarsana Samgraha* (*Compendium of Speculations*). With remarkable mental detachment he places himself in the position of an adherent of sixteen distinct systems. Mādhava also wrote a commentary on the Mīmāmsā Sūtras. He died as abbot of the monastery of Sringeri.

MADI (A-MADI), a negro race of the Nile valley, occupying both banks of the Bahr-el-Jebel immediately north of Albert Nyanza. Tradition makes them immigrants from the north-west. They are remarkable for the consideration shown to their women, who choose their own husbands, are never ill-treated or hard-worked, and take part in tribal deliberations. The Madi build sepulchral monuments of an elaborate type, two huge narrow stones sloping towards each other with two smaller slabs covering the opening between them. They have been much harried by the Azandeh and Abarambo. They were visited by W. Junker in 1882–1883, and described by him in *Petermann's Mittheilungen* for May 1883.

MADISON, JAMES (1751–1836), fourth president of the United States, was born at Port Conway, in King George county, Virginia, on the 16th of March 1751. His first ancestor in America may possibly have been Captain Isaac Maddyson, a colonist of 1623 mentioned by John Smith as an excellent Indian fighter. His father, also named James Madison, was the owner of large estates in Orange county, Virginia. In 1769 the son entered the college of New Jersey (now Princeton University), where, in the same year, he founded the well-known literary club, "The American Whig Society." He graduated in 1771, but remained for another year at Princeton studying, apparently for the ministry, under the direction of John Witherspoon (1722–1794). In 1772 he returned to Virginia, where he pursued his reading and studies, especially theology and Hebrew, and acted as a tutor to the younger children of the family. In 1775 he became chairman of the committee of public safety for Orange county, and wrote its response to Patrick Henry's call for the arming of a colonial militia, and in the spring of 1776 he was chosen a delegate to the new Virginia convention, where he was on the committee which drafted the constitution for the state, and proposed an amendment (not adopted) which declared that "all men are equally entitled to the full and free exercise" of religion, and was more radical than the similar one offered by George Mason. In 1777, largely, it seems, because he refused to treat the electors with rum and punch, after the custom of the time, he was not re-elected, but in November of the same year he was chosen a member of the privy council or council of state, in which he acted as interpreter for a few months, as secretary prepared papers for the governor, and in general took a prominent part from the 14th of January 1778 until the end of 1779, when he was elected a delegate to the Continental Congress.

He was in Congress during the final stages of the War of Independence, and in 1780 drafted instructions to Jay, then representing the United States at Madrid, that in negotiations with Spain he should insist upon the free navigation of the Mississippi and upon the principle that the United States succeeded to British rights affirmed by the treaty of Paris of 1763. When the confederation was almost in a state of collapse because of the failure of the states to respond to requisitions of Congress for supplies for the federal treasury, Madison was among the first to advocate the granting of additional powers to Congress, and urged that congress should forbid the states to issue more paper money. In 1781 he favoured an amendment of the Articles of Confederation giving Congress power to enforce its requisitions, and in 1783, in spite of the open opposition of the Virginia legislature, which considered the Virginian delegates wholly subject to its instructions, he advocated that the states should grant to Congress for twenty-five years authority to levy an import duty, and suggested a scheme to provide for the interest on the debt not raised by the import duty—apportioning it among the states on the basis of population, counting three-fifths of the slaves, a ratio suggested by Madison himself. Accompanying this plan was an address to the states drawn up by Madison, and one of the ablest of his state papers. In the same year, with Oliver Ellsworth of Connecticut, Nathaniel Gorham of Massachusetts, Gunning Bedford of Delaware, and John Rutledge of South Carolina, he was a member of the committee which reported on the Virginia proposal as to the terms of cession to the Confederation of the "back lands," or unoccupied Western territory, held by several of the states; the report was a skilful compromise made by Madison, which secured the approval of the rather exigent Virginia legislature.

In November 1783 Madison's term in Congress expired, and he returned to Virginia and took up the study of the law. In the following year he was elected to the House of Delegates. As a member of its committee on religion, he opposed the giving of special privileges to the Episcopal (or any other) church, and contended against a general assessment for the support of the churches of the state. His petition of remonstrance against the proposed assessment, drawn up at the suggestion of George Nicholas (*c.* 1755–1799), was widely circulated and procured its defeat. On the 26th of December 1785 Jefferson's Bill for establishing religious freedom in Virginia, which had been introduced by Madison, was passed. In the Viginia House of Delegates, as in the Continental Congress, he opposed the further issue of paper money; and he tried to induce the legislature to repeal the law confiscating British debts, but he did not lose sight of the interests of the Confederacy. The boundary between Virginia and Maryland, according to the Baltimore grant, was the south shore of the Potomac, a line to which Virginia had agreed on condition of free navigation of the river and the Chesapeake Bay. Virginia now feared that too much had been given up, and desired joint regulation of the navigation and commerce of the river by Maryland and Virginia. On Madison's proposal commissioners from the two states met at Alexandria (*q.v.*) and at Mount Vernon in March 1785. The Maryland legislature approved the Mount Vernon agreement and proposed to invite Pennsylvania and Delaware to join in the arrangement. Madison, seeing an opportunity for more general concert in regard to commerce and trade (and possibly for the increase of the power of Congress), proposed that all the states should be invited to send commissioners to consider commercial questions, and a resolution to that effect was adopted (on Jan. 21, 1786) by the Virginia legislature. This led to the Annapolis convention of 1786, and that in turn led to the Philadelphia convention of 1787. In April 1787 Madison had written a paper, *The Vices of the Political System of the United States*, and from his study of confederacies, ancient and modern, later summed up in numbers 17, 18, and 19 of *The Federalist*, he had concluded that no confederacy could long endure if it acted upon states only and not directly upon individuals. As the time for the convention of 1787 approached he drew up an outline of a new system of government, the basis of the "Virginia plan" presented in the convention by Edmund Jennings Randolph. Madison's scheme, as expressed in a letter to Washington dated the 16th of April 1787, was that individual sovereignty of states was irreconcilable with aggregate sovereignty, but that the "consolidation of the whole into one simple republic would be as inexpedient as it is unattainable." He considered as a practical middle ground changing the basis of representation in Congress from states to population; giving the national government "positive and complete authority in all cases which require uniformity"; giving it a negative on all state laws, a power which might best be vested in the Senate, a comparatively permanent body; electing the lower house, and the more numerous, for a short term; providing for a national executive, for extending the national supremacy over the judiciary and the militia, for a council to revise all laws, and for an express statement of the right of coercion; and finally, obtaining the ratification of a new constitutional instrument from the people, and not merely from the legislatures. The "Virginia plan" was the basis of the convention's deliberations which resulted in the constitution favourably voted on by the convention on the 17th of September 1787. Among the features of the plan which were not embodied in the constitution were the following: proportionate representation in the Senate and the election of its members by the lower house "out of a proper number of persons nominated by the individual legislatures"; the vesting in the national Congress of power to negative state acts; and the establishment of a council of revision (the executive and a convenient number of national judges) with veto power over all laws passed by the national Congress. Madison, always an opponent of slavery, disapproved of the compromise (in Art. I. § 9 and Art. V.) postponing to 1808 (or later) the prohibition of the importation of slaves. He took a leading part in the debates of the convention, of which he kept full and careful notes, afterwards published by order of Congress (3 vols., Washington, 1843). Many minute and wise provisions are due to him, and he spoke before the convention more frequently than any delegate except James Wilson and Gouverneur Morris. In spite of the opposition to the constitution of the Virginia leaders George Mason and E. J. Randolph, Madison induced the state's delegation to stand by the constitution in the convention. His influence largely shaped the form of the final draft of the constitution, but the labour was not finished with this draft; that the constitution was accepted by the people was due in an eminent degree to the efforts of Madison, who, to place the new constitution before the public in its true light, and to meet the objections brought against it, joined Alexander Hamilton (*q.v.*) and John Jay in writing *The Federalist*, a series of eighty-five papers, out of which twenty certainly, and nine others probably, were written by him. In the Virginia convention for ratifying the constitution (June 1788), when eight states had ratified and it seemed that Virginia's vote would be needed to make the necessary nine (New Hampshire's favourable vote was cast only shortly before that of Virginia), and it appeared that New York would vote against the constitution if Virginia did not ratify it, Madison was called upon to defend that instrument again, and he appeared at his best against its opponents, Patrick Henry, George Mason, James Monroe, Benjamin Harrison, William Grayson and John Tyler. He answered their objections in detail, calmly and with an intellectual power and earnestness that carried the convention. The result was a victory against an originally adverse public opinion and against the eloquence of the opponents of the constitution, for Madison and for his lieutenants, Edmund Pendleton, John Marshall, George Nicholas, Harry Innes and Henry Lee. At the same time Madison's labours in behalf of the constitution alienated from him valuable political support in Virginia. He was defeated by Richard Henry Lee and William Grayson in his candidacy for the United States Senate, but in his own district he was chosen a representative to Congress, defeating James Monroe, who seems to have had the powerful support of Patrick Henry.

Madison took his seat in the House of Representatives in April 1789, and assumed a leading part in the legislation necessary to the organization of the new government. He drafted a Tariff Bill giving certain notable advantages to nations with which the United States had commercial treaties, hoping to force Great Britain into a similar treaty; but his policy of discrimination against England was rejected by Congress. It was his belief that such a system of retaliation would remove the possibility of war arising from commercial quarrels. He introduced resolutions calling for the establishment of three executive departments, foreign affairs, treasury and war, the head of each removable by the president. Most important of all, he proposed nine amendments to the constitution, embodying suggestions made by a number of the ratifying states, especially those made by Virginia at the instance of George Mason; and the essential principles of Madison's proposed amendments were included in a Bill of Rights, adopted by the states in the form of ten amendments. The absence of a Bill of Rights from the constitution as first adopted had been the point on which the opposition had made common cause, and the adoption of this now greatly weakened the same opposition. Although a staunch friend of the constitution, Madison believed, however, that the instrument should be interpreted conservatively and not be made the means of introducing radical innovations. The tide of strict construction was setting in strongly in his state, and he was borne along with the flood. It is very probable that Jefferson's influence over Madison, which was greater than Hamilton's, contributed to this result. Madison now opposed Hamilton's measures for the funding of the debt, the assumption of state debts, and the establishment of a National Bank, and on other questions he sided more and more with the opposition, gradually assuming its leadership in the House of Representatives and labouring to confine the powers of the national government within the narrowest possible limits; his most important argument against Hamilton's Bank was that the constitution did not provide for it explicitly, and could not properly be construed into permitting its creation. Madison, Jefferson and Randolph were consulted by Washington, and they advised him not to sign the bill providing for the Bank, but Hamilton's counter-argument was successful. On the same constitutional grounds Madison objected to the carrying out of the recommendations in Hamilton's famous report on manufactures (Dec. 5, 1791), which favoured a protective tariff. In the presidential campaign of 1792 Madison seems to have lent his influence to the determined efforts of the Jeffersonians to defeat John Adams by electing George Clinton vice-president. In 1793–1796 he strongly criticized the administration for maintaining a neutral position between Great Britain and France, writing for the public press five papers (signed "Helvidius"), attacking the "monarchical prerogative of the executive" as exercised in the proclamation of neutrality in 1793 and denying the president's right to recognize foreign states. He found in Washington's attitude—as in Hamilton's failure to pay an instalment of the moneys due France—an "Anglified complexion," in direct opposition to the popular sympathy with France and French Republicanism. In 1794 he tried again his commercial weapons, introducing in the House of Representatives resolutions based on Jefferson's report on commerce, advising retaliation against Great Britain and discrimination in commercial and navigation laws in favour of France; and he declared that the friends of Jay's treaty were "a British party systematically aiming at an exclusive connexion with the British government," and in 1796 strenuously but unsuccessfully opposed the appropriation of money to carry this treaty into effect. Still thinking that foreign nations could be coerced through their commercial interests, he scouted as visionary the idea that Great Britain would go to war on a refusal to carry Jay's treaty into effect, thinking it inconceivable that Great Britain "would wantonly make war" upon a country which was the best market she had in the world for her manufactures, and one with which her export trade was so much larger than her import.

In 1797 Madison retired from Congress, but not to a life of inactivity. In 1798 he joined Jefferson in opposing the Alien and Sedition Laws, and Madison himself wrote the resolutions of the Virginia legislature declaring that it viewed "the powers of the Federal government as resulting from the compact to which the states are parties, as limited by the plain sense and intention of the instrument constituting that compact; as no further valid than they are authorized by the grants enumerated in that compact; and that, in case of a deliberate, palpable and dangerous exercise of other powers, not granted by the said compact, the states, who are parties thereto, have the right and are in duty bound to interpose for arresting the progress of the evil, and for maintaining within their respective limits, the authorities, rights and liberties appertaining to them." The Virginia resolutions and the Kentucky resolutions (the latter having been drafted by Jefferson) were met by dissenting resolutions from the New England states, from New York, and from Delaware. In answer to these, Madison, who had become a member of the Virginia legislature in the autumn of 1799, wrote for the committee to which they were referred a report elaborating and sustaining in every point the phraseology of the Virginia resolutions.[1]

Upon the accession of the Republican party to power in 1801, Madison became secretary of state in Jefferson's cabinet, a position for which he was well fitted both because he possessed to a remarkable degree the gifts of careful thinking and discreet and able speaking, and of large constructive ability; and because he was well versed in constitutional and international law and practised a fairness in discussion essential to a diplomat. During the eight years that he held the portfolio of state, he had continually to defend the neutral rights of the United States against the encroachments of European belligerents; in 1806 he published *An Examination of the British Doctrine which subjects to Capture a Neutral Trade not open in Time of Peace*, a careful argument—with a minute examination of authorities on international law—against the rule of war of 1756 extended by Great Britain in 1793 and 1803.

During Jefferson's presidency and whilst Madison was secretary of state, by the purchase of Louisiana, Madison's campaign begun in 1780 for the free navigation of the Mississippi was brought to a successful close. The candidate in 1808 of the Republican party, although bitterly opposed in the party by John Randolph and George Clinton, Madison was elected president, defeating C. C. Pinckney, the Federalist candidate, by 122 votes to 47. Madison had no false hopes of placating the Federalist opposition, but as the preceding administration was one with which he was in harmony, his position was different from that of Jefferson in 1801, and he had less occasion for removing Federalists from office. Jefferson's peace policy—or, more correctly, Madison's peace policy—of commercial restrictions to coerce Great Britain and France he continued to follow until 1812, when he was forced to change these futile commercial weapons for a policy of war, which was very popular with the extreme French wing of his party. There is a charge, which has never been proved or disproved, that Madison's real desire was for peace, but that in order to secure the renomination he yielded to that wing of his party which was resolved on war with Great Britain. The only certain fact is that Madison, whatever were his personal feelings in this matter, acted according to the wishes of a majority of the Republicans; but whether in doing so he was influenced by the desire of another nomination is largely a matter of conjecture. Madison was renominated on the 18th of May 1812, issued his war message on the 1st of June, and in the November elections he was re-elected, defeating De Witt Clinton by 128 votes to 89. His administration during the war was pitiably weak. His cabinet in great part had been dictated to him in 1809 by a senatorial clique, and it was hopelessly discordant; for two years he was to all intents and purposes his own secretary of state, Robert Smith being a mere figure-head of whom he gladly got rid in 1811, giving Monroe the vacant place. Madison himself had attempted alternately to prevent war by his "commercial weapons" and to prepare the country for war, but he had met with no success, because of the tricky diplomacy of Great Britain and of France, and because of the general distrust of him coupled with the particular opposition to the war of the prosperous New England Federalists, who suggested with the utmost seriousness that his resignation should be demanded. In brief, Madison was too much the mere scholar to prove a strong leader in such a crisis. The supreme disgrace of the administration was the capture and partial destruction in August 1814 of the city of Washington—this was due, however, to incompetence of the military and not to any lack of prudence on the cabinet's part. In general, Congress was more blamable than either the president or his official family, or the army officers. With the declaration of peace the president again gained a momentary popularity much like that he had won in 1809 by his apparent willingness at that time to fight France.

Retiring from the presidency in 1817, Madison returned to his home, Montpelier (in Orange county, Virginia), which he left in no official capacity save in 1829, when he was a delegate to the state constitutional convention and served on several of its committees. Montpelier, like Jefferson's Monticello and Monroe's Oak-Hill, was an expensive bit of "gentleman farming," which with his generous Virginia hospitality nearly ruined its owner financially. Madison's home was peculiarly a centre for literary travellers in his last years; when he was eighty-three he was visited by Harriet Martineau, who reported her conversations with him in her *Retrospect of Western Travel* (1838). He took a great interest in education—his library was left to the university of Virginia, where it was burned in 1895—in emancipation, and in agricultural questions, to the very last. He died at Montpelier on the 28th of June 1836. Madison married, in 1794, Dorothy Payne Todd (1772–1849), widow of John Todd, a Philadelphia lawyer. She had great social charm, and upon Madison's entering Jefferson's cabinet became "first lady" in Washington society. Her plump beauty was often remarked—notably by Washington Irving—in contrast to her husband's delicate and feeble figure and wizened face—for even in his prime Madison was, as Henry Adams says, "a small man, quiet, somewhat precise in manner, pleasant, fond of conversation, with a certain mixture of ease and dignity in his address." Her son, spoiled by his mother and his step-father, became a wild young fellow, and added his debts to the heavy burden of Montpelier upon Madison.

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[1] Thirty years later Madison's arguments for the Virginia resolutions and the resolutions themselves were freely used by Calhoun and his followers in support of his doctrine of nullification. But Madison insisted that the Resolutions of 1798 did not involve the principles of nullification. Nearly all his arguments, especially where he attempts to interpret Jefferson's writings on the point, notably the Kentucky resolutions, are rather strained and specious, but it does seem that the Virginia resolutions were based on a different idea from Calhoun's doctrine of nullification. Madison's theory was that the legislature of Virginia, being one of the bodies which had chosen delegates to the constitutional convention, was legally capable of considering the question of the constitutionality of laws passed by the Federal government, and that the state of Virginia might invite other states to join her, but could not singly, as Calhoun argued, declare any law of the Federal legislature null and void. (It is to be noted the words "null and void" were in Madison's first draft of the Virginia resolutions, but that they were omitted by the Virginia legislature.) It is notable, besides, that Madison had always feared that the national congress would assume too great power, that he had approved of Supreme Court checks on the national legislature, and of veto power by a council of revision.

Madison's portrait was painted by Gilbert Stuart and by Charles Willson Peale; Giuseppe Ceracchi made a marble bust of him in 1792 and John H. J. Browere another in 1827, now in possession of the Virginia Historical Society at Richmond. Though commonly dignified and a little stiff he seems to have had a strong sense of humour and he was fond of telling a good story. Henry Clay, contrasting him with Jefferson, said that Jefferson had more genius, Madison more judgment and common sense; that Jefferson was a visionary and a theorist; Madison cool, dispassionate, practical, and safe.[1] The broadest and most accurate scholar among the "founders and fathers," he was particularly an expert in constitutional history and theory. In the great causes for which Madison fought in his earlier years—religious freedom and separation of church and state, the free navigation of the Mississippi, and the adoption of the constitution—he met with success. His greatest and truest fame is as the "father of the constitution." The "commercial weapons" with which he wished to prevent armed conflict proved less useful in his day than they have since been in international disputes.

AUTHORITIES.—Madison's personality is perplexingly vague; the biographies of him are little more than histories of the period, and the best history of the later period in which he was before the public, Henry Adams's *History of the United States from 1801 to 1817* (1889–1890), gives the clearest sketch and best criticism of him. The lives of Madison are: J. Q. Adams's (Boston, 1850); W. C. Rives's (Boston, 1859–1869, 3 vols.), covering the period previous to 1797; S. H. Gay's (Boston, 1884) in the "American Statesmen Series"; and Gaillard Hunt's (New York, 1902). Madison's *Writings* (7 vols., New York, 1900–1906) were edited by Hunt, who also edited *The Journal of the Debates in the Convention which framed the Constitution of the United States, as Recorded by James Madison* (2 vols., New York, 1908). See also Mrs Madison's *Memoirs and Letters* (Boston, 1887) and Maud Wilder Goodwin, *Dolly Madison* (New York, 1897).

MADISON, a city and the county-seat of Jefferson county, Indiana, U.S.A., on the N. bank of the Ohio river, about 90 m. below Cincinnati, and 44 m. above Louisville, Kentucky. Pop. (1870), 10,709; (1890), 8936; (1900), 7835 (554 foreign-born and 570 negroes); (1910), 6934. Madison is served by the Pittsburg, Cincinnati, Chicago & St Louis railroad and by river steamboats. The city is picturesquely situated on bluffs above the river and has two public parks. In Madison are a King's Daughters' Hospital, a children's home, and the Drusilla home for old ladies, and immediately north of the city are the buildings of the Indiana South-eastern Insane Hospital. Madison is a trading centre of the surrounding farming region, whose principal products are burley tobacco, grain and fruits (peaches, apples, pears, plums and small fruits). The municipality owns and operates the waterworks. Madison was settled about the beginning of the 19th century; was incorporated as a town in 1824, and was first chartered as a city in 1836.

MADISON, a borough of Morris county, New Jersey, U.S.A., 27 m. (by rail) W. of New York City and 4 m. S.E. of Morristown. Pop. (1890), 2469; (1900), 3754, of whom 975 were foreign-born and 300 were negroes; (1905), 4115; (1910), 4658. It is served by the Morris & Essex division of the Delaware, Lackawanna & Western railroad. The borough is attractively situated among the hills of Northern New Jersey, is primarily a residential suburb of New York and Newark, and contains many fine residences. There are a public library and a beautiful public park, both given to the borough by Daniel Willis James (1832–1907), a prominent metal manufacturer; the library is closely allied with the public schools. Madison is the seat of the well-known Drew theological seminary (Methodist Episcopal; founded in 1866 and opened in 1867), named in honour of Daniel Drew (1788–1879), who, having acquired great wealth from steamboat and railway enterprises, especially from trading in railway stocks, presented the large and beautiful grounds and most of the buildings. The seminary's course covers three years; no fee is charged. In connexion with the seminary the Drew settlement in New York City—officially the department of applied Christianity—has for its object the "practical study of present-day problems in city evangelism, church organization; and work among the poor." In 1907–1908 the seminary had 9 instructors, 175 students, and a library of more than 100,000 volumes, especially rich in works dealing with the history of Methodism and in Greek New Testament manuscripts. About 2 m. N.W. of Madison is Convent Station, the seat of a convent of the Sisters of Charity, who here conduct the college of St Elizabeth, for girls, founded in 1859; also conducted by the Sisters of Charity is St Joseph's preparatory school for boys, founded in 1862. The cultivation of roses and chrysanthemums is practically the only industry of Madison. Madison owns and operates its waterworks and electric-lighting plant. Before 1844 when it took its present name (in honour of President Madison), Madison was called Bottle Hill; it is one of the older places of the state, and its first church (Presbyterian) was built about 1748. The borough was incorporated in 1889.

MADISON, the capital of Wisconsin, U.S.A., and the county-seat of Dane County, situated between Lakes Mendota and Monona in the south central part of the state, about 82 m. W. of Milwaukee and about 131 m. N.W. of Chicago. Pop. (1890), 13,426; (1900) 19,164, of whom 3362 were foreign-born and 69 were negroes; (1910 census) 25,531. Madison is served by the Chicago & North-Western, the Chicago, Milwaukee & St Paul, and the Illinois Central railways (being the northern terminus of the last), and by interurban electric lines, connecting with Janesville, Beloit and Chicago. It has a picturesque situation in what is known as "the Four-Lakes region"; this region takes its name from a chain of lakes, Kegonsa, Waubesa, Monona and Mendota, which, lying in the order named and connected with one another by the Yahara or Catfish River, form the head-waters of Rock river flowing southward through Illinois into the Mississippi. The city occupies a hilly isthmus about a mile wide between Lakes Mendota and Monona, bodies of water of great clearness and beauty, with bottoms of white sand and granite.

The state capitol is in a wooded park at the summit of a hill 85 ft. high in the centre of the city. From this park the streets and avenues radiate in all directions. The capitol, built in 1860–1867 (with an addition in 1883) on the site of the original capitol building (1837–1838), was partially destroyed by fire in 1904, and in 1909–1910 was replaced by a larger edifice. The principal business portion of the city is built about the capitol park and the university. Among the public buildings on or near the park are the federal building, housing the post office and the United States courts, the city hall, the Dane county court-house, the public library, the Fuller opera-house, the county gaol, and the high school. Running directly west from the capitol is State Street, at the western end of which lie the grounds of the university of Wisconsin (*q.v.*), occupying a hilly wooded tract of 300 acres, and extending for a mile along the south shore of Lake Mendota. University Hill, on which the main building of the university stands, is 125 ft. above the lake; at its foot stands the magnificent library building of the State Historical Society. In it, in addition to the interesting and valuable historical museum and art gallery, are the Society's library of more than 350,000 books and pamphlets, the university library of 150,000 volumes, and the library of the Wisconsin academy of arts and sciences, 5000 volumes. Other libraries in the city include the state law library (45,000 volumes) in the capitol, the Madison public library (22,500 volumes), and the Woodman astronomical library (7500 volumes). The Madison public library houses also the state library school maintained by the Wisconsin library commission. Connected with the university is the Washburn observatory. On the margin of the city lies the extensive experimental farm of the state college of agriculture. In addition to the state university, Madison is the seat of several Roman Catholic and Lutheran parochial schools, two business schools, and the Wisconsin academy, a non-sectarian preparatory school of high grade. On the banks of Lake Monona are the beautiful grounds of the Monona Lake assembly, a summer assembly on the Chautauqua model. Near the city is one of the five fish-hatcheries maintained by the state; it is largely devoted to the propagation of trout and other small fish. North of the city, occupying a tract of 500 acres, on Lake Mendota, are the buildings and grounds of the state hospital for the insane, opened in 1860.

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[1] Clay's opinion is given in a report written by Mrs Samuel H. Smith of a conversation in 1829 between Clay and her husband, a prominent politician.

The city's streets are broad and heavily shaded with a profusion of elm, oak and maple trees. There are many fine stone residences dating from the middle of the 19th century. There are several parks of great beauty, and along the shores of Lake Mendota there is a broad boulevarded drive of 12 m. The municipality owns its waterworks, the water being obtained from eleven artesian wells, and being chemically similar to that of Waukesha Springs. The city and surrounding region are a summer resort, the lakes affording opportunities for fishing and for yachting and boating.

Madison is an important jobbing centre for central and south-western Wisconsin; it has an extensive trade in farm, garden and dairy products, poultry and tobacco; and there are various manufactures. In 1905 the value of the total factory product was $3,291,143, an increase of 22·4% over that in 1900.

At the time of the settlement by the whites the aboriginal inhabitants of the Four-Lakes region were the Winnebago. Prehistoric earthworks are to be seen in the neighbourhood, several animal-shaped mounds upon the shores of Lakes Mendota, Monona and Waubesa being among the best examples. A regular trading post is known to have been established on Lake Mendota as early as 1820. The title to the Indian lands was acquired by the United States by treaty in 1825. Colonel Ebenezer Brigham established himself at Blue Mounds, in the western part of Dane county, in 1827. In 1832 the "Four-Lakes" country was in the theatre of hostilities during the Black Hawk War; Colonel Henry Dodge held a conference with Winnebago chiefs on Lake Mendota, and there were several skirmishes in the neighbourhood between his troops and the followers of Black Hawk, one of which took place on the site of Madison. After Black Hawk's defeat on the Bad Axe he fled to the Wisconsin river Dalles, near the present Kilbourn, where he was betrayed by the Winnebago. In 1836 Stevens T. Mason, governor of Michigan, and James Duane Doty, then U.S. district judge, who had visited the region as early as 1829, recorded a tract of land, including most of the present site of Madison. Here they surveyed a "paper" city which they named in honour of James Madison. On the 3rd of December 1836 the territorial legislature in session at Belmont, after a protracted and acrimonious debate, determined, largely through Doty's influence, to make Madison the permanent capital. The construction of houses began in the early spring of 1837. The first constitutional convention met here in 1846, the second in 1847. Madison was chartered as a city in 1856. In 1862 a large number of Confederate prisoners were confined in Camp Randall, at Madison, and many of them died in hospital.

See D. S. Durrie, *History of Madison, Wisconsin* (Madison, 1874); Lyman C. Draper, *Madison the Capital of Wisconsin* (Madison, 1857); J. D. Butler, "The Four Lakes Country" in *Wisconsin Historical Society Collections*, vol. 10 (1888), and R. G. Thwaites, "Madison" in *Historic Towns of the Western States* (New York, 1900), and his "Story of Madison" in *The University of Wisconsin* (Madison, 1900).

MADOU, JEAN BAPTISTE (1796–1877), Belgian painter and lithographer, was born at Brussels on the 3rd of February 1796. He studied at the Brussels Academy of Fine Arts and was a pupil of François. While draughtsman to the topographical military division at Courtrai, he received a commission for lithographic work from a Brussels publisher. It was about 1820 that he began his artistic career. Between 1825 and 1827 he contributed to *Les Vues pittoresques de la Belgique*, to a *Life of Napoleon*, and to works on the costumes of the Netherlands, and later made a great reputation by his work in *La Physionomie de la société en Europe depuis 1400 jusqu' à nos jours* (1836) and *Les Scènes de la vie des peintres*. It was not until about 1840 that he began to paint in oils, and the success of his early efforts in this medium resulted in a long series of pictures representing scenes of village and city life, including "The Fiddler," "The Jewel Merchant," "The Police Court," "The Drunkard," "The Ill-regulated Household," and "The Village Politicians." Among his numerous works mention may also be made of "The Feast at the Château" (1851), "The Unwelcome Guests" (1852, Brussels Gallery), generally regarded as his masterpiece, "The Rat Hunt" (acquired by Leopold II., king of the Belgians), "The Arquebusier" (1860), and "The Stirrup Cup." At the age of sixty-eight he decorated a hall in his house with a series of large paintings representing scenes from La Fontaine's fables, and ten years later made for King Leopold a series of decorative paintings for the château of Ciergnon. Madou died at Brussels on the 31st of March 1877.

For a list of his paintings see the annual report of the Academy of Belgium for 1879. (F. K.*)

MADOZ, PASCUAL (1806–1870), Spanish statistician, was born at Pampeluna on the 7th of May 1806. In early life he was settled in Barcelona, as a writer and journalist. He joined the Progresista party formed during the first Carlist war, 1833–40. He saw some service against the Carlists; was elected deputy to the Cortes of 1836; took part for Espartero, and then against him; was imprisoned in 1843; went into exile and returned; was governor of Barcelona in 1854, and minister of finance in 1855; had a large share in secularizing the Church lands; and after the revolution of 1868 was governor of Madrid. He had, however, no great influence as a leader and soon went abroad, dying at Genoa in 1870. Madoz was distinguished from most of the politicians of his generation by the fact that in middle life he compiled what is still a book of value—a geographical, statistical and historical dictionary of Spain and its possessions oversea, *Diccionario geográfico, estadístico y historico de España, y sus posesiones de Ultramar* (Madrid, 1848–1850).

MADRAS, a presidency of British India—officially styled Fort St George—occupying, with its dependencies, the entire south of the Indian peninsula. The north boundary is extremely irregular. On the extreme N.E. is the Bengal province of Orissa; then the wild highlands of the Central Provinces; next the dominions of the nizam of Hyderabad; and lastly, on the N.W., the Bombay districts of Dharwar and North Kanara. Geographically Mysore and Coorg lie within the bounds of Madras, and politically it includes the Laccadive Islands, off the Malabar coast, in the Indian Ocean. Its total area, including native states, is 151,695 sq. m., and its population in 1901 was 42,397,522, showing an increase of 7·7% in the decade. The seat of government is at Madras city (*q.v.*).

Physical Aspect.—The Madras presidency may be roughly divided into three tracts: (1) the long and broad east coast, (2) the shorter and narrower west coast, and (3) the high interior table-land. These divisions are determined by the great mountain ranges of the Eastern and Western Ghats (*q.v.*). Between these two ranges lies the central table-land, with an elevation of 1000 to 3000 ft., which includes the whole of Mysore, and extends over about half a dozen districts of Madras. The Anaimudi mountain (8837 ft.) in Travancore is the highest in southern India. The Nilgiri hills, which join the Ghats, culminate in Dodabetta (8760 ft.). There are besides many outlying spurs and tangled masses of hills, of which the Shevaroys, Anamalais and Palnis are the most important. The Godavari, Kistna and Cauvery rivers, each having a large tributary system, all rise in the Western Ghats, and run across the peninsula in a south-east direction into the Bay of Bengal. In the upper parts of their course they drain rather than water the country through which they flow, and are comparatively valueless either for navigation or irrigation; but before reaching the sea they spread over alluvial deltas. Smaller rivers of the same character are the Pennar and South Pennar or Ponniar, Palar, Vaigai, Vellar and Tambraparni. The principal lake is that of Pulicat on the east coast, which is 37 m. long from north to south, and forms an important means of communication between Madras city and the northern districts. On the west coast are a remarkable series of backwaters or lagoons, fringing the seaboard of Kanara, Malabar and Travancore. The largest is the backwater of Cochin, which extends 120 m. from north to south.

Geology.—By far the greater part of Madras is occupied by granitic and gneissic rocks of very ancient date. Among them are the "charnockites," a series of associated eruptive rocks characterized by the presence of rhombic pyroxenes. In Bellary and Anantapur districts, as well as in Mysore and Hyderabad, several long narrow strips of a later formation, known as the Dharwar system, are folded or faulted into the gneissic floor. They run from N.N.W. to S.S.E., and consist of conglomerates, lavas and schists. All the quartz reefs which contain gold in paying quantities are found within these Dharwar bands, those of the Kolar goldfield in Mysore being the most important. The gneissic and Dharwar rocks are overlaid unconformably by the sandstones, limestones, shales, &c., of the Cuddapah and Kurnool series. It is in the sandstones and shales of the Kurnool group that most of the diamonds of southern India are found; but as these rocks are of sedimentary origin, it is probable that the diamonds were originally derived from some still unknown source. A strip of Gondwana beds follows approximately the course of the Godavari. In Hyderabad it includes the important Singareni coalfield, but in the Presidency no good coal seams have yet been found. Upper Gondwana beds also occur in small patches at several other places near the east coast. Marine cretaceous deposits are found in three detached areas, near Trichinopoly, Viruddhachalam and Pondicherry. Some of the coastal sandstones may be of late Tertiary age, but Tertiary fossils have not been found except in a few small patches on the west coast, the most southerly being near Quilon in Travancore.

Climate.—The climate varies in accordance with the height of the mountain chain on the western coast. Where this chain is lofty, as between Malabar and Coimbatore, the rainclouds are intercepted and give a rainfall of 150 in. on the side of the sea, and only 20 in. on the landward side. Where the range is lower, the rainclouds pass over the hills and carry their moisture to the interior districts. The Nilgiri hills enjoy the climate of the temperate zone, with a moderate rainfall. The Malabar coast has a rainfall of 150 in., and the clouds on the Western Ghats sometimes obscure the sun for months at a time. Along the eastern coasts and central table-lands the rainfall is low and the heat excessive. At Madras city the average rainfall is 50 in., but this is considerably above the mean of the east coast.

Minerals.—The mineral wealth of the province is undeveloped. Iron of excellent quality has been smelted by native smiths in many localities from time immemorial; but attempts to work the beds after European methods have proved unsuccessful. Carboniferous sandstone extends across the Godavari valley as far as Ellore, but the coal has been found to be of inferior quality. Among other minerals may be mentioned manganese in Vizagapatam, and mica in Nellore. Garnets are abundant in the sandstone of the Northern Circars, and diamonds of moderate value are found in the same region. Stone and gravel quarries are very numerous.

Forests.—The forest department of Madras was first organized in 1856, and it is estimated that forests cover a total area of more than 19,600 sq. m., the whole of which is under conservancy rules. An area of about 1500 sq. m. is strictly conserved. In the remaining forests, after supplying local wants, timber is either sold direct by the department or licences are granted to wood-cutters. The more valuable timber trees comprise teak, ebony, rosewood, sandal-wood and redwood. The trees artificially reared are teak, sandal-wood, *Casuarina* and eucalyptus. The finest teak plantation is near Beypur in Malabar. At Mudumalli there are plantations of both teak and sandal-wood; and the eucalyptus or Australian gum-tree grows on the Nilgiris in magnificent clumps.

Fauna.—The wild animals include the elephant, bison, sambur and ibex of the Western Ghats and the Nilgiris. Bison are found also in the hill tracts of the Northern Circars. In Travancore state the black leopard is not uncommon. The elephant is protected by law from indiscriminate destruction. The cattle are small, but in Nellore and along the Mysore frontier a superior breed is carefully kept up by the wealthier farmers. The best buffaloes are imported from the Bombay district of Dharwar.

Population.—The population in 1901 was divided into Hindus (37,026,471), Mahommedans (2,732,931), and Christians (1,934,480). The Hindus may be subdivided into Sivaites, Vishnuvites and Lingayats. The Sivaites are most numerous in the extreme south and on the west coast, while the Vishnuvites are chiefly found in the northern districts. The Lingayats, a sect of Sivaite puritans, derive their name from their practice of carrying about on their persons the *linga* or emblem of Siva. The Brahmans follow various pursuits, and some of them are recent immigrants, who came south in the train of the Mahratta armies. A peculiar caste of Brahmans, called Nambudri, is found in Malabar. The most numerous of the hill tribes are the Kondhs and Savaras, two cognate races who inhabit the mountainous tracts of the Eastern Ghats, attached to several of the large estates of Ganjam and Vizagapatam. On the Nilgiris the best known aboriginal tribe is the Todas (*q.v.*). The Mahommedans are subdivided into Labbai, Moplah, Arab, Sheikh, Sayad, Pathan and Mogul. The Labbais are the descendants of Hindu converts, and are traders by hereditary occupation, although many now employ themselves as sailors and fishermen. The Moplahs are the descendants of Malayalam converts to Islam—the head of the tribe, the raja of Cannanore, being descended from a fisher family in Malabar. They are a hard-working, frugal people, but quite uneducated and fanatical, and under the influence of religious excitement have often disturbed the public peace. Christians are more numerous in Madras than in any other part of India. In Travancore and Cochin states the native Christians constitute as much as one-fourth of the population. The Roman Catholics, whose number throughout southern India is estimated at upwards of 650,000, owe their establishment to St Francis Xavier and the famous Jesuit mission of Madura; they are partly under the authority of the archbishop of Goa, and partly under twelve Jesuit vicariates. Protestant missions date from the beginning of the 18th century. The Danes were the pioneers; but their work was taken up by the Society for Promoting Christian Knowledge, under whom laboured the great Lutherans of the 18th century—Schultz, Sartorius, Fabricius and Schwartz. The Church Missionary Society entered the field in 1814; and subsequently an American mission joined in the work.

Languages.—Broadly speaking, the entire population of Madras belongs to the five linguistic offshoots of the great Dravidian stock, dominant throughout southern India. At an early period, before the dawn of history, these races appear to have accepted some form of the Brahmanical or Buddhist faiths. Many storms of conquest have since swept over the land, and colonies of Mogul and Mahratta origin are to be found here and there. But the evidence of language proves that the ethnical character of the population has remained stable under all these influences, and that the Madras Hindu, Mahommedan, Jain and Christian are of the same stock. Of the five Dravidian languages in British territory Telugu is spoken by over 14,000,000 persons; Tamil by over 15,000,000 persons; Kanarese by over 1,500,000 persons; Malayalam by nearly 3,000,000 persons; and Tulu by about 500,000 persons. Oriya is the native tongue in the extreme north of Ganjam, bordering on Orissa; and various sub-dialects of Dravidian origin are used by the hill tribes of the Eastern Ghats, of whom the Kondhs may be taken as the type.

Agriculture.—Over the greater part of the area of Madras artificial irrigation is impossible, and cultivation is dependent upon the local rainfall, which rarely exceeds 40 in. a year, and is liable to fall irregularly. The Malabar coast is the only part where the rainfall brought by the south-west monsoon may be trusted both for its amount and regularity. Other districts, such as Bellary, are also dependent upon this monsoon; but in their case the rainclouds have spent themselves in passing over the Western Ghats, and cultivation becomes a matter of hazard. Over the greater part of the presidency the rainy season is caused by the south-east monsoon, which breaks about the end of September. The deltas of the Godavari, Kistna and Cauvery rivers are the only spots on the east coast which artificial irrigation is able to save from the risk of occasional scarcity. The principal food staples are rice, *cholam*, *cambu*, *ragi* and *varagu* (four kinds of millet). The most common oil-seed is gingelly (sesamum). Garden crops comprise tobacco, sugar-cane, chillies, betel-leaf and plantains. Sugar is chiefly derived from the sap of palms. The fruit trees are coco-nut, areca-nut, palmyra palm, jack, tamarind and mango. Special crops include cotton, indigo, coffee, tea, cinchona. The best cotton is grown in Tinnevelly. The principal coffee tract stretches along the slopes of the Western Ghats from the north of Mysore almost down to Cape Comorin. The larger portion of this area lies within Mysore, Coorg and Travancore states, but the Wynaad and the Nilgiri hills are within Madras. The first coffee plantation was opened in the Wynaad in 1840. Many of the early clearings proved unprofitable, and the enterprise made little progress till about 1855. Coffee, which is much cultivated on the Nilgiris, covers about 100 sq. m., though the area fluctuates. The tea plant was also introduced into the Nilgiri hills about 1840, but was not taken up as a commercial speculation till 1865, and is still unimportant. The cinchona plant was successfully introduced into the Nilgiri hills by the government in 1860, and there are now a few plantations belonging to private owners.

The greater part of the soil in Madras is held by the cultivators direct from the government under the tenure known as *ryotwari*. Besides these lands in the hands of the government, there are also proprietary or *zamindari* estates in all parts of the country. These estates are either the remains of ancient principalities, which the holder cannot sell or encumber beyond his own life interest, or they are creations of British rule and subject to the usual Hindu custom of partition. The total area of the *zamindari* estates is about 26 million acres, more than one-fourth of the whole presidency. The *peshkash* or tribute payable to government in perpetuity amounts to about £330,000 a year. *Ináms*, revenue-free or quit-rent grants of lands made for religious endowments or for services rendered to the state, occupy an aggregate area of nearly 8 million acres.

Manufactures.—Madras possesses few staple manufactures. The chief industries of the presidency are cotton-ginning, coffee-curing, fish-curing, indigo-pressing, oil-pressing, printing, rice-curing, rope-making, sugar-refining, tanning, tile and brick-making, and tobacco-curing. Up to the close of the 18th century cotton goods constituted the main article of export. Masulipatam, where the first English factory on the Coromandel coast was established in 1620, enjoyed a special reputation for its chintzes, which were valued for the freshness and permanency of their dyes. There is still a small demand for these articles in Burma, the Straits and the Persian Gulf; but Manchester goods have nearly beaten the Indian exporter out of the field. Native looms, however, still hold their own in the local market, in face of strenuous opposition. After weaving, working in metals appears to be the most widespread native industry. Among local specialities which have attracted European curiosity may be mentioned the jewelry of Trichinopoly, ornaments of ivory and horn worked at Vizagapatam, and sandal-wood carving in Kanara.

Commerce and Trade.—The continuous seaboard of the Madras presidency, without any natural harbours of the first rank, has tended to create a widely diffused trade. Madras city conducts nearly one-half of the total sea-borne commerce; next comes Malabar, containing the western railway terminus near Calicut; then Godavari, with its cluster of ports along the fringe of the delta; Tinnevelly, with the harbour at Tuticorin, which has opened large dealings with Ceylon and Burma; Tanjore, South Kanara, Ganjam and Vizagapatam. As compared with the other provinces, the trade of Madras is broadly marked by the larger proportion assigned to coasting trade with other Indian ports and with Ceylon. The chief staples of the export trade are hides and skins, coffee and raw cotton.

Railways and Irrigation.—The presidency is well supplied with railways, which naturally have their centre in Madras city, the chief seaport. The broad-gauge line of the Madras & Southern Mahratta railway connects with Bombay and Bangalore, and also crosses the peninsula to Calicut on the western coast. The South Indian (narrow-gauge) serves the extreme south, with its terminus at Tuticorin, and branches to Tinnevelly, Negapatam, Erade, Pondicherry and Nellore. The narrow-gauge line of the Madras & Southern Mahratta railway traverses the Deccan districts; and the East Coast line (broad-gauge), through the Northern Circars, has brought Madras into direct communication with Calcutta. The Madras system of irrigation has been most successful in the case of the three great eastern rivers, the Godavari, Kistna and Cauvery. Each of these is intercepted by an *anicut* or dam at the head of its delta, from which canals diverge on each side for navigation as well as irrigation. The scheme for diverting the waters of the Tungabhadra (a tributary of the Kistna) over the thirsty uplands of Kurnool proved a failure. The bold project of leading the Periyar river through a tunnel across the watershed of the Travancore hills on to the plain of Madura has been more successful.

Administration.—The Madras presidency is administered by a governor and a council, consisting of two members of the civil service, which number may be increased to four. There is also a board of revenue of three members. The number of districts is 24, each under the charge of a collector, with sub-collectors and assistants. The districts are not grouped into divisions or commissionerships, as in other provinces. For legislative purposes the council of the governor is augmented by additional members, numbering 45 in all, of whom not more than 17 may be nominated officials, while 19 are elected by various representative constituencies. Members of the legislative council enjoy the right of interpellation, of proposing resolutions on matters of public interest, and of discussing the annual financial statement. The principle of local devolution is carried somewhat further in Madras than in other provinces. At the bottom are union *panchayats* or village committees, whose chief duty is to attend to sanitation. Above them come *taluk* or subdivisional boards. At the head of all are district boards, a portion of whose members are elected by the *taluk* boards.

Education.—The chief educational institutions are the Madras University, the Presidency College, Madras Christian College, and Pachayyappa's College at Madras; the government arts colleges at Combaconum and Rajahmundry; the law college, medical college and engineering college at Madras; the college of agriculture at Coimbatore; the teachers' college at Saidapet; the school of arts at Madras; and the military ophanage at Ootacamund, in memory of Sir Henry Lawrence. In 1907, the total number of pupils at all institutions was 1,007,118, of whom 164,706 were females, and 132,857 were learning English.

History.—Until the British conquest the whole of southern India had never acknowledged a single ruler. The difficult nature of the hill passes and the warlike character of the highland tribes forbade the growth of great empires, such as succeeded one another on the plains of Hindustan. The Tamil country in the extreme south is traditionally divided between the three kingdoms of Pandya, Chola and Chera. The west coast supplied the nucleus of a monarchy which afterwards extended over the highlands of Mysore, and took its name from the Carnatic. On the north-east the kings of Kalinga at one time ruled over the entire line of seaboard from the Kistna to the Ganges. Hindu legend has preserved marvellous stories of these early dynasties, but our only authentic evidence consists in their inscriptions on stone and brass, and their noble architecture (see India). The Mahommedan invader first established himself in the south in the beginning of the 14th century. Ala-ud-din, the second monarch of the Khilji dynasty at Delhi, and his general Malik Kafur conquered the Deccan, and overthrew the kingdoms of Karnataka and Telingana, which were then the most powerful in southern India. But after the withdrawal of the Mussulman armies the native monarchy of Vijayanagar arose out of the ruins. This dynasty gradually extended its dominions from sea to sea, and reached a pitch of prosperity before unknown. At last, in 1565, it was overwhelmed by a combination of the four Mahommedan principalities of the Deccan. At the close of the reign of Aurangzeb, although that emperor nominally extended his sovereignty as far as Cape Comorin, in reality South India had again fallen under a number of rulers who owned no regular allegiance. The nizam of the Deccan, himself an independent sovereign, represented the distant court of Delhi. The most powerful of his feudatories was the nawab of the Carnatic, with his capital at Arcot. In Tanjore, a descendant of Sivaji ruled; and on the central table-land a Hindu chieftain was gradually establishing his authority and founding the state of Mysore, destined soon to pass to a Mahommedan usurper.

Vasco da Gama cast anchor off Calicut on the 20th of May 1498, and for a century the Portuguese retained in their control the commerce of India. The Dutch began to establish themselves on the ruin of the Portuguese at the beginning of the 17th century, and were quickly followed by the English, who established themselves at Calicut and Cranganore in 1616. Tellicherry became the principal English emporium on the west coast of Madras. The Portuguese eventually retired to Goa, and the Dutch to the Spice Islands. The first English settlement on the east coast was in 1611, at Masulipatam, even then celebrated for its fabrics. Farther south a fort, the nucleus of Madras city, was erected in 1640. Pondicherry was purchased by the French in 1762. For many years the English and French traders lived peacefully side by side, and with no ambition for territorial aggrandisement. The war of the Austrian succession in Europe lit the first flame of hostility on the Coromandel coast. In 1746 Madras was forced to surrender to La Bourdonnais, and Fort St David remained the only English possession in southern India. By the peace of Aix-la-Chapelle Madras was restored to the English; but from this time the rivalry of the two nations was keen, and found its opportunities in the disputed successions which always fill a large place in Oriental politics. English influence was generally able to secure the favour of the rulers of the Carnatic and Tanjore, while the French succeeded in placing their own nominee on the throne at Hyderabad. At last Dupleix rose to be the temporary arbiter of the fate of southern

India, but he was overthrown by Clive, whose defence of Arcot in 1751 forms the turning point in Indian history. In 1760 the crowning victory of Wandewash was won by Colonel (afterwards Sir Eyre) Coote, over Lally, and in the following year, despite help from Mysore, Pondicherry was captured.

Though the English had no longer any European rival, they had yet to deal with Mahommedan fanaticism and the warlike population of the highlands of Mysore. The dynasty founded by Hyder Ali, and terminating in his son Tippoo Sultan, proved itself in four several wars, which terminated only in 1799, the most formidable antagonist which the English had ever encountered (see HYDER ALI and INDIA). Since the beginning of the 19th century Madras has known no regular war, but occasional disturbances have called for measures of repression. The *pálegárs* or local chieftains long clung to their independence after their country was ceded to the British. On the west coast, the feudal aristocracy of the Nairs, and the religious fanaticism of the Moplahs, have more than once led to rebellion and bloodshed. In the extreme north, the wild tribes occupying the hills of Ganjam and Vizagapatam have only lately learned the habit of subordination. In 1836 the *zamíndári* of Gumsur in this remote tract was attached by government for the rebellious conduct of its chief. An inquiry then instituted revealed the wide prevalence among the tribe of Kondhs of human sacrifice, under the name of *meriah*. The practice has since been suppressed by a special agency. In 1879 the country round Rampa on the northern frontier was the scene of riots sufficiently serious to lead to the necessity of calling out troops. The same necessity arose three years later, when the Hindus and Mahommedans of Salem came into collision over a question of religious ceremonial. A more serious disturbance was that known as the "Anti-Shanar riots" of 1899. The Maravans of Tinnevelly and parts of Madura, resenting the pretensions of the Shanans, a toddy-drawing caste, to a higher social and religious status, organized attacks on Shanan villages. The town of Sivakasi was looted and burnt by five thousand Maravans. Quiet was restored by the military, and a punitive police force was stationed in the disturbed area.

The different territories comprising the Madras presidency were acquired by the British at various dates. In 1763 the tract encircling Madras city, then known as the Jagir, now Chingleput district, was ceded by the nawab of Arcot. In 1765 the Northern Circars, out of which the French had recently been driven, were granted to the Company by the Mogul emperor, but at the price of an annual tribute of £90,000 to the nizam of Hyderabad. Full rights of dominion were not acquired till 1823, when the tribute was commuted for a lump payment. In 1792 Tippoo was compelled to cede the Baramahal (now part of Salem district), Malabar and Dindigul subdivision of Madura. In 1799, on the reconstruction of Mysore state after Tippoo's death, Coimbatore and Kanara were appropriated as the British share; and in the same year the Mahratta rajá of Tanjore resigned the administration of his territory, though his descendant retained titular rank till 1855. In 1800 Bellary and Cuddapah were made over by the nizam of Hyderabad to defray the expense of an increased subsidiary force. In the following year the dominions of the nawab of the Carnatic, extending along the east coast almost continuously from Nellore to Tinnevelly, were resigned into the hands of the British by a puppet who had been put upon the throne for the purpose. The last titular nawab of the Carnatic died in 1855; but his representative still bears the title of prince of Arcot, and is recognized as the first native nobleman in Madras. In 1839 the nawab of Kurnool was deposed for misgovernment and suspicion of treason, and his territories annexed.

See *Madras Manual of Administration*, 3 vols. (Madras, 1885 and 1893); S. Ayyangar, *Forty Years' Progress in Madras* (Madras, 1893); J. P. Rees, *Madras* (Society of Arts, 1901); *Madras Provincial Gazetteer* (2 vols., Calcutta, 1908).

MADRAS, the capital of Madras presidency, and the chief seaport on the eastern coast of India, is situated in 13° 4′ N. and 80° 17′ E. The city, with its suburbs, extends nine miles along the sea and nearly four miles inland, intersected by the little river Cooum. Area, 27 sq. m.; pop. (1901), 509,346, showing an increase of 12·6% in the decade. Madras is the third city in India.

Although at first sight the city presents a disappointing appearance, and possesses not a single handsome street, it has several buildings of architectural pretensions, and many spots of historical interest. It is spread over a very wide area, and many parts of it are almost rural in character. Seen from the roadstead, the fort, a row of merchants' offices, a few spires and public buildings are all that strike the eye. Roughly speaking, the city consists of the following divisions. (1) George Town (formerly Black Town, but renamed after the visit of the Prince of Wales in 1906), an ill-built, densely-populated block, about a mile square, is the business part of the town, containing the banks, custom house, high court, and all the mercantile offices. The last, for the most part handsome structures, lie along the beach. On the sea-face of George Town are the pier and the new harbour. Immediately south of George Town there is (2) an open space which contains Fort St George, the Marina, or fashionable drive and promenade by the seashore, Government House, and several handsome public buildings on the sea-face. (3) West and south of this lung of the city are crowded quarters known by native names—Chintadrapet, Turuvaleswarampet, Pudupak, Royapet, Kistnampet and Mylapur, which bend to the sea again at the old town of Saint Thomé. (4) To the west of George Town are the quarters of Veperi and Pudupet, chiefly inhabited by Eurasians, and the suburbs of Egmore, Nangambakam, and Perambur, adorned with handsome European mansions and their spacious "compounds" or parks, which make Madras a city of magnificent distances. (5) South-west and south lie the European quarters of Tanampet and aristocratic Adyar. Among the most notable buildings are the cathedral, Scottish church, Government House, Pachayappa's Hall, senate house, Chepauk palace (now the revenue board), and the Central railway station.

Madras possesses no special industries. There are several cotton mills, large cement works, iron foundries and cigar factories. Large sums of money have from time to time been spent upon the harbour works, but without any great success. The port remains practically an open roadstead, protected by two breakwaters, and the P. & O. steamers ceased to call in 1898. Passengers or cargo are landed or embarked in flat-bottomed *masula* boats. The sea bottom is unusually flat, reaching a depth of ten fathoms only at a mile from the shore. The harbour is not safe during a cyclone, and vessels have to put out to sea. Madras conducts about 56% of the foreign trade of the presidency, but a much smaller share of the coasting trade. As the capital of southern India, Madras is the centre on which all the great military roads converge. It is also the terminal station of two lines of railway, the Madras & Southern Mahratta line and the Madras & Tanjore section of the South Indian railway. The Buckingham canal, which passes through an outlying part of the city, connects South Arcot district with Nellore and the Kistna and Godavari system of canal navigation. The municipal government of the city was framed by an act of the Madras legislature passed in 1884. The governing body consists of 32 commissioners, of whom 24 are elected by the ratepayers, together with a paid president. The Madras University was constituted in 1857, as an examining body, on the model of the university of London. The chief educational institutions in Madras city are the Presidency College; six missionary colleges and one native college; the medical college, the law college, the college of engineering, the teachers' college in the suburb of Saidapet, all maintained by government; and the government school of arts.

The foundation of Madras dates from 1640, when Francis Day, chief of the East India Company's settlement at Armagon, obtained a grant of the present site of the city from a native ruler. A fort—called Fort St George, presumably from having been finished on St George's Day (April 23)—was at once constructed, and a gradually increasing population settled around its walls. In 1653 Madras, which had previously been subordinate to the settlement of Bantam in Java, was raised to the rank of an independent presidency. In 1702 Daud Khan, Aurangzeb's general, blockaded the town for a few weeks, and in 1741 the Mahrattas unsuccessfully attacked the place. In 1746 La Bourdonnais bombarded and captured Madras. The settlement was restored to the English two years later by the Treaty of Aix-la-Chapelle, but the government of the presidency did not return to Madras till 1762. In 1758 the French under Lally occupied the Black Town and invested the fort. The siege was conducted on both sides with great skill and vigour. After two months the arrival of an English fleet relieved the garrison, and the besiegers retired with some precipitancy. With the exception of the threatening approach of Hyder Ali's horsemen in 1769, and again in 1780, Madras has since the French siege been free from external attack. The town of Saint Thomé, now part of Madras city, was founded and fortified by the Portuguese in 1504, and was held by the French from 1672 to 1674.

See Mrs F. Penny, *Fort St George* (1900); W. Foster, *Founding of Fort St George* (1902).

MADRAZO Y KUNT, DON FEDERICO DE (1815–1894), Spanish painter, was born in Rome on the 12th of February 1815. He was the son of the painter Madrazo y Agudo (1781–1859), and received his first instruction from his father. While still attending the classes at the Academy of San Fernando he painted his first picture, "The Resurrection of Christ" (1829), which was purchased by Queen Christina. Not long afterwards he painted "Achilles in his Tent," and subsequently presented to the Academy "The Continence of Scipio," which secured him admission as a member "for merit." While decorating the palace of Vista Alegre he took up portraiture. In 1852 he went to Paris, where he studied under Winterhalter, and painted portraits of Baron Taylor and of Ingres. In 1837 he was commissioned to produce a picture for the gallery at Versailles, and painted "Godfrey de Bouillon proclaimed King of Jerusalem." The artist then went to Rome, where he worked at various subjects, sacred and profane. Then he painted "Maria Christina in the Dress of a Nun by the bedside of Ferdinand III." (1843), "Queen Isabella," "The Duchess of Medina-Coeli," and "The Countess de Vilchès" (1845–1847), besides a number of portraits of the Spanish aristocracy, some of which were sent to the exhibition of 1855. He received the Legion of Honour in 1846. He was made a corresponding member of the Paris Academy of Fine Arts on the 10th of December 1853, and in 1873, on the death of Schnorr, the painter, he was chosen foreign member. After his father's death he succeeded him as director of the Prado Gallery and president of the Academy of San Fernando. He originated in Spain the production of art reviews and journals, such as *El Artista*, *El Renacimiento* and *El Semanario pintoresco*. He died at Madrid on the 11th of June 1894. His brother, Don Louis De Madrazo, was also known as a painter, chiefly by his "Burial of Saint Cecilia" (1855). Don Federico's best-known pupil was his son, Don Raimundo De Madrazo (b. 1841).

MADRID, a province of central Spain, formed in 1833 of districts previously included in New Castile, and bounded on the W. and N. by Ávila and Segovia, E. by Guadalajara, S.E. by Cuenca and S. by Toledo. Pop. (1900), 775,034, of whom 539,835 inhabit the city of Madrid; area, 3084 sq. m. Madrid belongs to the basin of the Tagus, being separated from that of the Douro by the Sierra de Guadarrama on the N.W. and N., and by the Sierra de Gredos on the S.W. The Tagus is the southern boundary for some distance, its chief tributary being the Jarama, which rises in the Somosierra in the north and terminates at Aranjuez. The Jarama, in turn, is joined by the Henares and Tajuña on the left, and by the Lozoya and Manzanares on the right. The Guadarrama, another tributary of the Tagus, has its upper course within the province. Like the rest of Castile, Madrid is chiefly of Tertiary formation; the soil is mostly clayey, but there are tracts of sandy soil. Agriculture is somewhat backward; the rainfall is deficient, and the rivers are not utilized as they might be for irrigation. The south-eastern districts are the best watered, and produce in abundance fruit, vegetables, wheat, olives, esparto grass and excellent wine. Gardening and viticulture are carried on to some extent near the capital, though the markets of Madrid receive their most liberal supply of fruits and vegetables from Valencia. Sheep, goats and horned cattle are reared, and fish are found in the Jarama and other rivers. Much timber is extracted from the forests of the northern and north-eastern parts of the province for building purposes and for firewood and charcoal. The royal domains of the Escorial, Aranjuez and El Pardo, and the preserves of the nobility, are all well wooded and contain much game. Efforts have also been made by the local authorities to cover the large stretches of waste ground and commons with pines and other trees.

The Sierra de Guadarrama has quarries of granite, lime and gypsum, and is known to contain iron, copper and argentiferous lead; but these resources are undeveloped. Other industries are chiefly confined to the capital; but cloth, leather, paper, earthenware, porcelain, glass, bricks and tiles, ironware, soap, candles, chocolate and lace are also manufactured on a small scale beyond its boundaries. There is very little commerce except for the supply of the capital with necessaries.

Besides the local lines, all the great railways in the kingdom converge in this province, and it contains in all 221 m. of line. Besides Madrid, the towns of Aranjuez (12,670) and Alcalá de Henares (11,206) and the Escorial are described in separate articles. The other towns with more than 5000 inhabitants are Vallecas (10,128), Colmenar de Oreja (6182), Colmenar Viejo (5255) and Carabanchel Bajo (5862).

MADRID, the capital of Spain and of the province of Madrid, on the left bank of the river Manzanares, a right-hand tributary of the Jarama, which flows south into the Tagus. Pop. (1877), 397,816; (1887), 472,228; (1897), 512,150; (1900), 539,835. Madrid was the largest city in Spain in 1900; it is the see of an archbishop, the focus of the principal Spanish railways, the headquarters of an army corps, the seat of a university, the meeting-place of parliament, and the chief residence of the king, the court, and the captain-general of New Castile. It is, however, surpassed in ecclesiastical importance by Toledo and in commerce by Barcelona.

Situation and Climate.—Madrid is built on an elevated and undulating plateau of sand and clay, which is bounded on the north by the Sierra Guadarrama and merges on all other sides into the barren and treeless table-land of New Castile. Numerous water-courses (*arroyos*), dry except at rare intervals, furrow the surface of the plateau; these as they pass through the city have in certain cases been converted into roads—*e.g.* the Paseo de Recoletos and Prado, which are still so liable to be flooded after prolonged rain that special channels have been constructed to carry away the water. The highest point in Madrid is 2372 ft. above sea-level. The city is close to the geographical centre of the peninsula, nearly equidistant from the Bay of Biscay, the Mediterranean and the Atlantic. Owing to its high altitude and open situation it is liable to sudden and frequent variations of climate, and the daily range of temperature sometimes exceeds 50° F.. In summer the heat is rendered doubly oppressive by the fiery, dust-laden winds which sweep across the Castilian table-land; at this season a temperature of 109° has been registered in the shade. In winter the northerly gales from the Sierra Guadarrama bring intense cold; snow falls frequently, and skating is carried on in the Buen Retiro park. A Spanish proverb describes the wind of Madrid as so deadly and subtle that "it will kill a man when it will not blow out a candle"; but, though pulmonary diseases are not uncommon, the climate appears to be exceptionally healthy. In 1901 the death-rate was 22·07 per 1000, or lower than that of any other town on the Spanish mainland. The Sierra Guadarrama renders the atmosphere unusually dry and clear by intercepting the moisture of the north-western winds which prevail in summer; hence the average daily number of deaths decreases from 80 in winter to about 25 in summer. The sanitation of the older quarters is defective, and overcrowding is common, partly owing to the royal decrees which formerly prohibited the extension of the city; but much has been done in modern times to remove or mitigate these evils.

The Inner City.—The form of Madrid proper (exclusive of the modern suburbs) is almost that of a square with the corners rounded off; from east to west it measures rather less than from north to south. It was formerly surrounded by a poor wall, partly of brick, partly of earth, some 20 ft. in height, and pierced by five principal gates (*puertas*) and eleven doorways (*portillos*). Of these only three, the Puerta de Alcalá on the east, the Puerta de Toledo on the south and the Portillo de San Vicente on the west, actually exist; the first and the third were erected in the time of Charles III. (1759–1788), and the second in honour of the restoration of Ferdinand VII. (1827). The Manzanares—or rather its bed, for the stream is at most seasons of the year quite insignificant—is spanned by six bridges, the Puente de Toledo and Puente de Segovia being the chief.

The Puerta del Sol is the centre of Madrid, the largest of its many plazas, and the place of most traffic. It derived its name from the former east gate of the city, which stood here until 1570, and had on its front a representation of the sun. On its south side stands the Palacio de la Gobernacion, or ministry of the interior, a heavy square building by a French architect, J. Marquet, dating from 1768. From the Puerta del Sol diverge, immediately or mediately, ten of the principal streets of Madrid—eastward by north, the Calle de Alcalá, terminating beyond the Buen Retiro park; eastward, the Carrera de San Jeronimo, terminating by the Plaza de las Cortes in the Prado; southward, the Calle de Carretas; westward, the Calle Mayor, which leads to the council chamber and to the palace, and the Calle del Arenal, terminating in the Plaza de Isabel II. and the royal opera house; north-westward, the Calles de Preciados and Del Carmen; and northward, the Calle de la Montera, which afterwards divides into the Calle de Fuencarral to the left and the Calle de Hortaleza to the right. The contract for another wide street through central Madrid, to be called the Gran Via, was given to an English firm in 1905.

The Calle de Alcalá is bordered on both sides with acacias, and contains the Real Academia de Bellas Artes, founded in 1752 as an academy of art and music; its collection of paintings by Spanish masters includes some of the best-known works of Murillo. The handsome Bank of Spain (1884–1891) stands where the Calle de Alcalá meets the Prado; in the oval Plaza de Madrid, at the same point, is a fine 18th-century fountain with a marble group representing the goddess Cybele drawn in a chariot by two lions. The Calle de Alcalá is continued eastward past the Buen Retiro gardens and park, and through the Plaza de Independencia, in the middle of which is the Puerta de Alcalá. The Plaza de las Cortes is so called from the Congreso de los Diputados, or House of Commons, on its north side. The square contains a bronze statue of Cervantes, by Antonio Sola, erected in 1835. The Calle de Carretas, on the west side of which is the General Post Office, ranks with the Carrera de San Jeronimo and Calle de la Montera for the excellence of its shops. From the Calle Mayor is entered the Plaza Mayor, a rectangle of about 430 ft. by 330 ft., formerly the scene of tournaments, bull fights, autos de fé, acts of canonization (including that of Ignatius Loyola in 1622) and similar exhibitions, which used to be viewed by the royal family from the balcony of one of the houses called the Panaderia (belonging to the guild of bakers). The square, which was built under Philip III. in 1619, is surrounded by an arcade; the houses are uniform in height and decoration. In the centre stands a bronze equestrian statue of Philip III., designed by Giovanni da Bologna, after a painting by Pantoja de la Cruz, and finished by Pietro Tacca. From the south-east angle of the Plaza Mayor the Calle de Atocha, one of the principal thoroughfares of Madrid, leads to the outskirts of the inner city; it contains two large hospitals and part of the university buildings (faculty of medicine). The house occupied by Cervantes from 1606 until his death in 1616 stands at the point where it meets the Calle de Léon; in this street is the Real Academia de la Historia, with a valuable library and collections of MSS. and plate. From the south-west angle of the Plaza Mayor begins the Calle de Toledo, the chief mart for the various woollen and silken fabrics from which the picturesque costumes peculiar to the peninsula are made. In the Plaza de Isabel II., at the western extremity of the Calle del Arenal, stands the royal opera-house, the principal front of which faces the Plaza del Oriente and the royal palace. In the centre of the plaza is a fine bronze equestrian statue of Philip IV. (1621–1665); it was designed by Velazquez and cast by Tacca, while Galileo is said to have suggested the means by which the balance is preserved. The gift of the grand duke of Tuscany in 1640, it stood in the Buen Retiro gardens until 1844.

Modern Development of the City.—The north and east of the city—the new suburbs—have developed past the Retiro Park as far as the Bull-ring, and have covered all the vast space included between the Retiro, the Bull-ring, the long Castellana Drive to the race-course and the exhibition building. On the slopes of the other side of the Castellana, and along what were the northern limits of Madrid in 1875, the modern suburbs have extended to the vicinity of the fine cellular prison that was built at the close of the reign of King Alphonso XII. to replace the gloomy building known as El Saladero.

The new parts of the capital, with their broad streets and squares, and their villas sometimes surrounded with gardens, their boulevards lined by rather stunted trees, and their modern public buildings, all resemble the similar features of other European capitals, and contrast with the old Madrid that has preserved so many of its traits in architecture, popular life and habits. Some of the streets have been slightly widened, and in many thoroughfares new houses are being built among the ugly, irregular dwelling-places of the 18th and earlier centuries. This contrast is to be seen especially in and about the Calle Mayor, the Plaza Mayor, the Calle de Toledo, the Rastro, and the heart of the city.

Few capitals have more extensively developed their electric and horse tramways, gas and electric light installations and telephones. Much was done to improve the sanitary conditions of the city in the last twenty years of the 19th century. The streets are deluged three times a day with fire-hose, but even that has little effect upon the dust. Unfortunately the water supply, which used to be famed for its abundance and purity, became wholly insufficient owing to the growth of the city. The old reservoir of the Lozoya canal, a cutting 32 m. long, and the additional reservoir opened in 1883, are quite inadequate for the requirements of modern Madrid, and were formerly kept in such an unsatisfactory state that for several months in 1898 and 1899 the water not only was on the point of giving out, but at times was of such inferior quality that the people had recourse to the many wells and fountains available. The construction of new waterworks was delayed by a terrible accident, which occurred on the 8th of April 1905; the whole structure collapsed, and nearly 400 persons lost their lives in the flooded ruins. A decided improvement has been made in the burial customs of Madrid. No bodies are allowed to be interred in the churches and convents. Some of the older burial grounds in the northern suburbs have been closed altogether, and in those which remain open few coffins are placed in the niche vaults in the depth of the thick walls, as was once the practice. A large modern necropolis has been established a few miles to the north-east.

Principal Buildings.—As compared with other capitals Madrid has very few buildings of much architectural interest. The Basilica de Nuestra Señora de Atocha, on the Paseo de Atocha, a continuation of the Calle de Atocha, was originally founded in 1523. After being almost destroyed by the French, it was restored by Ferdinand VII., and rebuilt after 1896. The modern church is Romanesque in style; it contains a much venerated statue of the Virgin, attributed to St Luke. The collegiate church of San Isidro el Real, in the Calle de Toledo, dates from 1651; it has no architectural merit, but contains one or two valuable pictures and other works of art. It was originally owned by the Jesuits, but after their expulsion in 1769 it was reconsecrated, and dedicated to St Isidore the Labourer (d. 1170), the patron saint of Madrid, whose remains were entombed here. When the diocese of Madrid was separated from that of Toledo San Isidro was chosen as the cathedral. The modern Gothic church of San Jeronimo el Real occupies a conspicuous site eastward of the town. The church of San Francisco el Grande, which contains many interesting monuments, is also known as the National Pantheon. An act was passed in 1837 declaring that the remains of all the most distinguished Spaniards should be buried here; but no attempt to enforce the act systematically was made until 1869, and even then the attempt failed. Towards the close of the 19th century the church was splendidly restored at the expense of the state. Its interior was decorated with paintings and statuary by most of the leading Spanish artists of the time. Of secular buildings unquestionably the most important is the royal palace (Palacio Real), on the west side of the town, on rising ground overhanging the Manzanares. It occupies the site of the ancient Moorish alcázar (citadel), where a hunting seat was built by Henry IV.; this was enlarged and improved by Charles V. when he first made Madrid his residence in 1532; was further developed by Phillip II., but ultimately was destroyed by fire in 1734. The present edifice was begun under Philip V. in 1737 by Sacchetti of Turin, and was finished in 1764. It is in the Tuscan style, and is 470 ft. square and 100 ft. in height, the material being white Colmenar granite, resembling marble. To the north of the palace are the royal stables and coach-houses, remarkable for their extent; to the south is the armoury (Museo de la Real Armería), containing what is possibly the best collection of the kind in existence. After the Palacio Real may be mentioned the royal picture gallery (Real Museo de Pinturas), adjoining the Salon del Prado; it was built about 1785 for Charles III. by Juan de Villanueva as a museum of natural history and academy of sciences. It contains the collections of Charles V., Philip II. and Philip IV., and the pictures number upwards of two thousand. The specimens of Titian, Raphael, Tintoretto, Velazquez, Vandyck, Rubens and Teniers give it a claim to be considered the finest picture gallery in the world. The Biblioteca Nacional, in the Paseo de Recoletos, was founded in 1866, and completed in 1892. Not only the national library, with its important collections of MSS. and documents, but the archaeological museum, the museums of modern painting and sculpture, and the fine arts academy of San Fernando, are within its walls. The two houses of the Cortes meet in separate buildings. The deputies have a handsome building with a very valuable library in the Carrera San Jeronimo; the senators have an old Augustinian convent which contains some fine pictures. A large and handsome building near the Retiro Park contains the offices of the ministers of public works, agriculture and commerce, and of fine arts and education; nearly opposite stands the new station of the Southern Railway Company. The Great Northern and the Spain to Portugal Railway Companies have also replaced their old stations by very spacious, handsome structures, much resembling those of Paris. In 1896 the Royal Exchange was installed in a large monumental building with a fine colonnade facing the Dos de Mayo monument, not far from the museum of paintings.

Of the promenades and open places of public resort the most fashionable and most frequented is the Prado (Paseo del Prado, Salon del Prado) on the east side of the town, with its northward continuation—the Paseo de Recoletos. To the south of the town is the Paseo de las Delicias, and on the west, below the royal palace, and skirting the Manzanares, is the Paseo de la Virgen del Puerto, used chiefly by the poorer classes. Eastward from the Prado are the Buen Retiro Gardens, with ponds and pavilions, and a menagerie. The gardens were formerly the grounds surrounding a royal hunting seat, on the site of which a palace was built for Philip IV. in 1633; it was destroyed during the French occupation.

Education, Religion and Charity.—Madrid University developed gradually out of the college of Doña Maria de Aragon, established in 1590 by Alphonso Orozco. Schools of mathematics and natural science were added in the 16th and 17th centuries, and in 1786 the medical and surgical college of San Carlos was opened. In 1836–1837 the university of Alcalá de Henares (*q.v.*) was transferred to the capital and the older foundations incorporated with it. The university of Madrid thenceforth became the headquarters of education in central Spain. It has an observatory, and a library containing more than 2,000,000 printed books and about 5500 MSS. It gives instruction, chiefly in law and medicine, but also in literature, philosophy, mathematics and physics, to about 5000 students. Associated with the university is the preparatory school of San Isidro, founded by Philip IV. (1621–1665), and reorganized by Charles III. in 1770.

There are upwards of 100 official primary schools and a large number of private ones, among which the schools conducted by the Jesuits and the Scolapian fathers claim special mention. Madrid also has schools of agriculture, architecture, civil and mining engineering, the fine arts, veterinary science and music. The school of military engineering is at Guadalajara. Besides these special schools there are a self-supporting institute for preparing girls for the higher degrees and for certificates as primary teachers, and an institute for secondary education, conducted chiefly by ecclesiastics. Among the educational institutions may be reckoned the botanical garden, dating from 1781, the libraries of the palace, the university, and San Isidro, and the museum of natural science, exceedingly rich in the mineralogical department. The principal learned society is the royal Spanish Academy, founded in 1713 for the cultivation and improvement of the Spanish tongue. The Academy of History possesses a good library, rich in MSS. and incunabula, as well as a fine collection of coins and medals. In addition to the academies of fine arts, the exact sciences, moral and political science, medicine and surgery, and jurisprudence and legislation, all of which possess libraries, there are also anthropological, economic and geographical societies, and a scientific and literary athenaeum. Madrid has a British cemetery opened in 1853, when the older Protestant cemetery in the Paseo de Recoletos was closed. The town also contains a British embassy chapel, a German chapel, and several Spanish Protestant chapels, attended by over 1200 native Protestants, while the Protestant schools, chiefly supported by British, German and American contributions, are attended by more than 2500 children. The first Protestant bishop of Madrid was consecrated in 1895 by Archbishop Plunkett of Dublin. The charitable institutions were greatly improved between 1885 and 1905. The Princess Hospital was completely restored on modern methods, and can accommodate several hundred patients. The old contagious diseases hospital of San Juan de Dios was pulled down and a fine new hospital built in the suburbs beyond the Retiro Park, to hold 700 patients. The military hospital was demolished and a very good one built in the suburbs. There are in all twenty hospitals in Madrid, and a lunatic asylum on the outskirts of the capital, founded by one of the most eminent of Spanish surgeons, and admirably conducted. New buildings have been provided for the orphanages, and for the asylums for the blind, deaf and dumb, incurables and aged paupers. There are hospitals supported by the French, Italian and Belgian colonies; these are old and well-endowed foundations. Public charity generally is very active. In Madrid, as in the rest of Spain, there has been an unprecedented increase in convents, monasteries and religious institutions, societies and Roman Catholic workmen's clubs and classes.

Apart from private institutions for such purposes, the state maintains in the capital a savings bank for the poorer classes, and acts as pawnbroker for their benefit. The mercantile and industrial classes are organized in gilds, which themselves collect the lump sum of taxation exacted by the exchequer and the municipality from each *gremio* or class of taxpayers. The working classes also have commercial and industrial *circulos* or clubs that are obeyed by the gilds with great *esprit de corps*, a chamber of commerce and industries, and "associations of productions" for the defence of economic interests.

Industries.—The industries of the capital have developed extraordinarily since 1890. In the town, and within the municipal boundaries in the suburbs, many manufactories have been established, giving employment to more than 30,000 hands, besides the 4000 women and girls of the Tobacco Monopoly Company's factory. Among the most important factories are those which make every article in leather, especially cigar and card cases, purses and pocket-books. Next come the manufactures of fans, umbrellas, sunshades, chemicals, varnishes, buttons, wax candles, beds, cardboard, porcelain, coarse pottery, matches, baskets, sweets and preserves, gloves, guitars, biscuits, furniture, carpets, corks, cards, carriages, jewelry, drinks of all kinds, plate and plated goods. There are also tanneries, saw and flour mills, glass and porcelain works, soap works, brickfields, paper mills, zinc, bronze, copper and iron foundries. The working classes are strongly imbued with socialistic ideas. Strikes and May Day demonstrations have often been troublesome. Order is kept by a garrison of 12,500 men in the barracks of the town and cantonments around, and by a strong force of civil guards or gendarmes quartered in the town itself. The civil and municipal authorities can employ beside the gendarmes the police, about 1400 strong, and what is called the *guardias urbanos*, another police force whose special duty it is to regulate the street traffic and prevent breaches of the municipal regulations. There is not, on the average, more crime in Madrid than in the provinces.

History.—Spanish archaeologists have frequently claimed for Madrid a very high antiquity, but the earliest authentic historical mention of the town (Majrīt, Majoritum) occurs in the Arab chronicle, and does not take us farther back than to the first half of the 10th century. The place was finally taken from the Moors by Alphonso VI. (1083), and was made a hunting-seat by Henry IV., but first rose into importance when Charles V., benefiting by its keen air, made it his occasional residence. Philip II. created it his capital and "only court" (*única corte*) in 1560. It is, however, only classed as a town (*villa*), having never received the title of city (*ciudad*). Fruitless attempts were made by Philip III. and Charles III. respectively to transfer the seat of government to Valladolid and to Seville. (See also SPAIN: *History*).

See J. Amador de los Rios, *Historia de la villa y corte de Madrid* (Madrid, 1861-1864); Valverde y Alvarez, *La Capital de España* (Madrid, 1883); E. Sepúlveda, *La Vida en Madrid en 1886* (Madrid, 1887); H. Peñasco, *Las Calles de Madrid* (Madrid, 1889); C. Perez Pastor, *Bibliografia madrileña, siglo XVI.* (Madrid, 1891); F. X. de Palacio y Garcia, count of las Almenas, *La Municipalidad de Madrid* (Madrid, 1896); E. Sepúlveda, *El Madrid de los recuerdos: colección de artículos* (Madrid, 1897); P. Hauser, *Madrid bajo el punto de vista medico-social* (Madrid, 1902); L. Williams, *Toledo and Madrid, their Records and Romances* (London, 1903).

MADRIGAL (Ital. *madrigale*), the name of a form of verse, the exact nature of which has never been decided in English, and of a form of vocal music.

(1) *In Verse.*—The definition given in the *New English Dictionary*, "a short lyrical poem of amatory character," offers no distinctive formula; some madrigals are long, and many have nothing whatever to do with love. The most important English collection of madrigals, not set to music, was published by William Drummond of Hawthornden (1585–1649) in his *Poems* of 1616. Perhaps the best way of ascertaining what was looked upon in the 17th century as a madrigal is to quote one of Drummond's:—

The beauty and the life
Of life's and beauty's fairest paragon,
O tears! O grief! hung at a feeble thread,
To which pale Atropos had set her knife;
The soul with many a groan
Had left each outward part,
And now did take his last leave of the heart;
Nought else did want, save death, even to be dead;
When the afflicted band about her bed,
Seeing so fair him come in lips, cheeks, eyes,
Cried ah! and can death enter Paradise?

This may be taken as a type of Drummond's madrigals, of which he has left us about eighty. They are serious, brief, irregular lyrics, in which neither the amatory nor the complimentary tone is by any means obligatory. Some of these pieces contain as few as six lines, one as many as fourteen, but they average from nine to eleven. In the majority of examples the little poem opens with a line of six syllables, and no line extends beyond ten syllables. The madrigal appears to be a short canzone of the Tuscan type, but less rigidly constructed. In French the madrigal has not this Italian character. It is simply a short piece of verse, ingenious in its turn and of a gallant tendency. The idea of compliment is essential. J. F. Guichard (1730–1811) writes:—

Orgon, poète marital,
  À Venus compare sa femme;
C'est pour la belle un madrigal,
  C'est pour Venus une épigramme.

This quatrain emphasizes the fact that in French a madrigal is a trifling piece of erotic compliment, neatly turned but not seriously meant. The credit of inventing the old French verse-form of madrigal belongs to Clément Marot, and one of his may be quoted in contrast to that of Drummond:—

Un doux nenni avec un doux sourire
  Est tant honneste, il le vous faut apprendre;
Quant est de oui, si veniez à le dire,
  D'avoir trop dit je voudrois vous reprendre;
  Non que je sois ennuyé d'entreprendre
D'avoir le fruit dont le désir me point;
  Mais je voudrois qu'en ne le laissant prendre,
  Vous me disiez: vous ne l'aurez point.

In English, when the word first occurred—it has not been traced farther back than 1588 (in the preface to Nicholas Yonge's *Musica transalpina*)—it was identified with the chief form of secular vocal music in the 16th century. In 1741 John Immyns (d. 1764) founded the Madrigal Society, which met in an ale-house in Bride Lane, Fleet Street; this association still exists, and is the oldest musical society in Europe.

The word "madrigal" is frequently also used to designate a sentimental or trifling expression in a half-contemptuous sense. (E. G.)

(2) *In Music.*—As a definite musical art-form, the madrigal was known in the Netherlands by the middle of the 15th century; like the motet, it obviously originated in the treatment of counterpoint on a canto fermo, some early examples even combining an ecclesiastical canto fermo in the tenor with secular counterpoint in the other parts. Thus Josquin's *Déploration de Jehan Okenheim* (see MUSIC) might equally well be called a madrigal or motet, if the word "madrigal" were used for compositions to French texts at all. But by the middle of the 16th century the Italian supremacy in music had developed the madrigal into the greatest of secular musical forms, and made it independent of the form of the words; and thus when Lasso sets Marot's madrigals to appropriately witty and tuneful music he calls the result a "chanson"; while when Palestrina composes Petrarca's Sonnets to the Virgin in memory of Laura, the result appears as a volume of *Madrigali spirituali*. Elegiac madrigals, whether spiritual or secular, were thus as common as any other kind; so that when the *Musica transalpina* brought the word "madrigal" to England it brought a precedent for the poet Drummond's melancholy type of madrigal poetry.

Italian madrigals, however, are by no means always elegiac; but the term always means a highly organized and flowing polyphonic piece, often as developed as the motet, though, in the mature classical period, distinct in style. Yet masses were often founded on the themes of madrigals, just as they were on the themes of motets (see MASS; MOTET); and it is interesting, in such beautiful cases as Palestrina's *Missa gia fu chi m'ebbe cara*, to detect the slight strain the mildly scandalous origin of the themes puts upon the ecclesiastical style.

The breaking strain was put on the madrigal style at the end of the 16th century, in one way by the new discords of Monteverde and (with more musical invention) Schütz; and in another way by the brilliant musical character-drawing of Vecchi, whose *Amfiparnasso* is a veritable comic opera in the form of a set of fourteen madrigals, all riotously witty in the purest and most masterly polyphonic style. It was probably meant, or at least made use of, to laugh down the earliest pioneers of opera (*q.v.*); but it is the beginning of the end for the madrigal as a living art. Long afterwards we occasionally meet with the word again, when a 17th or 18th century composer sets to some kind of accompanied singing a poem of madrigalesque character. But this does not indicate any continuation of the true musical history of the madrigal. The strict meaning of the word in its musical sense is, then, a musical setting of an Italian or English non-ecclesiastical poem (typically a canzone) for unaccompanied chorus, in a 16th-century style less ecclesiastical than the motet, but as like it in organization as the form and sentiment of the words admit. The greatest classics in the madrigal style are those of Italy; and but little, if at all, below them come the English. The form, though not the name, of course, exists in the 16th-century music of other languages whenever the poetry is not too light for it.

It is important but easy to distinguish the madrigal from the lighter 16th-century forms, such as the Italian *villanella* and the English ballet, these being very homophonic and distinguished by the strong lilt of their rhythm.

The madrigal has been very successfully revived in modern English music with a more or less strict adherence to the 16th century principles; the compositions of De Pearsall being of high artistic merit, while the *Madrigale spirituale* in Stanford's oratorio *Eden* is a movement of rare beauty. (D. F. T.)

MADURA (Dutch *Madoera*), an island of the Dutch East Indies, separated by the shallow Strait of Madura from the N.E. coast of Java. Pop. (1897), 1,652,580, of whom 1,646,071 were natives, 4252 Chinese and 558 Europeans. It extends from about 112° 32′ to 114° 7′ E., and is divided into two nearly equal portions by the parallel of 7° S.; the area is estimated at 1725 sq. m. It is a plateau-like prolongation of the limestone range of northern Java, with hills (1300 to 1600 ft. high) and dales. The formation of the coast and plains is Tertiary and recent alluvium. Hot springs are not infrequent; and in the valley between Gunong Geger and Banjar lies the mud volcano of

Banju Ening. The coasts are clothed with tropical vegetation; but the soil is better fitted for pastoral than agricultural purposes. Fishing and cattle-rearing are the chief means of subsistence. Besides rice and maize, Madura yields coco-nut oil and *jati*. The manufacture of salt for the government, abolished in other places, continues in Madura. Hence perhaps the name is derived (Sansk. *mandura*, salt). Petroleum is found in small quantities.

The principal town is Sumenep; and there are populous Malay, Arab and Chinese villages between the town and the European settlement of Maringan. On a hill in the neighbourhood lies Asta, the burial-place of the Sumenep princes. Pamekasan is the seat of government. Bangkalang is a large town with the old palace of the sultan of Madura and the residences of the princes of the blood; the mosque is adorned with the first three suras of the Koran, thus differing from nearly all the mosques in Java and Madura, though resembling those of western Islam. In the vicinity once stood the Erfprins fort. Arisbaya (less correctly Arosbaya) is the place where the first mosque was built in Madura, and where the Dutch sailors first made acquaintance with the natives. The once excellent harbour is now silted up. Sampang is the seat of an important market. The Kangean and Sapudi islands, belonging to Madura, yield timber, trepang, turtle, pisang and other products.

Madura formerly consisted of three native states—Madura or Bangkalang, Pamekasan and Sumenep. The whole island was considered part of the Java residency of Surabaya. The separate residency of Madura was constituted in 1857; it now consists of four "departments"—Pamekasan, Madura, Sumenep and Sampang.

See P. J. Veth, *Java*, vol. iii.; Kielstra, "Het Eiland Madoera," in *De Gids* (1890); H. van Lennep, "De Madoereezen," in *De Indische Gids* (1895), with detailed bibliography.

MADURA, a city and district of British India, in the Madras Presidency. The city is situated on the right bank of the river Vaigai, and has a station on the South Indian railway 345 m. S.E. of Madras. Pop. (1901), 105,984. The city was the capital of the old Pandyan dynasty, which ruled over this part of India from the 5th century B.C. to the end of the 11th century A.D. Its great temple forms a parallelogram about 847 ft. by 729 ft., and is surrounded by nine *gopuras*, of which the largest is 152 ft. high. These ornamental pyramids begin with door-posts of single stones 60 ft. in height, and rise course upon course, carved with rows of gods and goddesses, peacocks, bulls, elephants, horses, lions, and a bewildering entanglement of symbolical ornament all coloured and gilded, diminishing with distance until the stone *trisul* at the top looks like the finest jeweller's work. The temple, which contains some of the finest carving in southern India, is said to have been built in the reign of Viswanath, first ruler of the Nayak dynasty. Its chief feature is the sculptured "Hall of a Thousand Pillars." The palace of Tirumala Nayak is the most perfect relic of secular architecture in Madras. This palace, which covers a large area of ground, has been restored, and is utilized for public offices. The Vasanta, a hall 333 ft. long, probably dedicated to the god Sundareswara, and the Tamakam, a pleasure-palace, now the residence of the collector, are the other principal buildings of this period.

The last of the old Pandyan kings is said to have exterminated the Jains and conquered the neighbouring kingdom of Chola; but he was in his turn overthrown by an invader from the north, conjectured to have been a Mahommedan. In 1324 a Moslem army under Malik Kafur occupied Madura, and the Hindus were held in subjection for a period of fifty years. Subsequently Madura became a province of the Hindu Empire of Vijayanagar. In the middle of the 16th century the governor Viswanath established the Nayak dynasty, which lasted for a century. The greatest of the line was Tirumala Nayak (reigned 1623–1659), whose military exploits are recorded in the contemporary letters of the Jesuit missionaries. He adorned Madura with many public buildings, and extended his empire over the adjoining districts of Tinnevelly, Travancore, Coimbatore, Salem and Trichinopoly. His repudiation of the nominal allegiance paid to the raja of Vijayanagar brought him into collision with the sultan of Bijapur, and after a lapse of three centuries Mahommedans again invaded Madura and compelled him to pay them tribute. After the death of Tirumala the kingdom of Madura gradually fell to pieces, being invaded by both Mahommedans and Mahrattas. About 1736 the district fell into the hands of the nawab of the Carnatic, and the line of the Nayaks was extinguished. About 1764 British officers took charge of Madura in trust for Mahommed Ali (Wallah Jah), the last independent nawab of the Carnatic, whose son finally ceded his rights of sovereignty to the East India Company in 1801.

The District of Madura has an area of 8701 sq. m. Pop. (1901), 2,831,280, an increase of 8·5% in the decade. It consists of a section of the plain stretching from the mountains east to the sea, coinciding with the basin of the Vaigai river, and gradually sloping to the S.E. The plain is broken by the outlying spurs of the Ghats, and by a few isolated hills and masses of rock scattered over the country. The most important spur of the Ghats is known as the Palni hills, which project E.N.E. across the district for a distance of about 54 m. Their highest peaks are more than 8000 ft. above sea-level, and they enclose a plateau of about 100 sq. m., with an average height of 7000 ft. On this plateau is situated the sanatorium of Kodaikanal, and coffee-planting is successfully carried on. The other principal crops of the district are millets, rice, other food-grains, oil-seeds and cotton. Tobacco is grown chiefly in the neighbourhood of Dindigul, whence it is exported to Trichinopoly, to be made into cigars. There are several cigar factories and a number of saltpetre refineries. The only other large industry is that of coffee-cleaning. Madura is traversed by the main line of the South Indian railway. It has four small seaports, whose trade is chiefly carried on with Ceylon. The most important irrigation work, known as the Periyar project, consists of a tunnel through the Travancore hills, to convey the rainfall across the watershed.

See *Madura District Gazetteer* (Madras, 1906).

MADVIG, JOHAN NICOLAI (1804–1886), Danish philologist, was born on the island of Bornholm, on the 7th of August 1804. He was educated at the classical school of Frederiksborg and the university of Copenhagen. In 1828 he became reader, and in 1829 professor, of Latin language and literature at Copenhagen, and in 1832 was appointed university librarian. In 1848 Madvig entered parliament as a member of what was called the "Eider-Danish" party, because they desired the Eider to be the boundary of the country. When this party came into power Madvig became minister of education. In 1852 he became director of public instruction. Some years later, from 1856 to 1863, Madvig was president of the Danish parliament and leader of the National Liberal party. With these brief interruptions the greater part of his life was devoted to the study and teaching of Latin and the improvement of the classical schools, of which he was chief inspector. As a critic he was distinguished for learning and acumen. He devoted much attention to Cicero, and revolutionized the study of his philosophical writings by an edition of *De Finibus* (1839; 3rd ed., 1876). Perhaps his most widely known works are those on Latin grammar and Greek syntax, especially his Latin grammar for schools (Eng. trans. by G. Woods). In 1874 his sight began to fail, and he was forced to give up much of his work. He still, however, continued to lecture, and in 1879 he was chosen rector for the sixth time. In 1880 he resigned his professorship, but went on with his work on the Roman constitution, which was completed and published before his death. In this book Madvig takes a strongly conservative standpoint and attacks Mommsen's views on Caesar's programme of reforms. It is a clear exposition, though rather too dogmatic and without sufficient regard for the views of other scholars. His last work was his autobiography, *Livserindringer* (published 1887). Madvig died at Copenhagen on the 12th of December 1886.

See J. E. Sandys, *History of Classical Scholarship* (1908), iii., 319-324.

MAECENAS, GAIUS (Cilnius), Roman patron of letters, was probably born between 74 and 64 B.C., perhaps at Arretium. Expressions in Propertius (ii. 1, 25–30) seem to imply that he had taken some part in the campaigns of Mutina, Philippi and Perusia. He prided himself on his ancient Etruscan lineage, and claimed descent from the princely house of the Cilnii, who excited the jealousy of their townsmen by their preponderating wealth and influence at Arretium in the 4th century B.C. (Livy x. 3). The Gaius Maecenas mentioned in Cicero (*Pro Cluentio*, 56) as an influential member of the equestrian order in 91 B.C. may have been his grandfather, or even his father. The testimony of Horace (*Odes* iii. 8, 5) and Maecenas's own literary tastes imply that he had profited by the highest education of his time. His great wealth may have been in part hereditary, but he owed his position and influence to his close connexion with the emperor Augustus. He first appears in history in 40 B.C., when he was employed by Octavian in arranging his marriage with Scribonia, and afterwards in assisting to negotiate the peace of Brundusium and the reconciliation with Antony. It was in 39 B.C. that Horace was introduced to Maecenas, who had before this received Varius and Virgil into his intimacy. In the "Journey to Brundusium," (Horace, *Satires*, i. 5) in 37, Maecenas and Cocceius Nerva are described as having been sent on an important mission, and they were successful in patching up, by the Treaty of Tarentum, a reconciliation between the two claimants for supreme power. During the Sicilian war against Sextus Pompeius in 36, Maecenas was sent back to Rome, and was entrusted with supreme administrative control in the city and in Italy. He was vicegerent of Octavian during the campaign of Actium, when, with great promptness and secrecy, he crushed the conspiracy of the younger Lepidus, and during the subsequent absences of his chief in the provinces he again held the same position. During the latter years of his life he fell somewhat out of favour with his master Suetonius (*Augustus*, 66) attributes the loss of the imperial favour to Maecenas having indiscreetly revealed to Terentia, his wife, the discovery of the conspiracy in which her brother Murena was implicated. But according to Dio Cassius (liv. 19) it was due to the emperor's relations with Terentia. Maecenas died in 8 B.C., leaving the emperor heir to his wealth.

Opinions were much divided in ancient times as to the personal character of Maecenas; but the testimony as to his administrative and diplomatic ability was unanimous. He enjoyed the credit of sharing largely in the establishment of the new order of things, of reconciling parties, and of carrying the new empire safely through many dangers. To his influence especially was attributed the humaner policy of Octavian after his first alliance with Antony and Lepidus. The best summary of his character as a man and a statesman is that of Velleius Paterculus (ii 88), who describes him as "of sleepless vigilance in critical emergencies, far-seeing and knowing how to act, but in his relaxation from business more luxurious and effeminate than a woman."

Expressions in the *Odes* of Horace (ii. 17 1) seem to imply that Maecenas was deficient in the robustness of fibre characteristic of the average Roman. His character as a munificent patron of literature—which has made his name a household word—is gratefully acknowledged by the recipients of it and attested by the regrets of the men of letters of a later age, expressed by Martial and Juvenal. His patronage was exercised, not from vanity or a mere dilettante love of letters, but with a view to the higher interest of the state. He recognized in the genius of the poets of that time, not only the truest ornament of the court, but a power of reconciling men's minds to the new order of things, and of investing the actual state of affairs with an ideal glory and majesty The change in seriousness of purpose between the *Eclogues* and the *Georgics* of Virgil was in a great measure the result of the direction given by the statesman to the poet's genius. A similar change between the earlier odes of Horace, in which he declares his epicurean indifference to affairs of state, and the great national odes of the third book is to be ascribed to the same guidance. Maecenas endeavoured also to divert the less masculine genius of Propertius from harping continually on his love to themes of public interest. But if the motive of his patronage had been merely politic it never could have inspired the affection which it did in its recipients. The great charm of Maecenas in his relation to the men of genius who formed his circle was his simplicity, cordiality and sincerity. Although not particular in the choice of some of the associates of his pleasures, he admitted none but men of worth to his intimacy, and when once admitted they were treated like equals. Much of the wisdom of Maecenas probably lives in the *Satires* and *Epistles* of Horace. It has fallen to the lot of no other patron of literature to have his name associated with works of such lasting interest as the *Georgics* of Virgil, the first three books of Horace's *Odes*, and the first book of his *Epistles*.

Maecenas himself wrote in both prose and verse. The few fragments that remain show that he was less successful as an author than as a judge and patron of literature. His prose works on various subjects—*Prometheus*, *Symposium* (a banquet at which Virgil, Horace and Messalla were present), *De cultu suo* (on his manner of life)—were ridiculed by Augustus, Seneca and Quintilian for their strange style, the use of rare words and awkward transpositions. According to Dio Cassius, Maecenas was the inventor of a system of shorthand.

There is no good modern biography of Maecenas. The best known is that by P. S. Frandsen (1843). See "Horace et Mecène" by J. Girard, in *La Revue politique et littéraire* (Dec. 27, 1873); V. Gardthausen, *Augustus und seine Zeit*, i. 762 seq.; ii. 432 seq. The chief ancient authorities for his life are Horace (*Odes* with Scholia), Dio Cassius, Tacitus (*Annals*), Suetonius (*Augustus*). The fragments have been collected and edited by F. Harder (1889).

MAECIANUS, LUCIUS VOLUSIUS (2nd cent.) Roman jurist, was the tutor in law of the emperor Marcus Aurelius. When governor of Alexandria he was slain by the soldiers, as having participated in the rebellion of Avidius Cassius (175). Maecianus was the author of works on trusts (*Fideicommissa*), on the *Judicia publica*, and of a collection of the Rhodian laws relating to maritime affairs. His treatise on numerical divisions, weights and measures (*Distributio*) is extant, with the exception of the concluding portion.

See Capitolinus, *Antoninus*, 3; Vulcacius Gallicanus, *Avidius Cassius*, 7, edition of the metrological work by F. Hultsch in *Metrologicorum scriptorum reliquiae*, ii (1866). Mommsen in *Abhandlungen der sächsischen Gesellschaft der Wissenschaften*, iii. (1853).

MAELDUIN (or MAELDUNE), **VOYAGE OF** (*Imram Maeleduin*), an early Irish romance. The text exists in an 11th-century redaction, by a certain Aed the Fair, described as the "chief sage of Ireland," but it may be gathered from internal evidence that the tale itself dates back to the 8th century. It belongs to the group of Irish romance, the *Navigations* (*Imrama*), the common type of which was probably imitated from the classical tales of the wanderings of Jason, of Ulysses and of Aeneas. Maelduin, the foster-son of an Irish queen, learnt on reaching manhood that he was the son of a nun, and that his father, Ailill of the edge of battle, had been slain by a marauder from Leix. He set sail to seek his father's murderer, taking with him, in accordance with the instructions of a sorcerer, seventeen men. His three foster-brothers swam after him, and were taken on board This increase of the fateful number caused Maelduin's vengeance to be deferred for three years and seven months, until the last of the intruders had perished. The travellers visited many strange islands, and met with a long series of adventures, some of which are familiar from other sources. The *Voyage of St Brendan* (*q.v.*) has very close similarities with the *Maelduin*, of which it is possibly a clerical imitation, with the important addition of the whale-island episode, which it has in common with "Sindbad the Sailor."

Imram Curaig Mailduin is preserved, in each case imperfectly, in the *Lebor na h Uidre*, a MS. in the Royal Irish Academy, Dublin; and in the *Yellow Book of Lecan*, MS. H 216 in the Trinity College Library, Dublin; fragments are in Harleian MS. 5280 and Egerton MS. 1782 in the British Museum. There are translations by Patrick Joyce, *Old Celtic Romances* (1879), by Whitley Stokes (a more critical version, printed together with the text) in *Revue celtique*, vols. ix and x (1888–1889) See H. Zimmer, "Brendan's Meerfahrt" in *Zeitschrift für deutsches Altertum*, vol. xxxiii. (1889). Tennyson's *Voyage of Maeldune*, suggested by the Irish romance, borrows little more than its framework.

MAELIUS, SPURIUS (d. 439 B.C.), a wealthy Roman plebeian, who during a severe famine bought up a large amount of corn and sold it at a low price to the people. Lucius (or Gaius) Minucius, the patrician *praefectus annonae* (president of the market), thereupon accused him of courting popularity with a view to making himself king. The cry was taken up. Maelius, summoned before the aged Cincinnatus (specially appointed dictator), refused to appear, and was slain by Gaius Servilius Ahala; his house was razed to the ground, his corn distributed amongst the people, and his property confiscated. The open space called Aequimaelium, on which his house had stood, preserved the memory of his death. Cicero calls Ahala's deed a glorious one, but, whether Maelius entertained any ambitious projects or not, his summary execution was an act of murder, since by the Valerio-Horatian laws the dictator was bound to allow the right of appeal.

See Niebuhr's *History of Rome*, ii. 418 (Eng. trans., 1851); G. Cornewall Lewis, *Credibility of early Roman History*, ii.; Livy, iv. 13; Cicero, *De senectute* 16, *De amicitia* 8, *De republica*, ii. 27; Florus, i. 26; Dion. Halic. xii. 1.

MAELSTROM (whirlpool), a term originally applied to a strong current running past the south end of the island of Moskenaes, a member of the group of Lofoten Islands on the west coast of Norway. It is known also as the Moskenstrom. Though dangerous in certain states of wind and tide, the tales of ships being swallowed in this whirlpool are fables. The word is probably of Dutch origin, from *malen*, to grind or whirl, and *strom* or *stroom*, a stream or current. It appears on Mercator's *Atlas* of 1595.

MAENADS (Gr. Μαινάδες, frenzied women), the female attendants of Dionysus. They are known by other names—Bacchae, Thyiades, Clodones and Mimallones (the last two probably of Thracian origin)—all more or less synonymous.

See the exhaustive articles by A. Legrand in Daremberg and Saglio's *Dictionnaire des antiquités* and A. Rapp in Roscher's *Lexikon der Mythologie*; also editions of Euripides, *Bacchae* (*e.g.* J. E. Sandys).

MAENIUS, GAIUS, Roman statesman and general. Having completed (when consul in 338 B.C.) the subjugation of Latium, which with Campania had revolted against Rome, he was honoured by a triumph, and a column was erected to him in the Forum. When censor in 318, in order that the spectators might have more room for seeing the games that were celebrated in the Forum, he provided the buildings in the neighbourhood with balconies, which were called after him *maeniana*.

See Festus, *s.v.* Maeniana; Livy viii. 13, ix. 34; Pliny, *Nat. Hist.* xxxiv. 11 (5).

MAERLANT, JACOB VAN (*c.* 1235–*c.* 1300), Flemish poet, was born in the Franc de Burges (tradition says at Damme) between 1230 and 1240. He was sacristan of Maerlant, in the island of Ost-Voorne, and afterwards clerk to the magistrates at Damme. His early works are translations of French romances. Maerlant's most serious work in the field of romance was his *Ystorien van Troyen* (*c.* 1264), a poem of some forty thousand lines, translated and amplified from the *Roman de Troie* of Benoît de Sainte-More. From this time Maerlant rejected romance as idle, and devoted himself to writing scientific and historical works for the education and enlightenment of the Flemish people. His *Heimelicheit der Heimelicheden* (*c.* 1266) is a translation of the *Secreta secretorum*, a manual for the education of princes, ascribed throughout the middle ages to Aristotle. *Van der Naturen Bloeme* is a free translation of *De natura rerum*, a natural history in twenty books by a native of Brabant, Thomas de Cantimpré; and his *Rijmbijbel* is taken, with many omissions and additions, from the *Historia scholastica* of Petrus Comestor. He supplemented this metrical paraphrase of Scripture history by *Die Wrake van Jherusalem* (1271) from Josephus. Although Maerlant was an orthodox Catholic, he is said to have been called to account by the priests for translating the Bible into the vulgar tongue. In 1284 he began his *magnum opus*, the *Spiegel historiael*, a history of the world, derived chiefly from the third part of the *Speculum majus* of Vincent de Beauvais. This work was completed by two other writers, Philipp Utenbroeke and Lodowijk van Velthem. Maerlant died in the closing years of the 13th century, his last poem, *Van den lande van oversee*, dating from 1291. The greater part of his work consists of translations, but he also produced poems which prove him to have had real original poetic faculty. Among these are *Die Clausule van der Bible*, *Der Kerken Clage*, imitated from the *Complaintes* of Rutebeuf, and the three dialogues entitled *Martijn*, in which the fundamental questions of theology and ethics were discussed. In spite of his orthodoxy, Maerlant was a keen satirist of the corruptions of the clergy. He was one of the most learned men of his age, and for two centuries was the most celebrated of Flemish poets.

See monographs by J. van Beers (Ghent, 1860); C. A. Serrure (Ghent, 1861); K. Versnaeyen (Ghent, 1861); J. te Winkel (Leiden, 1877, 2nd ed., Ghent, 1892); and editions of *Torec* (Leiden, 1875) by J. te Winkel; of *Naturen Bloeme*, by Eelco Verwijs; of *Alexanders Geesten* (Groningen, 1882), by J. Franck; *Merlijn* (Leiden, 1880–1882), by J. van Bloten; *Heimelicheit der Heimelicheden* (Dordrecht, 1838), by Clarisse; *Der Naturen Bloeme* (Groningen, 1878), by Verwijs; of *Rijmbijbel* (Brussels, 1858–1869), by David; *Spiegel historiael* (Leiden 1857–1863), by Verwijs and de Vries; selections from the *Ystorien van Troyen* (1873), by J. Verdam.

MAES, NICOLAS (1632–1693), Dutch painter, was born at Dordrecht, and went about 1650 to Amsterdam, where he entered Rembrandt's studio. Before his return to Dordrecht in 1654 Maes painted a few Rembrandtesque genre pictures, with life-size figures and in a deep glowing scheme of colour, like the "Reverie" at the Ryks Museum in Amsterdam, the "Card Players" at the National Gallery, and the "Children with a Goat Carriage," belonging to Baroness N. de Rothschild. So closely did his early style resemble that of Rembrandt, that the last-named picture, and other canvases in the Leipzig and Budapest galleries and in the collection of Lord Radnor, were or are still ascribed to Rembrandt. In his best period, from 1655 to 1665, Maes devoted himself to domestic genre on a smaller scale, retaining to a great extent the magic of colour he had learnt from Rembrandt. Only on rare occasions did he treat scriptural subjects, as in the earl of Denbigh's "Hagar's Departure," which has been ascribed to Rembrandt. His favourite subjects were women spinning, or reading the Bible, or preparing a meal. In 1665 he went to Antwerp, where he remained till 1678, in which year he probably returned to Amsterdam. His Antwerp period coincides with a complete change in style and subject. He devoted himself almost exclusively to portraiture, and abandoned the intimacy and glowing colour harmonies of his earlier work for a careless elegance which suggests the influence of Van Dyck. So great indeed was the change, that it gave rise to the theory of the existence of another Maes, of Brussels. Maes is well represented at the National Gallery by five paintings: "The Cradle," "The Dutch Housewife," "The Idle Servant," "The Card Players," and a man's portrait. At Amsterdam, besides the splendid examples to be found at the Ryks Museum, is the "Inquisitive Servant" of the Six collection. At Buckingham Palace is "The Listening Girl" (repetitions exist), and at Apsley House "Selling Milk" and "The Listener." Other notable examples are at the Berlin, Brussels, St Petersburg, the Hague, Frankfort, Hanover and Munich galleries.

MAESTRO, a north-westerly wind observed in the Adriatic and surrounding regions, chiefly during summer. The maestro is a "fine weather" wind, and is the counterpart of the sirocco.

MAETERLINCK, MAURICE (1862–), Belgian-French dramatist and poet, of Flemish extraction, was born at Ghent on the 29th of August 1862. He was educated at the Collège Sainte-Barbe, and then at the university of his native city, where, at the age of twenty-four, he was enrolled as a barrister. In 1887 he settled in Paris, where he immediately became acquainted with Villiers de l'Isle-Adam and the leaders of the symbolist school of French poetry. At the death of his father, Maeterlinck returned to Belgium, where he thenceforth mainly resided: in the winter at Ghent, in the summer on an estate at Oostacker. He had by this time determined to devote his whole life to poetry, a dedication which his fortune permitted. His career as an author began in 1889, when he published a volume of verse, *Serres chaudes*, and a play, *La Princesse Maleine*, the latter originally composed in metre, but afterwards carefully rewritten in prose, the vehicle which the author continued to use for his dramatic work. Maeterlinck was at this time totally unknown, but he became famous through an article by Octave Mirbeau, prominently published in the Paris *Figaro*, entitled "A Belgian Shakespeare." The enthusiasm of this review and the excellence of the passages quoted combined to make Maeterlinck the talk of the town. Maeterlinck, among his Belgian roses, continued to work with extreme deliberation. In 1890 he published, in Brussels, two more plays, *L'Intruse* and *Les Aveugles*; followed in 1891 by *Les Sept princesses*. His strong leaning to mysticism was now explained, or defined, by a translation of the Flemish medieval visionary, the Admirable Ruysbroeck, which Maeterlinck brought out in 1891. In 1892 appeared what has been perhaps the most successful of all his plays on the stage, *Pelléas et Mélisande*, followed in 1894 by those very curious and powerful little dramas written to be performed by marionettes: *Alladine et Palomides*, *Intérieur* and *La Mort de Tintagiles*. In 1895 Maeterlinck brought out, under the title of *Annabella*, a translation of Ford's *'Tis Pity She's a Whore*, with a preface. Two philosophical works followed, a study on Novalis (1895) and *Le Trésor des humbles* (1896). In 1896 he returned to drama with *Aglavaine et Sélysette* and to lyric verse with *Douze chansons*. A monograph on the ethics of mysticism, entitled *La Sagesse et la destinée*, was issued, as a kind of commentary on his own dramas, in 1898; and in 1901 Maeterlinck produced a fascinating volume of prose, founded upon observations made in his apiaries at Oostacker, in which philosophy, fancy and natural history were surprisingly mingled—*La Vie des abeilles*. In 1902 he published *Le Temple enseveli* and *Monna Vanna*; in 1903 *Joyzelle*. In 1901 he began to issue, in Brussels, an edition of his complete dramatic works.

The nature of Maeterlinck's writings, whether in prose or verse, has been strictly homogeneous. Few poets have kept so rigorously to a certain defined direction in the practice of their art. Whether in philosophy, or drama, or lyric, Maeterlinck is exclusively occupied in revealing, or indicating, the mystery which lies, only just out of sight, beneath the surface of ordinary life. In order to produce this effect of the mysterious he aims at an extreme simplicity of diction, and a symbolism so realistic as to be almost bare He allows life itself to astonish us by its strangeness, by its inexplicable elements. Many of his plays are really highly pathetic records of unseen emotion; they are occupied with the spiritual adventures of souls, and the ordinary facts of time and space have no influence upon the movements of the characters. We know not who these orphan princesses, these blind persons, these pale Arthurian knights, these aged guardians of desolate castles, may be; we are not informed whence they come, nor whither they go; there is nothing concrete or circumstantial about them. Their life is intense and consistent, but it is wholly of a spiritual character; they are mysterious with the mystery of the movements of a soul. These characteristics, which make the dramatic work of Maeterlinck so curious and unique, are familiar to most readers in *Pelléas et Mélisande*, but are carried, perhaps, to their farthest intensity in *Aglavaine et Sélysette*, which seems to be written for a phantom stage and to be acted by disembodied spirits. In spite of the violence of his early admirers, and of the fact that the form of his dramas easily lent itself to the cheap ridicule of parodists, the talent of Maeterlinck has hardly met with opposition from the criticism of his time. It has been universally felt that his spirit is one of grave and disinterested attachment to the highest moral beauty, and his seriousness, his serenity and his extreme originality have impressed even those who are bewildered by his diaphanous graces and offended at his nebulous mysticism. While the crude enthusiasm which compared him with Shakespeare has been shown to be ridiculous, the best judges combine with Camille Mauclair when he says: "Maurice Maeterlinck est un homme de génie authentique, un très grand phénomène de puissance mentale à la fin du xix^e siècle." In spite of the shadowy action of Maeterlinck's plays, which indeed require some special conditions and contrivances for their performance, they are frequently produced with remarkable success before audiences who cannot be suspected of mysticism, in most of the countries of Europe. In his philosophical writings Maeterlinck shows himself a disciple of Novalis, of Emerson, of Hello, of the Flemish Catholic mystics, and he evolves from the teachings of those thinkers a system of aesthetics applicable to the theatre as he conceives it. (E. G.)

MAFEKING, a town in the British Bechuanaland division of the Cape, 870 m. N.E. of Cape Town and 492 m. S.S.W. of Bulawayo by rail, and 162 m. in a direct line W. by N. of Johannesburg. (Pop. 1904), 2713. It is built on the open veld, at an elevation of 4194 ft., by the banks of the Upper Molopo, is 9 m. W. of the western frontier of the Transvaal and 15 m. S. of the southern boundary of the Bechuanaland protectorate. The Madibi goldfields are some 10 m. south of the town. Mafeking is thus an important trading and distributing centre for Bechuanaland and the western Transvaal. Here are, too, the chief railway workshops between Kimberley and Bulawayo. The headquarters of the administration for the Bechuanaland protectorate are in the town. The chief buildings are the town-hall, Anglican church, Masonic temple, and hospital.

Mafeking was originally the headquarters of the Barolong tribe of Bechuana and is still their largest station, the native location (pop. 2860) being about a mile distant from the town. It was from Pitsani Pothlugo (or Potlogo), 24 m. north of Mafeking, that Dr Jameson started, on the 29th of December 1895, on his raid into the Transvaal. On the outbreak of the Anglo-Boer war in 1899 Mafeking was invested by a Boer force. Colonel R. S. S. Baden-Powell was in command of the defence, which was stubbornly maintained for 217 days (Oct. 12 to May 17), when a relief column arrived and the Boers dispersed (see TRANSVAAL: *History*). The fate of the town had excited the liveliest sympathy in England, and the exuberant rejoicings in London on the news of its relief led to the coining of the word *mafficking* to describe the behaviour of crowds on occasions of extravagant demonstrations of a national kind. In September 1904 Lord Roberts unveiled at Mafeking an obelisk bearing the names of those who fell in defence of the town.

R. S. S. Baden-Powell's *Sketches in Mafeking and East Africa* (1907) and Lady Sarah Wilson's *South African Memories* (1909) deal largely with the siege of Mafeking.

MAFFEI, FRANCESCO SCIPIONE, MARCHESE DI (1675–1755), Italian archaeologist and man of letters, was born at Verona on the 1st of June 1675. He studied for five years in Parma, at the Jesuit College, and afterwards from 1698 at Rome; and in 1703–1704 he took part as a volunteer in the war of succession, fighting on the Bavarian side at Donauwerth In 1709 he began at Padua along with Apostolo Zeno and Valisnieri the *Giornale dei letterati d'Italia*, a literary periodical which had but a short career; and subsequently an acquaintance with the actor Riccoboni led him to exert himself for the improvement of dramatic art in Italy. His *Merope*, a tragedy, appeared in 1713; *Teatro italiano*, a small collection of works for presentation on the stage, in 1723–1725; and *Le Ceremonie*, an original comedy, in 1728. From 1718 he became specially interested in the archaeology of his native town, and his investigations resulted in the valuable *Verona illustrata* (1731–1732). Maffei afterwards devoted four years to travel in France, England, Holland and Germany. He died at Verona on the 11th of February 1755.

A complete edition of his works appeared at Venice (28 vols., 8vo) in 1790.

MAFIA (MAFFIA), a secret society of Sicily. Its organization and purposes much resemble those of the Camorra (*q.v.*).

Various derivations are found for the name. Some hold it to be a Tuscan synonym for *miseria*; others, a corruption of Fr. *mauvais* (bad). Others connect it with the name of an alleged Arab tribe, Mà-âfir, once settled at Palermo. Giuseppe Pitré asserts that the word is peculiar to western Sicily and that, with its derivatives, it formerly meant, in Il Borgo, a district of Palermo, beauty or excellence. Thus, a handsome woman showily dressed was said "to have *mafia*," or to be *mafiusa*. Often in Palermo the street merchants call *arance-mafiuse* (fine oranges). Thus, Pitré argues, *mafia*, applied to a man to express manly carriage and bravery, would naturally become the title of a society the members of which were all "bravos." A less credible explanation of the term is connected with Mazzini, who is said to have formed a secret society the members of which were called *Mafiusi*, from *Mafia*, a word composed of the initial letters of five Italian words, *Mazzini autorizza furti, incendi, avvelenamenti*, "Mazzini authorizes theft, arson and poisoning." This theory suggests that the word was unknown before 1859 or 1860.

The Mafia, however named, existed long before Mazzini's day. In its crudest form it was co-operative brigandage, blended with the Vendetta (*q.v.*). The more strictly organized Mafia was the result of the disorders consequent upon the expulsion of the king of Naples by Napoleon. When the Bourbon court took refuge in Sicily there were a large number of armed retainers in the service of the Sicilian feudal nobility. Ferdinand IV, at the bidding of England, granted a constitution to the island in 1812, and with the destruction of feudalism most of the feudal troops became brigands. Powerless to suppress them, Ferdinand organized the bandits into a rural *gendarmerie*, and they soon established a reign of terror. The abject poverty of the poorer classes, unable to eke out existence by work in the sulphur mines or on the fields, fostered the growth of two classes of *mafiusi*—the vast majority of the inhabitants who were glad to put themselves as passive members under the protection of the Mafia, while the active members shared in the plunder. The Mafia thus became a loosely organized society under an unwritten code of laws or ethics known as *Omertà*, *i.e.*, manliness (from Sicil. *omu*, Ital. *uomo*, a man), which embodied the rules of the Vendetta. Candidates were admitted after trial by duel, and were sworn to resist law and defeat justice. Like the Camorra, the Mafia was soon powerful in all classes, and even the commander of the royal troops acted in collusion with it. The real home of Mafia was in and around Palermo, where no traveller was safe from robbery and the knife. In an organized form the Mafia survives only in isolated districts. Generally speaking, it is to-day not a compact criminal association but a complex social phenomenon, the consequence of centuries of misgovernment. The Mafiuso is governed by a sentiment akin to arrogance which imposes a special line of conduct upon him. He considers it dishonourable to have recourse to lawful authority to obtain redress for a wrong or a crime committed against him. He therefore hides the identity of the offender from the police, reserving vengeance to himself or to his friends and dependants. This sentiment, still widely diffused among the lower classes of many districts, and not entirely unknown to the upper classes, renders difficult legal proof of culpability for acts of violence, and multiplies sanguinary private reprisals. In September 1892 about 150 Mafiusi were arrested at Catania, but all repressive measures proved useless. The only result was to drive some of the members abroad, with disastrous results to other countries. In October 1890 David Hennessy, chief of police in New Orleans, was murdered. Subsequent legal inquiry proved the crime to be the work of the Mafia, which had been introduced into the United States thirty years before. In May 1890 a band of Italians living in New Orleans had ambushed another gang of their fellow-countrymen belonging to a society called *Stoppaghera*. The severe police measures taken brought the vengeance of the society upon Hennessy. Eleven Italians were indicted on suspicion of being implicated in his murder; but the jury was terrorized and acquitted six. On the 14th of March 1891 a mob led by well-known New Orleans citizens broke into the gaol where nineteen Italians were imprisoned and lynched eleven of them.

See W. Agnew Paton, *Picturesque Sicily* (1898); C. W. Heckethorn, *Secret Societies of all Ages* (1897); Alongi, *La Maffia* (Turin, 1887); Le Faure, *La Maffia* (Paris, 1892).

MAFRA, a town of Portugal, in the district of Lisbon (formerly in the province of Estremadura), near the Atlantic coast and the right bank of the river Lizandro, and 20 m. N.W. of Lisbon. Pop. (1900), 4769. Mafra is remarkable for its monastery, church, and palace, built by John V. in 1717–1732, in consequence of a vow made during a dangerous illness to build a convent for the poorest friary of the kingdom—which proved to be a small Franciscan settlement here. The architects, Johann Friedrich Ludwig of Regensburg, and his son Johann Peter, took the Escurial for their model; but the imitation is less successful than the original, though the cost exceeded £4,000,000. The building is in the form of a parallelogram measuring upwards of 800 ft. from north to south and 700 ft. from east to west, it is said to contain 866 rooms, and to be lighted by no fewer than 5200 windows. The centre is occupied by the church, sumptuously built of marble, and richly adorned with statues and other objects of art. In each of the twin towers there is a chime of 57 bells. Part of the palace, originally designed as barracks, is used as a military academy. Adjoining the palace are fine gardens and a royal model farm.

MAGADHA, an ancient kingdom of India, mentioned in both the *Ramayana* and the *Mahābhārata*. It comprised that portion of Behar lying S. of the Ganges, with its capital at Pataliputra or Patna. As the scene of many incidents in the life of Gautama Buddha, it was a holy land. It was also the seat of the Maurya Empire, founded by Chandragupta, which extended over all India under Asoka; and, later, of the powerful Gupta dynasty.

MAGALDÁN, a town in the northern part of the province of Pangasinan, Luzon, Philippine Islands, about 2 m. from the shore of the Gulf of Lingayen. Pop. (1903), 15,841. In 1903 the adjacent municipality of Mapandan (pop. in 1903, 4198) was annexed to Magaldán. Most of its inhabitants are engaged in rice culture. The principal language is Pangasinan; Ilocano is also spoken.

MAGALLANES (Spanish form of *Magellan*), a territory of southern Chile extending from 47° S. to Cape Horn and including the mainland from the Argentine frontier to the Pacific coast, the islands extending along that coast, the Fuegian archipelago, and the western half of Tierra del Fuego. Area, about 71,127 sq. m.; pop. (1895), 5170. It is one of the most inhospitable regions of the world, being exposed to cold westerly storms for most of the year. The islands are barren, but the mainland is covered with forests, practically inaccessible to exploitation because of the inclement climate and the wet spongy soil. The coast is indented with bays and fjords and affords remarkable scenery. There is little animal life on land, but the coast is frequented by the seal and sea-otter and the sheltered waters by countless sea-fowl. The only permanent settlements are at Punta Arenas, the capital, on the Straits of Magellan, Palomares on Otway Water, Mina Marta on Skyring Water, and Ultima Esperanza (Last Hope) on the east shore of Worsley Sound. All are east of the Andean ranges and partially sheltered from the westerly storms. In this sheltered region there are open plains where sheep are grazed. A few sheep ranges have been established on Tierra del Fuego. Some nomadic tribes of Indians inhabit Tierra del Fuego and the extreme southern end of the mainland, but their numbers are small. Coal has been found in the vicinity of Punta Arenas, and gold occurs.

See *The Voyage of the Adventure and Beagle* (1839).

MAGAZINE, primarily a warehouse for goods or merchandise (Arab. *makhzan*, a storehouse, from *khazana*, to store up). In Morocco *makhzan* (or *maghzen*) has come to be used as the name of the government. The Spaniards adopted the Arabic in the form *magacen*, and the English form comes through the older French *magazin*, modern *magasin*. The meaning of a storehouse or large shop, common in French, is rare in English except in the military use of the term for a building for the storage of explosives and ammunition. It is applied to the chamber of a repeating rifle or machine-gun containing the supply of cartridges. The name as applied to a periodical publication containing articles on various subjects was first used in the *Gentleman's Magazine* (1731), described as "a monthly collection, to treasure up as in a magazine" articles on the subjects with which it was proposed to deal.

MAGDALA (more correctly Makdala), a natural stronghold in the country of the Wollo Gallas, Abyssinia, about 250 m. W. of Jibuti on the Gulf of Aden, in 11° 22′ N., 39° 25′ E. The basaltic plateau of which it consists rises 9110 ft. above the sea. It is about three-quarters of a mile in length by less than half a mile in breadth, and lies more than a thousand feet higher than the neighbouring plain of Arogié. Chosen about 1860 by the emperor Theodore of Abyssinia as his principal stronghold in the south, Magdala owes its celebrity to the fact that, as the place of imprisonment of the English captives, it became the goal of the great English Expedition of 1868. At the time of its capture it contained huts for a population of about three thousand. The whole rock was burned bare by order of the commander of the British force, Sir Robert Napier, who, on being raised to the peerage for his services on this occasion, took the title of Lord Napier of Magdala. The plateau was subsequently refortified by the Abyssinians.

See Clements Markham, *History of the Abyssinian Expedition* (1869); and H. Rassam, *British Mission to Theodore* (1869).

MAGDEBURG, a city of Germany, capital of the Prussian province of Saxony, a fortress of the first rank and one of the principal commercial towns of the German Empire. It lies in a broad and fertile plain, mainly on the left bank of the Elbe, 88 m. S.W. from Berlin and at the junction of main lines to Leipzig, Brunswick, Cassel and Hamburg. Pop. (1885), 159,520; (1890), 202,234; (1905), 240,661. It consists of the town proper, and of the five suburbs of Friedrichstadt, Wilhelmstadt, Neustadt, Sudenburg and Buckau; the last four are separated from the town by the ramparts and glacis, but are all included within the new line of advanced bastions, while Friedrichstadt lies on the right bank of the river. In the Elbe, between the old town and the Friedrichstadt, lies an island whereon stands the citadel; this is united with both banks by bridges. With the exception of the Breite Weg, a handsome thoroughfare running from north to south, the streets of the town proper are narrow and crooked. Along the Elbe, however, extend fine promenades, the Fürstenwall and the Fürsten Ufer. To the south of the inner town is the Friedrich Wilhelms Garten, a beautiful park laid out on the site of the celebrated convent of Berge, which was founded in 968 and suppressed in 1809. By far the most important building in Magdeburg is the cathedral, dedicated to SS Maurice and Catherine, a handsome and massive structure of the 14th century, exhibiting an interesting blending of Romanesque and Gothic architecture. The two fine western towers were completed about 1520. The interior contains the tombs of the emperor Otto the Great and his wife Edith, an English princess, and the fine monument of Archbishop Ernest (d. 1513), executed in 1495 by Peter Vischer of Nuremberg. The Liebfrauenkirche, the oldest church in Magdeburg, is an interesting Romanesque edifice of the 12th and 13th centuries, which was restored in 1890–1891. The chief secular buildings are the town-hall (Rathaus), built in 1691 and enlarged in 1866, the government offices, the palace of justice, the central railway station and the exchange. The Breite Weg and the old market contain numerous fine gable-ended private houses in the style of the Renaissance. In front of the town-hall stands an equestrian statue of Otto the Great, erected about 1290. The modern streets are spacious, and the houses well-built though monotonous. There are two theatres, an agricultural college, an art school, several gymnasia, a commercial and other schools, an observatory, and two fine hospitals. The first place amongst the industries is taken by the ironworks (one being a branch of the Krupp firm, the Grusonwerke, employing about 4000 hands), which produce naval armour and munitions of war. Of almost equal importance are the sugar refineries and chicory factories. Then come establishments for making tobacco, gloves, chocolate, artificial manure, cement, varnish, chemicals and pottery. There are also distilleries and breweries, and factories for the manufacture of cotton and silk goods. Magdeburg is the central market in Germany for sugar and chicory, but trades extensively also in cereals, fruit, vegetables, groceries, cattle, horses, wool, cloth, yarn, leather, coal and books. A new winter harbour, made at a cost of £400,000, facilitates the river traffic along the Elbe. Three million tons of merchandise pass Magdeburg, going upstream, and nearly 1 million tons, going downstream, annually. Magdeburg is the headquarters of the IV. corps of the German army and the seat of the provincial court of appeal and administrative offices, and of a Lutheran consistory.

History.—Magdeburg, which was in existence as a small trading settlement at the beginning of the 9th century, owes its early prosperity chiefly to the emperor Otto the Great, who established a convent here about 937. In 968 it became the seat of an archbishop, who exercised sway over an extensive territory. Although it was burnt down in 1188, Magdeburg became a flourishing commercial town during the 13th century, and was soon an important member of the Hanseatic League. Its bench of jurats (*Schöppenstuhl*) became celebrated, and "Magdeburg law" (*Magdeburger Recht*), securing the administrative independence of municipalities, was adopted in many parts of Germany, Poland and Bohemia. During the middle ages the citizens were almost constantly at variance with the archbishops, and by the end of the 15th century had become nearly independent of them. It should, however, be noted that Magdeburg never became a free city of the Empire. The town embraced the Reformation in 1524, and was thenceforth governed by Protestant titular archbishops (see Bishop). On the refusal of the citizens to accept the "Interim," issued by the emperor Charles V., Magdeburg was besieged by Maurice of Saxony in 1550, and capitulated on favourable terms in November 1551. During the Thirty Years' War it was twice besieged, and suffered terribly. It successfully resisted Wallenstein for seven months in 1629, but was stormed and sacked by Tilly in May 1631. The whole town, with the exception of the cathedral, and about 140 houses, was burned to the ground, and the greater part of its 36,000 inhabitants were butchered without regard to age or sex, but it recovered from this deadly blow with wonderful rapidity. By the peace of Westphalia (1648) the archbishopric was converted into a secular duchy, to fall to Brandenburg on the death of the last administrator, which happened in 1680. In 1806 Magdeburg was taken by the French and annexed to the kingdom of Westphalia, but it was restored to Prussia in 1814, on the downfall of Napoleon. Otto von Guericke (1602–1686), the inventor of the air-pump, was burgomaster of Magdeburg. Count Lazare Carnot died here in exile, and was buried in the cemetery, but his remains were exhumed in 1889 and conveyed to Paris. Luther was at school here, and sang in the streets for bread with other poor choristers.

See W. Kawerau, *Aus Magdeburgs Vergangenheit* (Halle, 1886) O. von Guericke, *Geschichte der Belagerung, Eroberung und Zerstörung von Magdeburg* (Magdeburg, 1887); M. Dittmar, *Beiträge zur Geschichte der Stadt Magdeburg* (Halle, 1885); F. W. Hoffmann, *Geschichte der Stadt Magdeburg* (Magdeburg, 1885–1886); F. Hülsse, *Die Einführung der Reformation in der Stadt Magdeburg* (Magdeburg, 1883); R. Volkholz, *Die Zerstörung Magdeburgs 1631* (Magdeburg, 1892); W. Leinung and R. Stumvoll, *Aus Magdeburgs Sage und Geschichte* (Magdeburg, 1894); and the *Urkundenbuch der Stadt Magdeburg* (1892).

The Archbishopric of Magdeburg was carved out of the bishopric of Halberstadt when it was founded in 968, and its history is largely bound up with that of the city and of the prelates who have ruled the see. The first archbishop was Adalbert, and he and his successors had six or seven suffragan bishops. Several of the archbishops took very prominent parts in German politics. Early in the 15th century their residence was fixed at Halle, and about the same time it became the custom to select them from one of the reigning families of Germany, most often from the house of Brandenburg. The doctrines of the reformers made their appearance in the diocese early in the 16th century, and soon Archbishop Sigismund, a son of Joachim II., elector of Brandenburg, openly avowed his adherence to Lutheranism. After the issue of the edict of restitution by the emperor Ferdinand II. in 1629, there were three rival candidates for the see, and their struggles added to the confusion caused by the Thirty Years' War. By the peace of Prague, however, in 1635, the archbishopric was given to Augustus, prince of Saxe-Weissenfels, who retained it until his death in 1680. In 1773 the area of the see was over 2000 sq. m. It included 29 towns and over 400 villages and contained about 250,000 inhabitants.

See the *Regesta archiepiscopatus magdeburgensis*, edited by G. A. von Mülverstedt (Magdeburg, 1876–1899); and K. Uhlirz, *Geschichte des Erzbistums Magdeburg unter den Kaisern aus sächsischem Hause* (Magdeburg, 1887).

Distinct both from the archbishopric and from the city was the BURGRAVIATE OF MAGDEBURG. The office of burgrave dates from the time of Charlemagne, although its holder was not at first called by this name, and it soon became one of great importance. The burgrave was the king's representative; he was charged with the administration of the royal estates in a given district, and in general with watching the royal interests therein. The burgraviate of Magdeburg was held by several countly families in turn until 1269, when it was purchased by Archbishop Conrad II., who, however, soon sold it. In 1294 it was again united with the archbishopric and the prelates retained it until 1538; then in 1579 Augustus, elector of Saxony, made an arrangement which again gave the office to the archbishops, who held it until the secularization of the see.

The MAGDEBURG CENTURIES (*Magdeburger Zenturien*) is the name given to the first general history of the Christian Church written from a Protestant point of view. It was compiled in Magdeburg, and the history is divided into periods of one hundred years each. It was written in Latin in 1562, its principal author being the reformer Matthias Flacius, who was assisted by other Lutheran theologians. The cost of the undertaking was borne by some of the German Protestant princes. As the *Historia ecclesiae Christi* it was first published at Basel in seven volumes (1559–1574). It deals with the history of the Church down to 1400, and considering the time at which it was written it is a remarkable monument to the scholarship of its authors. The earlier part of it has been translated into German (Jena, 1560–1565).

See E. Schaumkell, *Beitrag zur Entstehungsgeschichte der Magdeburger Zenturien* (Ludwigslust, 1898).

MAGEE, WILLIAM (1766–1831), archbishop of Dublin, was born at Enniskillen, Co. Fermanagh, and educated at Trinity College, Dublin, where he was elected fellow in 1788. He was ordained in 1790. Two sermons, preached in the college chapel in 1798 and 1799, form the basis of his *Discourses on the Scriptural Doctrines of Atonement and Sacrifice* (1801), a polemic against Unitarian theology which was answered by Lant Carpenter. Magee was appointed professor of mathematics and senior fellow of Trinity in 1800, but in 1812 he resigned, and undertook the charge of the livings of Cappagh, Co. Tyrone, and Killeleagh, Co. Down. Next year he became dean of Cork. He was well known as a preacher and promoter of the Irish reformation, and in 1819 he was consecrated bishop of Raphoe. In 1822 the archbishop of Dublin was translated to Armagh, and Magee succeeded him at Dublin. Though in most respects a tolerant man, he steadily opposed the movement for Catholic Emancipation. He died on the 18th of August 1831.

A memoir of his life is included with the *Works of the Most Reverend William Magee, D.D.* (1842), by A. H. Kenney.

MAGEE, WILLIAM CONNOR (1821–1891), Anglican divine, archbishop of York, was born at Cork in 1821. His father was curate of the parish attached to the Protestant cathedral in that city; his grandfather was archbishop of Dublin. Young Magee entered Trinity College, Dublin, with a scholarship at thirteen. He was ordained to the curacy of St Thomas's, Dublin, but, being threatened with consumption, went after two years to Malaga. On his return he took a curacy at Bath, and was speedily appointed to the Octagon Chapel, where his fame both as preacher and platform speaker continued to spread. Some years afterwards he was made prebendary of Wells Cathedral. In 1860 the delicate state of his health caused him to accept the living of Enniskillen. In 1864 he was made dean of Cork and chaplain to the lord lieutenant. Here he manifested those great gifts which ultimately raised him to high office; a powerful grasp of mental, moral and political problems, combined with eloquence of a high order, and illuminated with brilliant flashes of wit. In 1868 the question of the disestablishment of the Irish Church came to the front, and Magee threw himself into the task of its defence with his usual energy and vivacity. The success of his orations caused Disraeli to offer him the bishopric of Peterborough. He justified his appointment by his magnificent speech when the Disestablishment Bill reached the House of Lords in 1869, and then plunged into diocesan and general work in England. He preached three remarkable sermons on Christian Evidence in Norwich Cathedral in 1871. He took up the temperance question, and declared in the House of Lords that he would rather see "England free than England compulsorily sober," an utterance which the extreme advocates of total abstinence misquoted and attacked. He was also a supporter of the movement for abolishing the recitation of the Athanasian Creed in the public services of the Church of England, believing, as he said, that the "presence" of the damnatory clauses, "as they stand and where they stand, is a real peril to the Church and to Christianity itself," and that those clauses "are no essential part" of the creed. The project was laid aside in consequence of the hostility of a large body of the clergy, reinforced by the threat of Dr Pusey and Canon Liddon to abandon their offices if it were carried. Magee took a prominent part in the Ritual controversy, opposing what he conceived to be romanizing excess in ritual, as well as the endeavour of the opposite party to "put down Ritualism," as Disraeli expressed it, by the operation of the civil law. His incisive way of putting things earned for him the title of the "Militant Bishop," but, as he himself remarked in relation to this title, his efforts were ever for peace. Unfortunately for the Church, he was not elevated to the see of York until his energies were exhausted. He died on the 5th of May 1891, about four months after his appointment. Magee's manifold activities, his capability as an administrator, his sound judgment, and his remarkable insight into the ecclesiastical problems of his time, rank him among the most distinguished of English prelates.

See *Life and Letters*, by Canon MacDonnell (2 vols. 1896).

MAGELLAN, FERDINAND (in Sp. FERNANDO MAGALLANES, in Port. FERNÃO DE MAGALHÃES) (*c.* 1480–1521), the first circumnavigator of the globe, was born at Sabrosa in the Villa Real district of the Traz-os-Montes province of Portugal. He was a son of Pedro de Magalhães, and belonged to the fourth order of Portuguese nobility (*fidalgos de cota de armas*). He was brought up as one of the pages of Queen Leonor, consort of King John (João) II "the Perfect." In 1495 he entered the service of Manuel "the Fortunate," John's successor, and in 1504 enlisted as a volunteer for the Indian voyage of the first Portuguese viceroy in the East, Francisco d'Almeida. He sailed on the 25th of March 1505; was wounded at Cannanore on the 16th of March 1506; was then sent with Nuno Vaz Pereira to Sofala to build a Portuguese fortress at that place; returned to India early in 1508; and was again wounded at the battle of Diu on the 3rd of February 1509. At Cochin (Aug. 19, 1509) he joined Diogo Lopes de Sequeira on his famous voyage intended for the Spice Islands, when the Portuguese almost fell victims to Malay treachery at Malacca. In this crisis he fought bravely and skilfully (though it is not true, as often asserted, that he discovered the Malay plot); and before the 10th of October 1510 he had been rewarded for his many services with the rank of captain. He again distinguished himself at the taking of Malacca by Albuquerque (July-Aug., 1511), and was then sent on by the viceroy with Antonio d'Abreu to explore the Spice Islands (Moluccas). Leaving Malacca at the end of December 1511, this squadron sailed along the north of Java, passed between Java and Madura, left Celebes on their left, coasted by the Gunong Api volcano, touched at Bura, and so reached Amboyna and Banda. At the last-named they found such abundance of spices that they came straight back to Malacca without visiting Ternate, as had been intended.

Magellan returned to Portugal in 1512. On the 14th of July of that year he was raised to the rank of *fidalgo escudeiro*; and in 1513 he accompanied a Portuguese expedition against Azamor in Morocco. The city was taken on the 28th–29th of August 1513; but Magellan was subsequently wounded, and lamed for life, in a sortie; he was also accused of trading with the Moors. The accusation was subsequently dropped, but Magellan fell into disfavour with King Manuel, who let him understand that he would have no further employment in his country's service (after the 15th of May 1514). Magellan formally renounced his nationality, and went to offer his services to the court of Spain. He reached Seville on the 20th of October 1517, and thence went to Valladolid to see Charles V. With the help of Juan de Aranda, one of the three chief officials of the India House at Seville, and of other friends, especially Diogo Barbosa, a Portuguese like himself, naturalized as a Spaniard, who had acquired great influence in Seville, and whose daughter he now married, he gained the ear of Charles and of the powerful minister, Juan Rodriguez de Fonseca, bishop of Burgos, the persistent enemy of Columbus, the steady supporter of his great successor. Magellan proposed to reach the Spice Islands of the East Indies by the west; for that purpose he hoped to discover a strait at the extreme south of South America, and is said to have declared himself ready to sail southwards to 75° to realize his project. Ruy Faleiro the astronomer, another Portuguese exile, aided him in the working out of his plan, and he found an invaluable financial ally in Christopher de Haro, a member of a great Antwerp firm, who owed a grudge to the king of Portugal. On the 22nd of March 1518, Magellan and Faleiro, as joint captains-general, signed an agreement with Charles V., by which one-twentieth of the clear profits were to fall to them; further, the government of any lands discovered was vested in them and their heirs, with the title of *Adelantados*. On the 10th of August 1519, the fleet of five vessels, under Magellan's command, left Seville and dropped down the Guadalquivir to S. Lucar de Barrameda, at the mouth of the river, where they remained more than five weeks. On the 20th of September the armada put to sea. Of the vessels which composed it, the "Trinidad" was the flagship, and the "Vittoria" the only one which accomplished the circumnavigation. The crew, officers, volunteers, &c., numbered about 270–280, of whom the names of 268 are preserved; 237 of these received pay; at least 37 were Portuguese, 30 or more Italians (mostly Genoese), 19 French, 1 English, 1 German. Only 31 returned in the "Vittoria"; 4 survivors of the crew of the "Trinidad" reappeared later. Antonio Pigafetta of Vicenza, an Italian gentleman who has left the best history of the voyage, went as a volunteer in Magellan's suite. Faleiro stayed behind, having cast his horoscope and found that the venture would be fatal to him. The fleet was well armed, and the total cost of equipment was 8,751,000 maravedis, or £5032 (equal to over £50,000 in present value). Three-quarters were defrayed by the Spanish Crown, one-quarter by Christopher Haro and his friends. Before starting, Magellan made his will and addressed a memorandum to Charles V., assigning geographical positions connected with the controversy he was intending to settle: viz., the proper drawing of a demarcation-line between the spheres of Spain and Portugal in the East Indies, and the inclusion of the Moluccas within the Spanish sphere.

Steering south-west and calling at Teneriffe (Sept. 26–Oct. 3), Magellan sighted South America at Cape St Augustine, near Pernambuco on the 29th of November; thence he followed the east coast of the New World down to the La Plata estuary, which he examined in the hope of finding a passage at this point (Jan. 11–Feb. 6, 1520). On the 31st of March following, he arrived at Port St Julian (in 49° 20′ S.) where he wintered. Here he crushed a formidable mutiny (April 1-2), and made acquaintance with the natives, whom he called *Patagonians* ("Big Feet"), whose great size and lofty stature are magnified by Pigafetta to gigantic proportions. Leaving Port St Julian on the 24th of August 1520, he discovered on the 21st of October the cape of the Eleven Thousand Virgins, the eastern entrance of the long-sought passage. Through this strait, 360 m. long, often narrow and very tortuous, fringed by snow-clad mountains, he guided his armada for thirty-eight days, weakened by the desertion of one vessel (the "S. Antonio"). On the 21st of November a council of pilots and captains was held to consider the continuation of the voyage, and on the 28th of November the fleet rounded Cabo Deseado, the "desired" western terminus of the strait, variously called by the first discoverers, "Victoria Strait," "Strait of the Patagonians," "of all Saints," "of the Eleven Thousand Virgins," or "of Magellan," now only known by the last of these names. To the south of the passage lay the forbidding land "stark with eternal cold," which from the many fires here observed Magellan named "Tierra del Fuego." The expedition now entered the "Great South Sea," first sighted by Vasco Nuñez de Balboa (*q.v.*), which, from the steady and gentle winds that drove the fleet across the immeasurable expanse, was by Magellan called "Pacific." For ninety-eight days Magellan crossed this sea, almost beyond the grasp of man's mind for vastness (as Maximilian of Transylvania puts it), from Cabo Deseado to the Ladrones. On the whole transit he discovered only two islands, sterile and uninhabited, which he called "St Paul's" (Jan, 24, 1521) and "Shark Island" (Feb. 3). The first of these has been identified with Puka Puka in the Tuamotu Archipelago, the second with Flint Island in the Manihiki group; neither identification seems convincing. For most of these ninety-eight days the explorers had no fresh provisions, little water (and that bad), and putrid biscuit; the ravages of scurvy became terrible. The worst anticipations of Magellan ("he would push on, if they had to eat the leather of the rigging") were realized; ox-hides, sawdust, and rats became coveted food. At last, on the 6th of March 1521, the Ladrones (so named by Magellan from the thievish habits of the natives) came in sight, Guam being probably the first port of call. Here the fleet rested, watered, revictualled and refitted; on the 9th of March they started again westward; and on the 16th of March sighted the southern point of Samar Island in the archipelago, since 1542 called the Philippines, but named by Magellan, its first discoverer, after St Lazarus. On the 7th of April the squadron arrived at Cebu, south-west of Samar, in the heart of the Philippines; here Magellan contracted a close friendship and alliance with the treacherous native sovereign, who professed Christianity the better to please and utilize his Catholic friends. Undertaking an expedition to conquer, for the Catholic faith and the king of Cebu, the neighbouring island of Mactan, Magellan was killed there in a fight with the islanders (April 27, 1521). The king of Cebu after this got into his power several of the leading personages of the squadron, including Juan Serrano, one of the two admirals elected to replace Magellan, and murdered them. The survivors, burning one of the three remaining vessels, left the Philippines, and made their way to the Moluccas (Nov. 6), visiting Borneo on the way (July 9–Sept. 27, 1521). At Tidor a heavy cargo of cloves was taken in; the "Trinidad," becoming leaky, stayed behind with her crew; and the "Vittoria," under Juan Sebastian del Cano, proceeded to Europe alone (Dec. 21, 1521). To double the Cape of Good Hope the "Vittoria" reached between 40° and 41° S. (April 7-16, 1522) and suffered from contrary winds, heavy seas, scurvy and starvation. In the Cape Verde Islands (July 9-15, 1522) thirteen of the crew were detained prisoners by the Portuguese. Only thirty-one men returned with del Cano to Seville in the first vessel that had ever made the tour of the earth. Though Magellan had not quite reached the Spice Islands when he fell at Mactan, his task had then been accomplished. He had already reached and passed the longitude of the Moluccas, where he had already been; the way home from the Philippines by the Indian Ocean and the Cape of Good Hope was perfectly known to the Portuguese, himself included. Magellan's name has never received its due recognition in general history. It ranks with those of Columbus, Marco Polo, and Henry the Navigator. The circumnavigation of the globe is as great an event as the discovery of America. Magellan achieved what Columbus planned—the linking of west Europe with east Asia by direct transit over the western ocean. Had America not intervened, the project of 1492 must have failed; by 1519 European pioneers had formed a more adequate notion of the task and its magnitude.

Magellan's Straits, the Magellanic clouds (not first observed by him), and Magellan's Land—a name long given to Patagonia and that hypothetical southern continent of which Tierra del Fuego was considered only a portion, and now again bestowed by Chile on her territory in the extreme south—preserve the memory of the first circumnavigator. The largest of the oceans has also kept the flattering name given to it by the man who first crossed it.

No record of his exploits was left by Magellan himself; and contemporary accounts are less detailed and consistent than could be wished. The best is that of Antonio Pigafetta, a volunteer in the fleet. It is printed in Ramusio, and exists in four early MS. copies, one in Italian and three in French. The latter was perhaps the original language of this work, which was addressed by Pigafetta, as a knight of Rhodes, to the Frenchman Villiers de l'Isle Adam, grand master of the order of the Hospital of St John. But this view is rejected by J. A. Robertson (see below), who believes the Ambrosian MS. to be the ultimate text. See the *Primo viaggio intorno al mondo*, otherwise the *Navigation et descouvrement de la Indie supérieure faicte par moi Anthoyne Pigapheta, Vincentin, chevallier de Rhodes*, probably published in 1524 (in August of that year Pigafetta obtained leave to print his book in Venice). Of the three French MSS., two are in the Bibliothèque Nationale, Paris (5650 and 24,224 Fr.), the latter is wrongly supposed by Thomassy, followed by Lord Stanley of Alderley, to have been the copy presented by Pigafetta to the regent of France, Marie Louise of Savoy, mother of Francis I. The third French MS., often called the MS. of Nancy, first noticed by Thomassy in 1841, was bought by Sir Thomas Phillipps at Libri's sale, and became MS. Phillipps 16,405. The Italian MS. is in the Ambrosian library at Milan. From this Carlo Amoretti, prefect of the Ambrosiana, published his Italian edition of Pigafetta in 1800; a French translation of this, by Amoretti himself, was issued by H. J. Jansen, 1801. An English version of Pigafetta was made by Richard Eden in his *Decades of the Newe Worlde* (London, 1555). The earliest printed edition, apparently a summary of the Italian MS., was issued in French by Simon de Colines of Paris about 1525. The earliest Italian edition is of 1534 (or 1536).

Other authorities are: (1) The narrative of an unknown Portuguese in Ramusio's *Navigationi et viaggi*; (2) the *Derrotero* or Log-Book in the Seville Archives, supposed to be the work of Francisco Albo, *contramaestre* of Magellan's flagship, the "Trinidad": this consists mainly of nautical observations; (3) the narrative of the so-called Genoese pilot, written in excellent Portuguese, and printed in vol. iv. of the *Collecão de noticias* of the Lisbon Academy; (4) various *informaciones* and other papers in the Seville Archives, especially bearing on the mutiny; (5) the letter of Maximilian of Transylvania, under-secretary to Charles V., to the cardinal of Salzburg; (6) the references in Correa and Herrera, often based on good information, and adding points of interest to other records. Of these (1)–(3), (5), and an instance of (6) are translated in the Hakluyt Society's volume. Magellan's two wills (i) executed at Belem on the 17th of December 1504, on the eve of his departure with Almeida, (ii) executed at Seville on the 24th of August, 1519, just before starting on his voyage round the world, are both of some value for his life.

See also Lord Stanley of Alderley, *The First Voyage round the World by Magellan, translated from . . . Pigafetta, &c.*, Hakluyt Society (London, 1874); Diego de Barros Arana, *Vida e viagems de Fernão de Magalhães*, a trans. of the Spanish life by Fernando de Magalhães Villas Boas (Lisbon, 1881); F. H. H. Guillemard, *Life of Magellan* (London, 1890); *Magellan . . . the original text of the Ambrosian MS.* (of Pigafetta), with English translation, notes, bibliography, &c., by J. A. Robertson (Cleveland, U.S.A., 1906). Before the appearance of this indispensable work, the best edition of Pigafetta had been in vol. iii. part 5 of the *Raccolta di documenti e studi pubblicati nella r. commissione colombiana*, edited by Andrea da Mosto (Rome, Ministry of Public Instruction, 1894). (C. R. B.)

MAGELLANIC CLOUDS (named after Ferdinand Magellan), two cloud-like condensations of stars in the southern constellation of Mensa about 69° S. Dec. and between 5° and 5° 40′ of R. A. They are remarkable in the resemblance of their stars as regards spectra and physical constitution to the stars of the Milky Way, though entirely detached from that object.

MAGENTA, a town of Lombardy, Italy, in the province of Milan, 16 m. by rail W. of Milan city, 364 ft. about sea-level situated in the midst of rice-fields. Pop. (1901), 8012. It manufactures silks and matches, and is famous for the battle (1859) in which the allied French and Piedmontese defeated the Austrians (see ITALIAN WARS). A memorial chapel and a monument were erected on the battle-field in 1862. A crimson-purple aniline dye, discovered about the time of the battle, was given from it the name of "magenta,"

MAGGIORE, LAGO (*Lacus Verbanus* of the Romans; Fr. *Lac Majeur*; Ger. *Langensee*), the most extensive of the lakes that extend along the foot of the Alps in Lombardy, N. Italy. Its area is about 83 sq. m., its length 37 m., its greatest width 5½ m., and its greatest depth 1198 ft., while its surface is 646 ft. about sea-level. It is mainly formed by the Ticino (Tessin) River, flowing in at the north and out at the south end, on its way to join the Po, but on the west the lake receives a very important tributary, the Toce or Tosa River, which flows down through the Val d'Ossola from the mountains around the Simplon Pass. Other important affluents are the Maggia (N.W.) and the Tresa (E.). The upper end of the lake (about 16 sq. m.) is in the Swiss canton of Ticino (Tessin). Locarno, at the northern or Swiss end, is 14 m. by rail S.W. of Bellinzona on the St Gotthard line. There is a railway along the south-eastern shore, from Magadino (10½ m. S.W. of Bellinzona) to Sesto Calende (36½m.), at the southern end of the lake and 20 m. by rail from Novara. The east shore of the lake is reached at Luino by a steam tramway from Ponte Tresa on the lake of Lugano (8 m.), while the direct Simplon line runs along the west shore of the lake for 15½ m. from near Pallanza past Baveno and Stresa to Arona, which is 23 m. by rail from Novara. On the east shore are Luino (Ital. Luvino) and Laveno. On the west shore are (reckoning from N. to S.) Cannobio, Pallanza, Baveno, Stresa and Arona. Opposite (S.E.) Baveno are the famous Borromean Islands, on the largest of which (Isola Bella) are very remarkable gardens (formed about 1617), wherein many tropical plants flourish abundantly, while south-west of Baveno rises the glorious view-point of the Monte Mottarone (4892 ft.) between Lago Maggiore and the northern end of the Lake of Orta. In the morning the *tramontana* wind blows from the north down the lake, while in the afternoon the *inverna*, blowing from the south, prevails. The first steamer was placed on the lake in 1826. (W. A. B. C.)

MAGIC[1] (*i.e.* "art magic"; Lat. *ars magica*), the general term for the practice and power of wonder-working, as depending on the employment of supposed supernatural agencies. Etymologically the Gr. μαγεία meant the science and religion of the *magi*, or priests of Zoroaster, as known among the Greeks; in this sense it was opposed to γοητεία (? necromancy) and φαρμακεία (the use of drugs); but this distinction was not universally recognized, and γοητεία is often used as a synonym of μαγεία There is no general agreement as to the proper definition of "magic," which depends on the view taken of "religion."

I.—Nature of Magic

Theories of Magic.—Existing theories of magic may be classified as *objective* or *subjective*. The objective school regards magic as a thing by itself, entirely distinct from religion, recognizable by certain characteristics, and traceable to a definite psychological origin. Magic, on this view, is a system of savage science based on imaginary laws supposed to operate with the regularity ascribed to natural laws by the science of to-day. If practices prima facie magical form part of the recognized ritual of religion, it is because the older ideas have persisted and at most assumed a veneer of religion. For the subjective school, on the other hand, only those rites are magical which their practitioners qualify with the name of magic; there is no inherent quality which makes a rite magical; practices based on a belief in the law of sympathy may be religious as well as magical; rites may pass from the category of religion to that of magic when public recognition is withdrawn from them.

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[1] For what is often called "magic," but is really trick-performance, see CONJURING.

a. For E. B. Tylor the distinguishing characteristic of magic is its unreality; it is a confused mass of beliefs and practices, and their unity consists in the absence of the ordinary nexus of natural cause and effect. Under the general head of magic he distinguishes (i) a spiritual and (ii) a non-spiritual element. (i) The former is made up of such rites as involve the intervention of spiritual beings, ghosts of the dead, demons or gods; hence, in Tylor's view, this form of magic is merely an inferior branch of religion. (ii) The non-spiritual part, but for which the category of magic would be unnecessary, depends on imagined powers and correspondences in nature; it is merely imperfect reasoning, the mistaking of an ideal connexion for a real one. When the American Indian medicine man draws the picture of a deer on a piece of bark and expects that shooting at it will cause him to kill a real deer the next day, he mistakes a connexion which exists only in the mind of the sorcerer for a real bond independent of the human mind.

b. In J. G. Frazer's view all magic is based on the law of sympathy—*i.e.* the assumption that things act on one another at a distance through a secret link, due either to the fact that there is some similarity between them or to the fact that they have at one time been in contact, or that one has formed part of the other. These two branches of "sympathetic magic" Frazer denominates "homoeopathic magic" and "contagious magic." Homoeopathic or imitative (mimetic) magic may be practised by itself, but contagious magic generally involves the application of the imitative principle. (i) One of the most familiar applications of the former is the belief that an enemy may be destroyed or injured by destroying or injuring an image of him. (ii) Under the head of contagious magic are included such beliefs as that which causes the peasant to anoint the weapon with which he has been injured, which, according to Frazer, is founded on the supposition that the blood on the weapon continues to feel with the blood in the body. (iii) Implicitly Frazer seems to distinguish a third kind of magic; "the rain-charm," he says, "operates partly or wholly through the dead . . . in Halmahera there is a practice of throwing stones on a grave, in order that the ghost may fall into a passion and avenge the disturbance, as he imagines, by sending heavy rain." Here there is no assumption of an invariable course of nature set in motion by magical rites; save that it is coercive and not propitiatory, the practice does not differ from ordinary religious rites.

In his theory of the origin of magic Frazer follows the associationist school. But, as R. R. Marett has pointed out in a criticism of the associationist position, it is proved beyond question that even in the individual mind association by similarity, contiguity or contrast, is but the passive condition, the important element being interest and attention. Frazer assumes that magic has everywhere preceded religion: man tried to control nature by using what he conceived to be immutable laws; failing in this he came to believe in the existence of higher powers whom he could propitiate but not coerce; with this transformation religion appeared on the scene; the priest supplanted the magician, at least in part, and the first blows were struck in the perennial warfare of magic and religion. Frazer recognizes, however, that magical and religious rites are at the present day, and have been in historical times, frequently intermingled; it should be noted that for him religion means propitiation and that he does not recognize the existence of anything beyond magic among the aborigines of Australia. His theory is based on a selection of facts, and not on the whole body of beliefs and rites recognized as magical, among which are many wherein spirits figure. Frazer's position appears to be that such rites are relatively late and may be neglected in framing a definition of magic. It may be perfectly true that the idea of magic has been progressively extended; but belief in transformation is also for Dr Frazer magical; this belief is certainly primitive; yet sympathy will not explain it, as it should if Frazer's theory is correct.

c. L. Marillier distinguished three classes of magic: (i) the magic of the word or act; (ii) the magic of the human being, independent of rite or formula, &c.; (iii) the magic which demands at once a human being of special powers (or in a special state) and the use of certain forms. (i) Under the first head he included such rites as mimetic dances, rain-making, disease-making, and sympathetic magic generally. Some of these rites are conceived to affect the course of nature directly, as by influencing winds or the sun, others do so through the intermediary of a god or spirit, who controls the course of nature, and is himself coerced by man with magical acts and incantations. (ii) Other rites cannot be performed by all and sundry: ceremonial purity, initiation or other conditions may be needed to make the charm effective. (iii) Individuals are found who are invested with magical power (*mana*), whose will rules the universe, whose simple words bring rain or sunshine, and whose presence gives fertility to the fields. Sometimes this power is an attribute of the individual, sometimes it is bound up with the office which he fills. In many cases the magical powers of both men and other objects, animate and inanimate, are put down to the fact that a god resides in them.

d. Hubert and Mauss have made the most complete and systematic study of magic which has yet appeared. They hold that, implicitly at any rate, magic is everywhere distinguished from other systems of social facts; in order to be magical an act or belief must be common to the whole of a society; the acts which the whole of a group does not regard as efficacious are not, for this school of thought, magical: consequently the practices of gamesters, &c., do not come under the head of magic. Magic is essentially traditional; a distinguishing characteristic of primitive thought is that the individual mind is markedly unoriginal; and this feature is as prominent, if not more so, in magic as in technology or any other important element in human life. The correspondence between magic and technology can be traced far; for the gestures of the craftsman are as strictly prescribed as the ritual acts of the magician or priest: but in magic the results of the gestures are not of the same order as the results of the craftsman's movements, and herein lies the distinction between magic and technic. The distinction between magic and religion is to be sought not in the sympathetic character of the former, nor in any supposed necessary sequence of cause and effect, nor yet in its maleficent character. Religion is prescribed, official, an organized cult. Magic is prohibited, secret; at most it is permitted, without being prescribed. Three important laws may be traced in the machinery of magical operations—magical power flows along channels determined by the contiguity, similarity or contrast of the object of the act and the object to be affected; but these laws do not suffice to explain magic: equally insufficient are the demonological theory and the theory of properties inherent in the objects used in magical operations. The underlying idea of magic is dynamical; to this power may be given the name of *mana* (see below), of which sanctity is a special development. This *mana* operates in a *milieu* different from the ordinary material world; distance is no obstacle to contact; wishes are immediately realized; but law reigns in the milieu in question, necessary relations are conceived as existing. The notion of time as it is found in the world of magic is even more alien from European ideas; the notion of sanctity enters into it, but time in magic and religion is qualitative rather than quantitative. The homogeneity of periods of time not depending on their duration, conventional numbers are employed; successive periods of time apparently equal are not so for the primitive consciousness; and both in magic and religion periods are homogeneous by reason of occupying the same position in the calendar.

e. For A. Lehmann magic is the practice of superstitions, and his explanation of magic is purely psychological. Relying mainly on modern spiritualism for his examples, he traces magic back to illusions, prejudices and false precepts due to strained attention. This is ultimately also the view of Hubert and Mauss, who hold that "at the root of magic are states of consciousness which generate illusions; and that these states are not individual but collective and arise from the amalgamation of the ideas of a given person with those current in the society of which he forms a part." The reunion of a group supplies a soil in which illusions flourish readily, and it is important to note that in magic and religion attention is above all necessary for the success of a rite, witness the frequent rule imposing silence; but this concentration of attention is precisely calculated to favour illusions; it is indeed the ordinary condition of successful hypnotism; even in civilized countries collective hallucinations without verbal suggestion are not unknown.

f. R. R. Marett regards religion and magic as two forms of a social phenomenon originally one and indivisible; primitive man had an institution which dealt with the supernatural, and in this institution were the germs of both magic and religion, which were gradually differentiated; magic and religion differ in respectability; religion is always the higher, the accepted cult; but between what is definitely religious and what is definitely magical lies a mass of indeterminate elements, such as "white-magic," which do not attain to the public recognition of religion, nor suffer the condemnation meted out to the indisputably magical. For primitive man the abnormal was the supernormal, and the supernormal was the supernatural, the object of fear; this is especially evident when we consider the case of taboo; it may be regarded as a public scare for which no particular individual is responsible, which becomes traditional along fairly constant lines, growing as it goes. *Mana* was attributed to taboo objects, among which were men in any way abnormal, whether as geniuses or idiots; and such men were expected to exercise their powers for the good of society; hence came into existence the professional medicine man; man originally argued from cause to effect and not vice versa. Priest and magician were originally one; but the former, learning humility in the face of might greater than his own, discarded the spell for the prayer and prostrated himself before a higher power.

Definition of Magic.—To arrive at a definition of magic we may either follow the a priori road mapped out by Frazer and decline to recognize the distinction actually drawn by various societies between magical and religious practices; or we may ask what magic and corresponding terms actually connote. Frazer's method ignores the fact that magic, like religion, is an institution, *i.e.* a product of society, not of any single individual; there is no more reason to suppose that a child reared in isolation would develop any kind of magical practices than that it would invent for itself a religion; but if this is the case, the associationist account of magic cannot be true. It is therefore by an analysis of actually existing practices that we must define and limit the term magic. There is, however, a serious difficulty in the way of determining the attitude of non-European peoples towards religio-magical practices; general terms are things of slow growth; it is therefore prima facie improbable that peoples in the lower stages of culture will have anything corresponding to our terms "religion" and "magic"; moreover, if we are right in assuming the fundamental unity of the two, it is by no means certain that they have even the consciousness of any distinction. Even when this consciousness is present, it by no means follows that the whole of the field is mapped out according to our categories; there will be a large indeterminate area which is neither magical nor religious. This suggests that the consciousness of the educated Occidental, for which the spheres of magic and religion in civilized society are sharply defined and contrasted, should be the ultimate arbiter; but here again we are confronted by a difficulty, for, to the educated man, the characteristic of magic is its unreality, and this does not help us to distinguish primitive magic and religion.

We must, it appears, determine the relation of magic to religion by an analysis of the conceptions of those who believe in both; but in so doing we must consider that, like all other institutions, magic has a history. Even if we go back to the 16th century and take the view of magic then held by the average European, it is still a complex idea. When we ask what the most primitive races now on the earth regard as magic, we are applying to their ideas a touchstone made for a very different age and culture; as well might we ask what their theory of knowledge is. If, however, we reverse the process and ask what elements of primitive institutions correspond most nearly to later conceptions of magic, we can at once say that the forbidden and private arts are the prototypes of the magic of later times. Magic is therefore the practice of maleficent arts which involve the use of religio-magical power, with perhaps a secondary idea of the use of private arts, which are to benefit, not the community as a whole, but a single individual. Religion in the lower stages of culture is essentially the tribal creed which all practise and in which all believe; if therefore an individual has a cult of his own, even if otherwise indistinguishable from a public cult, it is for this very reason on a lower plane, and probably corresponds in a degree to what is later regarded as magic. But our information as to the attitude of the uncivilized towards magico-religious rites in general is seldom sufficiently clear; our terminology is influenced by the prepossession of alien observers whose accounts cannot be assumed to correspond to the native view of the case.

Magico-religious Force.—The mere fact that we cannot draw an exact line between magic and religion suggests that they may have some fundamental feature in common. Both terms have greatly changed their connotation in the course of their existence; *religio* seems to have meant originally *καταδεσμός* (magical spell), and Pliny says that *μαγεία* is a deceptive art compounded of medicine, religion and astrology. Among the Greeks, on the other hand, *μαγεία* occupied a respectable position. More important is the fact that taboo (*q.v.*) is both religious and magical. There is a universal tendency to regard as magical the religions of alien races, as well as national religions which have been superseded; Leland tells us that witchcraft in Italy is known as *la vecchia religione*. An examination of the ideas of primitive peoples shows that there is a widely found notion of a power which manifests itself both in religion and magic. Observers have often been content to describe ceremonies without attempting to penetrate to the fundamental ideas which underlie them; this is particularly the case with magic, and only recently have anthropologists realized that in many primitive societies exists a fairly well-defined idea of magico-religious power, to which the generic name of *mana*, from the Melanesian word, has been given.

a. *Mana* in Melanesia is a force, a being, an action, a quality, or a state; it is transmissible and contagious, and is hence associated with taboo; it may be regarded as material and seen in the form of flames or heard; it is the power which is inherent in certain spirits, among which are included such of the dead as are denominated *tindalos*; it may also be a force inherent in some inanimate object, such as a stone which causes the yams to grow, but it is a spiritual force and does not act mechanically; it is the power of the magician and of the rite; the magic formula is itself *mana*. There seem to be a variety of *manas*, but probably the underlying idea is essentially one, though it does not follow that the Melanesians have arrived at the consciousness of this unity. Hubert and Mauss go even further and regard all force as *mana*; it is a quality added to objects without prejudice to their other qualities, one which supplements without destroying their mechanical action.

b. Similar ideas are found in other areas. (i) The continental Malays have a word *Kramât* (*krm*), which means sacred or magical; in Indo-China the Bahnars use the word *deng*, in Madagascar *hasina* seems to embody in part the same notion. (ii) In Africa the idea is less apparent; perhaps the *ngai* of the Tanganika tribes comes nearest to the notion of *mana*; on the Congo *nkici* has a similar but more restricted sense. (iii) In Australia there are two, or perhaps three, kinds of magical power distinguished by the aborigines; all over the continent we find the maleficent power, *boolya* in West Australia, *arungquiltha* in the central tribes, *koochie* in New South Wales; the central tribes have certain objects termed *churinga*, to which magical power (which we may term *churinga*) is attributed; the power of magicians is held to reside in certain stones, called *atnongara*, and in this we must, provisionally at any rate, see a third kind of magical power: *churinga* is beneficent and seems to originate with the mythical ancestors, whereas *arungquiltha* is of immediate origin, created by means of incantations or acquired by contact with certain objects; the power of the magicians seems to proceed from the ancestors in like manner. (iv) In America these ideas are widely found; the *orenda* of the Hurons has been elaborately described by J. N. B. Hewitt; everything in nature, and particularly all animate objects, have their *orenda*; so have gods and spirits; and natural phenomena are the product of the *orenda* of their spirits. *Orenda* is distinct from the things to which it is attached; the cry of birds, the rustle of the trees, the soughing of the wind, are expressions of their *orenda*; the voice of the magician is *orenda*, so are the prayer and the spell, and in fact all rites; *orenda* is above all the power of the medicine man. Among the Algonquins we find the word *manitu*, among the Sioux *wakanda*, *mahowa*, &c., among the Shoshones *pokunt*; all of which seem to carry, at least in part, the same signification. In Central America, according to Hubert and Mauss, *naual* or *nagual* is the corresponding term. (v) Traces of similar ideas may be found in more advanced nations; the Hindu *brahman* is identified by Hubert and Mauss as the correlative of *mana*, in Greece *φύσις* is possibly the echo of a similar idea; but we are yet far from having adequately fathomed the dynamical theories of pre-scientific days.

Origin of Magic.—The associationist theory of magic sets out with the assumption that primitive man began with general conceptions; he started with certain means at his disposal—the law of sympathy—by which he could, in his own belief, influence the outer world. But it is more probable that he argued from concrete instances and arrived little by little at abstract ideas of magical power.

a. Death and disease are universally regarded by uncivilized people as due to so-called "magic," *i.e.* to non-natural causes. Primitive man was familiar with the wounds and bruises caused by physical means; he would naturally attribute any pain not so caused to the operation of analogous but invisible weapons, and eventually attempt to discover how he himself could apply on his own behalf the forces thus used against him. Similarly he may have asked himself to what causes were to be attributed the superiority of one man over another; he may have decided the problem by referring it to the superior power of the one, and then inquired in what way this power could in individual instances be increased. In fact we may say generally that man probably explained the already existing and happening by reference to the supernormal, and then endeavoured to guide the supernormal for his own benefit, direct or indirect.

b. Ritual, however (the primitive magico-religious plasm), is negative as well as positive. The corpse is uncanny, and man's dread of the corpse may well have been an early development; this dread, become traditional, with accretions of various sorts, crystallized into *taboo*, the magico-religious prohibition. The notion of the uncanny, once arrived at, may have been exploited positively; psychical abnormalities are present among savage races in very different degrees; but if they were developed at an early stage in human history they doubtless suggested the possibility that man might exploit them for the collective advantage. But it by no means follows that beneficent rites were originally regarded as magical; and it should be noted that the initiator of the so-called magician in Australia is often the god of the tribe or nation. The limits of magic or its correlatives in the lower stages of culture are thus far undecided.

c. Magic as it represents itself to the Occidental mind of the present day, and perhaps to the great part of the inhabitants of the world seems to be a thing of gradual growth. (i) In the earlier stages there was probably no animistic feature about magic; it was essentially "the prohibited." (ii) Then with the rise of animistic beliefs and practices came the association of the magician with demons—the spirits of the dead, or of animals, or unattached spirits—upon whose co-operation the powers of the magician are often now held to depend. These spirits were not in the position of gods; such recognition, worship, or cult as they received was often not a social institution, but the work of individuals, liable to fall into desuetude at the death of the individual, if not earlier. (iii) Again, the magical tends to be the less important and eventually the less respectable; therefore ancient cults which are conquered, like the religion of Rome by Christianity, come to be reckoned as within the sphere of magic and witchcraft. (iv) All non-animistic practices tend to become *ipso facto* magical; many ritual prohibitions fall under the head of negative magic. Religion is predominantly animistic, and with the rise of gods magic and religion become antagonistic. Thus rites of a neutral character, such as leechcraft, and perhaps agricultural ceremonies which are not absorbed by religion, tend to acquire the reputation of being magical, as also do all amulets and talismans, and, in fact, everything not directly associated with religion. We therefore arrive at a period when magic is distinguished as *white*, *i.e.* the laudable, or at least permitted form, and *black*, *i.e.* the prohibited form.

Magic and Demonology.—Primitive psychology tends to anthropomorphize and personify; it is in many of its stages inclined to an animistic philosophy. To this is due in part the difficulty of distinguishing magic from religion. In many rites there is no obvious indication that a spirit or personal being is concerned. A portion of the ceremonies in which the spirits of the dead are concerned falls under the head of religion (see ANCESTOR WORSHIP), but in the very name "necromancy" (νεκρός, corpse) lies an implication of magic; and dealings with the departed are viewed in this light in many parts of the world, sometimes concurrently with a cult of ancestors. Side by side with the human souls we find demons (see DEMONOLOGY); but on the whole only a small proportion of the world of spirits is recognized as powerful in magic; others, such as disease-spirits, are objects, not sources, of magical influence. Magic is sometimes made to depend upon the activity of demons and spirits, and it is true that the magician usually if not invariably has a spirit helper, often an animal; but there is no evidence that magical power had ever been confined to those who are thus aided. It is not easy to define the relation of fetishism (*q.v.*) to magic.

Magic and Science.—It is a commonplace that the sciences have developed from non-scientific beginnings; the root of astronomy is to be sought in astrology (*q.v.*), of chemistry in alchemy (*q.v.*), of leechcraft in the practices of the savage magician, who depends for much of his success on suggestion, conscious or unconscious, but also relies on a pharmacopeia of no mean extent. The dynamical theory of magic and religion brings primitive man from one point of view far nearer to the modern man of science than was previously suspected, we may fairly say that the Australians have an idea not unlike that of the transformation and conservation of energy, that this energy they store in accumulators, transmit by means of conductors, and so on. The discovery of these complicated ideas only serves to show how far the present-day peoples in the lower stages of culture have travelled from the primitive man who knew neither magic nor religion. But it is perhaps less in respect of abstract ideas than by its concrete investigations into properties, experiment and otherwise that magic has been the forerunner of science.

Magic and Divination.—Magic is an attempt to influence the course of events, divination (*q.v.*) to foresee them; but divination is frequently regarded as magical. It is certain that a large part of divination is religious, and the knowledge is explained as a message from the gods; but necromancy, the practice of discovering the future by consulting the dead, is in many respects essentially magical. Perhaps the magical character of divination may be in part explained, when we regard it as a group of practices in many varieties of which animism plays no part; for non-animistic ceremonies tend to be regarded as magical (cf. rain-making). Thus, heteroscopic divination seems to involve the idea of what may be termed a return current of magico-religious force; the event is not influenced, but itself determines the issue of the diviner's experiment.

II.—LAWS AND RITUAL OF MAGIC

The practice of magic involves the belief in the operation of certain laws, and demands certain conditions. The number of positive rites is not unlimited; a certain rite tends to become stable and is finally used for all sorts of purposes; and each magician tends to specialize in this respect. Just as there are well-marked schools of magic, and the rain-maker is not the same as the fetish-man, so within the school there are various groups, differentiated not by the purposes at which they aim nor by the powers they claim to possess, but by the ceremonies which they practise. Chief among the laws lying at the base of magical practice is that of sympathy.

Sympathy.—That the law of sympathy is an essential element of magic is admitted equally by the associationist school and by its critics. Under the head of sympathy are embraced the laws of contiguity or contagion, of similarity or homoeopathy, and of contrariety or antipathy.

a. In its simplest form the law of contiguity asserts that whatever has once formed part of a body continues to form part of it or to represent it for magical purposes; thus, by obtaining possession of the parings of a person's nails, or the clippings of his hair, and by working magic upon them, it is held to be possible to produce on the actual human body the effects which are in reality produced on the object of the magical rite. As is clear by the well-known case of the "life index," the current of magical power may pass in either direction; if the life of a man is supposed to be bound up with the life of a tree, so that any injury to the tree reacts on the man, it is equally believed that the death of the man will not fail to be manifest by the state of the tree. In particular this sympathetic relation is predicated of wizards or witches and their animal familiars; it is then known by the name of "repercussion." It is not only upon parts of the body that contagious magic can be worked; anything which has been in contact with the body, such as clothes, anything which has been in part assimilated by the body, such as the remains of food, and even representations of the body or of parts of it such as footprints, &c., may be used as objects of magical rites, in order to transmit to the human being some influence, maleficent or otherwise. The contact demanded may be actual, or mediate, for in Australia it suffices to connect the magician and his patient by a thread in order that the disease may be removed. (i) The use of clothes for magical purposes gives us perhaps the clue to the widespread custom of "rag-trees"; in nearly every part of the world it is the practice to suspend wool or rags to trees associated with some spirit, or, in Christian countries, with some saint, in order to reap a benefit; similarly nails are driven into trees or images; pins are dropped into wells, stones are cast upon cairns, and missiles aimed at various holy objects; but it cannot be assumed that the same explanation lies at the root of the whole group of practices. (ii) This law may perhaps be taken as the explanation of the "couvade"; in many parts of the world relatives, and in particular the father of a new-born child, are compelled to practise various abstinences, in order that the health of the child may not be affected, membership of the same family therefore establishes a sympathetic relation. (iii) In this direct transference of qualities is exemplified another magical process, which may also be referred to the operation of the law of sympathy; it is a world-wide belief that the assimilation of food involves the transference to the eater of the qualities, or of some of them, inherent in the source of the food; a South African warrior, for example, may not eat hedgehog, because the animal is held to be cowardly and the eater would himself become a coward; on the other hand, the flesh of lions is fit meat for brave men, because they at the same time transfer its courage to themselves.

b. The law of homoeopathy takes two forms. (i) The magician may proceed on the assumption that like produces like; he may, for example, take an image of wax or wood, and subject it to heat or other influences under the belief that it represents the human being against whom his malefice is directed, and that without any contact, real or pretended; so that any results produced on the image, which may be replaced by an animal or a portion of one, are equally produced in the human being. There need not even be any resemblance between the representation and the person or thing represented; a pot may serve to represent a village; hence step by step we pass from the representation to the symbol. (ii) The law of homoeopathy also manifests itself in the formula *similia similibus curantur*; the Brahman in India treated dropsy with ablutions, not in order to add to, but to subtract from, the quantity of liquid in the patient's body. So, too, the yellow turmeric was held to be a specific for jaundice.

c. Here we approach the third class of sympathetic rites; it is clear that a remedy produces the contrary, when it cures the like; conversely, like by producing like expels its contrary.

Some statements of the law of sympathy suggest that it is absolute in its application. It is true that the current of magical power is sometimes held to be transmitted along lines indicated by the law of sympathy, without the intervention of any volition, human or otherwise; thus, the crow which carries stray hairs away to weave them into the structure of its nest is nowhere supposed to be engaged in a magical process; but it is commonly held that the person whose hair is thus used will suffer from headache or other maladies; this seems to indicate that the law of sympathy operates mechanically in certain directions, though the belief may also be explained as a secondary growth. In general the operation of these laws is limited in the extreme. For example, the medieval doctrine known as the Law of Signatures asserted that the effects of remedies were correlated to their external qualities; bear's grease is good for baldness, because the bear is a hairy animal. But the transference was held to terminate with the acquisition by the man of this single quality; in some magical books powdered mummy is recommended as a means of prolonging life, but it is simply the age of the remedy which is to benefit the patient; the magician who removes a patient's pains or diseases does not transfer them to himself; the child whose parents eat forbidden foods is held to be affected by their transgression, while they themselves come off unharmed. The magical effects are limited by exclusive attention and abstraction; and this is true not only of the kind of effect produced but also as to the direction in which it is held to be produced.

The Magic of Names.—For primitive peoples the name is as much a part of the person as a limb; consequently the magical use of names is in some of its aspects assimilable to the processes dependent on the law of sympathy. In some cases the name must be withheld from any one who is likely to make a wrong use of it, and in some parts of the world people have secret names which are never used. Elsewhere the name must not be told by the bearer of it, but any other person may communicate it without giving an opening for the magical use of it. Not only human beings but also spirits can be coerced by the use of their names; hence the names of the dead are forbidden, lest the mention of them act as an evocation, unintentional though it be. Even among more advanced nations it has been the practice to conceal the real name of supreme gods; we may probably explain this as due to the fear that an enemy might by the use of them turn the gods away from those to whom they originally belonged. For the same reason ancient Rome had a secret name.

Magical Rites.—The magic of names leads us up to the magic of the spoken word in general. The spell or incantation and the magical act together make up the rite. (*a*) The manual acts are very frequently symbolic or sympathetic in their nature; sometimes they are mere reversals of a religious rite; such is the marching against the sun (known as *widdershins* or *deisul*); sometimes they are purificatory; and magic has its sacrifices just as much as religion. (*b*) There are many types of oral rites; some of the most curious consist in simply reciting the effect intended to be produced, describing the manual act, or, especially in Europe, telling a mythical narrative in which Christ or the apostles figure, and in which they are represented as producing a similar effect to the one desired; in other cases the "origin" of the disease or maleficent being is recited. Oral rites, which are termed spells or incantations, correspond in many cases to the oral rites of religion; they, like the manual rites, are a heterogeneous mass and hardly lend themselves to classification. Some formulae may be termed sympathetic; it suffices to name the result to be produced in order to produce it; but often an incantation is employed, not to produce a result directly, but to coerce a god or other being and compel him to fulfil the magician's will. The language of the incantations often differs from that of daily life; it may be a survival of archaic forms or may be a special creation for magical purposes. In many languages the word used to express the idea of magic means an act, a deed; and it may be assumed that few if any magical ceremonies consist of formulae only; on the other hand, it is certain that no manual act in magic stands absolutely alone without oral rite; if there is no spoken formula, there is at least an unspoken thought. It is in many cases difficult to discover the relative proportions and importance of manual and oral acts. Not only the words but also the tone are of importance in magic; in fact, the tone may be the more important. Rhythm and repetition are no less necessary in oral than in manual acts. (*c*) As preliminaries, more seldom as necessary sequels to the central feature of the rite, manual or oral, we usually find a certain number of accessory observances prescribed, which find their parallel in the sacrificial ritual. For example, it is laid down at what time of year, at what period of the month or week, at what hour of the day a rite must be performed; the waxing or waning of the moon must be noted; and certain days must be avoided altogether. Similarly, certain places may be prescribed for the performance of the ritual; often the altar of the god serves magical purposes also; but elsewhere it is precisely the impure sites which are devoted to magical operations—the cemeteries and the cross roads. The instruments of magic are in like manner often the remains of a sacrifice, or otherwise consecrated by religion; sometimes, especially when they belong to the animal or vegetable world, they must be sought at certain seasons, May Day, St George's Day, Midsummer Day, &c. The magician and his client must undergo rites of preparation, and the exit may be marked by similar ceremonies.

Magicians.—Most peoples know the professional worker of magic, or what is regarded as magic. (*a*) In most if not all societies magic, or certain sorts of it, may be performed by any one, so far as we can see, who has mastered the necessary ritual; in other cases the magician is a specialist who owes his position to an accident of birth (seventh son of a seventh son); to simple inheritance (families of magicians in modern India, rain-makers in New Caledonia); to revelation from the gods or the spirits of the dead (Malays), showing itself in the phenomena of possession; or to initiation by other magicians. (*b*) From a psychical point of view it may probably be said that the initiation of a magician corresponds to the "development" of the modern spiritualistic medium; that is to say, that it resolves itself into exercises and rites which have for their object the creation or evolution of a secondary personality. From this point of view it is important to notice that certain things are forbidden to magicians under pain of loss of their powers; thus, hot tea is taboo to the Arunta medicine man; and if this seems unlikely to cause the secondary personality to disappear, it must be remembered that to the physiological effects, if any, must be added the effects of suggestion. Of this duplication of personality various explanations are given; in Siberia the soul of the *shaman* is said to wander into the other world, and this is a widely spread theory; where the magician is supposed to remain on earth, his soul is again believed to wander, but there is an alternative explanation which gives him two or more bodies. Here we reach a point at which the familiar makes its appearance; this is at times a secondary form of the magician, but more often is a sort of life index or animal helper (see LYCANTHROPY); in fact, the magician's power is sometimes held to depend on the presence—that is, the independence—of his animal auxiliary. Concurrent with this theory is the view that the magician must first enter into a trance before the animal makes its appearance, and this makes it a double of the magician, or, from the psychological point of view, a phase of secondary personality. (*c*) In many parts of the world magical powers are associated with the membership of secret societies, and elsewhere the magicians form a sort of corporation; in Siberia, for example, they are held to be united by a certain tie of kinship; where this is not the case, they are believed, as in Africa at the present day or in medieval Europe, to hold assemblies, so-called witches' Sabbaths; in Europe the meetings of heretics seem to be responsible for the prominence of the idea if not for its origin (see WITCHCRAFT). The magician is often regarded as possessed (see POSSESSION) either by an animal or by a human or super-human spirit. The relations of priest and magician are for various reasons complex; where the initiation of the magician is regarded as the work of the gods, the magician is for obvious reasons likely to develop into a priest, but he may at the same time remain a magician; where a religion has been superseded, the priests of the old cult are, for those who supersede them, one and all magicians; in the medieval church, priests were regarded as especially exposed to the assaults of demons, and were consequently often charged with working magic. The great magicians who are gods rather than men—*e.g.* kings of Fire and Water in Cambodia—enjoy a reverence and receive a cult which separates them from the common herd, and assimilates them to priests rather than to magicians. The function of the so-called magician is often said to be beneficent; in Africa the witch-doctor's business is to counteract evil magic; in Australia the magician has to protect his own tribe against the assaults of hostile magicians of other tribes; and in Europe "white magic" is the correlative of this beneficent power; but it may be questioned how far the beneficent virtue is regarded as magical outside Europe.

Talismans and Amulets.—Inanimate objects as well as living beings are credited with stores of magical force; when they are regarded as bringing good, *i.e.* are positive in their action, they may be termed "talismans"; "amulets" are protective or negative in their action, and their function is to avert evil; a single object may serve both purposes. Broadly speaking, the fetish, whose "magical" properties are due to association with a spirit, tends to become a talisman or amulet. The "medicine" of the Red Indian, originally carried as means of union between him and his *manito*, is perhaps the prototype of many European charms. In other cases it is some specific quality of the object or animal which is desired; the boar's tusk is worn on the Papuan Gulf as a means of imparting courage to the wearer; the Lukungen Indians of Vancouver Island rub the ashes of wasps on the faces of their warriors, in order that they may be pugnacious. Some Bechuanas wear a ferret as a charm, in the belief that it will make them difficult to kill, the animal being very tenacious of life. Among amulets may be mentioned horns and crescents, eyes or their representations, and grotesque figures, all of which are supposed to be powerful against the Evil Eye (*q.v.*).

Tylor has shown that the brass objects so often seen on harness were originally amuletic in purpose, and can be traced back to Roman times. Some amulets are supposed to protect from the evil eye simply by attracting the glance from the wearer to themselves, but, as a rule, magical power is ascribed to them.

Evil Magic.—The object of "black" magic is to inflict injury, disease, or death on an enemy, and the various methods employed illustrate the general principles dealt with above and emphasize the conclusion that magic is not simply a matter of sympathetic rites, but involves a conception of magical force. (*a*) It has been mentioned that contagious magic makes use of portions of a person's body; the Cherokee magician follows his victim till he spits on the ground; collecting the spittle mingled with dust on the end of a stick, the magician puts it into a tube made of a poisonous plant together with seven earth worms, beaten into a paste, and splinters of a tree blasted by lightning; the whole is buried with seven yellow stones at the foot of a tree struck by lightning, and a fire is built over the spot; the magician fasts till the ceremony is over. Probably the worms are supposed to feed on the victim's soul, which is said to become "blue" when the charm works; the yellow stones are the emblem of trouble, and lightning-struck trees are reputed powerful n magic. If the charm does not work, the victim survives the critical seven days, and the magician and his employer are themselves n danger, for a charm gone wrong returns upon the head of him who sent it forth. (*b*) In homoeopathic magic the victim is represented by an image or other object. In the Malay Peninsula the magician makes an image like a corpse, a footstep long. "If you want to cause sickness, you pierce the eye and blindness results; or you pierce the waist and the stomach gets sick. If you want to cause death, you transfix the head with a palm twig; then you enshroud the image as you would a corpse and you pray over it as if you were praying over the dead; then you bury it in the middle of the path which leads o the place of the person whom you wish to charm, so that he may step over it." Sometimes the wizard repeats a form of words signifying that not he but the Archangel Gabriel is burying the victim; sometimes he exclaims, "It is not wax I slay but the liver, heart and spleen of So-and-so." Finally, the image is buried in front of the victim's doors. (*c*) Very widespread is the idea that a magician can influence his victim by charming a bone, stick or other object, and then projecting the magical influence from it. It is perhaps he commonest form of evil magic in Australia; in the Arunta tribe a man desirous of using one of these pointing sticks or bones goes away by himself into the bush, puts the bone on the ground and crouches over it, muttering a charm: "May your heart be rent asunder." After a time he brings the *irna* back to the camp and hides it; then one evening after dark he takes it and creeps near enough to see the features of his victim; he stoops down with the *rna* in his hand and repeatedly jerks it over his shoulder, muttering curses all the time. The evil magic, *arungquiltha*, is said to go straight to the victim, who sickens and dies without apparent cause, unless some medicine-man can discover what is wrong and save him by removing the evil magic. The *irna* is concealed after the ceremony, for the magician would at once be killed if it were known that he had used it. (*d*) Magicians are often said to be able to assume animal form or to have an animal familiar. They are said to suck he victim's blood or send a messenger to do so; sometimes they are aid to steal his soul, thus causing sickness and eventually death. These beliefs bring the magician into close relation with the werwolf see Lycanthropy).

Rain-making.—In the lower stages of culture rain-making assumes ather the appearance of a religious ceremony, and even in higher tages the magical character is by no means invariably felt. It will, however, be well to notice some of the methods here. (*a*) Among he Dieri of Central Australia the whole tribe takes part in the eremony; a hole is dug, and over this a hut is built, large enough for he old men; the women are called to look at it and then retire some ive hundred yards. Two wizards have their arms bound at the houlder, the old men huddle in the hut, and the principal wizard bleeds the two men selected by cutting them inside the arm below he elbow. The blood is made to flow on the old men, and the two men throw handfuls of down into the air. The blood symbolizes he rain; the down is the clouds. Then two large stones are placed n the middle of the hut; these two represent gathering clouds. The women are again summoned, and then the stones are placed high n a tree; other men pound gypsum and throw it into a water-hole; he ancestral spirits are supposed to see this and to send rain. Then he hut is knocked down, the men butting at it with their heads; this ymbolizes the breaking of the clouds, and the fall of the hut is the ain. If no rain comes they say that another tribe has stopped their ower or that the *Mura-mura* (ancestors) are angry with them. b) Rain-making ceremonies are far from uncommon in Europe. ometimes water is poured on a stone; a row of stepping-stones runs nto one of the tarns on Snowdon, and it is said that water thrown upon the last one will cause rain to fall before night. Sometimes the mages of saints are carried to a river or a fountain and ducked or prinkled with water in the belief that rain will follow; sometimes ain is said to ensue when the water of certain springs is troubled; perhaps the idea is that the rain-god is disturbed in his haunts. But perhaps the commonest method is to duck or drench a human figure or puppet, who represents in many instances the vegetation demon. The gipsies of Transylvania celebrate the festival of "Green George" at Easter or on St George's Day; a boy dressed up in leaves and blossoms is the principal figure; he throws grass to the cattle of the tribe, and after various other ceremonies a pretence is made of throwing him into the water; but in fact only a puppet is ducked in the stream.

Negative Magic.—There is also a negative side to magic, which, together with ritual prohibitions of a religious nature, is often embraced under the name of taboo (*q.v.*); this extension of meaning is not justified, for taboo is only concerned with sacred things, and the mark of it is that its violation causes the taboo to be transmitted. All taboos are ritual prohibitions, but all ritual prohibitions are not taboos; they include also (*a*) interdictions of which the sanction is the wrath of a god; these may be termed religious interdictions; (*b*) interdictions, the violation of which will automatically cause some undesired magico-religious effect; to these the term negative magic should be restricted, and they might conveniently be called "bans"; they correspond in the main to positive rites and are largely based on the same principles.

(*a*) Certain prohibitions, such as those imposed on totem kins, seem to occupy an intermediate place; they depend on the sanctity of the totem animal without being taboos in the strict sense; to them no positive magical rites correspond, for the totemic prohibition is clearly religious, not magical.

(*b*) Among cases of negative magic may be mentioned (i.) the couvade, and prohibitions observed by parents and relatives generally; this is most common in the case of young children, but a sympathetic relation is held to exist in other cases also. In Madagascar a son may not eat fallen bananas, for the result would be to cause the death of his own father; the sympathy between father and son establishes a sympathy between the father and objects touched or eaten by the son, and, in addition, the fall of the bananas is equated with the death of a human being. Again, the wife of a Malagasy warrior may not be faithless to him when he is absent; if she is, he will be killed or wounded. Ownership, too, may create a sympathetic relation of this kind, for it is believed in parts of Europe that if a man kills a swallow his cows will give bloody milk. In some cases it is even harder to see how the sympathetic bond is established; some Indians of Brazil always hamstring animals before bringing them home, in the belief that by so doing they make it easier for themselves and their children to run down their enemies, who are then magically deprived of the use of their legs. These are all examples of negative magic with regard to persons, but things may be equally affected; thus in Borneo men who search for camphor abstain from washing their plates for fear the camphor, which is found crystallized in the crevices of trees, should dissolve and disappear. (ii.) Rules which regulate diet exist not only for the benefit of others but also for that of the eater. Some animals, such as the hare, are forbidden, just as others, like the lion, are prescribed; the one produces cowardice, while the other makes a man's heart bold. (iii.) Words may not be used; Scottish fishermen will not mention the pig at sea; the real names of certain animals, like the bear, may not be used; the names of the dead may not be mentioned; a sacred language must be used, *e.g.* camphor language in the Malay peninsula, or only words of good omen (cf. Gr. εὐφημεῖτε); or absolute silence must be preserved. Personal names are concealed; a man may not mention the names of certain relatives, &c. There are customs of avoidance not only as to (iv.) the names of relatives, but as to the persons themselves; the mother-in-law must avoid the son-in-law, and vice versa; sometimes they may converse at a distance, or in low tones, sometimes not at all, and sometimes they may not even meet. (v.) In addition to these few classes selected at random, we have prohibitions relating to numbers (cf. unlucky thirteen, which is, however, of recent date), the calendar (Friday as an unlucky day, May as an unlucky month for marriage), places, persons, orientation, &c; but it is impossible to enumerate even the main classes. The individual origin of such beliefs, which with us form the superstitions of daily life but in a savage or semi-civilized community play a large part in regulating conduct, is often shrouded in darkness; the meaning of the positive rite is easily forgotten; the negative rite persists, but it is observed merely to avoid some unknown misfortune. Sometimes we can, however, guess at the meaning of our civilized notions of ill luck; it is perhaps as a survival of the savage belief that stepping over a person is injurious to him that many people regard going under a ladder as unlucky; in the one case the luck is taken away by the person stepping over, in the other left behind by the person passing under.

History of Magic.—The subject is too vast and our data are too slight to make a general sketch of magic possible. Our knowledge of Assyrian magic, for example, hardly extends beyond the rites of exorcism; the magic of Africa is most inadequately known, and only in recent years have we well-analysed repertories of magical rituals from any part of the world. For certain departments of ancient magic, however, like the Pythagorean philosophy, there is no lack of illustrative material; it depended on mystical speculations based on numbers or analogous principles. The importance of numbers is recognized in the magic of America and other areas, but the science of the Mediterranean area, combined with the art of writing, was needed to develop such mystical ideas to their full extent. Among the neo-Platonists there was a strong tendency to magical speculation, and they sought to impress into their service the demons with which they peopled the universe. Alexandria was the home of many systems of theurgic magic, and gnostic gems afford evidence of the nature of their symbols. In the middle ages the respectable branches of magic, such as astrology and alchemy, included much of the real science of the period; the rise of Christianity introduced a new element, for the Church regarded all the religions of the heathen as dealings with demons and therefore magical (see WITCHCRAFT). In our own day the occult sciences still find devotees among the educated; certain elements have acquired a new interest, in so far as they are the subject matter of psychical research (*q.v.*) and spiritualism (*q.v.*). But it is only among what are regarded as the lower classes, and in England especially the rural population, that belief in its efficacy still prevails to any large extent.

Psychology of Magic.—The same causes which operated to produce a belief in witchcraft (*q.v.*) aided the creed of magic in general. Fortuitous coincidences attract attention; the failures are disregarded or explained away. Probably the magician is never wholly an impostor, and frequently has a whole-hearted belief in himself; in this connexion may be noted the fact that juggling tricks have in all ages been passed off as magical; the name of "conjuring" (*q.v.*) survives in our own day, though the conjurer no longer claims that his mysterious results are produced by demons. It is interesting to note that magical leechcraft depended for its success on the power of suggestion (*q.v.*), which is to-day a recognized element in medicine; perhaps other elements may have been instrumental in producing a cure, for there are cases on record in which European patients have been cured by the apparently meaningless performances of medicine-men, but an adequate study of savage medicine is still a desideratum.

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(N. W. T.)

MAGIC SQUARE, a square divided into equal squares, like a chess-board, in each of which is placed one of a series of consecutive numbers from 1 up to the square of the number of cells in a side, in such a manner that the sum of the numbers in each row or column and in each diagonal is constant.

From a very early period these squares engaged the attention of mathematicians, especially such as possessed a love of the marvellous, or sought to win for themselves a superstitious regard. They were then supposed to possess magical properties, and were worn, as in India at the present day, engraven in metal or stone, as amulets or talismans. According to the old astrologers, relations subsisted between these squares and the planets. In later times such squares ranked only as mathematical curiosities; till at last their mode of construction was systematically investigated. The earliest known writer on the subject was Emanuel Moscopulus, a Greek (4th or 5th century). Bernard Frenicle de Bessy constructed magic squares such that if one or more of the encircling bands of numbers be taken away the remaining central squares are still magical. Subsequently Poignard constructed squares with numbers in arithmetical progression, having the magical summations. The later researches of Phillipe de la Hire, recorded in the *Mémoires de l'Académie Royale* in 1705, are interesting as giving general methods of construction. He has there collected the results of the labours of earlier pioneers; but the subject has now been fully systematized, and extended to cubes.

200	217	232	249	8	25	40	57	72	89	104	121	136	153	168	185
58	39	26	7	250	231	218	199	186	167	154	135	122	103	90	71
198	219	230	251	6	27	38	59	70	91	102	123	134	155	166	187
60	37	28	5	252	229	220	197	188	165	156	133	124	101	92	69
201	216	233	248	9	24	41	56	73	88	105	120	137	152	169	184
55	42	23	10	247	234	215	202	183	170	151	138	119	106	87	74
203	214	235	246	11	22	43	54	75	86	107	118	139	150	171	182
53	44	21	12	245	236	213	204	181	172	149	140	117	108	85	76
205	212	237	244	13	20	45	52	77	84	109	116	141	148	173	180
51	46	19	14	243	238	211	206	179	174	147	142	115	110	83	78
207	210	239	242	15	18	47	50	79	82	111	114	143	146	175	178
49	48	17	16	241	240	209	208	177	176	145	144	113	112	81	80
196	221	228	253	4	29	36	61	68	93	100	125	132	157	164	189
62	35	30	3	254	227	222	195	190	163	158	131	126	99	94	67
194	223	226	255	2	31	34	63	66	95	98	127	130	159	162	191
64	33	32	1	256	225	224	193	192	161	160	129	128	97	96	65

FIG. 1

Two interesting magical arrangements are said to have been given by Benjamin Franklin; these have been termed the "magic square of squares" and the "magic circle of circles." The first (fig. 1) is a square divided into 256 squares, *i.e.* 16 squares along a side, in which are placed the numbers from 1 to 256. The chief properties of this square are (1) the sum of the 16 numbers in any row or column is 2056; (2) the sum of the 8 numbers in half of any row or column is 1028, *i.e.* one half of 2056; (3) the sum of the numbers in two half-diagonals equals 2056; (4) the sum of the four corner numbers of the great square and the four central numbers equals 1028; (5) the sum of the numbers in any 16 cells of the large square which themselves are disposed in a square is 2056. This square has other curious

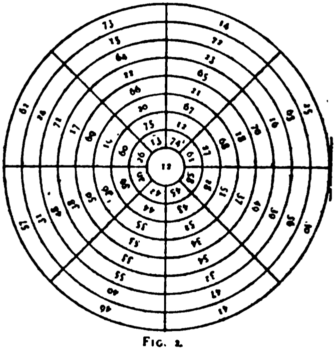

FIG. 2.

properties. The "magic circle of circles" (fig. 2) consists of eight annular rings and a central circle, each ring being divided into eight cells by radii drawn from the centre; there are therefore 65 cells. The number 12 is placed in the centre, and the consecutive numbers 13 to 75 are placed in the other cells. The properties of this figure include the following: (1) the sum of the eight numbers in any ring together with the central number 12 is 360, the number of degrees in a circle; (2) the sum of the eight numbers in any set of radial cells together with the central number is 360; (3) the sum of the numbers in any four adjoining cells, either annular, radial, or both radial and two annular, together with half the central number, is 180.

Construction of Magic Squares.—A square of 5 (fig. 3) has adjoining it one of the eight equal squares by which any square may be conceived to be surrounded, each of which has two sides resting on adjoining squares, while four have sides resting on the surrounded square, and four meet it only at its four angles. 1, 2, 3 are placed along the path of a knight in chess; 4, along the same path, would fall in a cell of the outer square, and is placed instead in the corresponding cell of the original square; 5 then falls within the square. *a*, *b*, *c*, *d* are placed diagonally in the square; but *e* enters the outer square, and is removed thence to the same cell of the square it had left. *α*, *β*, *γ*, *δ*, *ε* pursue another regular course; and the diagram shows how that course is recorded in the square they have twice left. Whichever of the eight surrounding squares may be entered, the corresponding cell of the central square is taken instead. The 1, 2, 3, ..., *a*, *b*, *c*, ..., *α*, *β*, *γ*, ... are said to lie in "paths."

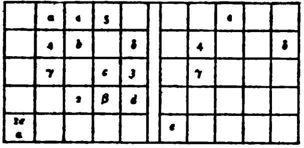

FIG. 3.

Squares whose Roots are Odd.—Figs 4, 5, and 6 exhibit one of the earliest methods of constructing magic squares. Here the 3's in fig. 4 and 2's in fig. 5 are placed in opposite diagonals to secure the two diagonal summations; then each number in fig. 5 is multiplied by 5 and added to that in the corresponding square in fig. 4, which gives the square of fig. 6. Figs. 7, 8 and 9 give De la Hire's method; the squares of figs. 7 and 8, being combined, give the magic square of fig. 9. C. G. Bachet arranged the numbers as in fig. 10, where there are three numbers in each of four surrounding squares; these being placed in the corresponding cells of the central square, the square of fig. 11 is formed. He also constructed squares such that if one or more outer bands of numbers are removed the remaining central squares are magical. His method of forming them may be understood from a square of 5. Here each summation is 5×13; if therefore 13 is subtracted from each number, the summations will be zero, and the twenty-five cells will contain the series ± 1, ± 2, ± 3, ... ± 12, the odd cell having 0. The central square of 3 is formed with four of the twelve numbers with + and − signs and zero in the middle; the band is filled up with the rest, as in fig. 12; then, 13 being added in each cell, the magic square of fig. 13 is obtained

1	4	2	5	3
4	2	5	3	1
2	5	3	1	4
5	3	1	4	2
3	1	4	2	5

FIG 4.

2	4	0	3	1
1	2	4	0	3
3	1	2	4	0
0	3	1	2	4
4	0	3	1	2

FIG. 5.

11	24	2	20	8
9	12	25	3	16
17	10	13	21	4
5	18	6	14	22
23	1	19	7	15

FIG. 6.

2	1	5	3	4
3	4	2	1	5
1	5	3	4	2
4	2	1	5	3
5	3	4	2	1

FIG. 7.

15	5	0	20	10
0	20	10	15	5
10	15	5	0	20
5	0	20	10	15
20	10	15	5	0

FIG. 8.

17	6	5	23	14
3	24	12	16	10
11	20	8	4	22
9	2	21	15	18
25	13	19	7	1

FIG. 9.

Squares whose Roots are Even.—These were constructed in various ways, similar to that of 4 in figs. 14, 15 and 16. The numbers in fig. 15 being multiplied by 4, and the squares of figs. 14 and 15 being superimposed, give fig. 16. The application of this method to squares the half of whose roots are odd requires a complicated adjustment. Squares whose half root is a multiple of 4, and in which there are summations along all the diagonal paths, may be formed, by observing, as when the root is 4, that the series 1 to 16 may be changed into the series 15, 13, ... 3, 1, −1, −3, ... −13, −15, by multiplying each number by 2 and subtracting 17; and, vice versa, by adding 17 to each of the latter, and dividing by 2. The diagonal summations of a square, filled as in fig. 17, make zero; and, to obtain the same in the rows and columns, we must assign such values to the *p*'s and *q*'s as satisfy the equations $p_1+p_2+a_1+a_2=0$, $p_3+p_4+a_3+a_4=0$, $p_1+p_3-a_1-a_3=0$, and $p_2+p_4-a_2-a_4=0$,—a solution of which is readily obtained by inspection, as in fig. 18; this leads to the square, fig. 19. When the root is 8, the upper four subsidiary rows may at once be written, as in fig, 20; then, if 65 be added to each, and the sums halved, the square is completed. In such squares as these, the two opposite squares about the same diagonal (except that of 4) may be turned through any number of right angles, in the same direction, without altering the summations.

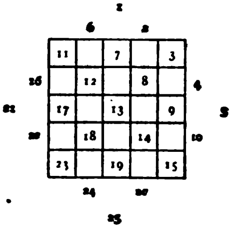

FIG. 10.

11	24	7	20	3
4	12	25	8	16
17	5	13	21	9
10	18	1	14	22
23	6	19	2	15

FIG. 11.

-9	12	5	-2	-6
1	7	-11	4	-1
-8	-3	0	3	8
10	-4	11	-7	-10
6	-12	-5	2	9

FIG. 12.

4	25	18	11	7
14	20	2	17	12
5	10	13	16	21
23	9	24	6	3
19	1	8	15	22

FIG. 13.

1	3	2	4
4	2	3	1
4	2	3	1
1	3	2	4

FIG. 14.

0	3	3	0
2	1	1	2
1	2	2	1
3	0	0	3

FIG. 15.

1	15	14	4
12	6	7	9
8	10	11	5
13	3	2	16

FIG. 16.

p_1	p_2	a_1	a_2
p_3	p_4	a_3	a_4
a_1	$-a_2$	$-p_1$	$-p_2$
a_3	$-a_4$	$-p_3$	$-p_4$

FIG. 17

1	-3	11	-9
5	7	-15	13
11	9	-1	3
15	-13	5	7

FIG. 18.

9	7	14	4
6	12	1	15
3	13	8	10
16	2	11	5

FIG. 19.

-1	3	5	-7	-33	35	37	-39
9	-11	-13	15	41	-43	-45	47
17	-19	-21	23	49	-51	-53	55
-25	27	29	-31	-57	59	61	-63

FIG. 20.

Nasik Squares.—Squares that have many more summations than in rows, columns and diagonals were investigated by A. H. Frost (*Cambridge Math. Jour.*, 1857), and called Nasik squares, from the town in India where he resided; and he extended the method to cubes, various sections of which have the same singular properties. In order to understand their construction it will be necessary to consider carefully fig. 21, which shows that when the root is a prime, and not composite, number, as 7, eight letters *a*, *b*, ... *h* may proceed from any, the same, cell, suppose that marked 0, each letter being repeated in the cells along different paths. These eight paths are called "normal paths," their number being one more than the root. Observe here that, excepting the cells from which any two letters start, they do not occupy again the same cell, and that two letters, starting from any two different cells along different paths, will appear together in one and only one cell. Hence, if p_1 be placed in the cells of one of the $n+1$ normal paths, each of the remaining n normal paths will contain one, and only one, of these p_1's. If now we fill each row with p_2, p_3, ... p_n in the same order, commencing from the p_1 in that row, the p_2's, p_3's and p_n's will lie each in a path similar to that of p_1, and each of the n normal paths will contain one, and only one, of the letters p_1, p_2, ... p_n, whose sum will be Σp. Similarly, if q_1 be placed along any of the normal paths, different from that of the p's, and each row filled as above with the letters q_2, q_3, ... q_n, the sum of the q's along any normal path different from that of the q_1 will be Σq. The n^2 cells of the square will now be found to contain all the combinations of the p's and q's; and if the q's be multiplied by n, the p's made equal to 1, 2, ... n, and the q's to 0, 1, 2, ... $(n-1)$ in any order, the Nasik square of n will be obtained, and the summations along all the normal paths, except those traversed by the p's and q's, will be the constant $\Sigma nq + \Sigma p$. When the root is an odd composite number, as 9, 15, &c., it will be found that in some paths, different from the two along which the p_1 and q_1 were placed, instead of having each of the p's and q's, some will be wanting, while some are repeated. Thus, in the case of 9, the triplets, $p_1p_4p_7$, $p_2p_5p_8$, $p_3p_6p_9$, and $q_1q_4q_7$, $q_2q_5q_8$, $q_3q_6q_9$ occur, each triplet thrice, along paths whose summation should be—Σp 45 and Σr 36. But if we make p_1, p_2, ... p_9, = 1, 3, 6, 5, 4, 7, 9, 8, 2, and the r_1, r_2, ... r_9 = 0, 2, 5, 4, 3, 6, 8, 7, 1, thrice each of the above sets of triplets will equal Σp and q respectively. If now the q's are multiplied by 9, and added to the p's in their several cells, we shall have a Nasik square, with a constant summation along eight of its ten normal paths. In fig. 22 the numbers are in the nonary scale; that in the centre is the middle one of 1 to 9^2, and the sum of pair of numbers equidistant from and opposite to the central 45 is twice 45; and the sum of any number and the 8 numbers 3 from it, diagonally, and in its row and column, is the constant Nasical summation, *e.g.* 72 and 32, 22, 76, 77, 26, 37, 36, 27. The numbers in fig. 22 being kept in the nonary scale, it is not necessary to add any nine of them together in order to test the Nasical summation; for, taking the first column, the figures in the place of units are seen at once to form the series, 1, 2, 3, ... 9, and those in the other place three triplets of 6, 1, 5. For the squares of 15 the p's and q's may be respectively 1, 2, 10, 8, 6, 14, 15, 11, 4, 13, 9, 7, 3, 12, 5, and 0, 1, 9, 7, 5, 13, 14, 10, 3, 12, 8, 6, 2, 11, 4, where five times the sum of every third number and three times the sum of every fifth number makes Σp and Σq; then, if the q's are multiplied by 15, and added to the p's, the Nasik square of 15 is obtained. When the root is the multiple of 4, the same process gives us, for the square of 4, fig. 23. Here the columns give Σp, but alternately $2q_1$, $2q_3$, and $2q_2$, $2q_4$; and the rows give Σq, but alternately $2p_1$, $2p_3$, and $2p_2$, $2p_4$; the diagonals giving Σp and Σq. If p_1, p_2, p_3, p_4 and q_1, q_2, q_3, q_4 be 1, 2, 4, 3, and 0, 1, 3, 2, we have the Nasik square of fig. 24. A square like this is engraved in the Sanskrit character on the gate of the fort of Gwalior, in India. The squares of higher multiples of 4 are readily obtained by a similar adjustment.

a	*g*	*f*	*e*	*d*	*c*	*b*
a	*d*	*g*	*c*	*f*	*b*	*e*
a	*c*	*e*	*g*	*b*	*d*	*f*
a	*f*	*d*	*b*	*g*	*e*	*c*
a	*e*	*b*	*f*	*c*	*g*	*d*
a	*b*	*c*	*d*	*e*	*f*	*g*
O	*h*	*h*	*h*	*h*	*h*	*h*

FIG. 21.

63	88	74	13	8	24	53	48	34
11	9	25	51	49	35	61	89	75
52	47	36	62	87	76	12	7	26
68	84	73	18	4	23	58	44	33
19	5	21	59	45	31	69	85	71
57	46	32	67	86	72	17	6	22
64	83	78	14	3	28	54	43	38
15	1	29	55	41	39	65	81	79
56	42	37	66	82	77	16	2	27

FIG. 22.

p_4q_3	p_2q_4	p_4q_1	p_2q_2
p_3q_1	p_1q_2	p_3q_3	p_1q_4
p_2q_3	p_4q_4	p_2q_1	p_4q_2
p_1q_1	p_3q_2	p_1q_3	p_3q_4

FIG. 23.

15	10	3	6
4	5	16	9
14	11	2	7
1	8	13	12

FIG. 24.

Nasik Cubes.—A Nasik cube is composed of n^3 small equal cubes, here called cubelets, in the centres of which the natural numbers from 1 to n^3 are so placed that every section of the cube by planes perpendicular to an edge has the properties of a Nasik square; also sections by planes perpendicular to a face, and passing through the cubelet centres of any path of Nasical summation in that face. Fig. 25 shows by dots the way in which these cubes are constructed. A dot is here placed on three faces of a cubelet at the corner, showing that this cubelet belongs to each of the faces AOB, BOC, COA, of the cube. Dots are placed on the cubelets of some path of AOB (here the knight's path), beginning from O, also on the cubelets of a knight's path in BOC. Dots are now placed in the cubelets of similar paths to that on BOC in the other six sections parallel to BOC, starting from their dots in AOB. Forty-nine of the three hundred and forty-three cubelets will now contain a dot; and it will be observed that the dots in sections perpendicular to BO have arranged themselves in similar paths. In this manner, p_1, q_1, r_1 being placed in the corner cubelet O, these letters are severally placed in the cubelets of three different paths of AOB, and again along any similar paths in the seven sections perpendicular to AO, starting from the letters' position in AOB Next, $p_2q_2r_2$, $p_3q_3r_3$, ... $p_7q_7r_7$, are placed in the other cubelets of the edge AO, and dispersed in the same manner as $p_1q_1r_1$. Every cubelet will then be found to contain a different combination of the p's, q's and r's. If therefore the p's are made equal to 1, 2, ... 7, and the q's and r's to 0, 1, 2, ... 6, in any order, and the q's multiplied by 7, and the r's by 7^2, then, as in the case of the squares, the 7^3 cubelets will contain the numbers from 1 to 7^3, and the Nasical summations will be $\Sigma 7^2r + \Sigma 7q + p$. If 2, 4, 5 be values of r, p, q, the number for that cubelet is written 245 in the septenary scale, and if all the cubelet numbers are kept thus, the paths along which summations are found can be seen without adding, as the seven numbers would contain 1, 2, 3, ... 7 in the unit place, and 0, 1, 2, ... 6 in each of the other places. In all Nasik cubes, if such values are given to the letters on the central cubelet that the number is the middle one of the series 1 to n^3, the sum of all the pairs of numbers opposite to and equidistant from the middle number is the double of it. Also, if around a Nasik cube the twenty-six surrounding equal cubes be placed with their cells filled with the same numbers, and their corresponding faces looking the same way,—and if the surrounding space be conceived thus filled with similar cubes, and a straight line of unlimited length be drawn through any two cubelet centres, one in each of any two cubes,—the numbers along that line will be found to recur in groups of seven, which (except in the three cases where the same p, q or r recur in the group) together make the Nasical summation of the cube. Further, if we take n similarly filled Nasik cubes of n, n new letters, s_1, s_2, ... s_n, can be so placed, one in each of the n^4 cubelets of this group of n cubes, that each shall contain a different combination of the p's, q's, r's and s's. This is done by placing s_1 on each of the n^3 cubelets of the first cube that contain p_1, and on the n^3 cubelets of the 2d, 3d, ... and nth cube that contain p_2, p_3, ... p_n respectively. This process is repeated with s_2, beginning with the cube at which we ended, and so on with the other s's; the n^4 cubelets, after multiplying the q's, r's, and s's by n, n^2, and n^3 respectively, will now be filled with the numbers from 1 to n^4, and the constant summation will be $\Sigma n^3s + \Sigma n^2r + \Sigma nq + \Sigma p$. This process may be carried on without limit; for, if the n cubes are placed in a row with their faces resting on each other, and the corresponding faces looking the same way, n such parallelepipeds might be put side by side, and the n^5 cubelets of this solid square be Nasically filled by the introduction of a new letter t; while, by introducing another letter, the n^6 cubelets of the compound cube of n^2 Nasik

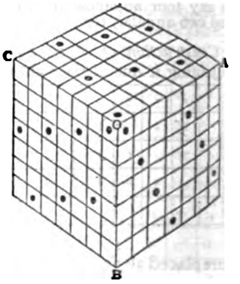

FIG. 25—Nasik Cube.

1	8	29	28		11	14	23	18
30	27	2	7		21	20	9	16
4	5	32	25		10	15	22	19
31	26	3	6		24	17	12	13

FIG. 26.

23	18	11	6	25
10	5	24	17	12
19	22	13	4	7
14	9	2	21	16
1	20	15	8	3

FIG. 27.

30	21	6	15	28	19
7	16	29	20	5	14
22	31	8	35	18	27
9	36	17	26	13	4
32	23	2	11	34	25
1	10	33	24	3	12

FIG. 28.

cubes might be filled by the numbers from 1 to n^6, and so *ad infinitum*. When the root is an odd composite number the values of the three groups of letters have to be adjusted as in squares, also in cubes of an even root. A similar process enables us to place successive numbers in the cells of several equal squares in which the Nasical summations are the same in each, as in fig. 26.

Among the many ingenious squares given by various writers, this article may justly close with two by L. Euler, in the *Histoire de l'académie royale des sciences* (Berlin, 1759). In fig. 27 the natural numbers show the path of a knight that moves within an odd square in such a manner that the sum of pairs of numbers opposite to and equidistant from the middle figure is its double. In fig. 28 the knight returns to its starting cell in a square of 6, and the difference between the pairs of numbers opposite to and equidistant from the middle point is 18.

A model consisting of seven Nasik cubes, constructed by A. H. Frost, is in the South Kensington Museum. The centres of the cubes are placed at equal distances in a straight line, the similar faces looking the same way in a plane parallel to that line. Each of the cubes has seven parallel glass plates, to which, on one side, the seven numbers in the septenary scale are fixed, and behind each, on the other side, its value in the common scale. 1201, the middle number from 1 to 7^4, occupies the central cubelet of the middle cube. Besides each cube having separately the same Nasical summation, this is also obtained by adding the numbers in any seven similarly situated cubelets, one in each cube. Also, the sum of all pairs of numbers, in a straight line, through the central cube of the system, equidistant from it, in whatever cubes they are, is twice 1201. (A. H. F.)

Fennell's Magic Ring.—It has been noticed that the numbers of magic squares, of which the extension by repeating the rows and columns of n numbers so as to form a square of $2n-1$ sides yields n^2 magic squares of n sides, are arranged as if they were all inscribed round a cylinder and also all inscribed on another cylinder at right angles to the first. C. A. M. Fennell explains this apparent anomaly by describing such magic squares as Mercator's projections, so to say, of "magic rings."

The surface of these magic rings is symmetrically divided into n^2 quadrangular compartments or cells by n equidistant zonal circles parallel to the circular axis of the ring and by n transverse circles which divide each of the n zones between any two neighbouring zonal circles into n equal quadrangular cells, while the zonal circles divide the sections between two neighbouring transverse circles into n unequal quadrangular cells. The diagonals of cells which follow each other passing once only through each zone and section, form similar and equal closed curves passing once quite round the circular axis of the ring and once quite round the centre of the ring. The position of each number is regarded as the intersection of two diagonals of its cell. The numbers are most easily seen if the smallest circle on the surface of the ring, which circle is concentric with the axis, be one of the zonal circles. In a perfect magic ring the sum of the numbers of the cells whose diagonals form any one of the $2n$ diagonal curves aforesaid is $\frac{1}{2}n(n^2 + 1)$ with or without increment, *i.e.* is the same sum as that of the numbers in each zone and each transverse section. But if n be 3 or a multiple of 3, only from 2 to n of the diagonal curves carry the sum in question, so that the magic rings are imperfect; and any set of numbers which can be arranged to make a perfect magic ring or magic square can also make an imperfect magic ring, *e.g.* the set 1 to 16 if the numbers 1, 6. 11, 16 lie thus on a diagonal curve instead of in the order 1, 6, 16 11. From a perfect magic ring of n^2 cells containing one number each, n^2 distinct magic squares can be read off; as the four numbers round each intersection of a zonal circle and a transverse circle constitute corner numbers of a magic square. The shape of a magic ring gives it the function of an indefinite extension in all directions of each of the aforesaid n^2 magic squares. (C. A. M. F.)

See F. E. A. Lucas, *Récréations mathématiques* (1891–1894); W. W. R. Ball, *Mathematical Recreations* (1892); W. E. M. G. Ahrens, *Mathematische Unterhaltungen und Spiele* (1901); H. C. H. Schubert, *Mathematische Mussestunden* (1900). A very detailed work is B. Violle, *Traité complet des carrés magiques* (3 vols., 1837–1838). The theory of "path nasiks" is dealt with in a pamphlet by C. Planck (1906).

MAGINN, WILLIAM (1793–1842), Irish poet and journalist, was born at Cork on the 10th of July 1793. The son of a schoolmaster, he graduated at Trinity College, Dublin, in 1811, and after his father's death in 1813 succeeded him in the school. In 1819 he began to contribute to the *Literary Gazette* and to *Blackwood's Magazine*, writing as "R. T. Scott" and "Morgan O'Doherty." He first made his mark as a parodist and a writer of humorous Latin verse. In 1821 he visited Edinburgh, where he made acquaintance with the Blackwood circle. He is credited with having originated the idea of the *Noctes ambrosianae*, of which some of the most brilliant chapters were his. His connexion with Blackwood lasted, with a short interval, almost to the end of his life. His best story was "Bob Burke's Duel with Ensign Brady." In 1823 he removed to London. He was employed by John Murray on the short-lived *Representative*, and was for a short time joint-editor of the *Standard*. But his intemperate habits and his imperfect journalistic morality prevented any permanent success. In connexion with Hugh Fraser he established *Fraser's Magazine* (1830), in which appeared his "Homeric Ballads." Maginn was the original of Captain Shandon in *Pendennis*. In spite of his inexhaustible wit and brilliant scholarship, most of his friends were eventually alienated by his obvious failings and his persistent insolvency. He died at Walton-on-Thames on the 21st of August 1842.

His *Miscellanies* were edited (5 vols., New York, 1855–1857) by R. Shelton Mackenzie and (2 vols., London, 1885) by R. W. Montagu [Johnson].

MAGISTRATE (Lat. *magistratus*, from *magister*, master, properly a public office, hence the person holding such an office), in general, one vested with authority to administer the law or one possessing large judicial or executive authority. In this broad sense the word is used in such phrases as "the first magistrate" of a king in a monarchy or "the chief magistrate" of the president of the United States. But it is more generally applied to minor or subordinate judicial officers, whether unpaid, as justices of the peace, or paid, as stipendiary magistrates. A stipendiary magistrate is appointed in London under the Metropolitan Police Courts Act 1839, in municipal boroughs under the Municipal Corporations Act 1882, and in particular districts under the Stipendiary Magistrates Act 1863 and special acts. In London and municipal boroughs a stipendiary magistrate must be a barrister of at least seven years' standing, while under the Stipendiary Magistrates Act 1863 he may be of five years' standing. A stipendiary magistrate may do alone all acts authorized to be done by two justices of the peace.

The term *magistratus* in ancient Rome originally implied the office of *magister* (master) of the Roman people, but was subsequently applied also to the holder of the office, thus becoming identical in sense with *magister*, and supplanting it in reference to any kind of public office. The fundamental conception of Roman magistracy is tenure of the *imperium*, the sovereignty which resides with the Roman people, but is by it conferred either upon a single ruler for life, as in the later monarchy, or upon a college of magistrates for a fixed term, as in the Republican period. The Roman theory of magistracy underwent little change when two consuls were substituted for the king; but the subdivision of magisterial powers which characterized the first centuries of the Republic, and resulted in the establishment of twenty annually elected magistrates of the people, implied some modification of this principle of the investiture of magistrates with supreme authority. For when the magistracies were multiplied a distinction was drawn between magistrates with *imperium*, namely consuls, praetors and occasionally dictators, and the remaining magistrates, who, although exercising independent magisterial authority and in no sense agents of the higher magistrates, were invested merely with an authority (*potestas*) to assist in the administration of the state. At the same time the actual authority of every magistrate was weakened not only by his colleagues' power of veto, but by the power possessed by any magistrate of quashing the act of an inferior, and by the tribune's right of putting his veto on the act of any magistrate except a dictator; and the subdivision of authority, which placed a great deal of business in the hands of young and inexperienced magistrates, further tended to increase the actual power as well as the influence of the senate at the expense of the magistracy.

In the developed Republic magistracies were divided into two classes: (*a*) magistrates of the whole people (*populi Romani*) and (*b*) magistrates of the *plebs*. The former class is again divided into two sections: (α) curule and (β) non-curule, a distinction which rests mainly on dignity rather than on actual power, for it cuts across the division of magistrates according to their tenure or non-tenure of *imperium*.

a. The magistrates of the people—also known as patrician magistrates, probably because the older and more important of these magistracies could originally be held only by patricians (*q.v.*)—were: (α) Dictator, master of the horse (see DICTATOR), consuls, praetors, curule, aediles and censors (curule); and (β) Quaestors, and the body of minor magistrates known as *xxvi. viri* (non-curule). The dictatorship and consulship were as old as the Republic. The first praetor was appointed in 366 B.C., a second was added in 242 B.C., and the number was gradually increased for provincial government until Sulla brought it up to eight, and under the early principate it grew to eighteen. Censors were first instituted in 443 B.C., and the office continued unchanged until its abolition by Sulla, after which, though restored, it rapidly fell into abeyance. Curule aediles were instituted at the same time as the praetorship, and continued throughout the Republic. The quaestorship was at least as old as the Republic, but the number rose during the Republic from two to twenty. All these offices except the censorship continued for administrative purposes during the principate, though shorn of all important powers.

b. The plebeian magistrates had their origin in the secession of the *plebs* to Mons Sacer in 494 B.C. (see ROME: *History*). In that year tribunes of the *plebs* were instituted, and two aediles were given them as subordinate officials, who were afterwards known as plebeian aediles, to distinguish them from the curule magistrates of the same name. Both these offices were abolished during the decemvirate, but were restored in 449 B.C., and survived into the principate.

The powers possessed by all magistrates alike were two:—that of enforcing their enactments (*coercitio*) by the exercise of any punishment short of capital, and that of veto(*intercessio*) of any act of a colleague or minor magistrate. The right of summoning and presiding over an assembly of that body of citizens with whose powers the magistrate was invested lay with the higher magistrates only in each class, with the consuls and praetors, and with the tribunes of the *plebs*. Civil jurisdiction was always a magisterial prerogative at Rome, and criminal jurisdiction also, except in capital cases, the decision of which was vested in the people at least as early as the first year of the Republic, was wielded by magistrates until the establishment of the various *quaestiones perpetuae* during the last century of the Republic. But in civil cases the magistrate, though controlling the trial and deciding matters of law, was quite distinct from the judge or body of judges who decided the question of fact; and the *quaestiones perpetuae*, which reduced the magistrate in criminal cases to a mere president of the court, gave him a position inferior to that of the praetor, who tried civil cases, only in so far as the praetor controlled the trial in some degree by his *formula*, under which the judges decided the question of fact.

Tenure of magistracy was always held to depend upon election by the body whose powers the magistrate wielded. Thus the magistrates of the *plebs* were elected by the plebeian council, those of the people in the Comitia (*q.v.*). In every case the outgoing magistrate, as presiding officer of the elective assembly, exercised the important right of nominating his successor for election.

See A. H. J. Greenidge, *Roman Public Life*, 152 seq., 363 seq. (London, 1901); T. Mommsen, *Römisches Staatsrecht*, I. ii. i. (1887). (A. M. CL.)

MAGLIABECHI, ANTONIO DA MARCO (1633–1714), Italian bibliophile, was born at Florence on the 28th of October 1633. He followed the trade of a goldsmith until 1673, when he received the appointment of librarian to the grand-duke of Tuscany, a post for which he had qualified himself by his vast stores of self-acquired learning. He died on the 4th of July 1714, bequeathing his large private library to the grand-duke, who in turn handed it over to the city.

MAGLIANI, AGOSTINO (1824–1891), Italian financier, was a native of Lanzino, near Salerno. He studied at Naples, and a book on the philosophy of law based on Liberal principles won for him a post in the Neapolitan treasury. He entered the Italian Senate in 1871, and had already secured a reputation as a financial expert before his *Questione monetaria* appeared in 1874. In December 1877 he became minister of finance in the reconstructed Depretis ministry, and he subsequently held the same office in three other Liberal cabinets. In his second tenure he carried through (1880) the abolition of the grist tax, to take effect in 1884. Having to face an increased expenditure without offending the Radical electorate by unpopular taxes, he had recourse to unsound methods of finance, which seriously embarrassed Italian credit for some years after he finally laid down office in 1888. He died in Rome on the 22nd of February 1891. He was one of the founders of the anti-socialistic "Adam Smith Society" at Florence.

MAGNA CARTA, or the Great Charter, the name of the famous charter of liberties granted at Runnimede in June 1215 by King John to the English people. Although in later ages its importance was enormously magnified, it differs only in degree, not in kind, from other charters granted by the Norman and early Plantagenet kings. Its greater length, however, still more the exceptional circumstances attending its birth, gave to it a position absolutely unique in the minds of later generations of Englishmen. This feeling was fostered by its many confirmations, and in subsequent ages, especially during the time of the struggle between the Stuart kings and the parliament, it was regarded as something sacrosanct, embodying the very ideal of English liberties, which to some extent had been lost, but which must be regained. Its provisions, real and imaginary, formed the standard towards which Englishmen must strive.

The causes which led to the grant of Magna Carta are described in the article on *English History*. Briefly, they are to be found in the conditions of the time: the increasing insularity of the English barons, now no longer the holders of estates in Normandy; the substitution of an unpopular for a popular king, an active spur to the rising forces of discontent; and the unprecedented demands for money—demands followed, not by honour, but by dishonour, to the arms of England abroad. So much for the general causes. The actual crisis may be said to begin with the quarrel between John and Pope Innocent III. regarding the appointment of a new archbishop to the see of Canterbury. This was settled in May 1213, and in the new prelate, the papal nominee, Stephen Langton, who landed in England and absolved the king in the following July, the baronial party found an able and powerful ally. But before this event John had instituted a great inquiry, the inquest of service of June 1212, for the purpose of finding out how much he could exact from each of his vassals, a measure which naturally excited some alarm; and then, fearing a baronial rising, he had abandoned his proposed expedition into Wales, had taken hostages from the most prominent of his foes, and had sought safety in London.

His absolution followed, and then he took courage. Turning once more his attention to the recovery of Normandy, he asked the barons for assistance for this undertaking; in reply they, or a section of them, refused, and instead of crossing the seas the king marched northwards with the intention of taking vengeance on his disobedient vassals, who were chiefly barons of the north of England. Langton followed his sovereign to Northampton and persuaded him, at least for the present, to refrain from any serious measures of revenge. Before this interview a national council had met at St Albans at the beginning of August 1213, and this was followed by another council, held in St Paul's church, London, later in the same month; it was doubtless summoned by the archbishop, and was attended by many of the higher clergy and a certain number of the barons. Addressing the gathering, Langton referred to the laws of Edward the Confessor as "good laws," which the king ought to observe, and then mentioned the charter granted by Henry I. on his accession as a standard of good government. This event has such an important bearing on the issue of Magna Carta that it is not inappropriate to quote the actual words used by Matthew Paris in describing the incident. The chronicler represents the archbishop as saying "Inventa est quoque nunc carta quaedam Henrici primi regis Angliae per quam, si volueritis, libertates diu amissas poteritis ad statum pristinum revocare." Those present decided to contend to the death for their "long-lost liberties," and with this the meeting came to an end. Nothing, however, was done during the remainder of the year, and John, feeling his position had grown stronger, went abroad early in 1214, and remained for some months in France. With his mercenaries behind him he met with some small successes in his fight for Normandy, but on the 27th of July he and his ally, the emperor Otto IV., met with a crushing defeat at Bouvines at the hands of Philip Augustus, and even the king himself was compelled to recognise that his hopes of recovering Normandy were at an end.

Meanwhile in England, which was ruled by Peter des Roches as justiciar, the discontent had been increasing rather than diminishing, and its volume became much larger owing to an event of May 1214. Greatly needing money for his campaign, John ordered another scutage to be taken from his tenants; this, moreover, was to be at the unprecedented rate of three marks on the knight's fee, not as on previous occasions of two marks, although this latter sum had hitherto been regarded as a very high rate. The northern barons refused to pay, and the gathering forces of resistance received a powerful stimulus when a little later came the news of the king's humiliation at Bouvines. Then in October the beaten monarch returned to England, no course open to him but to bow before the storm. In November he met some of his nobles at Bury St Edmunds, but as they still refused to pay the scutage no agreement was reached. At once they took another step towards the goal. With due solemnity (*super majus altare*) they swore to withdraw their allegiance from the king and to make war upon him, unless within a stated time he restored to them their rightful laws and liberties. While they were collecting troops in order to enforce their threats, John on his part tried to divide his enemies by a concession to the clerical section. By a charter, dated the 21st of November 1214, he granted freedom of election to the church. However, this did not prevent the prelates from continuing to act to some extent with the barons, and early in January 1215 the malcontents asked the king to confirm the laws of Edward the Confessor and the other liberties of the kingdom. He evaded the request and secured a truce until Easter was passed. Energetically making use of this period of respite, he again issued the charter to the church, ordered his subjects to take a fresh oath of allegiance to him, and sent to the pope for aid; but neither these precautions, nor his expedient of taking the cross, deterred the barons from returning to the attack. In April they met in arms at Stamford, and as soon as the truce had expired they marched to Brackley, where they met the royal ministers and again presented their demands. These were carried to the king at Oxford, but angrily he refused to consider them. Then the storm burst. On the 5th of May the barons formally renounced their allegiance to John, and appointed Robert Fitzwalter as their leader. They marched towards London, while John made another attempt to delay the crisis, or to divide his foes, by granting a charter to the citizens of London (May 9, 1215), and then by offering to submit the quarrel to a court of arbitrators under the presidency of the pope. But neither the one nor the other expedient availed him. Arbitration under such conditions was contemptuously rejected, and after the king had ordered the sheriffs to seize the lands and goods of the revolting nobles, London opened its gates and peacefully welcomed the baronial army. Other towns showed also that their sympathies were with the insurgents, and John was forced to his knees. Promising to assent to their demands, he agreed to meet the barons, and the gathering was fixed for the 15th of June, and was to take place in a meadow between Staines and Windsor, called Runnimede.

At the famous conference, which lasted from Monday the 15th to Tuesday the 23rd of June, the hostile barons were present in large numbers; on the other hand John, who rode over each day from Windsor, was only attended by a few followers. At once the malcontents presented their demands in a document known popularly as the *Articles of the Barons*, more strictly as *Capitula quae barones petunt et dominus rex concedit*. Doubtless this had been drawn up beforehand, and was brought by the baronial leaders to Runnimede; possibly it was identical with the document presented to the royal ministers at Brackley a few weeks before. John accepted the Articles on the same day and at once the great seal was affixed to them. They are forty-eight in number, and on them Magna Carta was based, the work of converting them into a charter, which was regarded as a much more binding form of engagement, being taken in hand immediately. This duty occupied three days, negotiations between the two parties taking place over several disputed points, and it was completed by Friday the 19th, when several copies of the charter were sealed. All then took an oath to keep its terms, and orders were sent to the sheriffs to publish it, and to see that its provisions were observed, two or three days being taken up with making and sending out copies for this purpose. It should be mentioned that, although the charter was evidently not sealed until the 19th, the four existing copies of it are dated the 15th, the day on which John accepted the articles.

The days between Friday the 19th and the following Tuesday, when the conference came to an end, were occupied in providing, as far as possible, for the due execution of the reforms promised by the king in Magna Carta. The document itself provided for an elected committee of twenty-five barons, whose duty was to compel John, by force if necessary, to keep his promises; but this was evidently regarded as insufficient, and the matter was dealt with in a supplementary treaty (*Conventio facta inter regem Angliae et barones ejusdum regni*). As a guarantee of his good faith the king surrendered the city of London to his foes, while the Tower was entrusted to the neutral keeping of the archbishop of Canterbury. John then asked the barons for a charter that they on their part would keep the peace. This was refused, and although some of the bishops entered a mild protest, the question was allowed to drop. Regarding another matter also, the extent of the royal forests, the prelates made a protest. John and his friends feared lest the inquiry promised into the extent of the hated forest areas would be carried out too rigorously, and that these would be seriously curtailed, if not abolished altogether. Consequently, the two archbishops and their colleagues declared that the articles in the charter which provided for this inquiry, and for a remedy against abuses of the forest laws by the king, must not be interpreted in too harsh a spirit. The customs necessary for the preservation of the forests must remain in force.

No securities, however, could bind John. Even before Magna Carta was signed he had set to work to destroy it, and he now turned to this task with renewed vigour. He appealed to the pope, and hoped to crush his enemies by the aid of foreign troops, while the barons prepared for war, and the prelates strove to keep the peace. Help came first from the spiritual arm. On the 24th of August 1215 Innocent III. published a bull which declared Magna Carta null and void. It had been extorted from the king by force (*per vim et metum*), and in the words of the bull the pope said "compositionem hujusmodi reprobamus penitus et damnamus." He followed this up by excommunicating the barons who had obtained it, and in the autumn of 1215 the inevitable war began. Capturing Rochester castle, John met with some other successes, and the disheartened barons invited Louis, son of Philip Augustus of France and afterwards king as Louis VIII., to take the English crown. In spite of the veto of the pope Louis accepted the invitation, landed in England in May 1216, and occupied London and Winchester, the fortune of war having in the meantime turned against John. The "ablest and most ruthless of the Angevins," as J. R. Green calls this king, had not, however, given up the struggle, and he was still in the field when he was taken ill, dying in Newark castle on the 19th of October 1216.

In its original form the text of Magna Carta was not divided into chapters, but in later times a division of this kind was adopted. This has since been retained by all commentators, the number of chapters being 63.

The preamble states that the king has granted the charter on the advice of various prelates and barons, some of whom, including the archbishop of Canterbury, the papal legate Pandulf, and William Marshal, earl of Pembroke, are mentioned by name.

Chapter I. declares that the English church shall be free and shall enjoy freedom of election. This follows the precedent set in the accession charter of Henry I. and in other early charters, although it had no place in the Articles of the Barons. On the present occasion it was evidently regarded as quite a formal and introductory matter, and the same remark applies to the general grant of liberties to all freemen and their heirs, with which the chapter concludes.

Then follows a series of chapters intended to restrain the king from raising money by the harsh and arbitrary methods adopted in the past. These chapters, however, only afforded protection to the tenants-in-chief of the crown, and it is clear from their prominent position that the framers of the charter regarded them as of paramount importance.

Chapter II. fixes the amount of the relief to be paid to the king by the heir of any of his vassals. Previously John, disregarding the custom of the past, had taken as much as he could extort. Henceforward he who inherits a barony must pay £100, he who inherits a knight's fee 100 shillings or less, and for smaller holdings less "according to the ancient custom of fiefs."

Chapters III. to VI. deal with the abuses of the king's privilege of acting as guardian of minors and their lands. Money must not be extorted from a ward when he receives his inheritance. The guardian or his servant must not take from the ward's property more than a reasonable amount for his expenses and the like; on the contrary he must maintain the houses, estates and other belongings in a proper state of efficiency. A ward must be allowed a reasonable liberty in the matter of marriage. He or she must not, as had been so often the case in the past, be forced to marry some royal favourite, or some one who had paid a sum of money for the privilege.

Chapters VII. and VIII. are for the protection of the widows of tenants-in-chief. On the death of her husband a widow must receive her rightful inheritance, without delay or hindrance. Moreover she must not be compelled to marry, a proceeding sometimes adopted to get her lands into the possession of a royal minion.

Chapter IX. is intended to prevent the king from collecting the money owing to him in an oppressive manner.

Now for a short time the document leaves the great questions at issue between the king and the barons, and two chapters are devoted to protecting the people generally against the exactions of the Jews.

Chapter X. declares that money borrowed from the Jews shall not bear interest during a minority.

Chapter XI. provides for the repayment of borrowed money to the Jews, and also to other creditors. This, however, is only to be done after certain liabilities have been met out of the estate, including the services due to the lord of the land.

Having thus disposed of this matter, the grievances of the barons are again considered, the vexed question of scutage being dealt with.

Chapter XII. says that in future no scutage or aid, beyond the three recognized feudal aids, shall be levied except by the consent of the general council of the nation (*commune concilium regni nostri*), while the three recognized aids shall only be levied at a reasonable rate. In dealing with this matter the Articles of the Barons had declared that aids and tallages must not be taken from the citizens of London and of other places without the consent of the council. This provision was omitted from Magna Carta, except so far as it related to aids from the citizens of London. This chapter does not give the people the right to control taxation. It gives to the men interested a certain control over one form of taxation, and protects one class only from arbitrary exactions, and that class the most powerful and the most wealthy.

Chapter XIII. gives to the citizens of London all their ancient liberties and free customs.

Chapter XIV. provides for the assembly of the council when its consent is necessary for raising an aid or a scutage. Individual summonses must be sent to the prelates and greater barons, while the lesser barons will be called together through the sheriffs and bailiffs. At least forty days' notice of the meeting must be given, and the cause thereof specified. No chapter corresponding to this is found in the Articles and none was inserted in the reissues of Magna Carta. It is very interesting, but it does not constitute any marked advance in the history of parliament, as it merely expresses the customary method of summoning a council. It does not, as has been sometimes asserted, in any way establish a representative system, as this is understood to-day.

Chapter XV. extends the concessions obtained by the greater barons for themselves to the lesser landholders, the tenants of the tenants-in-chief.

Chapter XVI. declares that those who owe military service for their lands shall not be called upon to perform more than the due amount of such service.

We now come to an important series of articles which deal with abuses in the administration of justice. Henry II. made the royal courts of law a lucrative source of revenue, but he gave protection to suitors. Under his sons justice was equally, perhaps more, costly, while adequate protection was much harder to obtain. Here were many grievances, and the barons set to work to redress them.

Chapter XVII. declares that common pleas must henceforward be heard in a fixed place. This had already been to some extent the practice when this class of cases was heard; it was now made the rule. From this time suitors in this court were not put to the expense and inconvenience of following the king from place to place.

Chapters XVIII. and XIX. deal with the three petty assizes, three kinds of cases regarding disputes about the possession of land. These must be heard in the county courts before two visiting justices and four knights of the shire. The hardship of attendance at the county courts was to some extent obviated.

Chapters XX. to XXII. regulate the amount of fines imposed for offences against the law. Property necessary for one's livelihood must not be taken. The fines must only be imposed by the oath of honest men of the neighbourhood. In the same way earls and barons must only be fined by their peers, and a similar privilege is extended to the clergy, who, moreover, were not to be fined in accordance with the value of their benefices, but only of their other property. It should be noticed that trial by one's peers, as understood in Magna Carta, is not confined to the nobility; in every class of society an accused man is punished in accordance with the verdict of his peers, or equals.

Chapter XXIII. asserts that persons shall not be compelled to make bridges, unless they are bound to do so by ancient custom. John had oppressed his subjects in this way before he visited a district for purposes of sport, and the hardship was a real one.

Chapter XXIV. declared that the sheriffs and other officers of the king must not hold the pleas of the crown. This was intended to remove an old and serious evil, as the sheriffs had earned a very bad reputation by their methods of administering justice.

Chapter XXV. also concerns the sheriffs. It prevents the king from increasing by their agency the amount of money annually due to him from the various counties and hundreds. The custom was for the king to get a fixed sum from the sheriff of each county, this being called the *firma comitatus*, and for the sheriff to collect this as best he could. Henceforward this amount must not be raised.

Chapters XXVI. and XXVII. were intended to protect the property of deceased persons, and also to secure the full payment of debts due therefrom to the crown. Other creditors were also protected, and the property of an intestate must be distributed to his heirs under the supervision of the church.

Chapter XXVIII. strikes a blow at the custom of purveyance. Royal officials must pay for the corn and provisions which they take on behalf of the king.

Chapter XXIX. says knights must not be compelled to give money instead of performing castle-guard, if they are willing to perform this service. Castle-guard was the liability incumbent on the holders of some estates to serve in the garrison of the royal castles. The constables of these castles had adopted the custom of compelling these landholders to give money and not service, mercenaries being then hired to perform this.

Chapters XXX. and XXXI. forbid the royal officials to seize the horses or carts of freemen for transport duty, or to take wood for the king's buildings.

Chapter XXXII. says that the lands of convicted felons shall be handed over to the lords of such lands and not kept by the king beyond a year and a day. In cases of treason the king had a right to the forfeited lands, but he was not allowed to establish a similar right in cases of felony.

Chapter XXXIII. provided for the removal of kydells, or weirs, from all English rivers. This was intended to give greater freedom to inland navigation, the rivers being the main highways of trade.

Chapter XXXIV. limits the use of the writ known as *Praecipe*. This writ was one transferring cases concerning the ownership of property from the courts of the feudal lords to those of the king. This custom, which owes its origin to Henry II., meant a loss of revenue to the lords, whose victory in this matter, however, was a step backwards. It checked temporarily the process of centralizing the administration of justice.

Chapter XXXV. provides for the uniformity of weights and measures throughout the kingdom.

Chapter XXXVI. promises that in future writs of inquisition shall be granted freely without payment of any kind. This kind of writ allowed a man to refer the question of his guilt or innocence to the verdict of his neighbours instead of proving his innocence by the duel.

Chapter XXXVII. prevents the king from administering certain kinds of land when these fall into the possession of minors. In the past John had evidently stretched his authority and seized lands over which others had really the right of wardship.

Chapter XXXVIII. prevents a bailiff from compelling an accused man to submit to the ordeal without the approval of credible witnesses.

Chapter XXXIX. is more important and the English rendering of it may be given in full. "No freeman shall be arrested, or detained in prison, or deprived of his freehold, or outlawed, or banished, or in any way molested; and we will not set forth against him, nor send against him, unless by the lawful judgment of his peers and by the law of the land." The object of this was clearly to restrain John from arbitrary proceedings against his free subjects. The principle of judgment by one's peers is asserted, and is obviously the privilege of every class of freemen, not of the greater lords alone.

Chapter XL. simply says, "To no one will we sell, to no one will we refuse or delay, right or justice."

Chapters XLI. and XLII. give permission to merchants, both English and foreign, to enter and leave the kingdom, except in time of war. They are not to pay "evil tolls." The privilege is extended to all travellers, except the prisoner and the outlaw, and natives of a country with which England is at war.

Chapter XLIII. is intended to compel the king to refrain from exacting greater dues from an escheated barony than were previously due from such barony.

Chapter XLIV. deals with the hated and oppressive forest laws. In future attendance at the forest courts is only obligatory on those who have business thereat.

Chapter XLV. says that the royal officials must know something of the law and must be desirous of keeping it.

Chapter XLVI. gives to the founders of religious houses the right of acting as guardians of such houses when they are without heads.

Chapters XLVII. and XLVIII. deal again with the great grievance of the royal forests. John undertakes to disforest all forests which have been made in his time, and also to give up such river banks as he has seized for his own use when engaged in sport. Twelve knights in each county are to make a thorough inquiry into all evil customs connected with the forests, and these are to be utterly abolished.

Chapter XLIX. provides for the restoration of hostages. John had been in the habit of taking the children of powerful subjects as pledges for the good behaviour of their parents.

Chapter L. says that certain royal minions, who are mentioned by name, are to be removed from their offices.

Chapter LI. says that as soon as peace is made all foreign mercenaries are to be banished.

Chapters LII. and LIII. are those in which the king promises to make amends for the injuries he has done to his barons in the past. He will restore lands and castles to those who have been deprived of them without the judgment of their peers; he will do the same concerning property unlawfully seized by Henry II. or Richard I. and now in his hands. In the latter case, however, he was allowed a respite until he returned from the projected crusade. He promises also to do right concerning forests, abbeys and the wardship of lands which belong lawfully to others.

Chapter LIV. prevents any one from being arrested on the appeal of a woman, except on a charge of causing the death of her husband. As a woman could not prove her case in the judicial combat, it was felt that the earlier practice gave her an unfair advantage.

Chapter LV. provides for the remission of unjust fines. The decision on these matters is to rest with the archbishop of Canterbury and the twenty-five barons appointed to see that the terms of the charter are carried out.

Chapters LVI. and LVII. deal with the grievances of Welshmen. Restoration of property is promised to them practically in the same way as to Englishmen. Welsh law is to be used in Wales, and in the marches the law of the marches is to be employed.

Chapter LVIII. promises that his hostages and his charters shall be restored to Llewellyn, prince of Wales.

Chapter LIX. promises a restoration of hostages to Alexander I. king of Scotland. Right is also to be done to him concerning the lands which he holds in England.

Chapter LX. is a general statement that the aforesaid customs and liberties are to be observed by all classes.

Chapter LXI. provides for the execution of the royal promises. A committee is to be formed of twenty-five barons. Then if the king or any of his servants do wrong and complaint is made to four of the twenty-five, they are to ask for redress. In the event of this not being granted within forty days the matter is to be referred to the twenty-five, who are empowered to seize the lands and property of the king, or to obtain justice in any other way possible. They must, however, spare the persons of the king, the queen and their children. Vacancies in the committee are to be filled by the barons themselves. The twenty-five barons were duly appointed, their names being given by Matthew Paris. This chronicler also reports that another committee of thirty-eight members was appointed to assist and control the twenty-five. S. R. Gardiner calls the scheme "a permanent organization for making war against the king."

Chapter LXII. is an expression of general forgiveness.

Chapter LXIII. repeats the promise of freedom to the English church and of their rights and liberties to all.

Magna Carta is an elaboration of the accession charter of Henry I., and is based upon the Articles of the Barons. It is, however, very much longer than the former charter and somewhat longer than the Articles. Moreover, it differs in several particulars from the Articles, these differences being doubtless the outcome of deliberation and of compromise. For instance, the provisions in Magna Carta concerning the freedom of the church find no place in the Articles, while a comparison between the two documents suggests that in other ways also influences favourable to the church and the clergy were at work while the famous charter was being framed. When one reflects how active and prominent Langton and other prelates were at Runnimede the change is not surprising. Another difference between the two documents concerns the towns and the trading classes. Certain privileges granted to them in the Articles are not found in Magna Carta, although, it must be noted, this document bestows exceptionally favoured treatment on the citizens of London. The conclusion is that the friends of the towns and the traders were less in evidence at Runnimede than they were at the earlier meetings of the barons, but that the neighbouring Londoners were strong enough to secure a good price for their support.

Magna Carta throws much light on the condition of England in the early 13th century. By denouncing the evil deeds of John and the innovations practised by him, it shows what these were and how they were hated; how money had been raised, how forest areas had been extended, how minors and widows had been cheated and oppressed. By declaring, as it does, what were the laws and customs of a past age wherein justice prevailed, it shows what was the ideal of good government formed by John's prelates and barons. Magna Carta can hardly be said to have introduced any new ideas. As Pollock and Maitland (*History of English Law*) say "on the whole the charter contains little that is absolutely new. It is restorative." But although mature study has established the truth of this proposition it was not always so. Statesmen and commentators alike professed to find in Magna Carta a number of political ideas which belonged to a later age, and which had no place in the minds of its framers. It was regarded as having conferred upon the nation nothing less than the English constitution in its perfect and completed form. Sir Edward Coke finds in Magna Carta a full and proper legal answer to every exaction of the Stuart kings, and a remedy for every evil suffered at the time. Sir William Blackstone is almost equally admiring. Edmund Burke says "Magna Carta, if it did not give us originally the House of Commons, gave us at least a House of Commons of weight and consequence." Lord Chatham used words equally superlative. "Magna Carta, the Petition of Rights and the Bill of Rights form that code, which I call the Bible of the English Constitution." Modern historians, although less rhetorical, speak in the highest terms of the importance of Magna Carta, the view of most of them being summed up in the words of Dr Stubbs: "The whole of the constitutional history of England is a commentary on this charter."

Many regard Magna Carta as giving equal rights to all Englishmen. J. R. Green says "The rights which the barons claimed for themselves they claimed for the nation at large." As a matter of fact this statement is only true with large limitations. The villains, who formed the majority of the population, got very little from it; in fact the only clauses which protect them do so because they are property—the property of their lords—and therefore valuable. They get neither political nor civil rights under Magna Carta. The traders, too, get little, while preferential treatment is meted out to the clergy and the barons. Its benefits are confined to freemen, and of the benefits the lion's share fell to the larger landholders; the smaller landholders getting, it is true, some crumbs from the table. It did not establish freedom from arbitrary arrest, or the right of the representatives of the people to control taxation, or trial by jury, or other conceptions of a later generation.

The story of Magna Carta after the death of John is soon told. On the 12th of November 1216 the regent William Marshal, earl of Pembroke, reissued the charter in the name of the young king Henry III. But important alterations were made. War was being waged against Louis of France, and the executive must not be hampered in the work of raising money; moreover the personal equation had disappeared, the barons did not need to protect themselves against John. Consequently the chapter limiting the power of the crown to raise scutages and aids without the consent of the council vanished, and with it the complementary one which determined the method of calling a council. Other provisions, the object of which had been to restrain John from demanding more money from various classes of his subjects, were also deleted, and the same fate befell such chapters as dealt with mere temporary matters. The most important of these was Chapter LXI., which provided for the appointment of 25 executors to compel John to observe the charter. The next year peace was made at Lambeth (Sept. 11, 1217) between Henry III. and Louis and another reissue of the charter was promised. This promise was carried out, but two charters appeared, one being a revised issue of Magna Carta proper, and the other a separate charter dealing with the forests, all references to which were omitted from the more important document. The date of this issue appears to have been the 6th of November 1217. The issue of a separate forest charter at this time led subsequently to some confusion. Roger of Wendover asserts that John issued a separate charter of this kind when Magna Carta appeared. This statement was believed by subsequent writers until the time of Blackstone, who was the first to discover the mistake.

As issued in 1217 Magna Carta consists of 47 chapters only. It declares that henceforward scutages shall be taken according to the precedents of Henry II.'s reign. New provisions were introduced for the preservation of the peace—unlawful castles were to be destroyed—while others were directed towards making the administration of justice by the visiting justices less burdensome. With regard to the land and the services due therefrom a beginning was made of the policy which culminated in the statutes of Mortmain and of Quia Emptores. The sheriffs were ordered to publish the revised charter on the 22nd of February 1218. Then in February 1225 Henry III. again issued the two charters with only two slight alterations, and this is the final form taken by Magna Carta, this text being the one referred to by Coke and the other early commentators. Subsequently the charters were confirmed several times by Henry III. and by Edward I., the most important occasion being their confirmation by Edward at Ghent in November 1297. On this occasion some supplementary articles were added to the charter; these were intended to limit the taxing power of the crown.

There are at present in existence four copies of Magna Carta, sealed with the great seal of King John, and several unsealed copies. Of the four two are in the British Museum. Both came into the possession of the Museum with the valuable collection of papers which had belonged to Sir Robert Cotton, who had obtained possession of both. One was found in Dover castle about 1630. This was damaged by fire in 1731; the other is undamaged. The two other sealed copies belong to the cathedrals of Lincoln and of Salisbury. Both were written evidently in a less hurried fashion than those in the British Museum, and the one at Lincoln was regarded as the most perfect by the commissioners who were responsible for the appearance of the *Statutes of the Realm* in 1810. The British Museum also contains the original parchment of the Articles of the Barons. Magna Carta was first printed by Richard Pynson in 1499. This, however, was not the original text, which was neglected until the time of Blackstone, who printed the various issues of the charter in his book *The Great Charter and the Charter of the Forest* (1759). The earliest commentator of note was Sir Edward Coke, who published his *Second Institute*, which deals with Magna Carta, by order of the Long Parliament in 1642. Modern commentators, who also print the various texts of the charter, are Richard Thomson, *An Historical Essay on the Magna Carta of King John* (1829); C. Bémont, in his *Chartes des libertés anglaises* (1892); and W. Stubbs in his *Select Charters* (1895). A more recent book and one embodying the results of the latest research is W. S. McKechnie, *Magna Carta* (1905). The text of Magna Carta is also printed in the *Statutes of the Realm* (1810–1828), and in T. Rymer's *Foedera* (1816–1869). In addition to Blackstone, Coke and these later writers, the following works may also be consulted: John Reeves, *History of English Law* (1783–1784); L. O. Pike, *A Constitutional History of the House of Lords* (1894); W. Stubbs, *Constitutional History of England* (1897); Sir F. Pollock and F. W. Maitland, *The History of English Law* (1895); W. S. Holdsworth, *A History of English Law* (1903), and Kate Norgate, *John Lackland* (1902). (A. W. H.*)

MAGNA GRAECIA (*ἡ μεγάλη Ἑλλάς*), the name given (first, apparently, in the 6th century B.C.) to the group of Greek cities along the coast of the "toe" of South Italy (or more strictly those only from Tarentum to Locri, along the east coast), while the people were called Italiotes (Ἰταλιῶται). The interior, which the Greeks never subdued, continued to be in the hands of the Bruttii, the native mountaineers, from whom the district was named in Roman times (*Βρεττία* also in Greek writers). The Greek colonies were established first as trading stations, which grew into independent cities. At an early time a trade in copper was carried on between Greece and Temesa (Homer, *Od.* i. 181).[1] The trade for a long time was chiefly in the hands of the Euboeans; and Cyme (Cumae) in Campania was founded in the 8th century B.C., when the Euboean Cyme was still a great city. After this the energy of Chalcis went onward to Sicily, and the states of the Corinthian Gulf carried out the colonization of Italy, Rhegium having been founded, it is true, by Chalcis, but after Messana (Zancle), and at the request of the inhabitants of the latter. Sybaris (721) and Crotona (703) were Achaean settlements; Locri Epizephyrii (about 710) was settled by Ozolian Locrians, so that, had it not been for the Dorian colony of Tarentum, the southern coast of Italy would have been entirely occupied by a group of Achaean cities. Tarentum (whether or no founded by pre-Dorian Greeks—its founders bore the unexplained name of Partheniae) became a Laconian colony at some unknown date, whence a legend grew up connecting the Partheniae with Sparta, and 707 B.C. was assigned as its traditional date. Tarentum is remarkable as the only foreign settlement made by the Spartans. It was industrial, depending largely on the purple and pottery trade. Ionian Greeks fleeing from foreign invasion founded Siris about 650 B.C., and, much later, Elea (540).

The Italian colonies were planted among friendly, almost kindred, races, and grew much more rapidly than the Sicilian Greek states, which had to contend against the power of Carthage. After the Achaean cities had combined to destroy the Ionic Siris, and had founded Metapontum as a counterpoise to the Dorian Tarentum, there seems to have been little strife among the Italiotes. An amphictyonic league, meeting in common rites at the temple of Hera on the Lacinian promontory, fostered a feeling of unity among them. The Pythagorean and Eleatic systems of philosophy had their chief seat in Magna Graecia. Other departments of literature do not seem to have been so much cultivated among them. The poet Ibycus, though a native of Rhegium, led a very wandering life. They sent competitors to the Olympic games (among them the famous Milo of Croton); and the physicians of Croton early in the 6th century (especially in the person of Democedes) were reputed the best in Greece; but politically they appear to have generally kept themselves separate. One ship of Croton, however, fought at Salamis, though it is not recorded that Greece asked the Italiotes for help when it sent ambassadors to Gelon of Syracuse. Mutual discord first sapped the prosperity of Magna Graecia. In 510 Croton, having defeated the Sybarites in a great battle, totally destroyed their city. Croton maintained alone the leading position which had belonged jointly to the Achaean cities (Diod. xiv. 103); but from that time Magna Graecia steadily declined. In the war between Athens and Syracuse Magna Graecia took comparatively little part; Locri was strongly anti-Athenian, but Rhegium, though it was the headquarters of the Athenians in 427, remained neutral in 415. Foreign enemies pressed heavily on it. The Lucanians and Bruttians on the north captured one town after another. Dionysius of Syracuse attacked them from the south; and after he defeated the Crotoniate league and destroyed Caulonia (389 B.C.), Tarentum remained the only powerful city. Henceforth the history of Magna Graecia is only a record of the vicissitudes of Tarentum (*q.v.*). Repeated expeditions from Sparta and Epirus tried in vain to prop up the decaying Greek states against the Lucanians and Bruttians; and when in 282 the Romans appeared in the Tarentine Gulf the end was close at hand. The aid which Pyrrhus brought did little good to the Tarentines, and his final departure in 274 left them defenceless. During these constant wars the Greek cities had been steadily decaying; and in the second Punic war, when most of them seized the opportunity of revolting from Rome, their very existence was in some cases annihilated. Malaria increased in strength as the population diminished. We are told by Cicero (*De am.* 4), *Magna Graecia nunc quidem deleta est.* Many of the cities completely disappeared, and hardly any of them were of great importance under the Roman empire; some, like Tarentum, maintained their existence into modern times, and in these only (except at Locri) have archaeological investigations of any importance been carried on; so that there still remains a considerable field for investigation. (T. As.)

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[1] This passage should perhaps be referred to the 8th century B.C. It is the first mention of an Italian place in a literary record.

MAGNATE (Late Lat. *magnas*, a great man), a noble, a man in high position, by birth, wealth or other qualities. The term is specifically applied to the members of the Upper House in Hungary, the *Förendihaz* or House of Magnates (see HUNGARY).

MAGNES (*c* 460 B.C.), Athenian writer of the Old Comedy, a native of the deme of Icaria in Attica. His death is alluded to by Aristophanes (*Equites*, 518–523, which was brought out in 424 B.C.), who states that in his old age Magnes had lost the popularity which he had formerly enjoyed. The few titles of his plays that remain, such as the *Frogs*, the *Birds*, the *Gall-flies*, indicate that he anticipated Aristophanes in introducing grotesque costumes for the chorus.

See T. Kock, *Comicorum atticorum fragmenta*, i. (1880); G. H. Bode, *Geschichte der hellenischen Dichtkunst*, iii. pt. 2 (1840).

MAGNESIA, in ancient geography the name of two cities in Asia Minor and of a district in eastern Thessaly, lying between the Vale of Tempe and the Pagasaean Gulf.

(1) MAGNESIA AD MAEANDRUM, a city of Ionia, situated on a small stream flowing into the Maeander, 15 Roman miles from Miletus and rather less from Ephesus. According to tradition, reinforced by the similarity of names, it was founded by colonists from the Thessalian tribe of the Magnetes, with whom were associated, according to Strabo, some Cretan settlers (Magnesia retained a connexion with Crete, as inscriptions found there attest). It was thus not properly an Ionic city, and for this reason, apparently, was not included in the Ionian league, though superior in wealth and prosperity to most of the members except Ephesus and Miletus. It was destroyed by the Cimmerii in their irruption into Asia Minor, but was soon after rebuilt, and gradually recovered its former prosperity. It was one of the towns assigned by Artaxerxes to Themistocles for support in his exile, and there the latter ended his days. His statue stood in its market-place. Thibron, the Spartan, persuaded the Magnesians to leave their indefensible and mutinous city in 399 B.C. and build afresh at Leucophrys, an hour distant, noted for its temple of Artemis Leucophryne, which, according to Strabo, surpassed that at Ephesus in the beauty of its architecture, though inferior in size and wealth. Its ruins were excavated by Dr K. Humann for the Constantinople Museum in 1891–1893; but most of the frieze of the temple of Artemis Leucophryne, representing an Amazon battle, had already been carried off by Texier (1843) to the Louvre. It was an octostyle, pseudo-dipteral temple of highly ornate Ionic order, built on older foundations by Hermogenes of Alabanda at the end of the 3rd century B.C. The platform has been greatly overgrown since the excavation, but many bases, capitals, and other architectural members are visible. In front of the west façade stood a great altar. An immense *peribolus* wall is still standing (20 ft. high), but its Doric colonnade has vanished. The railway runs right through the precinct, and much of Magnesia has gone into its bridges and embankments. South and west of the temple are many other remains of the Roman city, including a fairly perfect theatre excavated by Hiller von Gärtringen, and the shell of a large gymnasium. Part of the Agora was laid open to Humann, but his trenches have fallen in. The site is so unhealthy that even the Circassians who settled there twenty years ago have almost all died off or emigrated. Magnesia continued under the kings of Pergamum to be one of the most flourishing cities in this part of Asia; it resisted Mithradates in 87 B.C., and was rewarded with civic freedom by Sulla; but it appears to have greatly declined under the Roman empire, and its name disappears from history, though on coins of the time of Gordian it still claimed to be the seventh city of Asia.

See K. Haumann, *Magnesia am Maeander* (1904).

(2) MAGNESIA AD SIPYLUM (mod. *Manisa*, *q.v.*), a city of Lydia about 40 m. N.E. of Smyrna on the river Hermus at the foot of Mt Sipylus. No mention of the town is found till 190 B.C., when Antiochus the Great was defeated under its walls by the Roman consul L. Scipio Asiaticus. It became a city of importance under the Roman dominion and, though nearly destroyed by an earthquake in the reign of Tiberius, was restored by that emperor and flourished through the Roman empire. It was one of the few towns in this part of Asia Minor which remained prosperous under the Turkish rule. The most famous relic of antiquity is the " Niobe of Sipylus " (*Surallu Tash*) on the lowest slopes of the mountain about 4 m. east of the town. This is a colossal seated image cut in a niche of the rock, of "Hittite" origin, and perhaps that called by Pausanias the " very ancient statue of the Mother of the Gods," carved by Broteas, son of Tantalus, and sung by Homer. Near it lie many remains of a primitive city, and about half a mile east is the rock-seat conjecturally identified with Pausanias' " Throne of Pelops." There are also hot springs and a sacred grotto of Apollo. The whole site seems to be that of the early " Tantalus " city. (D. G. H.)

MAGNESITE, a mineral consisting of magnesium carbonate, $MgCO_3$, and belonging to the calcite group of rhombohedral carbonates. It is rarely found in crystals or crystalline masses, being usually compact or earthy and intermixed with more or less hydrous magnesium silicate (meerschaum). The compact material has the appearance of unglazed porcelain, and the earthy that of chalk. In colour it is usually dead white, sometimes yellowish. The hardness of the crystallized mineral is 4; sp. gr. 3·1. The name magnesite as originally applied by J. C. Delamétherie in 1797 included several minerals containing magnesium, and at the present day it is used by French writers for meerschaum. The mineral has also been called baudisserite from the locality Baudissero near Ivrea in Piedmont. Breunnerite is a ferriferous variety.

Magnesite is a product of alteration of magnesium silicates, and occurs as veins and patches in serpentine, talc-schist or dolomite-rock. It is extensively mined in the island of Euboea in the Grecian Archipelago, near Salem in Madras, and in California, U.S.A. It is principally used for the manufacture of highly refractory fire-bricks for lining steel furnaces and electric furnaces; also for making plaster, tiles and artificial stone; for the preparation of magnesium salts (Epsom salts, &c.); for whitening paper-pulp and wool; and as a paint.

MAGNESIUM [symbol Mg, atomic weight 24·32 (O = 16)], a metallic chemical element. The sulphate or " Epsom salts " (*q.v.*) was isolated in 1695 by N. Grew, while in 1707 M. B. Valentin prepared *magnesia alba* from the mother liquors obtained in the manufacture of nitre. Magnesia was confounded with lime until 1755, when J. Black showed that the two substances were entirely different; and in 1808 Davy pointed out that it was the oxide of a metal, which, however, he was not able to isolate. Magnesium is found widely distributed in nature, chiefly in the forms of silicate, carbonate and chloride, and occurring in the minerals olivine, hornblende, talc, asbestos, meerschaum, augite, dolomite, magnesite, carnallite, kieserite and kainite. The metal was prepared (in a state approximating to purity) by A. A. B. Bussy (*Jour. de pharm.* 1829, 15, p. 30; 1830, 16, p. 142), who fused the anhydrous chloride with potassium; H. Sainte Claire Deville's process, which used to be employed commercially, was essentially the same, except that sodium was substituted for potassium (*Comptes rendus*, 1857, 44, p. 394), the product being further purified by redistillation. It may also be prepared by heating a mixture of carbon, oxide of iron and magnesite to bright redness; and by heating a mixture of magnesium ferrocyanide and sodium carbonate, the double cyanide formed being then decomposed by heating it with metallic zinc. Electrolytic methods have entirely superseded the older methods. The problem of magnesium reduction is in many respects similar to that of aluminium extraction, but the lightness of the metal as compared, bulk for bulk, with its fused salts, and the readiness with which it burns when exposed to air at high temperatures, render the problem somewhat more difficult.

Moissan found that the oxide resisted reduction by carbon in the electric furnace, so that electrolysis of a fusible salt of the metal must be resorted to. Bunsen, in 1852, electrolysed fused magnesium chloride in a porcelain crucible. In later processes, carnallite (a natural double chloride of magnesium and potassium) has commonly, after careful dehydration, been substituted for the single chloride. Graetzel's process, which was at one time employed, consisted in electrolysing the chloride in a metal crucible heated externally, the crucible itself forming the cathode, and the magnesium being deposited upon its inner surface. W. Borchers also used an externally heated metal vessel as the cathode; it is provided with a supporting collar or flange a little below the top, so that the upper part of the vessel is exposed to the cooling influence of the air, in order that a crust of solidified salt may there be formed, and so prevent the creeping of the electrolyte over the top. The carbon anode passes through the cover of a porcelain cylinder, open at the bottom, and provided with a side-tube at the top to remove the chlorine formed during electrolysis. The operation is conducted at a dull red heat (about 760° C. or 1400° F.), the current density being about 0·64 amperes per sq. in. of cathode surface, and the pressure about 7 volts. The fusing-point of the metal is about 730° C. (1350° F.), and the magnesium is therefore reduced in the form of melted globules which gradually accumulate. At intervals the current is interrupted, the cover removed, and the temperature of the vessel raised considerably above the melting-point of magnesium. The metal is then removed from the walls with the aid of an iron scraper, and the whole mass poured into a sheet-iron tray, where it solidifies. The solidified chloride is then broken up, the shots and fused masses of magnesium are picked out, run together in a plumbago crucible without flux, and poured into a suitable mould. Smaller pieces are thrown into a bath of melted carnallite and pressed together with an iron rod, the bath being then heated until the globules of metal float to the top, when they may be removed in perforated iron ladles, through the holes in which the fused chloride can drain away, but through which the melted magnesium cannot pass by reason of its high surface tension. The globules are then re-melted. F. Oettel (*Zeit. f. Elektrochem.*, 1895, 2, p. 394) recommends the electrolytic preparation from carnallite; the mineral should be freed from water and sulphates.

Magnesium is a silvery white metal possessing a high lustre. It is malleable and ductile. Sp. gr. 1·75. It preserves its lustre in dry air, but in moist air it becomes tarnished by the formation of a film of oxide. It melts at 632·7° C. (C. T. Heycock and F. H. Neville), and boils at about 1100°C. Magnesium and its salts are diamagnetic. It burns brilliantly when heated in air or oxygen, or even in carbon dioxide, emitting a brilliant white light and leaving a residue of magnesia, MgO. The light is rich in the violet and ultra-violet rays, and consequently is employed in photography. The metal is also used in pyrotechny. It also burns when heated in a current of steam, which it decomposes with the liberation of hydrogen and the formation of magnesia. At high temperatures it acts as a reducing agent, reducing silica to silicon, boric acid to boron, &c. (H. Moissan, *Comptes rendus*, 1892, 114, p. 392). It combines directly with nitrogen, when heated in the gas, to form the nitride Mg_3N_2 (see ARGON). It is rapidly dissolved by dilute acids, with the evolution of hydrogen and the formation of magnesium salts. It precipitates many metals from solutions of their salts.

Magnesium Oxide, magnesia, MgO, occurs native as the mineral periclase, and is formed when magnesium burns in air; it may also be prepared by the gentle ignition of the hydroxide or carbonate. It is a non-volatile and almost infusible white powder, which slowly absorbs moisture and carbon dioxide from air, and is readily soluble in dilute acids. On account of its refractory nature, it is employed in the manufacture of crucibles, furnace linings, &c. It is also used in making hydraulic cements. A crystalline form was obtained by M. Houdard (*Abst. J. C. S.*, 1907, ii. p. 621) by fusing the oxide and sulphide in the electric furnace. *Magnesium hydroxide* $Mg(OH)_2$, occurs native as the minerals brucite and némalite, and is prepared by precipitating solutions of magnesium salts by means of caustic soda or potash. An artificial brucite was prepared by A. de Schulten (*Comptes rendus*, 1885, 101, p. 72) by boiling magnesium chloride with caustic potash and allowing the solution to cool. Magnesium hydroxide is a white amorphous solid which is only slightly soluble in water; the solubility is, however, greatly increased by ammonium salts. It possesses an alkaline reaction and absorbs carbon dioxide. It is employed in the manufacture of cements.

When magnesium is heated in fluorine or chlorine or in the vapour of bromine or iodine there is a violent reaction, and the corresponding halide compounds are formed. With the exception of the fluoride, these substances are readily soluble in water and are deliquescent. The fluoride is found native as sellaïte, and the bromide and iodide occur in sea water and in many mineral springs. The most important of the halide salts is the *chloride* which, in the hydrated form, has the formula $MgCl_2 \cdot 6H_2O$. It may be prepared by dissolving the metal, its oxide, hydroxide, or carbonate in dilute hydrochloric acid, or by mixing concentrated solutions of magnesium sulphate and common salt, and cooling the mixture rapidly, when the less soluble sodium sulphate separates first. It is also formed as a by-product in the manufacture of potassium chloride from carnallite. The hydrated salt loses water on heating, and partially decomposes into hydrochloric acid and magnesium oxychlorides. To obtain the anhydrous salt, the double magnesium ammonium chloride, $MgCl_2 \cdot NH_4Cl \cdot 6H_2O$, is prepared by adding ammonium chloride to a solution of magnesium chloride. The solution is evaporated, and the residue strongly heated, when water and ammonium chloride are expelled, and anhydrous magnesium chloride remains. Magnesium chloride readily forms double salts with the alkaline chlorides. A strong solution of the chloride made into a thick paste with calcined magnesia sets in a few hours to a hard, stone-like mass, which contains an oxychloride of varying composition. Magnesium oxychloride when heated to redness in a current of air evolves a mixture of hydrochloric acid and chlorine and leaves a residue of magnesia, a reaction which is employed in the Weldon-Pechiney and Mond processes for the manufacture of chlorine.

Magnesium Carbonate, $MgCO_3$.—The normal salt is found native as the mineral magnesite, and in combination with calcium carbonate as dolomite, whilst hydromagnesite is a basic carbonate. It is not possible to prepare the normal carbonate by precipitating magnesium salts with sodium carbonate. C. Marignac has prepared it by the action of calcium carbonate on magnesium chloride. A salt $MgCO_3 \cdot 3H_2O$ or $Mg(CO_3H)(OH) \cdot 2H_2O$ may be prepared from the carbonate by dissolving it in water charged with carbon dioxide, and then reducing the pressure (W. A. Davis, *Jour. Soc. Chem. Ind.* 1906, 25, p. 788). The carbonate is not easily soluble in dilute acids, but is readily soluble in water containing carbon dioxide. *Magnesia alba*, a white bulky precipitate obtained by adding sodium carbonate to Epsom salts, is a mixture of $Mg(CO_3H)(OH) \cdot 2H_2O$, $Mg(CO_3H)(OH)$ and $Mg(OH)_2$. It is almost insoluble in water, but readily dissolves in ammonium salts.

Magnesium Phosphates.—By adding sodium phosphate to magnesium sulphate and allowing the mixture to stand, hexagonal needles of $MgHPO_4 \cdot 7H_2O$ are deposited. The *normal phosphate*, $Mg_3P_2O_8$, is found in some guanos, and as the mineral wagnerite. It may be prepared by adding normal sodium phosphate to a magnesium salt and boiling the precipitate with a solution of magnesium sulphate. It is a white amorphous powder, readily soluble in acids. *Magnesium ammonium phosphate*, $MgNH_4PO_4 \cdot 6H_2O$, is found as the mineral struvite and in some guanos; it occurs also in urinary calculi and is formed in the putrefaction of urine. It is prepared by adding sodium phosphate to magnesium sulphate in the presence of ammonia and ammonium chloride. When heated to 100° C., it loses five molecules of water of crystallization, and at a higher temperature loses the remainder of the water and also ammonia, leaving a residue of magnesium pyrophosphate, $Mg_2P_2O_7$. *Magnesium Nitrate*, $Mg(NO_3)_2 \cdot 6H_2O$, is a colourless, deliquescent, crystalline solid obtained by dissolving magnesium or its carbonate in nitric acid, and concentrating the solution. The crystals melt at 90° C. *Magnesium Nitride*, Mg_3N_2, is obtained as a greenish-yellow amorphous mass by passing a current of nitrogen or ammonia over heated magnesium (F. Briegleb and A. Geuther, *Ann.*, 1862, 123, p. 228; see also W. Eidmann and L. Moeser, *Ber.*, 1901, 34, p. 390). When heated in dry oxygen it becomes incandescent, forming magnesia. Water decomposes it with liberation of ammonia and formation of magnesium hydroxide. The chlorides of nickel, cobalt, chromium, iron and mercury are converted into nitrides when heated with it, whilst the chlorides of copper and platinum are reduced to the metals (A. Smits, *Rec. Pays Bas*, 1896, 15, p. 135). *Magnesium sulphide*, MgS, may be obtained, mixed with some unaltered metal and some magnesia, as a hard brown mass by heating magnesia, in sulphur vapour. It slowly decomposes in moist air. *Magnesium sulphate*, $MgSO_4$, occurs (with $1H_2O$) as Kieserite. A hexahydrate is also known. The salt may be obtained from Kieserite: formerly it was prepared by treating magnesite or dolomite with sulphuric acid.

Organic Compounds.—By heating magnesium filings with methyl and ethyl iodides A. Cahours (*Ann. chim. phys.*, 1860, 58, pp. 5, 19) obtained magnesium methyl, $Mg(CH_3)_2$, and magnesium ethyl, $Mg(C_2H_5)_2$, as colourless, strongly smelling, mobile liquids, which are spontaneously inflammable and are readily decomposed by water. The compounds formed by the action of magnesium on alkyl iodides in the cold have been largely used in synthetic organic chemistry since V. Grignard (*Comptes rendus*, 1900 et seq.) observed that magnesium and alkyl or aryl halides combined together in presence of anhydrous ether at ordinary temperatures (with the appearance of brisk boiling) to form compounds of the type RMgX (R = an alkyl or aryl group and X = halogen). These compounds are insoluble in ether, are non-inflammable and exceedingly reactive. A. V. Baeyer (*Ber.*, 1902, 35, p. 1201) regards them as oxonium salts containing tetravalent oxygen $(C_2H_5)_2{:}O{:}(MgR)\,(X)$, whilst W. Tschelinzeff (*Ber.*, 1906, 39, p. 773) considers that they contain two molecules of ether. In preparing the Grignard reagent the commencement of the reaction is accelerated by a trace of iodine. W. Tschelinzeff (*Ber.*, 1904, 37, p. 4534) showed that the ether may be replaced by benzene containing a small quantity of ether or anisole, or a few drops of a tertiary amine. With unsaturated alkyl halides the products are only slightly soluble in ether, and two molecules of the alkyl compound are brought into

Grignard Reagent.

the reaction. They are very unstable, and do not react in the normal manner. (V. Grignard and L. Tissier, *Comptes rendus*, 1901, 132, p. 558).

The products formed by the action of the Grignard reagent with the various types of organic compounds are usually thrown out of solution in the form of crystalline precipitates or as thick oils, and are then decomposed by ice-cold dilute sulphuric or acetic acids, the magnesium being removed as a basic halide salt.

Applications.—For the formation of primary and secondary alcohols see ALDEHYDES and KETONES. Formaldehyde behaves abnormally with magnesium benzyl bromide (M. Tiffeneau, *Comptes rendus*, 1903, 137, p. 573), forming ortho-tolylcarbinol, $CH_3\cdot C_6H_4\cdot CH_2OH$, and not benzylcarbinol, $C_6H_5CH_2\cdot CH_2OH$ (cf. the reaction of formaldehyde on phenols: O. Manasse, *Ber.* 1894, 27, p. 2904). Acid esters yield carbinols, many of which are unstable and readily pass over into unsaturated compounds, especially when warmed with acetic anhydride: $R\cdot CO_2R'(R'')_2\cdot R:C\cdot OMgX \rightarrow (R'')_2R:C\cdot OH$.

Formic ester yields a secondary alcohol under similar conditions. Acid chlorides behave in an analogous manner to esters (Grignard and Tissier, *Comptes rendus*, 1901, 132, p. 683). Nitriles yield ketones (the nitrogen being eliminated as ammonia), the best yields being given by the aromatic nitriles (E. Blaise, ibid., 1901, 133, p. 1217): $R\cdot CN \rightarrow RR':C:NMgI \rightarrow R\cdot CO\cdot R'$. Acid amides also react to form ketones (C. Béis, ibid., 1903, 137, 575):

$$R\cdot CONH_2 \rightarrow RR':C(OMgX)\cdot NHMgX + R'H \rightarrow R\cdot CO\cdot R';$$

the yield increases with the complexity of the organic residue of the acid amide. On passing a current of dry carbon dioxide over the reagent, the gas is absorbed and the resulting compound, when decomposed by dilute acids, yields an organic acid, and similarly with carbon oxysulphide a thio-acid is obtained:

$$RMgX \rightarrow R\cdot CO_2MgX \rightarrow R\cdot CO_2H;\ COS \rightarrow CS(OMgX)\cdot R \rightarrow R\cdot CSOH.$$

A Klages (*Ber.*, 1902, 35, pp. 2633 et seq.) has shown that if one uses an excess of magnesium and of an alkyl halide with a ketone, an ethylene derivative is formed. The reaction appears to be perfectly general unless the ketone contains two ortho-substituent groups. Organo-metallic compounds can also be prepared, for example

$$SnBr_4 + 4MgBrC_6H_5 = 4MgBr_2 + Sn(C_6H_5)_4.$$

For a summary see A. McKenzie, *B. A. Rep.* 1907.

Detection.—The magnesium salts may be detected by the white precipitate formed by adding sodium phosphate (in the presence of ammonia and ammonium chloride) to their solutions. The same reaction is made use of in the quantitative determination of magnesium, the white precipitate of magnesium ammonium phosphate being converted by ignition into magnesium pyrophosphate and weighed as such. The atomic weight of magnesium has been determined by many observers. J. Berzelius (*Ann. chim. phys.*, 1820, 14, p. 375), by converting the oxide into the sulphate, obtained the value 12·62 for the equivalent. R. F. Marchand and T. Scheerer (*Jour. prakt. Chem.*, 1850, 50, p. 358), by ignition of the carbonate, obtained the value 24·00 for the atomic weight, whilst C. Marignac, by converting the oxide into the sulphate, obtained the value 24·37. T. W. Richards and H. G. Parker (*Zeit. anorg. Chem.*, 1897, 13, p. 81) have obtained the value 24·365 (O = 16).

Medicine.—These salts of magnesium may be regarded as the typical *saline purgatives*. Their aperient action is dependent upon the minimum of irritation of the bowel, and is exercised by their abstraction from the blood of water, which passes into the bowel to act as a diluent of the salt. The stronger the solution administered, the greater is the quantity of water that passes into the bowel, a fact to be borne in mind when the salt is administered for the purpose of draining superfluous fluid from the system, as in dropsy. The oxide and carbonate of magnesium are also invaluable as antidotes, since they form insoluble compounds with oxalic acid and salts of mercury, arsenic, and copper. The result is to prevent the local corrosive action of the poison and to prevent absorption of the metals. As alkaloids are insoluble in alkaline solutions, the oxide and carbonate—especially the former—may be given in alkaloidal poisoning. The compounds of magnesium are not absorbed into the blood in any appreciable quantity, and therefore exert no remote actions upon other functions. This is fortunate, as the result of injecting a solution of a magnesium salt into a vein is rapid poisoning. Hence it is of the utmost importance to avoid the use of salts of this metal whenever it is necessary—as in diabetic coma—to increase the alkalinity of the blood rapidly. The usual doses of the oxide and carbonate of magnesium are from half a drachm to a drachm.

MAGNETISM. The present article is a digest, mainly from an experimental standpoint, of the leading facts and principles of magnetic science. It is divided into the following sections:

1. General Phenomena.
2. Terminology and Elementary Principles.
3. Magnetic Measurements.
4. Magnetization in Strong Fields.
5. Magnetization in Weak Fields.
6. Changes of Dimensions attending Magnetization.
7. Effects of Mechanical Stress on Magnetization.
8. Effects of Temperature on Magnetism.
9. Magnetic Properties of Alloys and Compounds of Iron.
10. Miscellaneous Effects of Magnetization:—
    Electric Conductivity—Hall Effect—Electro-Thermal Relations—Thermoelectric Quality—Elasticity—Chemical and Voltaic Effects.
11. Feebly Susceptible Substances.
12. Molecular Theory of Magnetism.
13. Historical and Chronological Notes.

Of these thirteen sections, the first contains a simple description of the more prominent phenomena, without mathematical symbols or numerical data. The second includes definitions of technical terms in common use, together with so much of the elementary theory as is necessary for understanding the experimental work described in subsequent portions of the article; a number of formulae and results are given for purposes of reference, but the mathematical reasoning by which they are obtained is not generally detailed, authorities being cited whenever the demonstrations are not likely to be found in ordinary textbooks. The subjects discussed in the remaining sections are sufficiently indicated by their respective headings. (See also ELECTROMAGNETISM, TERRESTRIAL MAGNETISM, MAGNETO-OPTICS and UNITS.)

1. GENERAL PHENOMENA

Pieces of a certain highly esteemed iron ore, which consists mainly of the oxide Fe_3O_4, are sometimes found to possess the power of attracting small fragments of iron or steel. Ore endowed with this curious property was well known to the ancient Greeks and Romans, who, because it occurred plentifully in the district of Magnesia near the Aegean coast, gave it the name of *magnes*, or the *Magnesian stone*. In English-speaking countries the ore is commonly known as *magnetite*, and pieces which exhibit attraction as *magnets*; the cause to which the attractive property is attributed is called *magnetism*, a name also applied to the important branch of science which has been evolved from the study of phenomena associated with the magnet.

If a magnet is dipped into a mass of iron filings and withdrawn, filings cling to certain parts of the stone in moss-like tufts, other parts remaining bare. There are generally two regions where the tufts are thickest, and the attraction therefore greatest, and between them is a zone in which no attraction is evidenced. The regions of greatest attraction have received the name of *poles*, and the line joining them is called the *axis* of the magnet; the space around a magnet in which magnetic effects are exhibited is called the *field of magnetic force*, or the *magnetic field*.

Up to the end of the 15th century only two magnetic phenomena of importance, besides that of attraction, had been observed. Upon one of these is based the principle of the mariner's compass, which is said to have been known to the Chinese as early as 1100 B.C., though it was not introduced into Europe until more than 2000 years later; a magnet supported so that its axis is free to turn in a horizontal plane will come to rest with its poles pointing approximately north and south. The other phenomenon is mentioned by Greek and Roman writers of the 1st century: a piece of iron, when brought into contact with a magnet, or even held near one, itself becomes "inductively" magnetized, and acquires the power of lifting iron. If the iron is soft and fairly pure, it loses its attractive property when removed from the neighbourhood of the magnet; if it is hard, some of the induced magnetism is permanently retained, and the piece becomes an artificial magnet. Steel is much more retentive of magnetism than any ordinary iron, and some form of steel is now always used for making artificial magnets. Magnetism may be imparted to a bar of hardened steel by stroking it several times from end to end, always in the same direction, with one of the poles of a magnet. Until 1820 all the artificial magnets in practical use derived their virtue, directly or indirectly, from the natural magnets found in the earth: it is now recognized that the source of all magnetism, not excepting that of the magnetic ore itself, is electricity, and it is usual to have direct recourse to electricity for producing magnetization, without the intermediary of the magnetic ore. A wire carrying an electric current is surrounded by a magnetic field, and if the wire is bent into the form of an elongated coil or spiral, a field having certain very useful qualities is generated in the interior. A bar of soft iron introduced into the coil is at once magnetized, the magnetism, however, disappearing almost completely as soon as the current ceases to flow. Such a combination constitutes an *electromagnet*, a valuable device by means of which a magnet can be instantly made and unmade at will. With suitable arrangements of iron and coil and a sufficiently strong current, the intensity of the temporary magnetization may be very high, and electromagnets capable of lifting weights of several tons are in daily use in engineering works (see ELECTROMAGNETISM). If the bar inserted into the coil is of hardened steel instead of iron, the magnetism will be less intense, but a larger proportion of it will be retained after the current has been cut off. Steel magnets of great strength and of any convenient form may be prepared either in this manner or by treatment with an electromagnet; hence the natural magnet, or *lodestone* as it is commonly called, is no longer of any interest except as a scientific curiosity.

Some of the principal phenomena of magnetism may be demonstrated with very little apparatus; much may be done with a small bar-magnet, a pocket compass and a few ounces of iron filings. Steel articles, such as knitting or sewing needles and pieces of flat spring, may be readily magnetized by stroking them with the bar-magnet; after having produced magnetism in any number of other bodies, the magnet will have lost nothing of its own virtue. The compass needle is a little steel magnet balanced upon a pivot; one end of the needle, which always bears a distinguishing mark, points approximately, but not in general exactly, to the north,[1] the vertical plane through the direction of the needle being termed the *magnetic meridian*. The bar-magnet, if suspended horizontally in a paper stirrup by a thread of unspun silk, will also come to rest in the magnetic meridian with its marked end pointing northwards. The north-seeking end of a magnet is in English-speaking countries called the *north pole* and the other end the *south pole*; in France the names are interchanged. If one pole of the bar-magnet is brought near the compass, it will attract the opposite pole of the compass-needle; and the magnetic action will not be sensibly affected by the interposition between the bar and the compass of any substance whatever except iron or other magnetizable metal. The poles of a piece of magnetized steel may be at once distinguished if the two ends are successively presented to the compass; that end which attracts the south pole of the compass needle (and is therefore north) may be marked for easy identification.

Similar magnetic poles are not merely indifferent to each other, but exhibit actual repulsion. This can be more easily shown if the compass is replaced by a magnetized knitting needle, supported horizontally by a thread. The north pole of the bar-magnet will repel the north pole of the suspended needle, and there will likewise be repulsion between the two south poles. Such experiments as these demonstrate the fundamental law that *like poles repel each other; unlike poles attract*. It follows that between two neighbouring magnets, the poles of which are regarded as centres of force, there must always be four forces in action. Denoting the two pairs of magnetic poles by N, S and N′, S′, there is attraction between N and S′, and between S and N′; repulsion between N and N′, and between S and S′. Hence it is not very easy to determine experimentally the law of magnetic force between poles. The difficulty was overcome by C. A. Coulomb, who by using very long and thin magnets, so arranged that the action of their distant poles was negligible, succeeded in establishing the law, which has since been confirmed by more accurate methods, that *the force of attraction or repulsion exerted between two magnetic poles varies inversely as the square of the distance between them*. Since the poles of different magnets differ in strength, it is important to agree upon a definite unit or standard of reference in terms of which the strength of a pole may be numerically specified. According to the recognized convention, the unit pole is that which acts upon an equal pole at unit distance with unit force: a north pole is reckoned as positive (+) and a south pole as negative (−). Other conditions remaining unchanged, the force between two poles is proportional to the product of their strengths; it is repulsive or attractive according as the signs of the poles are like or unlike.

If a wire of soft iron is substituted for the suspended magnetic needle, either pole of the bar-magnet will attract either end of the wire indifferently. The wire will in fact become temporarily magnetized by induction, that end of it which is nearest to the pole of the magnet acquiring opposite polarity, and behaving as if it were the pole of a permanent magnet. Even a permanent magnet is susceptible of induction, its polarity becoming thereby strengthened, weakened, or possibly reversed. If one pole of a strong magnet is presented to the like pole of a weaker one, there will be repulsion so long as the two are separated by a certain minimum distance. At shorter distances the magnetism induced in the weaker magnet will be stronger than its permanent magnetism, and there will be attraction; two magnets with their like poles in actual contact will always cling together unless the like poles are of exactly equal strength. Induction is an effect of the field of force associated with a magnet. Magnetic force has not merely the property of acting upon magnetic poles, it has the additional property of producing a phenomenon known as *magnetic induction*, or *magnetic flux*, a physical condition which is of the nature of a flow continuously circulating through the magnet and the space outside it. Inside the magnet the course of the flow is from the south pole to the north pole; thence it diverges through the surrounding space, and again converging, re-enters the magnet at the south pole. When the magnetic induction flows through a piece of iron or other magnetizable substance placed near the magnet, a south pole is developed where the flux enters and a north pole where it leaves the substance. Outside the magnet the direction of the magnetic induction is generally the same as that of the magnetic force. A map indicating the direction of the force in different parts of the field due to a magnet may be constructed in a very simple manner. A sheet of cardboard is placed above the magnet, and some iron filings are sifted thinly and evenly over the surface: if the cardboard is gently tapped, the filings will arrange themselves in a series of curves, as shown in fig. 1. This experiment suggested to Faraday the conception of "lines of force," of which the curves formed by the filings afford a rough indication; Faraday's lines are however not confined to the plane of the cardboard, but occur in the whole of the space around the magnet. A *line of force* may be defined as an imaginary line so drawn that its direction at every point of its course coincides with the direction of the magnetic force at that point. Through any point in the field one such line can be drawn, but not more than one, for the force obviously cannot have more than one direction; the lines therefore never intersect. A line of force is regarded as proceeding from the north pole towards the south pole of the magnet, its direction being that in which an isolated north pole would be urged along

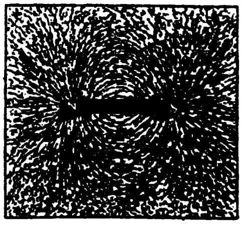

FIG. 1.

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[1] In London in 1910 the needle pointed about 16° W. of the geographical north. (See TERRESTRIAL MAGNETISM.)

it. A south pole would be urged oppositely to the conventional "direction" of the line; hence it follows that a very small magnetic needle, if placed in the field, would tend to set itself along or tangentially to the line of force passing through its centre, as may be approximately verified if the compass be placed among the filings on the cardboard. In the internal field of a long coil of wire carrying an electric current, the lines of force are, except near the ends, parallel to the axis of the coil, and it is chiefly for this reason that the field due to a coil is particularly well adapted for inductively magnetizing iron and steel. The older operation of magnetizing a steel bar by drawing a magnetic pole along it merely consists in exposing successive portions of the bar to the action of the strong field near the pole.

Faraday's lines not only show the direction of the magnetic force, but also serve to indicate its magnitude or strength in different parts of the field. Where the lines are crowded together, as in the neighbourhood of the poles, the force is greater (or the field is stronger) than where they are more widely separated; hence the strength of a field at any point can be accurately specified by reference to the concentration of the lines. The lines presented to the eye by the scattered filings are too vague and ill-defined to give a satisfactory indication of the field-strength (see Faraday, *Experimental Researches*, § 3237) though they show its direction clearly enough. It is however easy to demonstrate by means of the compass that the force is much greater in some parts of the field than in others. Lay the compass upon the cardboard, and observe the rate at which its needle vibrates after being displaced from its position of equilibrium; this will vary greatly in different regions. When the compass is far from the magnet, the vibrations will be comparatively slow; when it is near a pole, they will be exceedingly rapid, the frequency of the vibrations varying as the square root of the magnetic force at the spot. In a refined form this method is often employed for measuring the intensity of a magnetic field at a given place, just as the intensity of gravity at different parts of the earth is deduced from observations of the rate at which a pendulum of known length vibrates.

It is to the non-uniformity of the field surrounding a magnet that the apparent attraction between a magnet and a magnetizable body such as iron is ultimately due. This was pointed out by W. Thomson (afterwards Lord Kelvin) in 1847, as the result of a mathematical investigation undertaken to explain Faraday's experimental observations. If the inductively magnetized body lies in a part of the field which happens to be uniform there will be no resulting force tending to move the body, and it will not be "attracted." If however there is a small variation of the force in the space occupied by the body, it can be shown that the body will be urged, not necessarily towards a magnetic pole, but *towards places of stronger magnetic force*. It will not in general move along a line of force, as would an isolated pole, but will follow the direction in which the magnetic force increases most rapidly, and in so doing it may cross the lines of force obliquely or even at right angles.

If a magnetized needle were supported so that it could move freely about its centre of gravity it would not generally settle with its axis in a horizontal position, but would come to rest with its north-seeking pole either higher or lower than its centre. For the practical observation of this phenomenon it is usual to employ a needle which can turn freely in the plane of the magnetic meridian upon a horizontal axis passing through the centre of gravity of the needle. The angle which the magnetic axis makes with the plane of the horizon is called the *inclination* or *dip*. Along an irregular line encircling the earth in the neighbourhood of the geographical equator the needle takes up a horizontal position, and the dip is zero. At places north of this line, which is called the *magnetic equator*, the north end of the needle points downwards, the inclination generally becoming greater with increased distance from the equator. Within a certain small area in the Arctic Circle (about 97° W. long., 70° N. lat.) the north pole of the needle points vertically downwards, the dip being 90°. South of the magnetic equator the south end of the needle is always inclined downwards, and there is a spot within the Antarctic Circle (148° E. long., 74° S. lat.) where the needle again stands vertically, but with its north end directed upwards. All these observations may be accounted for by the fact first recognized by W. Gilbert in 1600, that the earth itself is a great magnet, having its poles at the two places where the dipping needle is vertical. To be consistent with the terminology adopted in Britain, it is necessary to regard the pole which is geographically north as being the south pole of the terrestrial magnet, and that which is geographically south as the north pole; in practice however the names assigned to the terrestrial magnetic poles correspond with their geographical situations. Within a limited space, such as that contained in a room, the field due to the earth's magnetism is sensibly uniform, the lines of force being parallel straight lines inclined to the horizon at the angle of dip, which at Greenwich in 1910 was about 67°. It is by the horizontal component of the earth's total force that the compass-needle is directed.

The magnets hitherto considered have been assumed to have each two poles, the one north and the other south. It is possible that there may be more than two. If, for example, a knitting needle is stroked with the south pole of a magnet, the strokes being directed from the middle of the needle towards the two extremities alternately, the needle will acquire a north pole at each end and a south pole in the middle. By suitably modifying the manipulation a further number of *consequent poles*, as they are called, may be developed. It is also possible that a magnet may have no poles at all. Let a magnetic pole be drawn several times around a uniform steel ring, so that every part of the ring may be successively subjected to the magnetic force. If the operation has been skilfully performed the ring will have no poles and will not attract iron filings. Yet it will be magnetized; for if it is cut through and the cut ends are drawn apart, each end will be found to exhibit polarity. Again, a steel wire through which an electric current has been passed will be magnetized, but so long as it is free from stress it will give no evidence of magnetization; if, however, the wire is twisted, poles will be developed at the two ends, for reasons which will be explained later. A wire or rod in this condition is said to be *circularly magnetized*; it may be regarded as consisting of an indefinite number of elementary ring-magnets, having their axes coincident with the axis of the wire and their planes at right angles to it. But no magnet can have a single pole; if there is one, there must also be at least a second, of the opposite sign and of exactly equal strength. Let a magnetized knitting needle, having north and south poles at the two ends respectively, be broken in the middle; each half will be found to possess a north and a south pole, the appropriate supplementary poles appearing at the broken ends. One of the fragments may again be broken, and again two bipolar magnets will be produced; and the operation may be repeated, at least in imagination, till we arrive at molecular magnitudes and can go no farther. This experiment proves that the condition of magnetization is not confined to those parts where polar phenomena are exhibited, but exists throughout the whole body of the magnet; it also suggests the idea of *molecular magnetism*, upon which the accepted theory of magnetization is based. According to this theory the molecules of any magnetizable substance are little permanent magnets the axes of which are, under ordinary conditions, disposed in all possible directions indifferently. The process of magnetization consists in turning round the molecules by the application of magnetic force, so that their north poles may all point more or less approximately in the direction of the force; thus the body as a whole becomes a magnet which is merely the resultant of an immense number of molecular magnets.

In every magnet the strength of the south pole is exactly equal to that of the north pole, the action of the same magnetic force upon the two poles being equal and oppositely directed. This may be shown by means of the uniform field of force due to the earth's magnetism. A magnet attached to a cork and floated upon water will set itself with its axis in the magnetic meridian, but it will be drawn neither northward nor southward; the forces acting upon the two poles have therefore no horizontal resultant. And again if a piece of steel is weighed in a delicate balance before and after magnetization, no change whatever in its weight can be detected; there is consequently no upward or downward resultant force due to magnetization; the contrary parallel forces acting upon the poles of the magnet are equal, constituting a couple, which may tend to turn the body, but not to propel it.

Iron and its alloys, including the various kinds of steel, though exhibiting magnetic phenomena in a pre-eminent degree, are not the only substances capable of magnetization. Nickel and cobalt are also strongly magnetic, and in 1903 the interesting discovery was made by F. Heusler that an alloy consisting of copper, aluminium and manganese (Heusler's alloy), possesses magnetic qualities comparable with those of iron. Practically the metals iron, nickel and cobalt, and some of their alloys and compounds constitute a class by themselves and are called *ferromagnetic* substances. But it was discovered by Faraday in 1845 that all substances, including even gases, are either attracted or repelled by a sufficiently powerful magnetic pole. Those substances which are attracted, or rather which tend, like iron, to move from weaker to stronger parts of the magnetic field, are termed *paramagnetic;* those which are repelled, or tend to move from stronger to weaker parts of the field, are termed diamagnetic. Between the ferromagnetics and the paramagnetics there is an enormous gap. The maximum magnetic susceptibility of iron is half a million times greater than that of liquid oxygen, one of the strongest paramagnetic substances known. Bismuth, the strongest of the diamagnetics, has a negative susceptibility which is numerically 20 times less than that of liquid oxygen.

Many of the physical properties of a metal are affected by magnetization. The dimensions of a piece of iron, for example, its elasticity, its thermo-electric power and its electric conductivity are all changed under the influence of magnetism. On the other hand, the magnetic properties of a substance are affected by such causes as mechanical stress and changes of temperature. An account of some of these effects will be found in another section.[1]

2. TERMINOLOGY AND ELEMENTARY PRINCIPLES

In what follows the C.G.S. electromagnetic system of units will be generally adopted, and, unless otherwise stated, magnetic substances will be assumed to be *isotropic*, or to have the same physical properties in all directions.

Vectors.—Physical quantities such as magnetic force, magnetic induction and magnetization, which have direction as well as magnitude, are termed *vectors*; they are compounded and resolved in the same manner as mechanical force, which is itself a vector. When the direction of any vector quantity denoted by a symbol is to be attended to, it is usual to employ for the symbol either a block letter, as H, I, B, or a German capital, as 𝔋, 𝔍, 𝔅.[2]

Magnetic Poles and Magnetic Axis.—A *unit magnetic pole* is that which acts on an equal pole at a distance of one centimetre with a force of one dyne. A pole which points north is reckoned positive, one which points south negative. The action between any two magnetic poles is mutual. If m_1 and m_2 are the strengths of two poles, d the distance between them expressed in centimetres, and f the force in dynes,

$$f = m_1 m_2 / d^2 \qquad (1)$$

The force is one of attraction or repulsion, according as the sign of the product $m_1 m_2$ is negative or positive. The poles at the ends of an infinitely thin uniform magnet, or *magnetic filament*, would act as definite centres of force. An actual magnet may generally be regarded as a bundle of magnetic filaments, and those portions of the surface of the magnet where the filaments terminate, and so-called "free magnetism" appears, may be conveniently called poles or polar regions. A more precise definition is the following: When the magnet is placed in a uniform field, the parallel forces acting on the positive poles of the constituent filaments, whether the filaments terminate outside the magnet or inside, have a resultant, equal to the sum of the forces and parallel to their direction, acting at a certain point N. The point N, which is the centre of the parallel forces, is called the *north* or *positive pole* of the magnet. Similarly, the forces acting in the opposite direction on the negative poles of the filaments have a resultant at another point S, which is called the *south* or *negative pole*. The opposite and parallel forces acting on the poles are always equal, a fact which is sometimes expressed by the statement that the total magnetism of a magnet is zero. The line joining the two poles is called the *axis* of the magnet.

Magnetic Field.—Any space at every point of which there is a finite magnetic force is called a *field of magnetic force*, or a *magnetic field*. The *strength* or *intensity* of a magnetic field at any point is measured by the force in dynes which a unit pole will experience when placed at that point, the *direction* of the field being the direction in which a positive pole is urged. The field-strength at any point is also called the *magnetic force* at that point; it is denoted by H, or, when it is desired to draw attention to the fact that it is a vector quantity, by the block letter H, or the German character 𝔋. Magnetic force is sometimes, and perhaps more suitably, termed *magnetic intensity*; it corresponds to the intensity of gravity g in the theory of heavy bodies (see Maxwell, *Electricity and Magnetism*, § 12 and § 68, footnote). A *line of force* is a line drawn through a magnetic field in the direction of the force at each point through which it passes. A *uniform magnetic field* is one in which H has everywhere the same value and the same direction, the lines of force being, therefore, straight and parallel. A magnetic field is generally due either to a conductor carrying an electric current or to the poles of a magnet. The magnetic field due to a long straight wire in which a current of electricity is flowing is at every point at right angles to the plane passing through it and through the wire; its strength at any point distant r centimetres from the wire is

$$\mathrm{H} = 2i/r, \qquad (2)$$

i being the current in C.G.S. units.[3] The lines of force are evidently circles concentric with the wire and at right angles to it; their direction is related to that of the current in the same manner as the rotation of a corkscrew is related to its thrust. The field at the centre of a circular conductor of radius r through which current is passing is

$$\mathrm{H} = 2\pi i/r, \qquad (3)$$

the direction of the force being along the axis and related to the direction of the current as the thrust of a corkscrew to its rotation. The field strength in the interior of a long uniformly wound coil containing n turns of wire and having a length of l centimetres is (except near the ends)

$$\mathrm{H} = 4\pi i n/l. \qquad (4)$$

In the middle portion of the coil the strength of the field is very nearly uniform, but towards the end it diminishes, and at the ends is reduced to one-half. The direction of the force is parallel to the axis of the coil, and related to the direction of the current as the thrust of a corkscrew to its rotation. If the coil has the form of a ring of mean radius r, the length will be $2\pi r$, and the field inside the coil may be expressed as

$$\mathrm{H} = 2ni/r. \qquad (5)$$

The uniformity of the field is not in this case disturbed by the influence of ends, but its strength at any point varies inversely as the distance from the axis of the ring. When therefore sensible uniformity is desired, the radius of the ring should be large in relation to that of the convolutions, or the ring should have the form of a short cylinder with thin walls. The strongest magnetic fields employed for experimental purposes are obtained by the use of electromagnets. For many experiments the field due to the earth's magnetism is sufficient; this is practically quite uniform throughout considerable spaces, but its total intensity is less than half a unit.

Magnetic Moment and Magnetization.—The *moment*, M, M or 𝔐, of a uniformly and longitudinally magnetized bar-magnet is the product of its length into the strength of one of its poles; it is the moment of the couple acting on the magnet when placed in a field of unit intensity with its axis perpendicular to the direction of the field. If l is the length of the magnet, $\mathrm{M} = ml$. The action of a magnet at a distance which is great compared with the length of the magnet depends solely upon its moment; so also does the action which the magnet experiences when placed in a uniform field. The moment of a small magnet may be resolved like a force. The *intensity of magnetization*, or, more shortly, the *magnetization* of a uniformly magnetized body is defined as the magnetic moment per unit of volume, and is denoted by I, I, or 𝔍. Hence

$$\mathrm{I} = M/v = ml/v = m/a,$$

v being the volume and a the sectional area. If the magnet is not uniform, the magnetization at any point is the ratio of the moment of an element of volume at that point to the volume itself, or $\mathrm{I} = m\,ds/dv$, where ds is the length of the element. The direction of the magnetization is that of the magnetic axis of the element; in isotropic substances it coincides with the direction of the magnetic force at the point. If the direction of the magnetization at the surface of a magnet makes an angle ϵ with the normal, the normal component of the magnetization, I cos ϵ, is called the *surface density* of the magnetism, and is generally denoted by σ.

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[1] For the relations between magnetism and light see MAGNETO-OPTICS.

[2] Clerk Maxwell employed German capitals to denote vector quantities. J. A. Fleming first recommended the use of blockletters as being more convenient both to printers and readers.

[3] The C.G.S. unit of current = 10 amperes.

Potential and Magnetic Force.—The *magnetic potential* at any point in a magnetic field is the work which would be done against the magnetic forces in bringing a unit pole to that point from the boundary of the field. The line through the given point along which the potential decreases most rapidly is the direction of the resultant magnetic force, and the rate of decrease of the potential in any direction is equal to the component of the force in that direction. If V denote the potential, F the resultant force, X, Y, Z, its components parallel to the co-ordinate axes and n the line along which the force is directed, then

$$-\frac{\delta V}{\delta n}=F,-\frac{\delta V}{\delta x}=X,-\frac{\delta V}{\delta y}=Y,-\frac{\delta V}{\delta z}=Z. \tag{6}$$

Surfaces for which the potential is constant are called *equipotential surfaces*. The resultant magnetic force at every point of such a surface is in the direction of the normal (n) to the surface; every line of force therefore cuts the equipotential surfaces at right angles. The potential due to a single pole of strength m at the distance r from the pole is

$$V=m/r, \tag{7}$$

the equipotential surfaces being spheres of which the pole is the centre and the lines of force radii. The potential due to a thin magnet at a point whose distance from the two poles respectively is r and r' is

$$V=m(1/r=1/r'). \tag{8}$$

When V is constant, this equation represents an equipotential surface.

The equipotential surfaces are two series of ovoids surrounding the two poles respectively, and separated by a plane at zero potential passing perpendicularly through the middle of the axis. If r and r' make angles θ and θ' with the axis, it is easily shown that the equation to a line of force is

$$\cos\theta-\cos\theta'=\text{constant}. \tag{9}$$

At the point where a line of force intersects the perpendicular bisector of the axis $r=r'=r_0$, say, and $\cos\theta-\cos\theta'$ obviously $=l/r_0$, l being the distance between the poles; l/r_0 is therefore the value of the constant in (9) for the line in question. Fig. 2 shows the lines of force and the plane sections of the equipotential surfaces for a thin magnet with poles concentrated at its ends. The potential due to a small magnet of moment M, at a point whose distance from the centre of the magnet is r, is

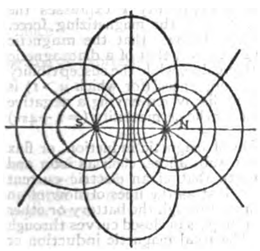

FIG. 2.

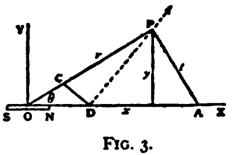

FIG. 3.

$$V=M\cos\theta/r^2, \tag{10}$$

where θ is the angle between r and the axis of the magnet. Denoting the force at P (see fig. 3) by F, and its components parallel to the co-ordinate axes by X and Y, we have

$$\left.\begin{aligned}X&=-\frac{\delta V}{\delta x}=\frac{M}{r^3}(3\cos^2\theta-1),\\ Y&=-\frac{\delta V}{\delta y}=\frac{M}{r^3}(3\sin\theta\cos\theta.\end{aligned}\right\} \tag{11}$$

If F_r is the force along r and F_t that along t at right angles to r,

$$F_r=X\cos\theta+Y\sin\theta=\frac{M}{r^3}\,2\cos\theta, \tag{12}$$

$$F_t=-X\sin\theta+Y\cos\theta=\frac{M}{r^3}\sin\theta. \tag{13}$$

For the resultant force at P,

$$F=\sqrt{F_r^2+F_t^2}=\frac{M}{r^3}\sqrt{3\cos^2\theta+1}. \tag{14}$$

The direction of F is given by the following construction: Trisect OP at C, so that OC=OP/3; draw CD at right angles to OP, to cut the axis produced in D; then DP will be the direction of the force at P. For a point in the axis OX, $\theta=0$; therefore $\cos\theta=1$, and the point D coincides with C; the magnitude of the force is, from (14),

$$F_x=2M/r^3, \tag{15}$$

its direction being along the axis OX. For a point in the line OY bisecting the magnet perpendicularly, $\theta=\pi/2$ therefore $\cos\theta=0$, and the point D is at an infinite distance. The magnitude of the force is in this case

$$F_y=M/r^3, \tag{16}$$

and its direction is parallel to the axis of the magnet. Although the above useful formulae, (10) to (15), are true only for an infinitely small magnet, they may be practically applied whenever the distance r is considerable compared with the length of the magnet.

Couples and Forces between Magnets.—If a small magnet of moment M is placed in the sensibly uniform field H due to a distant magnet, the couple tending to turn the small magnet upon an axis at right angles to the magnet and to the force is

$$MH\sin\theta, \tag{17}$$

where θ is the angle between the axis of the magnet and the direction of the force. In fig. 4 S′N′ is a small magnet of moment M′, and SN a distant fixed magnet of moment M; the axes of SN and S′N′ make angles of θ and ϕ respectively with the line through their middle points. It can be deduced from (17), (12) and (13) that the couple on S′N′ due to SN, and tending to increase ϕ, is

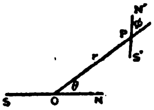

FIG. 4.

$$MM'(\sin\theta\cos\phi-2\sin\phi\cos\theta)/r^3. \tag{18}$$

This vanishes if $\sin\theta\cos\phi=2\sin\phi\cos\theta$, *i.e.* if $\tan\phi=\frac{1}{2}\tan\theta$, S′N′ being then along a line of force, a result which explains the construction given above for finding the direction of the force F in (14). If the axis of SN produced passes through the centre of S′N′, $\theta=0$, and the couple becomes

$$2MM'\sin\phi/r^3, \tag{19}$$

tending to diminish ϕ; this is called the "end on" position. If the centre of S′N′ is on the perpendicular bisector of SN, $\theta=\frac{1}{2}\pi$, and the couple will be

$$MM'\cos\phi/r^3, \tag{20}$$

tending to increase ϕ; this is the "broadside on" position. These two positions are sometimes called the first and second (or A and B) principal positions of Gauss. The components X, Y, parallel and perpendicular to r, of the force between the two magnets SN and S′N′ are

$$X=3MM'(\sin\theta\sin\phi-2\cos\theta\cos\phi)/r^4. \tag{21}$$
$$Y=3MM'(\sin\theta\cos\phi+\sin\phi\cos\theta)/r^4. \tag{22}$$

It will be seen that, whereas the couple varies inversely as the cube of the distance, the force varies inversely as the fourth power.

Distributions of Magnetism.—A magnet may be regarded as consisting of an infinite number of elementary magnets, each having a pair of poles and a definite magnetic moment. If a series of such elements, all equally and longitudinally magnetized, were placed end to end with their unlike poles in contact, the external action of the filament thus formed would be reduced to that of the two extreme poles. The same would be the case if the magnetization of the filament varied inversely as the area of its cross-section a in different parts. Such a filament is called a *simple magnetic solenoid*, and the product aI is called the *strength* of the solenoid. A magnet which consists entirely of such solenoids, having their ends either upon the surface or closed upon themselves, is called a *solenoidal magnet*, and the magnetism is said to be distributed solenoidally; there is no free magnetism in its interior. If the constituent solenoids are parallel and of equal strength, the magnet is also uniformly magnetized. A thin sheet of magnetic matter magnetized normally to its surface in such a manner that the magnetization at any place is inversely proportional to the thickness h of the sheet at that place is called a *magnetic shell;* the constant product hI is the *strength* of the shell and is generally denoted by Φ or ϕ. The potential at any point due to a magnetic shell is the product of its strength into the solid angle ω subtended by its edge at the given point, or $V=\Phi\omega$. For a given strength, therefore, the potential depends solely upon the boundary of the shell, and the potential outside a closed shell is everywhere zero. A magnet which can be divided into simple magnetic shells, either closed or having their edges on the surface of the magnet, is called a *lamellar magnet*, and the magnetism is said to be distributed lamellarly. A magnet consisting of a series of plane shells of equal strength arranged at right angles to the direction of magnetization will be uniformly magnetized.

It can be shown that uniform magnetization is possible only when the form of the body is ellipsoidal. (Maxwell, *Electricity and Magnetism*, II., § 437). The cases of greatest practical importance are those of a sphere (which is an ellipsoid with three equal axes) and an ovoid or prolate ellipsoid of revolution. The potential due to a uniformly magnetized sphere of radius a for an external point at a distance r from the centre is

$$V=\tfrac{4}{3}\pi a^3 I\cos\theta/r^2, \tag{23}$$

θ being the inclination of r to the magnetic axis. Since $\frac{4}{3}\pi a^3$I is the moment of the sphere (=volume × magnetization), it appears from (10) that the magnetized sphere produces the same external effect as a very small magnet of equal moment placed at its centre and magnetized in the same direction; the resultant force therefore is the same as in (14). The force in the interior is uniform, opposite to the direction of magnetization, and equal to $\frac{4}{3}\pi$I. When it is desired to have a uniform magnet with definitely situated poles, it usual to employ one having the form of an ovoid, or elongated ellipsoid of revolution, instead of a rectangular or cylindrical bar. If the magnetization is parallel to the major axis, and the lengths of the major and minor axes are $2a$ and $2c$, the poles are situated at a distance equal to $\frac{2}{3}a$ from the centre, and the magnet will behave externally like a simple solenoid of length $\frac{4}{3}a$. The internal force F is opposite to the direction of the magnetization, and equal to NI, where N is a coefficient depending only on the ratio of the axes. The moment $= \frac{4}{3}\pi ac^2\mathrm{I} = -\frac{4}{3}\pi ac^2\mathrm{F}N$.

The distribution of magnetism and the position of the poles in magnets of other shapes, such as cylindrical or rectangular bars, cannot be specified by any general statement, though approximate determinations may be obtained experimentally in individual cases.[1] According to F. W. G. Kohlrausch[2] the distance between the poles of a cylindrical magnet the length of which is from 10 to 30 times the diameter, is sensibly equal to five-sixths of the length of the bar. This statement, however, is only approximately correct, the distance between the poles depending upon the intensity of the magnetization.[3] In general, the greater the ratio of length to section, the more nearly will the poles approach the end of the bar, and the more nearly uniform will be the magnetization. For most practical purpose a knowledge of the exact position of the poles is of no importance; the magnetic moment, and therefore the mean magnetization, can always be determined with accuracy.

Magnetic Induction or Magnetic Flux.—When magnetic force acts on any medium, whether magnetic, diamagnetic or neutral, it produces within it a phenomenon of the nature of a flux or flow called *magnetic induction* (Maxwell, *loc. cit.*, § 428). Magnetic induction, like other fluxes such as electrical, thermal or fluid currents, is defined with reference to an area; it satisfies the same conditions of continuity as the electric current does, and in isotropic media it depends on the magnetic force just as the electric current depends on the electromotive force. The magnitude of the flux produced by a given magnetic force differs in different media. In a uniform magnetic field of unit intensity formed in empty space the induction or magnetic flux across an area of 1 square centimetre normal to the direction of the field is arbitrarily taken as the unit of induction. Hence if the induction per square centimetre at any point is denoted by B, then in empty space B is numerically equal to H; moreover in isotropic media both have the same direction, and for these reasons it is often said that in empty space (and practically in air and other non-magnetic substances) B and H are identical. Inside a magnetized body, B is the force that would be exerted on a unit pole if placed in a narrow crevasse cut in the body, the walls of the crevasse being perpendicular to the direction of the magnetization (Maxwell, §§ 399, 604); and its numerical value, being partly due to the free magnetism on the walls, is generally very different from that of H. In the case of a straight uniformly magnetized bar the direction of the magnetic force due to the poles of the magnet is from the north to the south pole outside the magnet, and from the south to the north inside. The magnetic flux per square centimetre at any point (B, B, or 𝔅) is briefly called the *induction*, or, especially by electrical engineers, the *flux-density*. The direction of magnetic induction may be indicated by *lines of induction*; a line of induction is always a closed curve, though it may possibly extend to and return from infinity. Lines of induction drawn through every point in the contour of a small surface form a re-entrant tube bounded by lines of induction; such a tube is called a *tube of induction*. The cross-section of a tube of induction may vary in different parts, but the total induction across any section is everywhere the same. A special meaning has been assigned to the term "lines of induction." Suppose the whole space in which induction exists to be divided up into *unit tubes*, such that the surface integral of the induction over any cross-section of a tube is equal to unity, and along the axis of each tube let a line of induction be drawn. These axial lines constitute the system of lines of induction which are so often referred to in the specification of a field. Where the induction is high the lines will be crowded together; where it is weak they will be widely separated, the number per square centimetre crossing a normal surface at any point being always equal to the numerical value of B. The induction may therefore be specified as B lines per square centimetre. The direction of the induction is also of course indicated by the direction of the lines, which thus serve to map out space in a convenient manner. Lines of induction are frequently but inaccurately spoken of as lines of force.

When induction or magnetic flux takes place in a ferromagnetic metal, the metal becomes magnetized, but the magnetization at any point is proportional not to B, but to B−H. The factor of proportionality will be $1/4\pi$, so that

$$\mathrm{I} = (\mathrm{B}-\mathrm{H})/4\pi, \tag{24}$$

or

$$\mathrm{B} = \mathrm{H} + 4\pi\mathrm{I}. \tag{25}$$

Unless the path of the induction is entirely inside the metal, free magnetic poles are developed at those parts of the metal where induction enters and leaves, the polarity being south at the entry and north at the exit of the flux. These free poles produce a magnetic field which is superposed upon that arising from other sources. The *resultant magnetic field*, therefore, is compounded of two fields, the one being due to the poles, and the other to the external causes which would be operative in the absence of the magnetized metal. The intensity (at any point) of the field due to the magnetization may be denoted by H_i, that of the external field by H_e, and that of the resultant field by H. In certain cases, as, for instance, in an iron ring wrapped uniformly round with a coil of wire through which a current is passing, the induction is entirely within the metal; there are, consequently, no free poles, and the ring, though magnetized, constitutes a poleless magnet. Magnetization is usually regarded as the direct effect of the resultant magnetic force, which is therefore often termed the *magnetizing force*.

Permeability and Susceptibility.—The ratio B/H is called the *permeability* of the medium in which the induction is taking place, and is denoted by μ. The ratio I/H is called the *susceptibility* of the magnetized substance, and is denoted by κ. Hence

$$\mathrm{B} = \mu\mathrm{H} \text{ and } \mathrm{I} = \kappa\mathrm{H}. \tag{26}$$

Also

$$\mu = \frac{\mathrm{B}}{\mathrm{H}} = \frac{\mathrm{H}+4\pi\mathrm{I}}{\mathrm{H}} = 1 + 4\pi\kappa, \tag{27}$$

and

$$\kappa = \frac{\mu - 1}{4\pi} \tag{28}$$

Since in empty space B has been assumed to be numerically equal to H, it follows that the permeability of a vacuum is equal to 1. The permeability of most material substances differs very slightly from unity, being a little greater than 1 in paramagnetic and a little less in diamagnetic substances. In the case of the ferromagnetic metals and some of their alloys and compounds, the permeability has generally a much higher value. Moreover it is not constant, being an apparently arbitrary function of H or of B; in the same specimen its value may, under different conditions vary from less than 2 to upwards of 5000. The magnetic susceptibility κ expresses the numerical relation of the magnetization to the magnetizing force. From the equation $\kappa = (\mu - 1)/4\pi$, it follows that the magnetic susceptibility of a vacuum (where $\mu = 1$) is 0, that of a diamagnetic substance (where $\mu < 1$) has a negative value, while the susceptibility of paramagnetic and ferromagnetic substances (for which $\mu > 1$) is positive. No substance has yet been discovered having a negative susceptibility sufficiently great to render the permeability ($= 1 + 4\pi\kappa$) negative.

Magnetic Circuit.—The circulation of magnetic induction or flux through magnetic and non-magnetic substances, such as iron and air, is in many respects analogous to that of an electric current through good and bad conductors. Just as the lines of flow of an electric current all pass in closed curves through the battery or other generator, so do all the lines of induction pass in closed curves through the magnet or magnetizing coil. The total magnetic induction or flux corresponds to the current of electricity (practically measured in amperes); the induction or flux density B to the density of the current (number of amperes to the square centimetre of section); the magnetic permeability to the specific electric conductivity; and the line integral of the magnetic force, sometimes called the magnetomotive force, to the electro-motive force in the circuit. The principal points of difference are that (1) the magnetic permeability, unlike the electric conductivity, which is independent of the strength of the current, is not in general constant; (2) there is no perfect insulator for magnetic induction, which will pass more or less freely through all known substances. Nevertheless, many important problems relating to the distribution of magnetic induction may be solved by methods similar to those employed for the solution of analogous problems in electricity. For the elementary theory of the magnetic circuit see ELECTRO-MAGNETISM.

Hysteresis, Coercive Force, Retentiveness.—It is found that when a piece of ferromagnetic metal, such as iron, is subjected to a magnetic field of changing intensity, the changes which take place in the induced magnetization of the iron exhibit a tendency to lag behind those which occur in the intensity of the field—a phenomenon to which J. A. Ewing (*Phil. Trans.* clxxvi. 524) has given the name of *hysteresis* (Gr. ὑστερέω, to lag behind). Thus it happens that there is no definite relation between the magnetization of a piece of metal which has been previously magnetized and the strength of the field in which it is placed. Much depends upon its antecedent magnetic condition, and indeed upon its whole magnetic history. A well-known example of hysteresis is presented by the case of permanent magnets. If a bar of hard steel is placed in a strong magnetic field, a certain intensity of magnetization is induced in the bar; but when the strength of the field is afterwards reduced to zero, the magnetization does not entirely disappear. That portion which is permanently retained, and which may amount to considerably more than one-half, is called the *residual magnetization*. The ratio of the residual magnetization to its previous maximum value measures the *retentiveness*, or

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[1] The principal theoretical investigations are summarized in Mascart and Joubert's *Electricity and Magnetism*, i. 391–398 and ii. 646–657. The case of a long iron bar has been experimentally studied with great care by C. G. Lamb, *Proc. Phys. Soc.*, 1899, 16, 509.

[2] *Wied. Ann.*, 1884, 22, 411.

[3] See C. G. Lamb, *loc. cit.* p. 518.

retentivity, of the metal.[1] Steel, which is well suited for the construction of permanent magnets, is said to possess great "coercive force." To this term, which had long been used in a loose and indefinite manner, J. Hopkinson supplied a precise meaning (*Phil. Trans.* clxxvi. 460). The *coercive force*, or *coercivity*, of a material is that reversed magnetic force which, while it is acting, just suffices to reduce the residual induction to nothing after the material has been temporarily submitted to any great magnetizing force. A metal which has great retentiveness may at the same time have small coercive force, and it is the latter quality which is of chief importance in permanent magnets.

Demagnetizing Force.—It has already been mentioned that when a ferromagnetic body is placed in a magnetic field, the resultant magnetic force H, at a point within the body, is compounded of the force H_o, due to the external field, and of another force, H_i, arising from the induced magnetization of the body. Since H_i generally tends to oppose the external force, thus making H less than H_o, it may be called the *demagnetizing force*. Except in the few special cases when a uniform external field produces uniform magnetization, the value of the demagnetizing force cannot be calculated, and an exact determination of the actual magnetic force within the body is therefore impossible. An important instance in which the calculation can be made is that of an elongated *ellipsoid of revolution* placed in a uniform field H_o, with its axis of revolution parallel to the lines of force. The magnetization at any point inside the ellipsoid will then be

$$I=\frac{\kappa H_0}{1+\kappa N} \tag{29}$$

where $$N=4\pi\left(\frac{1}{e^2}-1\right)\left(\frac{1}{2e}\log\frac{1+e}{1-e}-1\right),$$

e being the eccentricity (see Maxwell's *Treatise*, § 438). Since $I=\kappa H$, we have

$$\kappa H+\kappa NI=\kappa H_0, \tag{30}$$

or
$$H=H_0-NI,$$

NI being the demagnetizing force H_i. N may be called, after H. du Bois (*Magnetic Circuit*, p. 33), the *demagnetising factor*, and the ratio of the length of the ellipsoid $2c$ to its equatorial diameter $2a$ $(=c/a)$, the *dimensional ratio*, denoted by the symbol $\mathfrak{m}$.

Since $$e=\sqrt{1-\frac{a^2}{c^2}}=\sqrt{1-\frac{1}{\mathfrak{m}^2}},$$

the above expression for N may be written

$$N=\frac{4\pi}{\mathfrak{m}^2-1}\left(\frac{\mathfrak{m}}{2\sqrt{\mathfrak{m}^2-1}}\log\frac{\mathfrak{m}+\sqrt{\mathfrak{m}^2-1}}{\mathfrak{m}-\sqrt{\mathfrak{m}^2-1}}-1\right)$$
$$=\frac{4\pi}{\mathfrak{m}^2-1}\left\{\frac{\mathfrak{m}}{\sqrt{\mathfrak{m}^2-1}}\log\left(\mathfrak{m}+\sqrt{\mathfrak{m}^2-1}\right)-1\right\}$$

from which the value of N for a given dimensional ratio can be calculated. When the ellipsoid is so much elongated that 1 is negligible in relation to $\mathfrak{m}^2$, the expression approximates to the simpler form

$$N=\frac{4\pi}{\mathfrak{m}^2}\left(\log 2\mathfrak{m}-1\right). \tag{31}$$

In the case of a *sphere*, $e=0$ and $N=\frac{4}{3}\pi$; therefore from (29)

$$I=\kappa H=\frac{\kappa H_0}{1+\frac{4}{3}\pi\kappa}=\frac{3\kappa}{3+4\pi\kappa}H_0, \tag{32}$$

Whence $$H=\frac{3}{3+4\pi\kappa}H_0=\frac{3}{\mu+2}\,H_0, \tag{33}$$

and $$B=\mu H=\frac{3\mu}{\mu+2}\,H_0. \tag{34}$$

Equations (33) and (34) show that when, as is generally the case with ferromagnetic substances, the value of μ is considerable, the resultant magnetic force is only a small fraction of the external force, while the numerical value of the induction is approximately three times that of the external force, and nearly independent of the permeability. The demagnetizing force inside a *cylindrical rod* placed longitudinally in a uniform field H_0 is not uniform, being greatest at the ends and least in the middle part. Denoting its mean value by $\bar{H}_i$, and that of the demagnetizing factor by $\bar{N}$, we have

$$H=H_0-\bar{H}_i=H_0-\bar{N}I. \tag{35}$$

Du Bois has shown that when the dimensional ratio $\mathfrak{m}$ (=length/diameter) exceeds 100, $\bar{N}\mathfrak{m}^2=\text{constant}=45$, and hence for long thin rods

$$\bar{N}=45/\mathfrak{m}^2. \tag{36}$$

From an analysis of a number of experiments made with rods of different dimensions H. du Bois has deduced the corresponding mean demagnetizing factors. These, together with values of $\mathfrak{m}^2\bar{N}$ for cylindrical rods, and of N and $\mathfrak{m}^2N$ for ellipsoids of revolution, are given in the following useful table (*loc. cit.* p. 41):—

Demagnetising Factors.

m.	Cylinder.		Ellipsoid.	
	$\bar{N}$.	$\mathfrak{m}^2\bar{N}$.	N.	$\mathfrak{m}^2N$.
0	12·5664	0	12·5664	0
0·5	—	—	6·5864	—
1	—	—	4·1888	—
5	—	—	0·7015	—
10	0·2160	21·6	0·2549	25·5
15	0·1206	27·1	0·1350	30·5
20	0·0775	31·0	0·0848	34·0
25	0·0533	33·4	0·0579	36·2
30	0·0393	35·4	0·0432	38·8
40	0·0238	38·7	0·0266	42·5
50	0·0162	40·5	0·0181	45·3
60	0·0118	42·4	0·0132	47·5
70	0·0089	43·7	0·0101	49·5
80	0·0069	44·4	0·0080	51·2
90	0·0055	44·8	0·0065	52·5
100	0·0045	45·0	0·0054	54·0
150	0·0020	45·0	0·0026	58·3
200	0·0011	45·0	0.0016	64·0
300	0·00050	45·0	0·00075	67·5
400	0·00028	45·0	0·00045	72·0
500	0·00018	45·0	0·00030	75·0
1000	0·00005	45·0	0·00008	80·0

In the middle part of a rod which has a length of 400 or 500 diameters the effect of the ends is insensible; but for many experiments the condition of endlessness may be best secured by giving the metal the shape of a ring of uniform section, the magnetic field being produced by an electric current through a coil of wire evenly wound round the ring. In such cases $H_i=0$ and $H=H_0$.

The residual magnetization I_r retained by a bar of ferromagnetic metal after it has been removed from the influence of an external field produces a demagnetizing force $\bar{N}I_r$, which is greater the smaller the dimensional ratio. Hence the difficulty of imparting any considerable permanent magnetization to a short thick bar not possessed of great coercive force. The magnetization retained by a long thin rod, even when its coercive force is small, is sometimes little less than that which was produced by the direct action of the field.

Demagnetization by Reversals.—In the course of an experiment it is often desired to eliminate the effects of previous magnetization, and, as far as possible, wipe out the magnetic history of a specimen. In order to attain this result it was formerly the practice to raise the metal to a bright red heat, and allow it to cool while carefully guarded from magnetic influence. This operation, besides being very troublesome, was open to the objection that it was almost sure to produce a material but uncertain change in the physical constitution of the metal, so that, in fact, the results of experiments made before and after the treatment were not comparable. Ewing introduced the method (*Phil. Trans.* clxxvi. 539) of demagnetizing a specimen by subjecting it to a succession of magnetic forces which alternated in direction and gradually diminished in strength from a high value to zero. By means of a simple arrangement, which will be described farther on, this process can be carried out in a few seconds, and the metal can be brought as often as desired to a definite condition, which, if not quite identical with the virgin state, at least closely approximates to it.

Forces acting on a Small Body in the Magnetic Field.—If a small magnet of length ds and pole-strength m is brought into a magnetic field such that the values of the magnetic potential at the negative and positive poles respectively are V_1 and V_2, the work done upon the magnet, and therefore its potential energy, will be

$$W=m(V_2-V_1)=m\,dV,$$

which may be written

$$W=m\,ds\frac{dV}{ds}=M\frac{dV}{ds}=-MH_0=-vIH_0,$$

where M is the moment of the magnet, v the volume, I the magnetization, and H_0 the magnetic force along ds. The small magnet may be a sphere rigidly magnetized in the direction of H_0; if this is replaced by an isotropic sphere inductively magnetized by the field, then, for a displacement so small that the magnetization of the sphere may be regarded as unchanged, we shall have

$$dW=-vI\,dH_0=-v\frac{\kappa}{1+\frac{4}{3}\pi\kappa}H_0\,dH_0;$$

whence

$$W=-\frac{v}{2}\,\frac{\kappa}{1+\frac{4}{3}\pi\kappa}H_0^2. \tag{37}$$

The mechanical force acting on the sphere in the direction of displacement x is

$$F=-\frac{dW}{dx}=v\frac{\kappa}{1+\frac{4}{3}\pi\kappa}\,\frac{dH_0^2}{dx}. \tag{38}$$

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[1] Hopkinson specified the retentiveness by the numerical value of the "residual induction" $(=4\pi I)$.

If H_0 is constant, the force will be zero; if H_0 is variable, the sphere will tend to move in the direction in which H_0 varies most rapidly. The coefficient $\kappa/(1+\frac{4}{3}\pi\kappa)$ is positive for ferromagnetic and paramagnetic substances, which will therefore tend to move from weaker to stronger parts of the field; for all known diamagnetic substances it is negative, and these will tend to move from stronger to weaker parts. For small bodies other than spheres the coefficient will be different, but its sign will always be negative for diamagnetic substances and positive for others;[1] hence the forces acting on any small body will be in the same directions as in the case of a sphere.[2]

Directing Couple acting on an Elongated Body.—In a non-uniform field every volume-element of the body tends to move towards regions of greater or less force according as the substance is paramagnetic or diamagnetic, and the behaviour of the whole mass will be determined chiefly by the tendency of its constituent elements. For this reason a thin bar suspended at its centre of gravity between a pair of magnetic poles will, if paramagnetic, set itself along the line joining the poles, where the field is strongest, and if diamagnetic, transversely to the line. These are the "axial" and "equatorial" positions of Faraday. It can be shown[3] that in a uniform field an elongated piece of any non-crystalline material is in stable equilibrium only when its length is parallel to the lines of force; for diamagnetic substances, however, the directing couple is exceedingly small, and it would hardly be possible to obtain a uniform field of sufficient strength to show the effect experimentally.

Relative Magnetisation.—A substance of which the real susceptibility is κ will, when surrounded by a medium having the susceptibility k', behave towards a magnet as if its susceptibility were $\kappa_a=(\kappa-\kappa')/(1+4\pi\kappa')$. Since $1+4\pi\kappa'$ can never be negative, the apparent susceptibility κ_a will be positive or negative according as κ is greater or less than κ'. Thus, for example, a tube containing a weak solution of an iron salt will appear to be diamagnetic if it is immersed in a stronger solution of iron, though in air it is paramagnetic.[4]

Circular Magnetisation.—An electric current i flowing uniformly through a cylindrical wire whose radius is a produces inside the wire a magnetic field of which the lines of force are concentric circles around the axis of the wire. At a point whose distance from the axis of the wire is r the tangential magnetic force is

$$H=2ir/a^2 \tag{39}$$

it therefore varies directly as the distance from the axis, where it is zero.[5] If the wire consists of a ferromagnetic metal, it will become "circularly" magnetized by the field, the lines of magnetization being, like the lines of force, concentric circles. So long as the wire (supposed isotropic) is free from torsional stress, there will be no external evidence of magnetism.

Magnetic Shielding.—The action of a hollow magnetized shell on a point inside it is always opposed to that of the external magnetizing force,[6] the resultant interior field being therefore weaker than the field outside. Hence any apparatus, such as a galvanometer, may be partially shielded from extraneous magnetic action by enclosing it in an iron case. If a hollow sphere[7] of which the outer radius is R and the inner radius r is placed in a uniform field H_0, the field inside will also be uniform and in the same direction as H_0, and its value will be approximately

$$H_i=\frac{H_0}{1+\frac{2}{9}(\mu-2)\left(1-\frac{r^3}{R^3}\right)} \tag{40}$$

For a cylinder placed with its axis at right angles to the lines of force,

$$H_i=\frac{H_0}{1+\frac{1}{4}(\mu-2)\left(1-\frac{r^2}{R^2}\right)} \tag{41}$$

These expressions show that the thicker the screen and the greater its permeability μ, the more effectual will be the shielding action. Since μ can never be infinite, complete shielding is not possible.

Magneto-Crystallic Phenomenon.—In anisotropic bodies, such as crystals, the direction of the magnetization does not in general coincide with that of the magnetic force. There are, however, always three *principal axes* at right angles to one another along which the magnetization and the force have the same direction. If each of these axes successively is placed parallel to the lines of force in a uniform field H, we shall have

$$I_1=\kappa_1H,\ I_2=\kappa_2H,\ I_3=\kappa_3H,$$

the three susceptibilities κ being in general unequal, though in some cases two of them may have the same value. For crystalline bodies the value of κ (+ or −) is nearly always small and constant, the magnetization being therefore independent of the form of the body and proportional to the force. Hence, whatever the position of the body, if the field be resolved into three components parallel to the principal axes of the crystal, the actual magnetization will be the resultant of the three magnetizations along the axes. The body (or each element of it) will tend to set itself with its axis of greatest susceptibility parallel to the lines of force, while, if the field is not uniform, each volume-element will also tend to move towards places of greater or smaller force (according as the substance is paramagnetic or diamagnetic), the tendency being a maximum when the axis of greatest susceptibility is parallel to the field, and a minimum when it is perpendicular to it. The phenomena may therefore be exceedingly complicated.[8]

3. MAGNETIC MEASUREMENTS

Magnetic Moment.—The moment M of a magnet may be determined in many ways,[9] the most accurate being that of C. F. Gauss, which gives the value not only of M, but also that of H, the horizontal component of the earth's force. The product MH is first determined by suspending the magnet horizontally, and causing it to vibrate in small arcs. If A is the moment of inertia of the magnet, and t the time of a complete vibration, $MH=4\pi^2A/t^2$ (torsion being neglected). The ratio M/H is then found by one of the magnetometric methods which in their simplest forms are described below. Equation (44) shows that as a first approximation.

$$M/H=(d^2-l^2)\tan\theta/2d,$$

where l is half the length of the magnet, which is placed in the "broadside-on" position as regards a small suspended magnetic needle, d the distance between the centre of the magnet and the needle, and θ the angle through which the needle is deflected by the magnet. We get therefore

$$M^2=MH\times M/H=2\pi^2A(d^2-l^2)^2\tan\theta/t^2d \tag{42}$$

$$H^2=MH\times H/M=8\pi^2Ad/\{t^2(d^2-l^2)^2\tan\theta\} \tag{43}$$

When a high degree of accuracy is required, the experiments and calculations are less simple, and various corrections are applied. The moment of a magnet may also be deduced from a measurement of the couple exerted on the magnet by a uniform field H. Thus if the magnet is suspended horizontally by a fine wire, which, when the magnetic axis points north and south, is free from torsion, and if θ is the angle through which the upper end of the wire must be twisted to make the magnet point east and west, then $MH=C\theta$, or $M=C\theta/H$, where C is the torsional couple for 1°. A bifilar suspension is sometimes used instead of a single wire. If P is the weight of the magnet, l the length of each of the two threads, $2a$ the distance between their upper points of attachment, and $2b$ that between the lower points, then, approximately, $MH=P(ab/l)\sin\theta$. It is often sufficient to find the ratio of the moment of one magnet to that of another. If two magnets having moments M, M′ are arranged at right angles to each other upon a horizontal support which is free to rotate, their resultant R will set itself in the magnetic meridian. Let θ be the angle which the standard magnet M makes with the meridian, then $M'/R=\sin\theta$, and $M/R=\cos\theta$, whence $M'=M\tan\theta$.

A convenient and rapid method of estimating a magnetic moment has been devised by H. Armagnat.[10] The magnet is laid on a table with its north pole pointing northwards. A compass having a very short needle is placed on the line which bisects the axis of the magnet at right angles, and is moved until a neutral point is found where the force due to the earth's field H is balanced by that due to the magnet. If $2l$ is the distance between the poles m and $-m$, d the distance from either pole to a point P on the line AB (fig. 5), we have for the resultant force at P

$$R=-2\cos\theta\times m/d^2=-2lm/d^3=-M/d^3.$$

When P is the neutral point, H is equal and opposite to R; therefore $M=Hd^3$, or the moment is numerically equal to the cube of the distance from the neutral point to a pole, multiplied by the

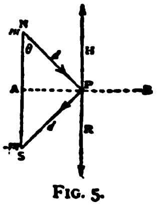

FIG. 5.

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[1] For all except ferromagnetic substances the coefficient is sensibly equal to κ.

[2] See W. Thomson's *Reprint.* §§ 615, 634–651.

[3] Ibid. §§ 646, 684.

[4] Faraday, *Exp. Res.* xxi.

[5] J. J. Thomson, *Electricity and Magnetism*, § 205.

[6] Maxwell, *Electricity and Magnetism*, § 431.

[7] H. du Bois, *Electrician*, 1898, 40, 317.

[8] M. Faraday, *Exp. Res.* xxii., xxiii.; W. Thomson, *Reprint*, § 604; J. C. Maxwell, *Treatise*, § 435; E. Mascart and J. Joubert, *Electricity and Magnetism*, §§ 384, 396, 1226; A. Winkelmann, *Physik*, v. 287.

[9] See A. Winkelmann, *Physik*, v. 69–94; Mascart and Joubert. *Electricity and Magnetism*, ii. 617.

[10] *Sci. Abs.* A, 1906, 9, 225.

horizontal intensity of the earth's force. The distance between the poles may with sufficient accuracy for a rough determination be assumed to be equal to five-sixths of the length of the magnet.

Measurement of Magnetization and Induction.—The magnetic condition assumed by a piece of ferromagnetic metal in different circumstances is determinable by various modes of experiment which may be classed as magnetometric, ballistic, and traction methods. When either the magnetization I or the induction B corresponding to a given magnetizing force H is known, the other may be found by means of the formula $B = 4\pi I + H$.

Magnetometric Methods.—Intensity of magnetization is most directly measured by observing the action which a magnetized body, generally a long straight rod, exerts upon a small magnetic needle placed near it. The magnetic needle may be cemented horizontally across the back of a little plane or concave mirror, about ¼ or ⅜ in. in diameter, which is suspended by a single fibre of unspun silk; this arrangement, when enclosed in a case with a glazed front to protect it from currents of air, constitutes a simple but efficient magnetometer. Deflections of the suspended needle are indicated by the movement of a narrow beam of light which the mirror reflects from a lamp and focusses upon a graduated cardboard scale placed at a distance of a few feet; the angular deflection of the beam of light is, of course, twice that of the needle. The suspended needle is, in the absence of disturbing causes, directed solely by the horizontal component of the earth's field of magnetic force H_E, and therefore sets itself approximately north and south. The magnetized body which is to be tested should be placed in such a position that the force H_r due to its poles may, at the spot occupied by the suspended needle, act in a direction at right angles to that due to the earth—that is, east and west. The direction of the resultant field of force will then make, with that of H_E, an angle θ, such that $H_r/H_E = \tan\theta$, and the suspended needle will be deflected through the same angle. We have therefore

$$H_r = H_E \tan\theta.$$

The angle θ is indicated by the position of the spot of light upon the scale, and the horizontal intensity of the earth's field H_E is known; thus we can at once determine the value of H_r, from which the magnetization I of the body under test may be calculated.

In order to fulfil the requirement that the field which a magnetized rod produces at the magnetometer shall be at right angles to that of the earth, the rod may be conveniently placed in any one of three different positions with regard to the suspended needle.

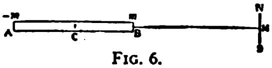

FIG. 6.

(1) The rod is set in a horizontal position level with the suspended needle, its axis being in a line which is perpendicular to the magnetic meridian, and which passes through the centre of suspension of the needle. This is called the "end-on" position, and is indicated in fig. 6. AB is the rod and C the middle point of its axis; NS is the magnetometer needle; AM bisects the undeflected needle NS at right angles. Let $2l$ = the length of the rod (or, more accurately, the distance between its poles), v = its volume, m and $-m$ the strength of its poles, and let d = the distance CM. For most ordinary purposes the length of the needle may be assumed to be negligible in comparison with the distance between the needle and the rod. We then have approximately for the field at M due to the rod

$$H_r = \frac{m}{(d-l)^2} - \frac{m}{(d+l)^2} = m\frac{4dl}{(d^2-l^2)^2}.$$

Therefore $$2ml = M = \frac{(d^2-l^2)^2 H_r}{2d} = \frac{(d^2-l^2)^2 H_E \tan\theta}{2d} \qquad (44)$$

And $$I = \frac{M}{v} = \frac{(d^2-l^2)^2 H_E}{2dv}\tan\theta, \qquad (45)$$

whence we can find the values of I which correspond to different angles of deflection.

(2) The rod may be placed horizontally east and west in such a position that the direction of the undeflected suspended needle bisects it at right angles. This is known as the "broadside-on" position, and is represented in fig. 7. Let the distance of each pole of the rod AB from the centre of the magnetometer needle = d. Then, since H_r, the force at M due to m and $-m$, is the resultant of $\frac{m}{d^2}$ and $-\frac{m}{d^2}$, we have

$$\frac{H_r}{\frac{m}{d^2}} = \frac{2l}{d}$$

or $$H_r = \frac{2ml}{d^3},$$

the direction being parallel to AB.

And $$I = \frac{d^3 H_r}{v} = \frac{d^3 H_E}{v}\tan\theta. \qquad (46)$$

(3) In the third position the test rod is placed vertically with one of its poles at the level of the magnetometer needle, and in the line drawn perpendicularly to the undeflected needle from its centre of suspension. The arrangement is shown in fig. 8, where AB is the vertical rod and M indicates the position of the magnetometer needle, which is supposed to be perpendicular to the plane of the paper. Denoting the distance AM by d_1, BM by d_2, and AB by l, we have for the force at M due to the magnetism of the rod

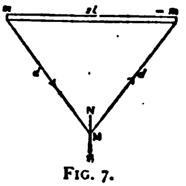

FIG. 7.

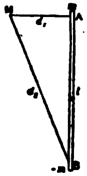

FIG. 8.

$$H_r = \frac{m}{d_1^2} - \text{horizontal component of } \frac{m}{d_2^2}$$
$$= m\left(\frac{1}{d_1^2} - \frac{d_1}{d_2^3}\right).$$

Therefore $$m = \frac{H_r}{\frac{1}{d_1^2}-\frac{d_1}{d_2^3}} = \frac{d_1^2 H_E}{1-\left(\frac{d_1}{d_2}\right)^3}\tan\theta,$$

and $$I = \frac{l d_1^2 H_E}{v\left\{1-\left(\frac{d_1}{d_2}\right)^3\right\}}\tan\theta. \qquad (47)$$

This last method of arrangement is called by Ewing the "one-pole" method, because the magnetometer deflection is mainly caused by the upper pole of the rod (*Magnetic Induction*, p. 40). For experiments with long thin rods or wires it has an advantage over the other arrangements in that the position of the poles need not be known with great accuracy, a small upward or downward displacement having little effect upon the magnetometer deflection. On the other hand, a vertically placed rod is subject to the inconvenience that it is influenced by the earth's magnetic field, which is not the case when the rod is horizontal and at right angles to the magnetic meridian. This extraneous influence may, however, be eliminated by surrounding the rod with a coil of wire carrying a current such as will produce in the interior a magnetic field equal and opposite to the vertical component of the earth's field.

If the cardboard scale upon which the beam of light is reflected by the magnetometer mirror is a flat one, the deflections as indicated by the movement of the spot of light are related to the actual deflections of the needle in the ratio of $\tan 2\theta$ to θ. Since θ is always small, sufficiently accurate results may generally be obtained if we assume that $\tan 2\theta = 2\tan\theta$. If the distance of the mirror from the scale is equal to n scale divisions, and if a deflection θ of the needle causes the reflected spot of light to move over s scale divisions, we shall have

$$s/n = \tan 2\theta \text{ exactly,}$$
$$s/2n = \tan\theta \text{ approximately.}$$

We may therefore generally substitute $s/2n$ for $\tan\theta$ in the various expressions which have been given for I.

Of the three methods which have been described, the first two are generally the most suitable for determining the moment or the magnetization of a permanent magnet, and the last for studying the changes which occur in the magnetization of a long rod or wire when subjected to various external magnetic forces, or, in other words, for determining the relation of I to H. A plan of the apparatus as arranged by Ewing for the latter purpose is shown diagrammatically in fig. 9. The cardboard scale SS is placed above a wooden screen, having in it a narrow vertical slit which permits a beam of light from the lamp L to reach the mirror of the magnetometer M, whence it is reflected upon the scale. A is the upper end of a glass tube, half a metre or so in length, which is clamped in a vertical position behind the magnetometer. The tube is wound over its whole length with two separate coils of insulated wire, the one being outside the other. The inner coil is supplied, through the intervening apparatus, with current from the battery of secondary cells B_1; this produces the desired magnetic field inside the tube. The outer coil derives current, through an adjustable resistance R, from a constant cell B_2; its object is to produce inside the tube a magnetic field equal and opposite to that due to the earth's magnetism. C is a "compensating coil" consisting of a few turns of wire through which the magnetizing current passes; it serves to neutralize the effect produced upon the magnetometer by the magnetizing coil, and its distance from the magnetometer is so adjusted that when the circuit is closed, no ferromagnetic metal being inside the magnetizing coil, the magnetometer needle undergoes no deflection. K is a commutator for reversing the direction of the magnetizing current, and G a galvanometer for measuring it. The strength of the magnetizing current is regulated by adjusting the position of the sliding contact E upon the resistance D. F. The current increases to a maximum as E approaches F, and diminishes to almost nothing when E is brought up to D; it can be completely interrupted by means of the switch H.

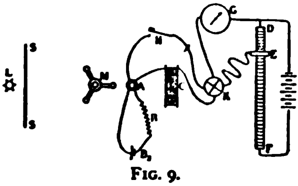

FIG. 9.

The specimen upon which an experiment is to be made generally consists of a wire having a "dimensional ratio" of at least 300 or 400; its length should be rather less than that of the magnetizing coil, in order that the field H_0, to which it is subjected, may be approximately uniform from end to end. The wire is supported inside the glass tube A with its upper pole at the same height as the magnetometer needle. Various currents are then passed through the magnetizing coil, the galvanometer readings and the simultaneous magnetometer deflections being noted. From the former we deduce H_0, and from the latter the corresponding value of I, using the formulae $H_0 = 4\pi in/l$ and

$$I = \frac{d_1{}^2 H_E}{2n\pi r^2 \left\{1 - \left(\frac{d_1}{d_2}\right)^3\right\}} \times s, \qquad (48)$$

where s is the deflection in scale-divisions, n the distance in scale-divisions between the scale and the mirror, and r the radius of the wire.

The curve, fig. 10, shows the result of a typical experiment made upon a piece of soft iron (Ewing, *Phil. Trans.* vol. clxxvi. Plate 59), the magnetizing field H_0 being first gradually increased and then diminished to zero. When the length of the wire exceeds 400 diameters, or thereabouts, H_0 may generally be considered as equivalent to H, the actual strength of the field as modified by the magnetization of the wire; but if greater accuracy is desired, the value of H, $(=\bar{N}I)$ may be found by the help of du Bois's table and subtracted from H_0. For a dimensional ratio of 400, $\bar{N} = 0{\cdot}00028$, and therefore $H = H_0 - 0{\cdot}00028\,I$. This correction may be indicated in the diagram by a straight line drawn from 0 through the point at which the line of $I = 1000$ intersects that of $H = 0{\cdot}28$ (Rayleigh, *Phil. Mag.* xxii. 175), the true value of H for any point on the curve being that measured from the sloping line instead of from the vertical axis. The effect of the ends of the wire is, as Ewing remarks, to *shear* the diagram in the horizontal direction through the angle which the sloping line makes with the vertical.

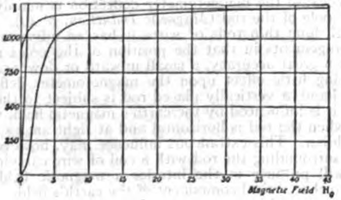

FIG. 10.

Since the induction B is equal to $H + 4\pi I$, it is easy from the results of experiments such as that just described to deduce the relation between B and H; a curve indicating such relation is called a curve of induction. The general character of curves of magnetization and of induction will be discussed later. A notable feature in both classes of curves is that, owing to hysteresis, the ascending and descending limbs do not coincide, but follow very different courses. If it is desired to annihilate the hysteretic effects of previous magnetization and restore the metal to its original condition, it may be demagnetized by reversals. This is effected by slowly moving the sliding contact E (fig. 9) from F to D, while at the same time the commutator K is rapidly worked, a series of alternating currents of gradually diminishing strength being thus caused to pass through the magnetizing coil.

The magnetometric method, except when employed in connexion with ellipsoids, for which the demagnetizing factors are accurately known, is generally less satisfactory for the exact determination of induction or magnetization than the ballistic method. But for much important experimental work it is better adapted than any other, and is indeed sometimes the only method possible.[1]

Ballistic Methods.—The so-called "ballistic" method of measuring induction is based upon the fact that a change of the induction through a closed linear conductor sets up in the conductor an electromotive force which is proportional to the rate of change. If the conductor consists of a coil of wire the ends of which are connected with a suitable galvanometer, the integral electromotive force due to a sudden increase or decrease of the induction through the coil displaces in the circuit a quantity of electricity $Q = \delta B ns/R$, where δB is the increment or decrement of induction per square centimetre, s is the area of the coil, n the number of turns of wire, and R the resistance of the circuit. Under the influence of the transient current, the galvanometer needle undergoes a momentary deflection, or "throw," which is proportional to Q, and therefore to δB, and thus, if we know the deflection produced by the discharge through the galvanometer of a given quantity of electricity, we have the means of determining the value of δB.

The galvanometer which is used for ballistic observations should have a somewhat heavy needle with a period of vibration of not less than five seconds, so that the transient current may have ceased before the swing has well begun; an instrument of the d'Arsonval form is recommended, not only because it is unaffected by outside magnetic influence, but also because the moving part can be instantly brought to rest by means of a short-circuit key, thus effecting a great saving of time when a series of observations is being made. In practice it is usual to standardize or "calibrate" the galvanometer by causing a known change of induction to take place within a standard coil connected with it, and noting the corresponding deflection on the galvanometer scale. Let s be the area of a single turn of the standard coil, n the number of its turns, and r the resistance of the circuit of which the coil forms part; and let S, N and R be the corresponding constants for a coil which is to be used in an experiment. Then if a known change of induction δB_s inside the standard coil is found to cause a throw of d scale-divisions, any change of induction δB through the experimental coil will be numerically equal to the corresponding throw D multiplied by $snRB_s/SNrd$. For a series of experiments made with the same coil this fraction is constant, and we may write $\delta B = kD$. Rowland and others have used an earth coil for calibrating the galvanometer, a known change of induction through the coil being produced by turning it over in the earth's magnetic field, but for several reasons it is preferable to employ an electric current as the source of a known induction. A primary coil of length l, having n turns, is wound upon a cylinder made of non-conducting and non-magnetic material, and upon the middle of the primary a secondary or induction coil is closely fitted. When a current of strength i is suddenly interrupted in the primary, the increment of induction through the secondary is sensibly equal to $4\pi in/l$ units. All the data required for standardizing the galvanometer can in this way be determined with accuracy.

The ballistic method is largely employed for determining the relation of induction to magnetizing force in samples of the iron and steel used in the manufacture of electrical machinery, and especially for the observation of hysteresis effects. The sample may have the form of a closed ring, upon which are wound the induction coil and another coil for taking the magnetizing current; or it may consist of a long straight rod or wire which can be slipped into a magnetizing coil such as is used in magnetometric experiments, the induction coil being wound upon the middle of the wire. With these arrangements there is no demagnetizing force to be considered, for the ring has not any ends to produce one, and the force due to the ends of a rod 400 or 500 diameters in length is quite insensible at the middle portion; H therefore is equal to H_0.

E. Grassot has devised a galvanometer, or "fluxmeter," which greatly alleviates the tedious operation of taking ballistic readings.[2] The instrument is of the d'Arsonval type; its coil turns in a strong uniform field, and is suspended in such a manner that torsion is practically negligible, the swings of the coil being limited by damping influences, chiefly electromagnetic. The index therefore remains almost stationary at the limit of its deflection, and the deflection is approximately the same whether the change of induction occurs suddenly or gradually.

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[1] See C. G. Lamb, *Proc. Phys. Soc.*, 1899, 16, 517.

[2] *Soc. Franc. Phys. Séances*, 1904, 1, 27.

Induction and Hysteresis Curves.—Some typical induction curves, copied from a paper by Ewing (*Proc. Inst. C.E.* vol. cxxvi.), are given in figs. 11, 12 and 13. Fig. 11 shows the relation of B to H in a specimen which has never before been magnetized. The experiment may be made in two different ways: (1) the magnetizing current is increased by a series of sudden steps, each of which produces a ballistic throw, the value of B after any one throw being proportional to the sum of that and all the previous throws; (2) the magnetizing current having been brought to any desired value, is suddenly reversed, and the observed throw taken as measuring twice the actual induction. Fig. 12 shows the nature of the course taken by the curve when the magnetizing current, after having been raised to the value corresponding to the point *a*, is diminished by steps until it is nothing, and then gradually increased in the reverse direction. The downward course of the curve is, owing to hysteresis, strikingly different from its upward course, and when the magnetizing force has been reduced to zero, there is still remaining an induction of 7500 units. If the operation is again reversed, the upward course will be nearly, but not exactly, of the form shown by the line *d e a*, fig. 13. After a few repetitions of the reversal, the process becomes strictly cyclic, the upward and downward curves always following with precision the paths indicated in the figure. In order to establish the cyclic condition, it is sufficient to apply alternately the greatest positive and negative forces employed in the test (greatest H = about ± 5 C.G.S. units in the case illustrated in the figure), an operation which is performed by simply reversing the direction of the maximum magnetizing current a few times.

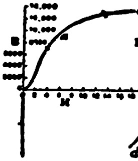

FIG. 11.

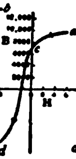

FIG. 12.

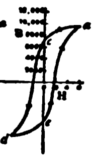

FIG. 13.

The closed figure *a c d e a* is variously called a *hysteresis curve* or *diagram* or *loop*. The area $\int HdB$ enclosed by it represents the work done in carrying a cubic centimetre of the iron through the corresponding magnetic cycle; expressed in ergs this work is $\frac{1}{4\pi}\int HdB$.[1] To quote an example given by J. A. Fleming, it requires about 18 foot-pounds of work to make a complete magnetic cycle in a cubic foot of wrought iron, strongly magnetized first one way and then the other, the work so expended taking the form of heat in the mass.

Fig. 14 shows diagrammatically a convenient arrangement described by Ewing (see *Proc. Inst. C.E.* vol. cxxvi., and *Phil. Trans.*, 1893A, p. 987) for carrying out ballistic tests by which either the simple B-H curve (fig. 11) or the hysteresis curve (figs. 12 and 13) can be determined. The sample under test is prepared in the form of a ring A, upon which are wound the induction and the magnetizing coils; the latter should be wound evenly over the whole ring, though for the sake of clearness only part of the winding is indicated in the diagram. The magnetizing current, which is derived from the storage battery B, is regulated by the adjustable resistance R and measured by the galvanometer G. The current passes through the rocking key K, which, when thrown over to the right, places *a* in contact with *c* and *b* with *d*, and when thrown over to the left, places *a* in contact with *e* and *b* with *f*. When the switch S is closed, K acts simply as a commutator or current-reverser, but if K is thrown over from right to left while S is opened, not only is the current reversed, but its strength is at the same time diminished by the interposition of the adjustable resistance R_2. The induction coil wound upon the ring is connected to the ballistic galvanometer G_2 in series with a large permanent resistance R_3. In the same circuit is also included the induction coil E, which is used for standardizing the galvanometer; this secondary coil is represented in the diagram by three turns of wire wound over a much longer primary coil. The short-circuit key F is kept closed except when an observation is about to be made; its object is to arrest the swing of the d'Arsonval galvanometer G_2. By means of the three-way switch C the battery current may be sent either into the primary of E, for the purpose of calibrating the galvanometer, or into the magnetizing coil of the ring under test. When it is desired to obtain a simple curve of induction, such as that in fig. 11, S is kept permanently closed, and corresponding values of H and B are determined by one of the two methods already described, the strength of the battery-current being varied by means of the adjustable resistance R. When a hysteresis curve is to be obtained, the procedure is as follows: The current is first adjusted by means of R to such a strength as will fit it to produce the greatest + and − values of the magnetizing force which it is intended to apply in the course of the cycle; then it is reversed several times, and when the range of the galvanometer throws has become constant, half the extent of an excursion indicates the induction corresponding to the extreme value of H, and gives the point *a* in the curve fig. 12. The reversing key K having been put over to the left side, the short-circuit key S is suddenly opened; this inserts the resistance R, which has been suitably adjusted beforehand, and thus reduces the current and therefore the magnetizing force to a known value. The galvanometer throw which results from the change of current measures the amount by which the induction is reduced, and thus a second point on the curve is found. In a similar manner, by giving different values to the resistance R, any desired number of points between *a* and *c* in the curve can be determined. To continue the process, the key K is turned over to the right-hand side, and then, while S is open, is turned back, thereby not only reversing the direction of the current, but diminishing its strength by an amount depending upon the previous adjustment of R_2. In this way points can be found lying anywhere between *c* and *d* of fig. 12, and the determination of the downward limb of the curve is therefore completed. As the return curve, shown in fig. 13, is merely an inverted copy of the other, no separate determination of it is necessary.

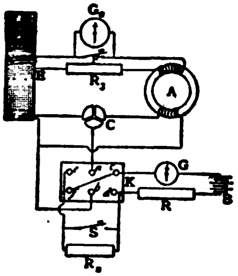

FIG. 14.

In fig. 15 (J. A. Fleming, *Magnets and Electric Currents*, p. 193) are shown three very different types of hysteresis curves, characteristic of the special qualities of the metals from which they were respectively obtained. The distinguishing feature of the first is the steepness of its outlines; this indicates that the induction increases rapidly in relation to the magnetic force, and hence the metal is well suited for the construction of dynamo magnets. The second has a very small area, showing that the work done in reversing the magnetization is small; the metal is therefore adapted for use in alternating current transformers. On the other hand, the form of the third curve, with its large intercepts on the axes of H and B, denotes that the specimen to which it relates possesses both retentiveness and coercive force in a high degree; such a metal would be chosen for making good permanent magnets.

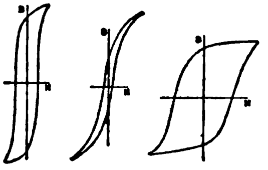

FIG. 15.

Several arrangements have been devised for determining hysteresis more easily and expeditiously than is possible by the ballistic method. The best known is J. A. Ewing's hysteresis-tester,[2] which is specially intended for testing the sheet iron used in transformers. The sample, arranged as a bundle of rectangular strips, is caused to rotate about a central horizontal axis between the poles of an upright C-shaped magnet, which is supported near its middle upon knife-edges in such a manner that it can oscillate about an axis in a line with that about which the specimen rotates; the lower side of the magnet is weighted, to give it some stability. When the specimen rotates, the magnet is deflected from its upright position by an amount which depends upon the work done in a single complete rotation, and therefore upon the hysteresis. The deflection is indicated by a pointer upon a graduated scale, the readings being interpreted by comparison with two standard specimens supplied with the instrument. G. F. Searle and T. G. Bedford[3] have introduced the method of measuring hysteresis by means of an electro-dynamometer used ballistically. The fixed and suspended coils of the dynamometer are respectively connected in series with the magnetizing solenoid and with a secondary wound upon the specimen. When the magnetizing current is twice reversed, so as to complete a cycle, the sum of the two deflections, multiplied by a factor depending upon the sectional area of the specimen and upon the constants of the apparatus, gives the hysteresis for a complete cycle in ergs per cubic centimetre. For specimens of large sectional area it is necessary to apply corrections in respect of the energy dissipated by eddy currents and in heating the secondary circuit. The method has been employed by the authors themselves in studying the effects of tension torsion and circular magnetization, while R. L. Wills[1] has made successful use of it in a research on the effects of temperature, a matter of great industrial importance.

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[1] E. G. Warburg, *Wied. Ann.* 1881, 13, 141; Ewing, *Phil. Trans.*, 1885, 176, 549; Hopkinson, *Phil. Trans.* 1885, 176, 466. For a simple proof, see Ewing, *Magnetic Induction* (1900), p. 99. Hopkinson pointed out that the greatest dissipation of energy which can be caused by a to-and-fro reversal is approximately represented by *Coercive force × maximum induction /π*.

[2] *Magnetic Induction*, 1900, 378.

[3] *Phil. Trans.*, 1902, 198, 33.

C.P Steinmetz (*Electrician*, 1891, 26, p. 261, 1892, 28, pp. 384, 408, 425) has called attention to a simple relation which appears to exist between the amount of energy dissipated in carrying a piece of iron or steel through a magnetic cycle and the limiting value of the induction reached in the cycle Denoting by W the work in ergs done upon a cubic centimetre of the metal $\left(=\frac{1}{4\pi}\int HdB \text{ or} \int HdI\right)$, he finds $W=\eta B^{1\cdot6}$ approximately, where η is a number, called the *hysteretic constant*, depending upon the metal, and B is the maximum induction. The value of the constant η ranges in different metals from about 0·001 to 0·04, in soft iron and steel it is said to be generally not far from 0·002. Steinmetz's formula may be tested by taking a series of hysteresis curves between different limits of B, measuring their areas by a planimeter, and plotting the logarithms of these divided by 4π as ordinates against logarithms of the corresponding maximum values of B as abscissae. The curve thus constructed should be a straight line inclined to the horizontal axis at an angle θ, the tangent of which is 1·6. Ewing and H. G. Klaassen (*Phil. Trans.*, 1893, 184, 1017) have in this manner examined how nearly and within what range a formula of the type $W=\eta B^{\epsilon}$ may be taken to represent the facts. The results of an example which they quote in detail may be briefly summarized as follows:—

Limits of B	Hysteretic Constant. η	Index. $\epsilon(=\tan\theta)$	Degrees. θ
200 to 500	...	1·9	62·25
500 to 1,000	...	1·68	59·25
1,000 to 2,000	...	1·55	57·25
2,000 to 8,000	0.01	1·475	55·75
8,000 to 14,000	0·00134	1·70	59·50

It is remarked by the experimenters that the value of the index ϵ is by no means constant, but changes in correspondence with the successive well-marked stages in the process of magnetization But though a formula of this type has no physical significance, and cannot be accepted as an equation to the actual curve of W and B, it is, nevertheless, the case that by making the index $\epsilon=1\cdot6$, and assigning a suitable value to η, a formula may be obtained giving an approximation to the truth which is sufficiently close for the ordinary purposes of electrical engineers, especially when the limiting value of B is neither very great nor very small. Alexander Siemens (*Journ. Inst. Eng.*, 1894, 23, 229) states that in the hundreds of comparisons of test pieces which have been made at the works of his firm, Steinmetz's law has been found to be practically correct.[2] An interesting collection of W–B curves embodying the results of actual experiments by Ewing and Klaassen on different specimens of metal is given in fig 16. It has been shown by Kennelly (*Electrician*, 1892, 28, 666) that Steinmetz's formula gives approximately correct results in the case of nickel. Working with two different specimens, he found that the hysteresis loss in ergs per cubic centimetre (W) was fairly represented by $0\cdot00125B^{1\cdot6}$ and $0\cdot00101B^{1\cdot6}$ respectively, the maximum induction ranging from about 300 to 3000. The applicability of the law to cobalt has been investigated by Fleming (*Phil. Mag.*, 1899, 48, 271), who used a ring of cast cobalt containing about 96% of the pure metal. The logarithmic curves which accompany his paper demonstrate that within wide ranges of maximum induction $W=0\cdot01B^{1\cdot6}=0\cdot527I^{1\cdot63}$ very nearly. Fleming rightly regards it as not a little curious that for materials differing so much as this cast cobalt and soft annealed iron the hysteretic exponent should in both cases be so near to 1·6. After pointing out that, since the magnetization of the metal is the quantity really concerned, W is more appropriately expressed in terms of I, the magnetic moment per unit of volume, than of B, he suggests an experiment to determine whether the mechanical work required to effect the complete magnetic reversal of a crowd of small compass needles (representative of magnetic molecules) is proportional to the 1·6th power of the aggregate maximum magnetic moment before or after completion of the cycle.

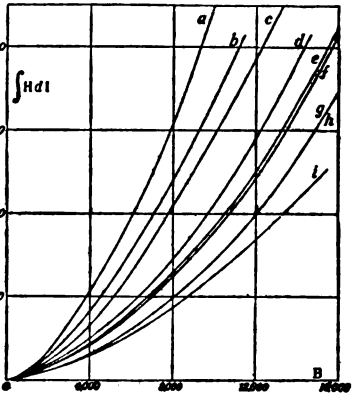

FIG. 16.

a, Fine steel wire 0·257 mm. diam.
b, Fine iron wire 0·34 mm. diam.
c, Fine iron wire 0·2475 mm. diam.
d, Thin sheet iron 0·47 mm. thick.
e, Iron wire 0·602 mm. diam.
f, Iron wire 0·975 mm. diam.
g, Sheet iron 1·95 mm. thick.
h, Thin sheet iron 0·367 mm. thick.
i, Very soft iron wire.

The experiments of K. Honda and S. Shimizu[3] indicate that Steinmetz's formula holds for nickel and annealed cobalt up to B = 3000, for cast cobalt and tungsten steel up to B = 8000, and for Swedish iron up to B = 18,000, the range being in all cases extended at the temperature of liquid air.

The diagram, fig. 17, contains examples of ascending induction curves characteristic of wrought iron, cast iron, cobalt and nickel.

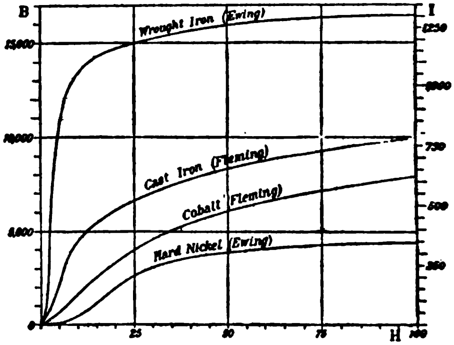

FIG. 17.

These are to be regarded merely as typical specimens, for the details of a curve depend largely upon the physical condition and purity of the material; but they show at a glance how far the several metals differ from and resemble one another as regards their magnetic properties. Curves of magnetization (which express the relation of I to H) have a close resemblance to those of induction; and, indeed, since $B=H+4\pi I$, and $4\pi I$ (except in extreme fields) greatly exceeds H in numerical value, we may generally, without serious error, put $I=B/4\pi$, and transform curves of induction into curves of magnetization by merely altering the scale to which the ordinates are referred. A scale for the approximate transformation for the curves in fig. 12 is given at the right-hand side of the diagram, the greatest error introduced by neglecting $H/4\pi$ not exceeding 0·6%. A study of such curves as these reveals the fact that there are three distinct stages in the process of magnetization. During the first stage, when the magnetizing force is small, the magnetization (or the induction) increases rather slowly with increasing force; this is well shown by the nickel curve in the diagram, but the effect would be no less conspicuous in the iron curve if the abscissae were plotted to a larger scale. During the second stage small increments of magnetizing force are attended by relatively large increments of magnetization, as is indicated by the steep ascent of the curve. Then the curve bends over, forming what is often called a "knee," and a third stage is entered upon, during which a considerable increase of magnetizing force has little further effect upon the magnetization. When in this condition the metal is popularly said to be "saturated." Under increasing magnetizing forces, greatly exceeding those comprised within the limits of the diagram, the magnetization does practically reach a limit, the maximum value being attained with a magnetizing force of less than 2000 for wrought iron and nickel, and less than 4000 for cast iron and cobalt. The induction, however, continues to increase indefinitely, though very slowly. These observations have an important bearing upon the molecular theory of magnetism, which will be referred to later.

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[1] *Phil. Mag.*, 1903, 5, 117.

[2] Some experiments by F. G. Baily showed that hysteresis ceased to increase when B was carried beyond 23,000. This value of B corresponds to I = 1640, the saturation point for soft iron.—*Brit. Assoc. Rep.*, 1895, p. 636.

[3] *Tokyo Phys.-Math. Soc.*, 1904, 2, No. 14.

The magnetic quality of a sample of iron depends very largely upon the purity and physical condition of the metal. The presence of ordinary impurities usually tends to diminish the permeability, though, as will appear later, the addition of small quantities of certain other substances is sometimes advantageous. A very pure form of iron, which from the method of its manufacture is called "steel," is now extensively used for the construction of dynamo magnets; this metal sometimes contains not more than 0·3% of foreign substances, including carbon, and is magnetically superior to the best commercial wrought iron. The results of some comparative tests published by Ewing (*Proc. Inst. C.E.*, 1896) are given in the accompanying table. Those in the second column are quoted from a paper by F. Lydall and A. W. Pocklington (*Proc. Roy. Soc.*, 1892, 52, 228) and relate to an exceptional specimen containing nearly 99·9% of the pure metal.

Magnetic Force.	Magnetic Induction.			
	Pure Iron.	Low Moor Iron.	Steel Forging.	Steel Casting.
5	12,700	10,900	12,300	9,600
10	14,980	13,120	14,920	13,050
15	15,800	14,010	15,800	14,600
20	16,300	14,580	16,280	15,310
30	16,950	15,280	16,810	16,000
40	17,350	15,760	17,190	16,510
50	..	16,060	17,500	16,900
60	..	16,340	17,750	17,180
70	..	16,580	17,970	17,400
80	..	16,800	18,180	17,620
90	..	17,000	18,390	17,830
100	..	17,200	18,600	18,030

To secure the highest possible permeability it is essential that the iron should be softened by careful annealing. When it is mechanically hardened by hammering, rolling or wire-drawing its permeability may be greatly diminished, especially under a moderate magnetizing force. An experiment by Ewing showed that by the operation of stretching an annealed iron wire beyond the limits of elasticity the permeability under a magnetizing force of about 3 units was reduced by as much as 75%. Ewing has also studied the effect of vibration in conferring upon iron an apparent or spurious permeability of high value; this effort also is most conspicuous when the magnetizing force is weak. The permeability of a soft iron wire, which was tapped while subjected to a very small magnetizing force, rose to the enormous value of about 80,000 (*Magnetic Induction*, § 85). It follows that in testing iron for magnetic quality the greatest care must be exercised to guard the specimen against any accidental vibration.

Low hysteresis is the chief requisite for iron which is to be used for transformer cores, and it does not necessarily accompany high permeability. In response to the demand, manufacturers have succeeded in producing transformer plate in which the loss of energy due to hysteresis is exceedingly small. Tests of a sample supplied by Messrs. Sankey were found by Ewing to give the following results, which, however, are regarded as being unusually favourable. In a valuable collection of magnetic data (*Proc. Inst. C.E.*, cxxvi.) H. F. Parshall quotes tests of six samples of iron, described as of good quality, which showed an average hysteresis loss of 3070 ergs per c.cm. per cycle at an induction of 8000, being 1·6 times the loss shown by Ewing's specimen at the same induction.

Limits of Induction.	Ergs per c.cm. per cycle.	Watts per lb. Frequency, 100.
2000	220	0·129
3000	410	0·242
4000	640	0·376
5000	910	0·535
6000	1200	0·710
7000	1520	0·890
8000	1900	1·120
9000	2310	1·360

The standard induction in reference to determinations of hysteresis is generally taken as 2500, while the loss is expressed in watts per lb at a frequency of 100 double reversals, or cycles, per second. In many experiments, however, different inductions and frequencies are employed, and the hysteresis-loss is often expressed as ergs per cubic centimetre per cycle and sometimes as horse-power per ton. In order to save arithmetical labour it is convenient to be provided with conversion factors for reducing variously expressed results to the standard form. The rate at which energy is lost being proportional to the frequency, it is obvious that the loss at frequency 100 may be deduced from that at any other frequency n by simply multiplying by $100\ n$. Taking the density of iron to be 7·7, the factor for reducing the loss in ergs per c.cm. to watts per lb with a frequency of 100 is 0·000589 (Ewing). Since 1 horse-power = 746 watts, and 1 ton = 2240 lb, the factor for reducing horse-power per ton to watts per lb is 746/2240, or just 1/3. The loss for any induction B within the range for which Steinmetz's law holds may be converted into that for the standard induction 2500 by dividing it by $B^{1\cdot6}/2500^{1\cdot6}$. The values of this ratio for different values of B, as given by Fleming (*Phil. Mag.*, 1897), are contained in the second column of the annexed table. The third column shows the relative amount of hysteresis deduced by Ewing as a general mean from actual tests of many samples (*Journ. Inst. Elec. Eng.*, 1895). Incidentally, these two columns furnish an undesigned test of the accuracy of Steinmetz's law: the greatest difference is little more than 1%.

Induction B.	$\frac{B^{1\cdot6}}{2500^{1\cdot6}}$	Observed relative Hysteresis.
2000	0·700	0·702
2500	1·000	1·000
3000	1·338	1·340
4000	2·118	2·128
5000	3·031	3·000
6000	4·058	4·022
7000	5·193	5·129
8000	6·430	6·384

Curves of Permeability and Susceptibility.—The relations of $\mu\ (=B/H)$ to B, and of $\kappa\ (=I/H)$ to I may be instructively exhibited by means of curves, a method first employed by H. A. Rowland.[1] The dotted curve for μ and B in fig. 18 is copied from Rowland's paper. The actual experiment to which it relates was carried only as the point marked X, corresponding to a magnetizing force of 65, and an induction of nearly 17,000. Rowland, believing that the curve would continue to fall in a straight line meeting the horizontal axis, inferred that the induction corresponding to the point B—about 17,500—was the highest that could be produced by any magnetizing force, however great. It has, however, been shown that, if the magnetizing force is carried far enough, the curve always becomes convex to the axis instead of meeting it. The full line shows the result of an experiment in which the magnetizing force was carried up to 585,[1] but though the force was thus increased ninefold, the induction only reached 19,800, and the ultimate value of the permeability was still as much as 33·9.

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[1] *Phil. Mag.*, 1873, 46, 140.

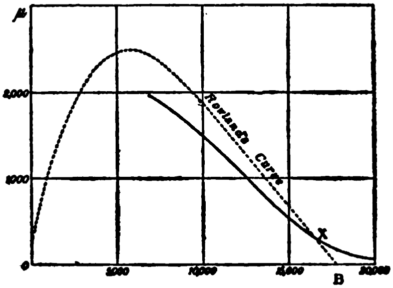

FIG. 18.

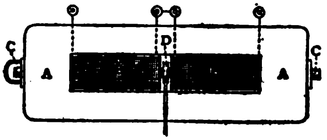

FIG. 19.

Ballistic Method with Yoke.—J. Hopkinson (*Phil. Trans.*, 1885, 176, 455) introduced a modification of the usual ballistic arrangement which presents the following advantages: (1) very considerable magnetizing forces can be applied with ordinary means; (2) the samples to be tested, having the form of cylindrical bars, are more easily prepared than rings or wires; (3) the actual induction at any time can be measured, and not only changes of induction. On the other hand, a very high degree of accuracy is not claimed for the results. Fig. 19 shows the apparatus by which the ends of the bar are prevented from exerting any material demagnetizing force, while the permeance of the magnetic circuit is at the same time increased. A A, called the "yoke," is a block of annealed wrought iron about 18 in. long, 6½ in. wide and 2 in. thick, through which is cut a rectangular opening to receive the two magnetizing coils B B. The test bar C C, which slides through holes bored in the yoke, is divided near the middle into two parts, the ends which come into contact being faced true and square. Between the magnetizing coils is a small induction coil D, which is connected with a ballistic galvanometer. The induction coil is carried upon the end of one portion of the test bar, and when this portion is suddenly drawn back the coil slips off and is pulled out of the field by an india-rubber spring. This causes a ballistic throw proportional to the induction through the bar at the moment when the two portions were separated. With such an arrangement it is possible to submit the sample to any series of magnetic forces, and to measure its magnetic state at the end. The uncertainty with which the results are affected depends chiefly upon the imperfect contact between the bar and the yoke and also between the ends of the divided bar. It is probable that Hopkinson did not attach sufficient importance to the demagnetizing action of the cut (cf. Ewing, *Phil. Mag*, Sept. 1888, p. 274), and that the values which he assigned to H are consequently somewhat too high. He applied his method with good effect, however, in testing a large number of commercial specimens of iron and steel, the magnetic constants of which are given in a table accompanying his paper. When it is not required to determine the residual magnetization there is no necessity to divide the sample bar, and ballistic tests may be made in the ordinary way—by steps or by reversals—the source of error due to the transverse cut thus being avoided. Ewing (*Magnetic Induction*, § 194) has devised an arrangement in which two similar test bars are placed side by side; each bar is surrounded by a magnetizing coil, the two coils being connected to give opposite directions of magnetization, and each pair of ends is connected by a short massive block of soft iron having holes bored through it to fit the bars, which are clamped in position by set-screws. Induction coils are wound on the middle parts of both bars, and are connected in series. With this arrangement it is possible to find the actual value of the magnetizing force, corrected for the effects of joints and other sources of error. Two sets of observations are taken, one when the blocks are fixed at the ends of the bars, and another when they are nearer together, the clear length of the bars between them and of the magnetizing coils being reduced to one-half. If H_1 and H_2 be the values of $4\pi in/l$ and $4\pi i'\frac{n}{2}\Big/\frac{l}{2}$ for the same induction B, it can be shown that the true magnetizing force is $H = H_1 - (H_2 - H_1)$. The method, though tedious in operation, is very accurate, and is largely employed for determining the magnetic quality of bars intended to serve as standards.

Traction Methods.—The induction of the magnetization may be measured by observing the force required to draw apart the two portions of a divided rod or ring when held together by their mutual attraction. If a transverse cut is made through a bar whose magnetization is I and the two ends are placed in contact, it can be shown that this force is $2\pi I^2$ dynes per unit of area (Mascart and Joubert, *Electricity and Magnetism*, § 322; and if the magnetization of the bar is due to an external field H produced by a magnetizing coil or otherwise, there is an additional force equal to HI. Thus the whole force, when the two portions of the bar are surrounded by a loosely-fitting magnetizing coil, is

$$F = 2\pi I^2 + HI$$

expressed as dynes per square centimetre. If each portion of the bar has an independent magnetizing coil wound tightly upon it, we have further to take into account the force due to the mutual action of the two magnetizing coils, which assists the forces already considered. This is equal to $H^2\,8\pi$ per unit of sectional area. In the case supposed therefore the total force per square centimetre is

$$F = 2\pi I^2 + HI + \frac{H^2}{8\pi}$$
$$= \frac{(4\pi I + H)^2}{8\pi}$$
$$= \frac{B^2}{8\pi}.$$

The equation $F = B^2/8\pi$ is often said to express "Maxwell's law of magnetic traction" (Maxwell, *Electricity and Magnetism*, §§ 642–646). It is, of course, true for permanent magnets, where $H = 0$, since then $F = 2\pi I^2$; but if the magnetization is due to electric currents, the formula is only applicable in the special case when the mutual action of the two magnets upon one another is supplemented by the electromagnetic attraction between separate magnetizing coils rigidly attached to them.[2]

The traction method was first employed by S. Bidwell (*Proc. Roy. Soc.*, 1886, 40, 486), who in 1886 published an account of some experiments in which the relation of magnetization to magnetic field was deduced from observations of the force in grammes weight which just sufficed to tear asunder the two halves of a divided ring electro-magnet when known currents were passing through the coils. He made use of the expression

$$F = Wg = 2\pi I^2 + HI,$$

where W is the weight in grammes per square centimetre of sectional area, and g is the intensity of gravity which was taken as 981. The term for the attraction between the coils was omitted as negligibly small (see *Phil. Mag.*, 1890, 29, 440). The values assigned to H were calculated from $H = 2ni/r$, and ranged from 3·9 to 585, but inasmuch as no account was taken of any demagnetizing action which might be due to the two transverse cuts, it is probable that they are somewhat too high. The results, nevertheless, agree very well with those for annealed wrought iron obtained by other methods. Below is given a selection from Bidwell's tables, showing corresponding values of magnetizing force, weight supported, magnetization, induction, susceptibility and permeability:—

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[1] S. Bidwell, *Proc. Roy. Soc.*, 1886, 40, 495.

[2] Since in most practicable experiments H^2 is negligible in comparison with B^2, the force may be taken as $B^2/8\pi$ without sensible error.

H.	W.	I.	B.	κ.	μ.
3·9	2,210	587	7,390	151·0	1889·1
5·7	3,460	735	9,240	128·9	1621·3
10·3	5,400	918	11,550	89·1	1121·4
22·2	8,440	1147	14,450	51·7	650·9
40	9,680	1226	15,460	30·7	386·4
115	12,170	1370	17,330	11·9	150·7
208	13,810	1452	18,470	7·0	88·8
362	14,740	1489	19,080	4·1	52·7
465	15,275	1508	19,420	3·2	41·8
585	15,905	1530	19,820	2·6	33·9

A few months later R. H. M. Bosanquet (*Phil. Mag.*, 1886, 22, 535) experimented on the relation of tractive force to magnetic induction. Instead of a divided ring he employed a divided straight bar, each half of which was provided with a magnetizing coil. The joint was surrounded by an induction coil connected with a ballistic galvanometer, an arrangement which enabled him to make an independent measurement of the induction at the moment when the two portions of the bar were separated. He showed that there was, on the whole, a fair agreement between the values determined ballistically and those given by the formula $B = \sqrt{8\pi F}$. The greatest weight supported in the experiments was 14,600 grammes per square cm., and the corresponding induction 18,500 units. Taylor Jones subsequently found a good agreement between the theoretical and the observed values of the tractive force in fields ranging up to very high intensities (*Phil. Mag.*, 1895, 39, 254, and 1896, 41, 153).

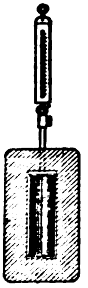
FIG. 20.

Permeameters.—Several instruments in which the traction method is applied have been devised for the rapid measurement of induction or of magnetization in commercial samples of iron and steel. The earliest of these is S. P. Thompson's *permeameter* (*Journ. Sci. Arts*, 1890, 38, 885), which consists of a rectangular block of iron shaped like Hopkinson's yoke, and slotted out in the same way to receive a magnetizing coil (fig. 20); the block is bored through at the upper end only, and its inner face opposite the hole is made quite flat and smooth. The sample has the form of a thin rod, one end of which is faced true; it is slipped into the magnetizing coil from above, and when the current is turned on its smooth end adheres tightly to the surface of the yoke. The force required to detach it is measured by a registering spring balance, which is clamped to the upper end of the rod, and thence the induction or the magnetization is deduced by applying the formula

$$(B-H)^2/8\pi = 2\pi I^2 = Pg/S,$$

where P is the pull in grammes weight, S the sectional area of the rod in square cm., and $g = 981$. If the pull is measured in pounds and the area in square inches, the formula may be written $B = 1317 \times \sqrt{P/S} + H$. The instrument exhibited by Thompson would, without undue heating, take a current of 30 amperes, which was sufficient to produce a magnetizing force of 1000 units. A testing apparatus of a similar type devised by Gisbert Kapp (*Journ. Inst. Elec. Eng.* xxiii. 199) differs only in a few details from Thompson's permeameter. Ewing has described an arrangement in which the test bar has a soft-iron pole piece clamped to each of its ends; the pole pieces are joined by a long well-fitting block of iron, which is placed upon them (like the "keeper" of a magnet), and the induction is measured by the force required to detach the block. In all such measurements a correction should be made in respect of the demagnetizing force due to the joint, and unless the fit is very accurate the demagnetizing action will be variable. In the *magnetic balance* of du Bois (*Magnetic Circuit*, p. 346) the uncertainty arising from the presence of a joint is avoided, the force measured being that exerted between two pieces of iron separated from each other by a narrow air-gap of known width. The instrument is represented diagrammatically in fig. 21. The test-piece A, surrounded by a magnetizing coil, is clamped between two soft-iron blocks B, B′. Y Y′ is a soft iron yoke, which rocks upon knife-edges K and constitutes the beam of the balance. The yoke has two projecting pieces C, C′ at unequal distances from the knife-edges, and separated from the blocks B, B′ by narrow air-gaps. The play of the beam is limited by a stop S and a screw R, the latter being so adjusted that when the end Y of the beam is held down the two air-gaps are of equal width. W is a weight capable of sliding from end to end of the yoke along a graduated scale. When there is no magnetization, the yoke is in equilibrium; but as soon as the current is turned on the block C is drawn downwards as far as the screw R will allow, for, though the attractive forces F between B and C and between B′ and C′ are equal, the former has a greater moment. The weight W is moved along the scale until the yoke just tilts over upon the stop S; the distance of W from its zero position is then, as can easily be shown, proportional to F, and therefore to B^2, and approximately to I^2. The scale is graduated in such a manner that by multiplying the reading by a simple factor (generally 10 or 2) the absolute value of the magnetization is obtained. The actual magnetizing force H is of course less than that due to the coil; the corrections required are effected automatically by the use of a set of demagnetization lines drawn on a sheet of celluloid which is supplied with the instrument. The celluloid sheet is laid upon the squared paper, and in plotting a curve horizontal distances are reckoned from the proper demagnetization line instead of from the vertical axis. An improved but somewhat more complex form of the instrument is described in *Ann. d. Phys.*, 1900, 2, 317.

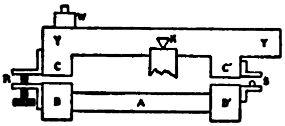

FIG. 21.

In Ewing's *magnetic balance* (*Journ. Inst. Elec. Eng.* 1898, 27, 526), the value of the magnetic induction corresponding to a single stated magnetizing force is directly read off on a divided scale. The specimen, which has the form of a turned rod, 4 in. long and ¼ in. in diameter, is laid across the poles of a horseshoe electromagnet, excited by a current of such strength as to produce in the rod a magnetizing force H = 20. One pole has a V-shaped notch for the rod to rest in; the surface of the other is slightly rounded, forming a portion of a cylinder, the axis of which is perpendicular to the direction of the length of the rod. The rod touches this pole at a single point, and is pulled away from it by the action of a lever, the long arm of which is graduated and carries a sliding weight. The position of the weight at the moment when contact is broken indicates the induction in the rod. The standard force H = 20 was selected as being sufficiently low to distinguish between good and bad specimens, and at the same time sufficiently high to make the order of merit the same as it would be under stronger forces.

Permeability Bridges.—Several pieces of apparatus have been invented for comparing the magnetic quality of a sample with that of a standard iron rod by a zero method, such as is employed in the comparison of electrical resistances by the Wheatstone bridge. An excellent instrument of the class is Ewing's *permeability bridge*. The standard rod and the test specimen, which must be of the same dimensions, are placed side by side within two magnetizing coils, and each pair of adjacent ends is joined by a short rectangular block or "yoke" of soft iron. An iron bar shaped like an inverted L projects upwards from each of the yokes, the horizontal portions of the bars being parallel to the rods, and nearly meeting at a height of about 8 in. above them (thus ┏ ┓). A compass needle placed in the gap serves to detect any flow of induction that may exist between the bent bars. For simplicity of calculation, the clear length of each rod between the yokes is made 12·56 ($= 4\pi$) centimetres, while the coil surrounding the standard bar contains 100 turns; hence the magnetizing force due to a current of n amperes will be $10n$ C.G.S. units. The effective number of turns in the coil surrounding the test rod can be varied by means of three dial switches (for hundreds, tens and units), which also introduce compensating resistances as the number of effective turns in the coil is reduced, thus keeping the total resistance of the circuit constant. The two coils are connected in series, the same current passing through both. Suppose the switches to be adjusted so that the effective number of turns in the variable coil is 100; the magnetizing forces in the two coils will then be equal, and if the test rod is of the same quality as the standard, the flow of induction will be confined entirely to the iron circuit, the two yokes will be at the same magnetic potential, and the compass needle will not be affected. If, however, the permeability of the test rod differs from that of the standard, the number of lines of induction flowing in opposite directions through the two rods will differ, and the excess will flow from one yoke to the other, partly through the air, and partly along the path provided by the bent bars, deflecting the compass needle. But a balance may still be obtained by altering the effective number of turns in the test coil, and thus increasing or decreasing the magnetizing force acting on the test rod, till the induction in the two rods is the same, a condition which is fulfilled when reversal of the current has no effect on the compass needle. Let m be the number of turns in use, and H_1 and H_2 the magnetizing forces which produce the same induction B in the test and the standard rods respectively; then $H_1 = H_2 \times m/100$. The value of B which corresponds to $H_2 m/100$ can be found from the

(B, H) curve for the standard, which is assumed to have been determined; and this same value corresponds to the force H in the case of the test bar. Thus any desired number of corresponding values of H and B can be easily and quickly found.

Measurement of Field Strength. Exploring Coil.—Since in air B = H, the ballistic method of measuring induction described above is also available for determining the strength of a magnetic field, and is more often employed than any other. A small coil of fine wire, connected in series with a ballistic galvanometer, is placed in the field, with its windings perpendicular to the lines of force, and then suddenly reversed or withdrawn from the field, the integral electromotive force being twice as great in the first case as in the second. The strength of the field is proportional to the swing of the galvanometer-needle, and, when the galvanometer is calibrated, can be expressed in C.G.S. units. Convenient arrangements have been introduced whereby the coil is reversed or withdrawn from the field by the action of a spring.

Bismuth Resistance.—The fact, which will be referred to later, that the electrical resistance of bismuth is very greatly affected by a magnetic field has been applied in the construction of apparatus for measuring field intensity. A little instrument, supplied by Hartmann and Braun, contains a short length of fine bismuth wire wound into a flat double spiral, half an inch or thereabouts in diameter, and attached to a long ebonite handle. Unfortunately the effects of magnetization upon the specific resistance of bismuth vary enormously with changes of temperature; it is therefore necessary to take two readings of the resistance, one when the spiral is in the magnetic field, the other when it is outside.

Electric Circuit.—If a coil of insulated wire is suspended so that it is in stable equilibrium when its plane is parallel to the direction of a magnetic field, the transmission of a known electric current through the coil will cause it to be deflected through an angle which is a function of the field intensity.

One of the neatest applications of this principle is that described by Edser and Stansfield (*Phil. Mag.*, 1893, 34, 186), and used by them to test the stray fields of dynamos. An oblong coil about an inch in length is suspended from each end by thin strips of rolled German silver wire, one of which is connected with a spiral spring for regulating the tension, the other being attached to a torsion-head. Inside the torsion-head is a commutator for automatically reversing the current, so that readings may be taken on each side of zero, and the arrangement is such that when the torsion-head is exactly at zero the current is interrupted. To take a reading the torsion-head is turned until an aluminium pointer attached to the coil is brought to the zero position on a small scale; the strength of the field is then proportional to the angular torsion. The small current required is supplied to the coil from a single dry cell. The advantages of portability, very considerable range (from H = 1 upwards), and fair accuracy are claimed for the instrument.

Polarized Light.—The intensity of a field may be measured by the rotation of the plane of polarization of light passing in the direction of the magnetic force through a transparent substance. If the field is uniform, $H = \theta/\omega d$, where θ is the rotation, d the thickness of the substance arranged as a plate at right angles to the direction of the field, and ω Verdet's constant for the substance.

For the practical measurement of field intensity du Bois has used plates of the densest Jena flint glass. These are preferably made slightly wedge-shape, to avoid the inconvenience resulting from multiple internal reflections, and they must necessarily be rather thin, so that double refractions due to internal strain may not exert a disturbing influence. Since Verdet's constant is somewhat uncertain for different batches of glass even of the same quality, each plate should be standardized in a field of known intensity. As the source of monochromatic light a bright sodium burner is used, and the rotation, which is exactly proportional to H, is measured by an accurate polarimeter. Such a plate about 1 mm. in thickness is said to be adapted for measuring fields of the order of 1000 units. A part of one surface of the plate may be silvered, so that the polarized ray, after having once traversed the glass, is reflected back again; the rotation is thus doubled, and moreover, the arrangement is, for certain experiments, more convenient than the other.

4. MAGNETIZATION IN STRONG FIELDS

Fields due to Coils.—The most generally convenient arrangement for producing such magnetic fields as are required for experimental purposes is undoubtedly a coil of wire through which an electric current can be caused to flow. The field due to a coil can be made as nearly uniform as we please throughout a considerable space; its intensity, when the constants of the coil are known, can be calculated with ease and certainty and may be varied at will through wide ranges, while the apparatus required is of the simplest character and can be readily constructed to suit special purposes. But when exceptionally strong fields are desired, the use of a coil is limited by the heating effect of the magnetizing current, the quantity of heat generated per unit of time in a coil of given dimensions increasing as the square of the magnetic field produced in its interior. In experiments on magnetic strains carried out by H. Nagaoka and K. Honda (*Phil. Mag.*, 1900, 49, 329) the intensity of the highest field reached in the interior of a coil was 2200 units; this is probably the strongest field produced by a coil which has hitherto been employed in experimental work. In 1890 some experiments in which a coil was used were made by du Bois (*Phil. Mag.*, 1890, 29, 253, 293) on the magnetization of iron, nickel, and cobalt under forces ranging from about 100 to 1250 units. Since the demagnetizing factor was 0·052, the strongest field due to the coil was about 1340; but though arrangements were provided for cooling the apparatus by means of ice, great difficulty was experienced owing to heating. Du Bois's results, which, as given in his papers, show the relation of H to the magnetic moment per unit of mass, have been reduced by Ewing to the usual form, and are indicated in fig. 22, the earlier portions of the curves being sketched in from other data.

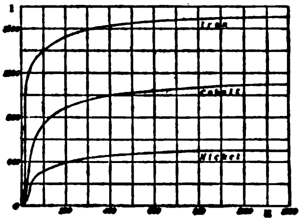

FIG. 22.

Fields due to Electromagnets.—The problem of determining the magnetization of iron and other metals in the strong fields formed between the poles of an electromagnet was first attacked by J. A. Ewing and W. Low. An account of their preliminary experiments by what they call the *isthmus method* was published in 1887 (*Proc. Roy. Soc.* 42, 200), and in the following year they described a more complete and perfect series (*Phil. Trans.*, 1889, 180, 221).

The sample to be inserted between the magnet poles was prepared in the form of a bobbin resembling an ordinary cotton reel, with a short narrow neck (constituting the "isthmus") and conical ends. Upon the central neck was wound a coil consisting of one or two layers of very fine wire, which was connected with a ballistic galvanometer for measuring the induction in the iron; outside this coil, and separated from it by a small and accurately determined distance, a second coil was wound, serving to measure the induction in the iron, together with that in a small space surrounding it. The difference of the ballistic throws taken with the two coils measured the intensity of the field in the space around the iron, and it also enabled a correction to be made for the non-ferrous space between the iron neck and the centre of the thickness of the inner coil. The pole pieces of the electromagnet (see fig. 23) were furnished with a pair of truncated cones *b b*, of soft iron forming an extension of the conical ends of the bobbin *c*. The most suitable form for the pole faces is investigated in the paper, and the conclusion arrived at is that to produce the greatest concentration of force upon the central neck, the cones should have a common vertex in the middle of the neck with a semi-vertical angle of 54° 44′, while the condition for a uniform field is satisfied when the cones have a semi-vertical angle of 39° 14′; in the latter case the magnetic force in the air just outside is sensibly equal to that within the neck. A pair of cones having a semi-vertical angle of 45° were considered to combine high concentrative power with a sufficient approximation to uniformity of field. In most of the experiments the measurements were made by suddenly withdrawing the bobbin from its place

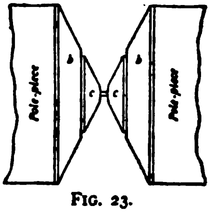

FIG. 23.

between the pole pieces. Two groups of observations were recorded, one giving the induction in the inner coil and the other that in the outer coil. The value of the residual induction which persisted when the bobbin was drawn out was added to that of the induction measured, and thus the total induction in the iron was determined. The highest induction reached in these experiments was 45,350 units, more than twice the value of any previously recorded. The corresponding intensity of the outside field was 24,500, but, owing to the wide angle of the cones used (about 2×63°), this was probably greater than the value of the magnetic force within the metal. The following table shows some results of other experiments in which H was believed to have sensibly the same value inside as outside the metal. Values of I are derived from $(B-H)/4\pi$ and of μ from B/H.

Metal.	H	B	I	μ
Swedish Iron	1,490	22,650	1680	15·20
	6,070	27,130	1680	4·47
	8,600	30,270	1720	3·52
	19,450	40,820	1700	2·10
	19,880	41,140	1700	2·07
Cast Iron	4,560	20,070	1230	4·40
	13,460	28,710	1210	2·13
	16,200	30,920	1170	1·91
	16,900	31,760	1180	1·88
Tool Steel	6,210	25,480	1530	4·10
	9,970	29,650	1570	2·97
	12,170	31,620	1550	2·60
	14,660	34,550	1580	2·36
	15,530	35,820	1610	2·31
Hard Nickel	2,220	7,100	390	3·20
	4,440	9,210	380	2·09
	7,940	12,970	400	1·63
	14,660	19,640	400	1·34
	16,000	21,070	400	1·32
Cobalt	1,350	16,000	1260	12·73
	4,040	18,870	1280	4·98
	8,930	23,890	1290	2·82
	14,990	30,210	1310	2·10

These results are of extreme interest, for they show that under sufficiently strong magnetizing forces the intensity of magnetization I reaches a maximum value, as required by W. E. Weber's theory of molecular magnetism. There appears to be no definite limit to the value to which the induction B may be raised, but the magnetization I attains a true saturation value under magnetizing forces which are in most cases comparatively moderate. Thus the magnetization which the sample of Swedish iron received in a field of 1490 was not increased (beyond the limits of experimental error) when the intensity of the field was multiplied more than thirteen-fold, though the induction was nearly doubled. When the saturation value of I has been reached, the relation of magnetic induction to magnetic force may be expressed by

$$B = H + \text{constant}.$$

The annexed table gives the saturation values of I for the particular metals examined by Ewing and Low:—

	Saturation Value of I
Wrought iron	1,700
Cast iron	1,240
Nickel (0·75% iron)	515
" (0·56% ")	400
Cobalt (1·66% ")	1,300

It is shown in the paper that the greatest possible force which the isthmus method can apply at a point in the axis of the bobbin is

$$F = 11{\cdot}137\, I_s \log_{10} b/a,$$

I_s being the saturation value of the magnet poles, a the radius of the neck on which the cones converge, and b the radius of the bases of the cones.

Some experiments made by H. du Bois (*Phil. Mag.*, 1890, 29, 293) with an electromagnet specially designed for the production of strong fields, confirm Ewing's results for iron, nickel and cobalt. The method employed did not admit of the production of such high magnetizing forces, but was of special interest in that both B and I were measured optically—B by means of the rotation of a polarized ray inside a glass plate, as before described, and I by the rotation of a polarized ray reflected from the polished surface of the magnetized metal (see "Kerr's constant," MAGNETO-OPTICS). $H(=B-4\pi I)$ was calculated from corresponding values of I and B. Taylor Jones (*Wied. Ann.*, 1896, 57, 258, and *Phil. Mag.*, 1896, 41, 153), working with du Bois's electromagnet and using a modification of the isthmus method, succeeded in pushing the induction B up to 74,200 with H=51,600, the corresponding value of I being 1798, and of μ only 1·44. The diameter of the isthmus was 0·241 mm., and the electromagnet was excited by a current of 40 amperes.

Tractive Force of a Magnet.—Closely connected with the results just discussed is the question what is the greatest tractive force that can be exerted by a magnet. In the year 1852 J. P. Joule (*Phil. Mag.*, 1852, 3, 32) expressed the opinion that no "force of current could give an attraction equal to 200 ℔ per sq. in.," or 14,000 grms. per square centimetre, and a similar view prevailed among high authorities more than twenty years later. For the greatest possible "lifting power" of permanent magnets this estimate is probably not very far from the truth, but it is now clearly understood that the force which can be exerted by an electromagnet, or by a pair of electromagnets with opposite poles in contact, is only limited by the greatest value to which it is practically possible to raise the magnetizing force H. This is at once evident when the tractive force due to magnetization is expressed as $2\pi I^2 + HI$. For fields of moderate intensity the first term of the expression is the more important, but when the value of H exceeds 12,000 or thereabouts, the second preponderates, and with the highest values that have been actually obtained, HI is several times greater than $2\pi I^2$. If H could be increased without limit, so also could the tractive force. The following table shows the greatest "lifting powers" experimentally reached at the dates mentioned:—

Observer.	Kilos per sq. cm.	℔ per sq. in.	Date.
Joule	12·3	175	1852
Bidwell	15·9	226	1886
Wilde	26·8	381	1891
T. Jones	114·9	1634	1896

5. MAGNETIZATION IN VERY WEAK FIELDS

Some interesting observations have been made of the effects produced by very small magnetic forces. It was first pointed out by C. Baur (*Wied. Ann.*, 1880, 11, 399) that in weak fields the relation of the magnetization I to the magnetizing force H is approximately expressed by an equation of the form

$$I = aH + bH^2,$$

or

$$\kappa = I/H = a + bH,$$

whence it appears that within the limits of Baur's experiments the magnetization curve is a parabola, and the susceptibility curve an inclined straight line, κ being therefore a known function of H. If these equations could be assumed to hold when H is indefinitely small, it would follow that κ has a finite initial value, from which there would be no appreciable deviation in fields so weak that bH was negligibly small in comparison with a. Such an assumption could not, however, without dangerous extrapolation, be founded upon the results of Baur's experiments, which did not go far enough to justify it. In some experiments carried out in 1887, Lord Rayleigh (*Phil. Mag.*, 1887, 23, 225) approached very much more nearly than Baur to the zero of magnetic force. Using an unannealed Swedish iron wire, he found that when H was gradually diminished from 0·04 to 0·00004 C.G.S. unit, the ratio of magnetization to magnetizing force remained sensibly constant at 6·4, wihch may therefore with great probability be assumed to represent the initial value of κ for the specimen in question. Experiments with annealed iron gave less satisfactory results, on account of the slowness with which the metal settled down into a new magnetic state, thus causing a "drift" of the magnetometer needle, which sometimes persisted for several seconds. Apart from this complication, it appeared that I was proportional to H when the value of H was less than 0·02.

The observations of Baur and Rayleigh have been confirmed and discussed by (amongst others) W. Schmidt (*Wied. Ann.*, 1895, 54, 655), who found the limiting values of κ to be 7·5 to 9·5 for iron, and 11·2 to 13·5 for steel, remaining constant up to $H = \cdot 06$; by P. Culmann (*Elekt. Zeit.*, 1893, 14, 345; *Wied. Ann.*, 1895, 56, 602); and by L. Holborn (*Berl. Ber.*, 1897, p. 95, and *Wied. Ann.*, 1897, 61, 281). The latter gives values of the constants *a* and *b* for different samples of iron and steel, some of which are shown in the following table:—

$$\kappa = a + bH$$

Metal.	*a*	*b*
English tungsten steel .	8·90	0·264
Tungsten steel, hardened	2·23	0·032
Silver steel . . .	8·66	0·384
Tool steel	8·30	0·400
Refined steel . . .	11·28	1·92
Cast iron	3·16	0·236
Soft iron , . . .	16·6	18·6
Hard drawn iron . .	5·88	1·76

For most samples of steel the straight-line law was found to hold approximately up to $H = 3$; in the case of iron and of soft steel the approximation was less close.

The behaviour of nickel in weak fields has been observed by Ewing (*Phil. Trans.*, 1888, 179A, 325), who found that the initial value of κ was 1·7, and that it remained sensibly constant until H had reached a value of about five units. While therefore the initial susceptibility of nickel is less than that of iron and steel, the range of magnetic force within which it is approximately constant is about one hundred times greater. Ewing has also made a careful study (*Proc. Roy. Soc.*, 1889, 46, 269) of "magnetic viscosity" under small forces—the cause of the magnetometer "drift" referred to by Rayleigh. On the application of a small magnetizing force to a bar of soft annealed iron, a certain intensity of magnetization is instantly produced; this, however, does not remain constant, but slowly increases for some seconds or even minutes, and may ultimately attain a value nearly twice as great as that observed immediately after the force was applied.[1] When the magnetizing current is broken, the magnetization at once undergoes considerable diminution, then gradually falls to zero, and a similar sudden change followed by a slow one is observed when a feeble current is reversed. Ewing draws attention to a curious consequence of this time-lag. By the alternate application and withdrawal of a small magnetizing force a cyclic condition may be established in an iron rod. If now the alternations are performed so rapidly that time is not allowed for more than the first sudden change in the magnetization, there will be no hysteresis loss, the magnetization exactly following the magnetizing force. Further, if the alternations take place so slowly that the full maximum and minimum values of the magnetization are reached in the intervals between the reversals, there will again be no dissipation of energy. But at any intermediate frequency the ascending and descending curves of magnetization will enclose a space, and energy will be dissipated. It is remarkable that the phenomena of magnetic viscosity are much more evident in a thick rod than in a thin wire, or even in a large bundle of thin wires. In hardened iron and steel the effect can scarcely be detected, and in weak fields these metals exhibit no magnetic hysteresis of any kind.

6. CHANGES OF DIMENSIONS ATTENDING MAGNETIZATION

It is well known that the form of a piece of ferromagnetic metal is in general slightly changed by magnetization. The phenomenon was first noticed by J. P. Joule, who in 1842 and 1847 described some experiments which he had made upon bars of iron and steel. His observations were for the most part confirmed by a number of subsequent workers, notably by A. M. Mayer; but with the single exception of the discovery by W. F. Barrett in 1882 that a nickel bar contracts when magnetized, nothing of importance was added by Joule's results for nearly forty years. Later researches have however thrown much new light upon a class of phenomena which cannot fail to have an important bearing upon the complete theory of molecular magnetism.[2] According to Joule's observations, the length of a bar of iron or soft steel was increased by magnetization, the elongation being proportional up to a certain point to the square of the intensity of magnetization; but when the "saturation point" was approached the elongation was less than this law would require, and a stage was finally reached at which further increase of the magnetizing force produced little or no effect upon the length. From data contained in Joule's paper it may be calculated that the strongest external field H_0 produced by his coil was about 126 C.G.S. units, but since the dimensional ratio of his bars was comparatively small, the actual magnetizing force H must have been materially below that value. In 1885 it was shown by Bidwell, in the first of a series of papers on the subject, that if the magnetizing force is pushed beyond the point at which Joule discontinued his experiments, the extension of the bar does not remain unchanged, but becomes gradually less and less, until the bar, after first returning to its original length, ultimately becomes actually shorter than when in the unmagnetized condition. The elongation is generally found to reach a maximum under a magnetizing force of 50 to 120 units, and to vanish under a force of 200 to 400, retraction occurring when still higher forces are applied. In order to meet the objection that the phenomenon might be due to electromagnetic action between the coil and the rod, Bidwell made some experiments with iron rings, and found that the length of their diameters varied under magnetization in precisely the same manner as the length of a straight rod. Experiments were afterwards made with rods of iron, nickel, and cobalt, the external field being carried up to the high value of 1500 units. The results are indicated in Fig. 24. It appears that the contraction which followed the initial extension of the iron reached a limit in fields of 1000 or 1100. Nickel exhibited retraction from the very beginning (as observed by Barrett), its greatest change of length considerably exceeding that undergone by iron; in a field of 800 the original length was diminished by as much as 1/40,000 part, but stronger forces failed to produce any further effect. The curve for cobalt is a very remarkable one. Little or no change of length was observed until the strength of the field H_0 reached about 50; then the rod began to contract, and after passing a minimum at $H_0 = 400$, recovered its original length at $H_0 = 750$; beyond this point there was extension, the amount of which was still increasing fast when the experiment was stopped at $H_0 = 1400$. Similar results were obtained with three different samples of the metal. Roughly speaking, therefore, cobalt behaves oppositely to iron.

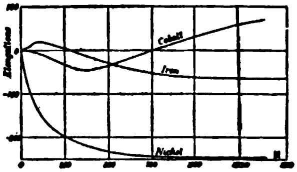

FIG. 24.

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[1] The same phenomenon is exhibited in a less marked degree when soft iron is magnetized in stronger fields (Ewing, *Phil. Trans.*, 1885, 176, 569).

[2] Principal publications: J. P. Joule, *Scientific Papers*, pp. 46, 235; A. M. Meyer, *Phil. Mag.*, 1873, 46, 177; W. F. Barrett, *Nature*, 1882, 26, 585; S. Bidwell, *Phil. Trans.*, 1888, 179A, 205; *Proc. Roy. Soc.*, 1886, 40, 109 and 257; 1888, 43, 406; 1890, 47, 469; 1892, 51, 495; 1894, 55, 228; 1894, 56, 94; 1904, 74, 60; *Nature*, 1899, 60, 222; M. Cantone, *Mem. d. Acc. d. Lincei*, 1889, 6, 487; *Rend. d. Acc. d. Lincei*, 1890, 6, 252; A. Berget, *C.R.*, 1892, 115, 722; S. J. Lochner, *Phil. Mag.*, 1893, 36, 498; H. Nagaoka, *Phil. Mag.*, 1894, 37, 131; *Wied. Ann.*, 1894, 53, 487; C. G. Knott, *Proc. Roy. Soc. Ed.*, 1891, 18, 315; *Phil. Mag.*, 1894, 37, 141; *Trans. Roy. Soc. Ed.*, 1896, 38, 527; 1898, 39, 457; C. G. Knott and A. Shand, *Proc. Roy. Soc. Ed.*, 1892, 19, 85 and 249; 1894, 20, 295; L. T. More, *Phil. Mag.*, 1895, 40, 345; G. Klingenberg, *Rostock Univ. Thesis*, Berlin, 1897; F. T. Jones, *Phil. Trans.*, 1897, 189A, 189; B. B. Brackett, *Phys. Rev.*, 1897, 5, 257; H. Nagaoka and K. Honda, *Phil. Mag.*, 1898, 46, 261; 1900, 49, 329; *Journ. Coll. Sci. Tokyo*, 1900, 13, 57; 1903, 19, art. 11; J. S. Stevens, *Phys. Rev.*, 1898, 7, 19; E. Rhoads, *Phys. Rev.*, 1898, 7, 5; *Phil. Mag.*, 1901, 2, 463; G. A. Shakespear, *Phil. Mag.*, 1899, 17, 539; K. Honda, *Journ. Coll. Sci. Tokyo*, 1900, 13, 77; L. W. Austin, *Phys. Rev.*, 1900, 10, 180; *Deutsch. Phys. Gesell. Verh.*, 1904, 6, 4, 211; K. Honda and S. Shimizu, *Phil. Mag.*, 1902, 4, 338; 1905, 10, 548.

Joule and others experimented with hardened steel, but failed to find a key to the results they obtained, which are rather complex, and have been thought to be inconsistent. The truth appears to be that a hardened steel rod generally behaves like one of iron or soft steel in first undergoing extension under increasing magnetizing force, and recovering its original length when the force has reached a certain critical value, beyond which there is contraction. But this "critical value" of the force is found to depend in an unexpected manner upon the hardness of the steel; the critical value diminishes as the hardness becomes greater *up to a certain point*, corresponding to a yellow temper, after which it increases and with the hardest steel becomes very high. For steel which has been made red-hot, suddenly cooled, and then let down to a yellow temper, the critical value of the magnetizing force is smaller than for steel which is either softer or harder; it is indeed so small that the metal contracts like nickel even under weak magnetizing forces, without undergoing any preliminary extension that can be detected.

Joule also made experiments upon iron wires under tension, and drew the erroneous inference (which has been often quoted as if it were a demonstrated fact) that under a certain critical tension (differing for different specimens of iron but independent of the magnetizing force) magnetization would produce no effect whatever upon the dimensions of the wire. What actually happens when an iron wire is loaded with various weights is clearly shown in Fig. 25. Increased tension merely has the effect of diminishing the maximum elongation and hastening the contraction; with the two greatest loads used in the experiment there was indeed no preliminary extension at all.[1] The effects of tension upon the behaviour of a nickel wire are of a less simple character. In weak fields the magnetic contraction is always diminished by pulling stress; in strong fields the contraction increases under a small load and diminishes under a heavy one. Cobalt, curiously enough, was found to be quite unaffected by tensile stress.

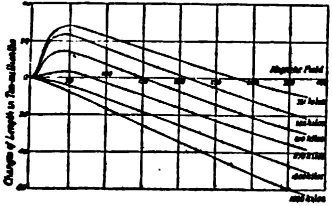

FIG. 25.

Certain experiments by C. G. Knott on magnetic twist, which will be referred to later, led him to form the conclusion that in an iron wire carrying an electric current the magnetic elongation would be increased. This forecast was shown by Bidwell to be well founded. The effect produced by a current is exactly opposite to that of tension, raising the elongation curve instead of depressing it. In the case of a wire 0·75 mm. in diameter the maximum elongation was nearly doubled when a current of two amperes was passing through the iron, while the "critical value" of the field was increased from 130 to 200. Yet notwithstanding this enormous effect in iron, the action of a current upon nickel and cobalt turned out to be almost inappreciable.

Some experiments were next undertaken with the view of ascertaining how far magnetic changes of length in iron were dependent upon the hardness of the metal, and the unexpected result was arrived at that softening produces the same effect as tensile stress; it depresses the elongation curve, diminishing the maximum extension, and reducing the "critical value" of the magnetizing force. A thoroughly well annealed ring of soft iron indeed showed no extension at all, beginning to contract, like nickel, under the smallest magnetizing forces. The experiments were not sufficiently numerous to indicate whether, as is possible, there is a critical degree of hardness for which the height of the elongation curve is a maximum.

Finally, experiments were made to ascertain the effect of magnetization upon the dimensions of iron rings in directions perpendicular to the magnetization, and upon the volume of the rings.[2] It was found that the curve showing the relation of transverse changes of dimensions to magnetizing force was similar in general character to the familiar elongation curves, but the signs were reversed; the curve was inverted, indicating at first retraction, which, after passing a maximum and vanishing in a critical field, was succeeded by elongation. The curve showing the circumferential (or longitudinal) changes was also plotted, and from the two curves thus obtained it was easy, on the assumption that the metal was isotropic in directions at right angles to the magnetization, to calculate changes of volume; for if circumferential elongation be denoted by l_1, and transverse elongation by l_2, then the cubical dilatation (+ or –) = $l_1 + 2l_2$ approximately. If l_1 were exactly equal to $-2l_2$ for all values of the magnetizing force, it is clear that the volume of the ring would be unaffected by magnetization. In the case of the ring in question, the circumferential changes were in weak fields less than twice as great as the transverse ones, while in strong fields they were more than twice as great; under increasing magnetic force therefore the volume of the ring was first diminished, then it regained its original value (for $H=90$), and ultimately increased. It was also shown that annealing, which has such a large effect upon circumferential (or longitudinal) changes, has almost none upon transverse ones. Hence the changes of volume undergone by a given sample of wrought iron under increasing magnetization must depend largely upon the state of the metal as regards hardness; there may be always contraction, or always expansion, or first one and then the other.

Most of the experiments described above have been repeated and the results confirmed by other workers, some of whom have added fresh observations. The complicated hysteresis effects which attend magnetic elongation and retraction have been studied by H. Nagaoka, who also, in conjunction with K. Honda, measured the changes of length of various metals shaped in the form of ovoids instead of cylindrical rods, and determined the magnetization curves for the same specimens; a higher degree of accuracy was thus attained, and satisfactory data were provided for testing theories. Among other things, it was found that the behaviour of cast cobalt was entirely changed by annealing; the sinuous curve shown in Fig. 24 was converted into an almost perfectly straight line passing through the origin, and lying below the horizontal axis; while the permeability of the metal was greatly diminished by the operation. They also tested several varieties of nickel-steel in the form of both ovoids and wires. With a sample containing 25% of nickel no appreciable change was detected; others containing larger percentages, and tested in fields up to 2000, all exhibited elongation, which tended to an asymptotic value as the field was increased. The influence of temperature varying between wide limits has formed the subject of a research by K. Honda and S. Shimizu. For soft iron, tungsten-steel and nickel little difference appeared to result from lowering the temperature down to –186° C. (the temperature of liquid air); at sufficiently high temperatures, 600° to 1000° or more, it was remarked that the changes of length in iron, steel and cobalt tended in every case to become proportional to the magnetic force, the curves being nearly straight lines entirely above the axis. The retraction of nickel was diminished by rising temperature, and at 400° had almost vanished. The influence of high temperature on cobalt was very remarkable, completely altering the character of the change of length: the curves for annealed cobalt show that at 450° this metal behaves just like iron at ordinary temperatures, lengthening in fields up to about 300 and contracting in stronger ones. The same physicists have made some additional experiments upon the effect of tension on magnetic change of length. Bidwell's results for iron and nickel were confirmed, and it was further shown that the elongation of nickel-steel was very greatly diminished by tension; when magnetized under very heavy loads, the wire was indeed found to undergo slight contraction. Honda subjected tubes of iron, steel and nickel to the simultaneous action of circular and longitudinal fields, and observed the changes of length when one of the fields was varied while the other remained constant at different successive values from zero upwards. The experimental results agreed in sign though not in magnitude with those calculated from the changes produced by simple longitudinal magnetization, discrepancies being partly accounted for by the fact that the metals employed were not actually isotropic. Heusler's alloy has been tested for change of length by L. Austin, who found continuous elongation with increasing fields, the curves obtained bearing some resemblance to curves of magnetization.

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[1] The loads were successively applied in decreasing order of magnitude. They are indicated in fig. 25 as kilos per sq. cm.

[2] Joule believed that the volume was unchanged.

As regards the effect of magnetization upon volume there are some discrepancies. Nagaoka and Honda, who employed a fluid dilatometer, found that the volume of several specimens of iron, steel and nickel was always slightly increased, no diminution being indicated in low fields; cobalt, on the other hand, was diminished in volume, and the amount of the change, though still very small, was greater than that shown by the other metals. Various nickel-steels all expanded under magnetization, the increase being generally considerable and proportional to the field; in the case of an alloy containing 29% of nickel the change was nearly 40 times greater than in soft iron. C. G. Knott, who made an exhaustive series of experiments upon various metals in the form of tubes, concluded that in iron there was always a slight increase of volume, and in nickel and cobalt a slight decrease. It is uncertain how far these various results are dependent upon the physical condition of the metals.

Attempts have been made to explain magnetic deformation by various theories of magnetic stress,[1] notably that elaborated by G. R. Kirchhoff (*Wied. Ann.*, 1885, 24, 52, and 1885, 25, 601), but so far with imperfect success. E. Taylor Jones showed in 1897 that only a small proportion of the contraction exhibited by a nickel wire when magnetized could be accounted for on Kirchhoff's theory from the observed effects of pulling stress upon magnetization; and in a more extended series of observations Nagaoka and Honda found wide quantitative divergences between the results of experiment and calculation, though in nearly all cases there was agreement as to quality. They consider, however, that Kirchhoff's theory, which assumes change of magnetization to be simply proportional to strain, is still in its infancy, the present stage of its evolution being perhaps comparable with that reached by the theory of magnetization at the time when the ratio I/H was supposed to be constant. In the light of future researches further development may reasonably be expected.

It has been suggested[2] that an iron rod under magnetization may be in the same condition as if under a mechanically applied longitudinal stress tending to shorten the iron. If a long magnetized rod is divided transversely and the cut ends placed nearly in contact, the magnetic force inside the narrow air gap will be $B=H+4\pi I$. The force acting on the magnetism of one of the faces, and urging this face towards the other, will be less than B by $2\pi I$, the part of the total force due to the first face itself; hence the force per unit of area with which the faces would press against each other if in contact is

$$P=(B-2\pi I)I=2\pi I^2+HI=(B^2-H^2)=/8\pi.$$

The width of the gap may be diminished until it is no greater than the distance between two neighbouring molecules, when it will cease to be distinguishable, but, assuming the molecular theory of magnetism to be true, the above statement will still hold good for the intermolecular gap. The same pressure P will be exerted across any imaginary section of a magnetized rod, the stress being sustained by the intermolecular springs, whatever their physical nature may be, to which the elasticity of the metal is due. The whole of the rod will therefore be subject to a compressive longitudinal stress P, the associated contraction R, expressed as a fraction of the original length, being

$$R=P/M=(B^2-H^2)/8\pi M,$$

where M is Young's modulus. This was found to be insufficient to account for the whole of the retraction exhibited by iron in strong fields, but it was pointed out by L. T. More[3] that R ought to be regarded as a "correction" to be applied to the results of experiments on magnetic change of length, the magnetic stress being no less an extraneous effect than a stress applied mechanically. Those who support this view generally speak of the stress as "Maxwell's stress," and assume its value to be $B^2/8\pi$. The stress in question seems, however, to be quite unconnected with the "stress in the medium" contemplated by Maxwell, and its value is not exactly $B^2/8\pi$ except in the particular case of a permanent ring magnet, when $H=0$. Further, Maxwell's stress is a tension along the lines of force, and is equal to $B^2/8\pi$ only when $B=H$, and there is no magnetization.[4] Some writers have indeed contended that the stress in magnetized iron is not compressive, but tensile, even when, as in the case of a ring-magnet, there are no free ends. The point at issue has an important bearing upon the possible correlation of magnetic phenomena, but, though it has given rise to much discussion, no accepted conclusion has yet been reached.[5]

7. Effects of Mechanical Stress upon Magnetization.

The effects of traction, compression and torsion in relation to magnetism have formed the subject of much patient investigation, especially at the hands of J. A. Ewing, C. G. Knott and the indefatigable physicists of Tokyo University. The results of their experiments embrace a multiplicity of details of which it is impossible to give an adequate summary. Only a few of the most important can be mentioned here; the reader who wishes for fuller information should consult the original papers.[6]

It was first discovered by E. Villari in 1868 that the magnetic susceptibility of an iron wire was increased by stretching when the magnetization was below a certain value, but diminished when that value was exceeded; this phenomenon has been termed by Lord Kelvin, who discovered it independently, the "Villari reversal," the value of the magnetization for which stretching by a given load produces no effect being known as the "Villari critical point" for that load. The Villari critical point for a given sample of iron is reached with a smaller magnetizing force when the stretching load is great than when it is small; the reversal also occurs with smaller loads and with weaker fields when the iron is soft than when it is hard. The following table shows the values of I and H corresponding to the Villari critical point in some of Ewing's experiments:—

Soft Iron.			Hard Iron.		
Kilos per sq. mm.	I.	H.	Kilos per sq. mm.	I.	H.
2·15	1220	7·3	27·6	1180	34
4·3	1040	4·3	32·2	1150	32
8·6	840	3·4	37·3	1110	29
12·9	690	3·05	42·5	1020	25

The effects of pulling stress may be observed either when the wire is stretched by a constant load while the magnetizing force is varied, or when the magnetizing force is kept constant while the load is varied. In the latter case the first application of stress is always attended by an increase—often a very great one—of the magnetization, whether the field is weak or strong, but after a load has been put on and taken off several times the changes of magnetization become cyclic. From experiments of both classes it appears that for a given field there is a certain value of the load for which the magnetization is a maximum, the maximum occuring at a smaller load the stronger the field. In very strong fields the maximum may even disappear altogether, the effect of the smallest stress being to diminish the magnetization; on the other hand, with very weak fields the maximum may not have been reached with the greatest load that the wire can support without permanent deformation. When the load on a hardened wire is gradually increased, the maximum value of I is found to correspond with a greater stress than when the load is gradually diminished, this being an effect of hysteresis. Analogous changes are observed in the residual magnetization which remains after the wire has been subjected to fields of different strength. The effects of longitudinal pressure are opposite to those of traction; when the cyclic condition has been reached, pressure reduces the magnetization of iron in weak fields and increases it in strong fields (Ewing, *Magnetic Induction*, 1900, 223).

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[1] For a discussion of theories of magnetic stress, with copious references, see Nagaoka, *Rap. du Congrès International de Physique* (Paris, 1900), ii. 545. Also Nagaoka and Jones, *Phil. Mag.*, 1896, 41, 454.

[2] S. Bidwell, *Phil. Trans.*, 1888, 179a, 321.

[3] *Phil. Mag.*, 1895, 40, 345.

[4] J. C. Maxwell, *Treatise*, § 643.

[5] See correspondence in *Nature*, 1896, 53, pp. 269, 316, 365, 462, 533; 1906, 74, pp. 317, 539; B. B. Brackett, *loc. cit.*, quotes the opinion of H. A. Rowland in support of compressive stress.

[6] J. A. Ewing, *Phil. Trans.*, 1885, 176, 580; 1888, 179, 333; *Magnetic Induction*, 1900, ch. ix.; J. A. Ewing and G. C. Cowan, *Phil. Trans.*, 1888, 179a, 325; C. G. Knott, *Trans. Roy. Soc. Ed.*, 1882–1883, 32, 193; 1889, 35, 377; 1891, 36, 485; *Proc. Roy. Soc. Ed.*, 1899, 586; H. Nagaoka, *Phil. Mag.*, 1889, 27, 117; 1890, 29, 123; H. Nagaoka and K. Honda, *Journ. Coll. Sci. Tokyo*, 1900, 13, 263; 1902, 16, art. 8; *Phil. Mag.*, 1898, 46, 261; 1902, 4, 45; K. Honda and S. Shimizu, *Ann. d. Phys.*, 1904, 14, 791; *Tokyo Physico-Math. Soc. Rep.*, 1904, 2, No. 13; K. Honda and T. Terada, *Journ. Coll. Sci. Tokyo*, 1906, 21, art. 4.

The influence of traction in diminishing the susceptibility of nickel was first noticed by Kelvin (W. Thomson), and was subsequently investigated by Ewing and Cowan. The latter found the effect to be enormous, not only upon the induced magnetization, but in a still greater degree upon the residual. Even under so "moderate" a load as 53 kilogrammes per square mm., the induced magnetization of a hard-drawn nickel wire in a field of 60 fell from 386 to 72 units, while the residual was reduced from about 280 to 10. Ewing has also examined the effects produced by longitudinal compression upon the susceptibility and retentiveness of nickel, and found, as was to be expected, that both were greatly increased by pressure. The maximum susceptibility of one of his bars rose from 5·6 to 29 under a stress of 19·8 kilos per square mm. There were reasons for believing that no Villari reversal would be found in nickel. Ewing and Cowan looked carefully for it, especially in weak fields, but failed to discover anything of the kind.[1] Some experiments by A. Heydweiller,[2] which appeared to indicate a reversal in weak fields (corresponding to $I=5$, or thereabouts), have been shown by Honda and Shimizu to be vitiated by the fact that his specimen was not initially in a magnetically neutral state; they found that when the applied field had the same direction as that of the permanent magnetization, Heydweiller's fallacious results were easily obtained; but if the field were applied in the direction opposite to that of the permanent magnetization, or if, as should rightly be the case, there were no permanent magnetization at all, then there was no indication of any Villari reversal. Thus a very important question, which has given rise to some controversy, appears to be now definitely settled.

The effects of longitudinal pressure upon the magnetization of cast cobalt have been examined by C. Chree,[3] and also by J. A. Ewing.[4] Chree's experiments were undertaken at the suggestion of J. J. Thomson, who, from the results of Bidwell's observations on the magnetic deformation of cobalt, was led to expect that that metal would exhibit a reversal opposite in character to the effect observed in iron. The anticipated reversal was duly found by Chree, the critical point corresponding, under the moderate stress employed, to a field of about 120 units. Ewing's independent experiments showed that the magnetization curve for a cobalt rod under a load of 16·2 kilogrammes per square mm. crossed the curve for the same rod when not loaded at $H=53$. Both observers noticed analogous effects in the residual magnetization. The effect of tension was subsequently studied by Nagaoka and Honda, who in 1902 confirmed, *mutatis mutandis*, the results obtained by Chree and Ewing for cast cobalt, while for annealed cobalt it turned out that tension always caused diminution of magnetization, the diminution increasing with increasing fields. They also investigated the magnetic behaviour of various nickel-steels under tension, and found that there was always increase of magnetization. Thus it has been proved that in annealed cobalt and in nickel-steel there is no Villari reversal.

It has been pointed out by J. J. Thomson (*Applications of Dynamics to Physics and Chemistry*, 47) that on dynamical principles there must be a reciprocal relation between the changes of dimensions produced by magnetization and the changes of magnetization attending mechanical strain. Since, for example, stretching diminishes the magnetization of nickel, it follows from theory that the length of a nickel rod should be diminished by magnetization and conversely. So, too, the Villari reversals in iron and cobalt might have been predicted—as indeed that in cobalt actually was—from a knowledge of the changes of length which those metals exhibit when magnetized.

The complete reciprocity of the effects of magnetization upon length and of stretching upon magnetization is shown by the following parallel statements:—

Iron.

Magnetization produces increase of length in weak fields, decrease in strong fields.	Tension produces increase of magnetization in weak fields, decrease in strong fields.

Cast Cobalt.

Magnetization produces decrease of length in weak fields, increase in strong fields.	Tension produces decrease of magnetization in weak fields, increase in strong fields.

Nickel and Annealed Cobalt.

Magnetization produces decrease of length in all fields.	Tension produces decrease of magnetization in all fields.

Nickel-Steel.

Magnetization produces increase of length in all fields.	Tension produces increase of magnetization in all fields.

Nagaoka and Honda (*Phil. Mag.*, 1898, 46, 261) have investigated the effects of hydrostatic pressure upon magnetization, using the same pieces of iron and nickel as were employed in their experiments upon magnetic change of volume. In the iron cylinder and ovoid, which expanded when magnetized, compression caused a diminution of magnetization; in the nickel rod, which contracted when magnetized, pressure was attended by an increase of magnetization. The amount of the change was in both cases exceedingly small, that in iron being less than 0·1 C.G.S. unit with a pressure of 250 atmospheres and $H=54$. It would hardly be safe to generalize from these observations; the effects may possibly be dependent upon the physical condition of the metals. In the same paper Nagaoka and Honda describe an important experiment on the effect of transverse stress. An iron tube, having its ends closed by brass caps, was placed inside a compressing vessel into which water was forced until the pressure upon the outer surface of the tube reached 250 atmospheres. The experiment was the reverse of one made by Kelvin with a gun-barrel subjected to internal hydrostatic pressure (*Phil. Trans.*, 1878, 152, 64), and the results were also the reverse. Under increasing magnetizing force the magnetization first increased, reached a maximum, and then diminished until its value ultimately became less than when the iron was in the unstrained condition. Experiments on the effect of external hydrostatic pressure upon the magnetization of iron rings have also been made by F. Frisbie,[5] who found that for the magnetizing forces used by Nagaoka and Honda pressure produced a small *increase* of magnetization, a result which appears to be in accord with theory.

The relations of torsion to magnetization were first carefully studied by G. Wiedemann, whose researches are described in his *Elektricität*, iii. 671. The most interesting of his discoveries, now generally known as the "Wiedemann effect," is the following: If we magnetize longitudinally a straight wire which is fixed at one end and free at the other, and then pass an electric current through the wire (or first pass the current and then magnetize), the free end of the wire will twist in a certain direction depending upon circumstances: if the wire is of iron, and is magnetized (with a moderate force) so that its free end has north polarity, while the current through it passes from the fixed to the free end, then the free end as seen from the fixed end will twist in the direction of the hands of a watch; if either the magnetization or the current is reversed, the direction of the twist will be reversed. To this mechanical phenomenon there is a magnetic reciprocal. If we twist the free end of a ferromagnetic wire while a current is passing through it, the wire becomes longitudinally magnetized, the direction of the magnetization depending upon circumstances: if the wire is of iron and is twisted so that its free end as seen from the fixed end turns in the direction of the hands of a watch, while the current passes from the fixed to the free end, then the direction of the resulting magnetization will be such as to make the free end a north pole. The twist effect exhibited by iron under moderate longitudinal magnetization has been called by Knott a *positive* Wiedemann effect; if the twist were reversed, the other conditions remaining the same, the sign of the Wiedemann effect would be *negative*. An explanation of the twist has been given by Maxwell (*Electricity and Magnetism*, § 448). The wire is subject to two superposed magnetizations, the one longitudinal, the other circular, due to the current traversing the wire; the resultant magnetization is consequently in the direction of a screw or spiral round the wire, which will be right-handed or left-handed according as the relation between the two magnetizations is right-handed or left-handed; the magnetic expansion or contraction of the metal along the spiral lines of magnetization produces the Wiedemann twist. Iron (moderately magnetized) expands along the lines of magnetization, and therefore for a right-handed spiral exhibits a right-handed twist. This explanation was not accepted by Wiedemann,[1] who thought that the effect was accounted for by molecular friction. Now nickel contracts instead of lengthening when it is magnetized, and an experiment by Knott showed, as he expected, that *caeteris paribus* a nickel wire twists in a sense opposite to that in which iron twists. The Wiedemann effect being positive for iron is negative for nickel. Further, although iron lengthens in fields of moderate strength, it contracts in strong ones; and if the wire is stretched, contraction occurs with smaller magnetizing forces than if it is unstretched. Bidwell[2] accordingly found upon trial that the Wiedemann twist of an iron wire vanished when the magnetizing force reached a certain high value, and was reversed when that value was exceeded; he also found that the vanishing point was reached with lower values of the magnetizing force when the wire was stretched by a weight. These observations have been verified and extended by Knott, whose researches have brought to light a large number of additional facts, all of which are in perfect harmony with Maxwell's explanation of the twist.

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[1] H. Tomlinson found a critical point in the "temporary magnetization" of nickel (*Proc. Phys. Soc.*, 1890, 10, 367, 445), but this does not correspond to a Villari reversal. Its nature is made clear by Ewing and Cowan's curves (*Phil. Trans.*, 1888, 179, plates 15, 16).

[2] *Wied. Ann.*, 1894, 52, 462; *Electrician*, 1894, 34, 143.

[3] *Phil. Trans.*, 1890, 131, 329.

[4] *Magnetic Induction*, 1900, 222.

[5] *Phys. Rev.*, 1904, 18, 432.

Maxwell has also given an explanation of the converse effect, namely, the production of longitudinal magnetization by twisting a wire when circularly magnetized by a current passing through it. When the wire is free from twist, the magnetization at any point P is in the tangential direction PB (see fig. 26) Suppose the wire to be fixed at the top and twisted at the bottom in the direction of the arrow-head T; then the element of the wire at P will be stretched in the direction P*e* and compressed in the direction P*r*. But tension and compression produce opposite changes in the magnetic susceptibility; if the metal is iron and its magnetization is below the Villari critical point, its susceptibility will be greater along P*e* than along P*r*; the direction of the magnetization therefore tends to approach P*e* and to recede from P*r*, changing, in consequence of the twist, from PB to some such direction as PB′, which has a vertical component downwards; hence the lower and upper ends will respectively acquire north and south polarity, which will disappear when the wire is untwisted. This effect has never been actually reversed in iron, probably, as suggested by Ewing, because the strongest practicable circular fields fail to raise the components of the magnetization along P*e* and P*r* up to the Villari critical value. Nagaoka and Honda have approached very closely to a reversal, and consider that it would occur if a sufficiently strong current could be applied without undue heating.

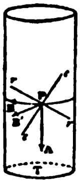

FIG. 26.

One other effect of torsion remains to be noticed. If a longitudinally magnetized wire is twisted, circular magnetization is developed; this is evidenced by the transient electromotive force induced in the iron, generating a current which will deflect a galvanometer connected with the two ends of the wire. The explanation given of the last described phenomenon will with the necessary modification apply also to this; it is a consequence of the aeolotropy produced by the twist. There are then three remarkable effects of torsion:

A A wire magnetized longitudinally and circularly becomes twisted.

B Twisting a circularly magnetized wire produces longitudinal magnetization.

C. Twisting a longitudinally magnetized wire produces circular magnetization.

And it has been shown earlier that—

D. Magnetization produces change of length.

E. Longitudinal stress produces change of magnetization.

Each of these five effects may occur in two opposite senses. Thus in A the twist may be right-handed or left-handed; in B the polarity of a given end may become north or south; in C the circular magnetization may be clockwise or counter-clockwise; in D the length may be increased or diminished; in E the magnetization may become stronger or weaker. And, other conditions remaining unchanged, the "sense" of any effect depends upon the nature of the metal under test, and (sometimes) upon the intensity of its magnetization. Let each of the effects A, B, C, D and E be called positive when it is such as is exhibited by moderately magnetized iron, and negative when its sense is opposite. Then the results of a large number of investigations may be briefly summarized as follows:

(W) = weakly magnetized. (S) = strongly magnetized.

Metal.	*Effects.*	*Sign.*
Iron (W)	A, B, C, D, E	+
Unannealed Cobalt (S)	A, D, E	+
Nickel-Steel (W)	A, D, E	+
Nickel	A, B, C, D, E	−
Annealed Cobalt	D, E	−
Iron (S)	A, C, D, E	−
Unannealed Cobalt	A, D, E	−

Several gaps remain to be filled, but the results so far recorded can leave no doubt that the five effects, varied as they may at first sight appear, are intimately connected with one another. For each of the metals tabulated in the first column all the effects hitherto observed have the same sign; there is no single instance in which some are positive and others negative. Until the mysteries of molecular constitution have been more fully explored, perhaps D may be most properly regarded as the fundamental phenomenon from which the others follow. Nagaoka and Honda have succeeded in showing that the observed relations between twist and magnetization are in qualitative agreement with an extension of Kirchhoff's theory of magnetostriction.

The effects of magnetization upon the torsion of a previously twisted wire, which were first noticed by Wiedemann, have been further studied by F. J. Smith[3] and by G. Moreau.[4] Nagaoka[5] has described the remarkable influence of combined torsion and tension upon the magnetic susceptibility of nickel, and has made the extraordinary observation that, under certain conditions of stress, the magnetization of a nickel wire may have a direction opposite to that of the magnetizing force.

8. EFFECTS OF TEMPERATURE UPON MAGNETISM

High Temperature.—It has long been known that iron, when raised to a certain "critical temperature" corresponding to dull red heat, loses its susceptibility and becomes magnetically indifferent, or, more accurately, is transformed from a ferromagnetic into a paramagnetic body. Recent researches have shown that other imporant changes in its properties occur at the same critical temperature. Abrupt alterations take place in its density, specific heat, thermo-electric quality, electrical conductivity, temperature-coefficient of electrical resistance, and in some at least of its mechanical properties. Ordinary magnetizable iron is in many respects an essentially different substance from the non-magnetizable metal into which it is transformed when its temperature is raised above a certain point (see *Brit. Assoc. Report*, 1890, 145). The first exact experiments demonstrating the changes which occur in the permeability of iron, steel and nickel when heated up to high temperatures were those of J. Hopkinson (*Phil. Trans.*, 1889, 180, 443; *Proc. Roy. Soc.*, 1888, 44, 317). The metal to be tested was prepared in the form of a ring, upon which were wound primary and secondary coils of copper wire insulated with asbestos. The primary coil carried the magnetizing current; the secondary, which was wound inside the other, could be connected either with a ballistic galvanometer for determining the induction, or with a Wheatstone's bridge for measuring the resistance, whence the temperature was calculated. The ring thus prepared was placed in a cast-iron box and heated in a gas furnace. The following are the chief results of Hopkinson's experiments: For small magnetizing forces the magnetization of iron steadily increases with rise of temperature till the critical temperature is approached, when the rate of increase becomes very high, the permeability in some cases attaining a value of about 11,000; the magnetization then with remarkable suddenness almost entirely disappears, the permeability falling to about 1·14. For strong magnetizing forces (which in these experiments did not exceed H = 48·9) the permeability remains almost constant at its initial value (about 400), until the temperature is within nearly 100° of the critical point; then the permeability diminishes more and more rapidly until the critical point is reached and the magnetization vanishes. Steel behaves in a similar manner, but the maximum permeability is not so high as in iron, and the fall, when the critical point is approached, is less abrupt. The critical temperature for various samples of iron and steel ranges from 690° C. to 870° C.; it is the temperature at which Barrett's "recalescence" occurs. The critical temperature for the specimen of nickel examined (which contained nearly 5% of impurities) was 310° C. F. Lydall and A. W. Pocklington found that the critical temperature of nearly pure iron was 874° C. (*Proc. Roy. Soc.*, 1893, 52, 228).

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[1] *Phil. Mag.*, 1886, 22, 50.

[2] *Ibid.* 251.

[3] *Phil. Mag.*, 1891, 32, 383.

[4] *C.R.*, 1896, 122, 1192; 1898, 126, 463.

[5] *Phil. Mag.*, 1889, 27, 117.

An exhaustive research into the effects of heating on the magnetic properties of iron has been carried out by D. K. Morris (*Proc. Phys. Soc.*, 1897, 15, 134; and *Phil. Mag.*, 1897, 44, 213), the results being embodied in a paper containing twelve pages of tables and upwards of 120 curves. As in Hopkinson's experiments, ring magnets were employed; these were wound with primary and secondary coils of insulated platinum wire, which would bear a much higher temperature than copper without oxidation or fusion. A third platinum coil, wound non-inductively between the primary and the secondary, served to carry the current by which the ring was heated; a current of 4·6 amperes, with 16 volts across the terminals, was found sufficient to maintain the ring at a temperature of 1150° C. In the ring itself was embedded a platinum-thermometer wire, from the resistance of which the temperature was determined. The whole was wrapped in several coverings of asbestos and placed in a glass vessel from which the air was partially exhausted, additional precautions being taken to guard against oxidation of the iron.

Some preliminary experiments showed the striking difference in the effects of annealing at a red heat (840° C.) and at a low white heat (1150° C.). After one of the rings had been annealed at 840°, its maximum permeability at ordinary temperatures was 4000 for H = 1·84; when it had been subsequently annealed at 1150°, the maximum permeability rose to 4680 for H = 1·48, while the hysteresis loss for B = ±4000 was under 500 ergs per c.cm. As regards the effects of temperature, Morris's results are in general agreement with those of Hopkinson, though no doubt they indicate details with greater clearness and accuracy. Specimens of curves showing the relation of induction to magnetic field at various temperatures, and of permeability to temperature with fields of different intensities, are given in figs. 27 and 28. The most striking feature presented by these is the enormous value, 12,660, which, with H = 0·153, is attained by the permeability at 765° C., followed by a drop so precipitous that when the temperature is only 15° higher, the value of the permeability has become quite insignificant. The critical temperatures for three different specimens of iron were 795°, 780°, and 770° respectively. Above these temperatures the little permeability that remained was found to be independent of the magnetizing force, but it appeared to vary a little with the temperature, one specimen showing a permeability of 100 at 820°, 2·3 at 950°, and 17 at 1050°. These last observations are, however, regarded as uncertain. The effects of temperature upon hysteresis were also carefully studied, and many hysteresis loops were plotted. The results of a typical experiment are given in the annexed table, which shows how greatly the hysteresis loss is diminished as the critical temperature is approached. The coercive force at 764°·5 is stated to have been little more than 0·1 C.G.S. unit; above the critical temperature no evidence of hysteresis could be obtained.

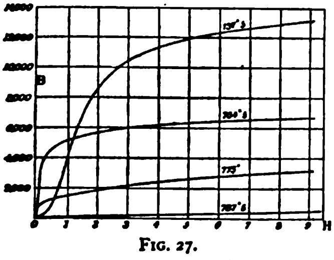

FIG. 27.

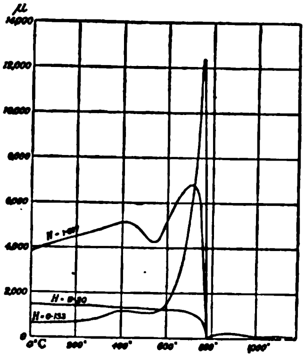

FIG. 28.

Hysteresis Loss in Ergs per c.cm. Max. H. = ±6·83.

Temp. C.°	Ergs.	Temp. C.°	Ergs
764·5	120	457	2025
748	328	352	2565
730	426	249	3130
695	797	137·5	3500
634	1010	24	3660
554	1345		

A paper by H. Nagaoka and S. Kusakabe[1] generally confirms Morris's results for iron, and gives some additional observations for steel, nickel and cobalt. The magnetometric method was employed, and the metals, in the form of ovoids, were heated by a specially designed burner, fed with gas and air under pressure, which directed 90 fine jets of flame upon the asbestos covering the ovoid. The temperature was determined by a platinum-rhodium and platinum thermo-junction in contact with the metal. Experiments were made at several constant temperatures with varying magnetic fields, and also at constant fields with rising and falling temperatures. For ordinary steel the critical temperature, at which magnetization practically disappeared, was found to be about 830°, and the curious fact was revealed that, on cooling, magnetization did not begin to reappear until the temperature had fallen 40° below the critical value. This retardation was still more pronounced in the case of tungsten-steel, which lost its magnetism at 910° and remained non-magnetic till it was cooled to 570°, a difference of 240° For nearly pure nickel the corresponding temperature-difference was about 100°. This phenomenon is of the same nature as that first discovered by J. Hopkinson for nickel-steel. The paper contains tables and curves showing details of the magnetic changes, sometimes very complex, at different temperatures and with different fields. The behaviour of cobalt is particularly noticeable; its permeability increased with rising temperature up to a maximum at 500°, when it was about twice as great as at ordinary temperatures, while at 1600°, corresponding to white heat, there was still some magnetization remaining.

Further contributions to the subject have been made by K. Honda and S. Shimizu,[2] who experimented at temperatures ranging from −186° to 1200°. As regards the higher temperatures, the chief point of interest is the observation that the curve of magnetization for annealed cobalt shows a small depression at about 450°, the temperature at which they had found the sign of the length-change to be reversed for all fields. In the case of all the metals tested a small but measurable trace of magnetization remained after the so-called critical temperature had been exceeded; this decreased very slightly up to the highest temperature reached (1200°) without undergoing any such variation as had been suspected by Morris. When the curve after its steep descent has almost reached the axis, it bends aside sharply and becomes a nearly horizontal straight line; the authors suggest that the critical temperature should be defined as that corresponding to the point of maximum curvature. As thus defined the critical temperatures for iron, nickel and cobalt were found to be 780°, 360° and 1090° respectively, but these values are not quite independent of the magnetizing force.

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[1] *Journ. Coll. Sci. Tokyo*, 1904, 19, art. 9.

[2] *Phil Mag.*, 1905, 10, 548; *Tokyo Phys.-Math. Soc. Rep.*, 1904, 2, No. 14; *Journ. Coll. Sci. Tokyo*, 1905, 20, art. 6.

Experiments on the effect of high temperatures have also been made by M. P. Ledeboer,[1] H. Tomlinson,[2] P. Curie,[3] and W. Kunz,[4] R. L. Wills,[5] J. R. Ashworth[6] and E. P. Harrison.[7]

Low Temperature.—J. A. Fleming and J. Dewar (*Proc. Roy. Soc.*, 1896, 60, 81) were the first to experiment on the permeability and hysteresis of iron at low temperatures down to that of liquid air (−186° C.). Induction curves of an annealed soft-iron ring were taken first at a temperature of 15° C., and afterwards when the ring was immersed in liquid air, the magnetizing force ranging from about 0·8 to 22. After this operation had been repeated a few times the iron was found to have acquired a stable condition, and the curves corresponding to the two temperatures became perfectly definite. They showed that the permeability of this sample of iron was considerably diminished at the lower temperature. The maximum permeability (for $H = 2$) was 3400 at 15° and only 2700 at −186°, a reduction of more than 20%; but the percentage reduction became less as the magnetizing force departed from the value corresponding to maximum permeability. Observations were also made of the changes of permeability which took place as the temperature of the sample slowly rose from −186° to 15°, the magnetizing force being kept constant throughout an experiment. The values of the permeability corresponding to the highest and lowest temperatures are given in the following table. Most of the permeability-temperature curves were more or less convex towards the axis of temperature, and in all the experiments, except those with annealed iron and steel wire, the permeability was greatest at the lowest temperature.[8] The hysteresis of the soft annealed iron turned out to be sensibly the same for equal values of the induction at −186° as at 15°, the loss in ergs per c.cm. per cycle being approximately represented by $0{\cdot}002\,B^{1\cdot 6}$ when the maximum limits of B were ± 9000. Experiments with the sample of unannealed iron failed to give satisfactory results, owing to the fact that no constant magnetic condition could be obtained.

Sample of Iron.	H.	μ at 15°.	μ at—186°.
Annealed Swedish . .	1·77	2835	2332
Unannealed „ . . .	1·78	917	1272
„ „ . . .	9·79	1210	1293
Hardened „ . . .	2·66	56	132
„ „ . . .	4·92	106·5	502
„ „ . . .	11·16	447·5	823
„ „ . . .	127·7	109	124
Steel wire	7·50	86	64·5
„	20·39	361	144

Honda and Shimizu have made similar experiments at the temperature of liquid air, employing a much wider range of magnetizing forces (up to about 700 C.G.S.) and testing a greater variety of metals. They found that the permeability of Swedish iron, tungsten-steel and nickel, when the metals were cooled to −186°, was diminished in weak fields but increased in strong ones, the field in which the effect of cooling changed its sign being 115 for iron and steel and 580 for nickel. The permeability of cobalt, both annealed and unannealed, was always diminished at the low temperature. The hysteresis-loss in Swedish iron was decreased for inductions below about 9000 and increased for higher inductions; in tungsten-steel, nickel and cobalt the hysteresis-loss was always increased by cooling. The range of ± B within which Steinmetz's formula is applicable becomes notably increased at low temperature. It may be remarked that, whereas Fleming and Dewar employed the ballistic method, their specimens having the form of rings, Honda and Shimizu worked magnetometrically with metals shaped as ovoids.

Permanent Magnets.—Fleming and Dewar (*loc. cit.* p. 57) also investigated the changes which occurred in permanently magnetized metals when cooled to the temperature of liquid air. The metals, which were prepared in the form of small rods, were magnetized between the poles of an electromagnet and tested with a magnetometer at temperatures of −186° and 15°. The first immersion into liquid air generally produced a permanent decrease of magnetic moment, and there was sometimes a further decrease when the metal was warmed up again; but after a few alternations of temperature the changes of moment became definite and cyclic. When the permanent magnetic condition had been thus established, it was found that in the case of all the metals, except the two alloys containing large percentages of nickel, the magnetic moment was temporarily increased by cooling to −186°. The following table shows the principal results. It is suggested that a permanent magnet might conveniently be "aged" (or brought into a constant condition) by dipping it several times into liquid air.

Metal.	Percentage Gain or Loss of Moment at —186° C.	
	First Effect.	Cyclic Effect.
Carbon steel, hard.	−6	+12
„ „ medium	Decrease	+22
„ „ annealed.	−33	+33
Chromium steels (four samples) . .	Increase	+12
Aluminium steels (three samples) .	−2	+10
Nickel steels, up to 7·65 % . . .	Small	+10
„ „ „ 19·64 % . . .	−50	−25
„ „ „ 29 %	−20	−10
Pure nickel	Decrease	+3
Silicon steel, 2·67 %	„	+4
Iron, soft	None	+2·5
„ hard	Decrease	+10
Tungsten steel, 15 %	„	+6
„ „ 7·5 %	„	+10
„ „ 1 %	„	+12

Other experiments relating to the effect of temperature upon permanent magnets have been carried out by J. R. Ashworth,[9] who showed that the temperature coefficient of permanent magnets might be reduced to zero (for moderate ranges of temperature) by suitable adjustment of temper and dimension ratio; also by R. Pictet,[10] A. Durward[11] and J. Trowbridge.[12]

Alloys of Nickel and Iron.—A most remarkable effect of temperature was discovered by Hopkinson (*Proc. Roy. Soc.*, 1890, 47, 23; 1891, 48, 1) in 1889. An alloy containing about 3 parts of iron and 1 of nickel—both strongly magnetic metals—is under ordinary conditions practically non-magnetizable ($\mu = 1{\cdot}4$ for any value of H). If, however, this non-magnetic substance is cooled to a temperature a few degrees below freezing-point, it becomes as strongly magnetic as average cast-iron ($\mu = 62$ for $H = 40$), and retains its magnetic properties indefinitely at ordinary temperatures. But if the alloy is heated up to 580° C. it loses its susceptibility—rather suddenly when H is weak, more gradually when H is strong—and remains non-magnetizable till it is once more cooled down below the freezing-point. This material can therefore exist in either of two perfectly stable conditions, in one of which it is magnetizable, while in the other it is not. When magnetizable it is a hard steel, having a specific electrical resistance of 0·000052; when non-magnetizable it is an extremely soft, mild steel, and its specific resistance is 0·000072. Alloys containing different proportions of nickel were found to exhibit the phenomenon, but the two critical temperatures were less widely separated. The following approximate figures for small magnetizing forces are deduced from Hopkinson's curves:—

Percentage of Nickel.	Susceptibility lost at temp. C.	Susceptibility gained at temp. C.
0·97	890	—
4·7	820	660
4·7	780	600
24·5	680	−10
30·0	140	125
33·0	207	193
73·0	202	202

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[1] *C.R.*, 1888, 106, 129.

[2] *Proc. Phys. Soc.*, 1888, 9, 181.

[3] *C.R.*, 1892, 115, 805; 1894, 118, 796 and 859.

[4] *Elekt. Zeits.*, 1894, 15, 194.

[5] *Phil. Mag.*, 1900, 50, 1.

[6] *Phil. Trans.*, 1903, 201, 1.

[7] *Phil. Mag.*, 1904, 8, 179.

[8] A. M. Thiessen (*Phys.*, 1899, 8, 65) and G. Claude (*C. R.*, 1899, 129, 409) found that for considerable inductions ($B = 15{,}000$) the permeability and hysteresis-loss remained nearly constant down to −186°; for weak inductions both notably diminished with temperature.

[9] *Proc. Roy. Soc.*, 1898, 62, 210.

[10] *C.R.*, 1895, 120, 263.

[11] *Amer. Journ. Sci.*, 1898, 5, 245.

[12] *Phys. Rev.*, 1901, 14, 181.

Honda and Shimizu (*loc. cit.*) have determined the two critical temperatures for eleven nickel-steel ovoids, containing from 24·04 to 70·32% of nickel, under a magnetizing force of 400, and illustrated by an interesting series of curves, the gradual transformation of the magnetic properties as the percentage of nickel was decreased. They found that the hysteresis-loss, which at ordinary temperatures is very small, was increased in liquid air, the increase for the alloys containing less than 30% of nickel being enormous. Steinmetz's formula applies only for very weak inductions when the alloys are at the ordinary temperature, but at the temperature of liquid air it becomes applicable through a wide range of inductions. According to C. E. Guillaume[1] the temperature at which the magnetic susceptibility of nickel-steel is recovered is lowered by the presence of chromium; a certain alloy containing chromium was not rendered magnetic even by immersion in liquid air. Experiments on the subject have also been made by E. Dumont[2] and F. Osmond.[3]

9. Alloys and Compounds of Iron

In 1885 Hopkinson (*Phil. Trans.*, 1885, 176, 455) employed his yoke method to test the magnetic properties of thirty-five samples of iron and steel, among which were steels containing substantial proportions of manganese, silicon, chromium and tungsten. The results, together with the chemical analysis of each sample, are given in a table contained in this paper, some of them being also represented graphically. The most striking phenomenon which they bring into prominence is the effect of any considerable quantity of manganese in annihilating the magnetic property of iron. A sample of Hadfield's manufacture, containing 12·36% of manganese, differed hardly at all from a non-magnetic substance, its permeability being only 1·27. According to Hopkinson's calculation, this sample behaved as if 91% of the iron contained in it had completely lost its magnetic property.[4] Another point to which attention is directed is the exceptionally great effect which hardening has upon the magnetic properties of chrome steel; one specimen had a coercive force of 9 when annealed, and of no less than 38 when oil-hardened. The effect of the addition of tungsten in increasing the coercive force is very clearly shown; in two specimens containing respectively 3·44 and 2·35% of tungsten the coercive force was 64·5 and 70·7. These high values render hardened tungsten-steel particularly suitable for the manufacture of permanent magnets. Hopkinson (*Proc. Roy. Soc.*, 1890, 48, 1) also noticed some peculiarities of an unexpected nature in the magnetic properties of the nickel-steel alloys already referred to. The permeability of the alloys containing from 1 to 4·7% of nickel, though less than that of good soft iron for magnetizing forces up to about 20 or 30, was greater for higher forces, the induction reached in a field of 240 being nearly 21,700. The induction for considerable forces was found to be greater in a steel containing 73% of nickel than in one with only 33%, though the permeability of pure nickel is much less than that of iron.

The magnetic qualities of various alloys of iron have been submitted to a very complete examination by W. F. Barrett, W. Brown and R. A. Hadfield (*Trans. Roy. Dub. Soc.*, 1900, 7, 67; *Journ. Inst. Elec. Eng.*, 1902, 31, 674).[5] More than fifty different specimens were tested, most of which contained a known proportion of manganese, nickel, tungsten, aluminium, chromium, copper or silicon; in some samples two of the substances named were present. Of the very numerous results published, a few of the most characteristic are collected in the following table. The first column contains the symbols of the various elements which were added to the iron, and the second the percentage proportion in which each element was present; the sample containing 0·03% of carbon was a specimen of the best commercial iron, the values obtained for it being given for comparison. All the metals were annealed.

Element.	Per cent.	B for H = 45.	B residual.	μ for H = 8.	Coercive Force.
C	0·03	16800	9770	1625	1·66
Cu	2·5	14300	10410	..	5·4
Mn	2·25	14720	10460	1080	6·0
Mn	15·2	0	..	..	..
Ni	3·82	16190	9320	1375	2·76
Ni	19·64	7770	4770	90	20·0
Ni	31·4	4460	1720	357	0·5
W	7·5	15230	13280	500	9·02
Al	2·25	16900	10500	1700	1·0
Cr	3·25	..	..	..	12·25
Si	2·5	16420	4080	1680	0·9
Si	5·5	15980	3430	1630	0·85

A few among several interesting points should be specially noticed. The addition of 15·2% of manganese produced an enormous effect upon the magnetism of iron, while the presence of only 2·25% was comparatively unimportant. When nickel was added to the iron in increasing quantities the coercive force increased until the proportion of nickel reached 20%; then it diminished, and when the proportion of nickel was 32% the coercive force had fallen to the exceedingly low value of 0·5. In the case of iron containing 7·5% of tungsten (W), the residual induction had a remarkably high value; the coercive force, however, was not very great. The addition of silicon in small quantities considerably diminished permeability and increased coercive force; but when the proportion amounted to 2·5% the maximum permeability ($\mu = 5100$ for $H = 2$) was greater than that of the nearly pure iron used for comparison, while the coercive force was only 0·9.[6] A small percentage of aluminium produced still higher permeability ($\mu = 6000$ for $H = 2$), the induction in fields up to 60 being greater than in any other known substance, and the hysteresis-loss for moderate limits of B far less than in the purest commercial iron. Certain non-magnetizable alloys of nickel, chromium-nickel and chromium-manganese were rendered magnetizable by annealing.

Later papers[7] give the results of a more minute examination of those specimens which were remarkable for very low and very high permeabilities, and were therefore likely to be of commercial importance. The following table gives the exact composition of some alloys which were found to be non-magnetizable, or nearly so, in a field of 320.

An. = Annealed. Un. = Unannealed.		
State.	Percentage Composition.	I, for H = 320.
Un.	Fe, 85·77; C, 1·23; Mn, 13.	0
An.	Fe, 84·64; C, 0·15; Mn, 15·2	0
An.	Fe, 80·16; C, 0·8; Mn, 5·04; Ni, 14·55.	3
Un.	Ditto	0
Un.	Fe, 75·36; C, 0·6; Mn, 5·04; Ni, 19.	3
An.	Fe, 86·61; C, 1·08; Mn, 10·2; W, 2·11.	5

A very small difference in the constitution often produces a remarkable effect upon the magnetic quality, and it unfortunately happens that those alloys which are hardest magnetically are generally also hardest mechanically and extremely difficult to work; they might however be used rolled or as castings. The specimens distinguished by unusually high permeability were constituted as follows:—

Silicon-iron.—Fe, 97·3; C, 0·2; Si, 2·5.
Aluminium-iron.—Fe, 97·33; C, 0·18; Al, 2·25.

The silicon-iron had, in fields up to about 10, a greater permeability than a sample of the best Swedish charcoal-iron, and its hysteresis-loss for max. $B = 9000$, at a frequency of 100 per second, was only 0·254 watt per pound, as compared with 0·382 for the Swedish iron. The aluminium-iron attained its greatest permeability in a field of 0·5, about that of the earth's force, when its value was 9000, this being more than twice the maximum permeability of the Swedish iron. Its hysteresis-loss for $B = 9000$ was 0·236 per pound. It was, however, found that the behaviour of this alloy was in part due to a layer of pure iron ("ferrite") averaging 0·1 mm. in thickness, which occurred on the outside of the specimen, and the exceptional magnetic quality which has been claimed for aluminium-iron cannot yet be regarded as established.

A number of iron alloys have been examined by Mme. Curie (*Bull. Soc. d'Encouragement*, 1898, pp. 36–76), chiefly with the object of determining their suitability for the construction of permanent magnets. Her tests appear to show that molybdenum is even more effective than tungsten in augmenting the coercive force, the highest values observed being 70 to 74 for tungsten-steel, and 80 to 85 for steel containing 3·5 to 4% of molybdenum. For additional information regarding the composition and qualities of permanent magnet steels reference may be made to the publications cited below.[1] Useful instructions have been furnished by Carl Barus (*Terrestrial Magnetism*, 1897, 2, 11) for the preparation of magnets calculated to withstand the effects of time, percussion and ordinary temperature variations. The metal, having first been uniformly tempered glass-hard, should be annealed in steam at 100° C. for twenty or thirty hours; it should then be magnetized to saturation, and finally "aged" by a second immersion in steam for about five hours.

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[1] *C.R.*, 1897, 124, 176 and 1515; 1897, 125, 235; 1898, 126, 738.

[2] Ibid., 1898, 126, 741.

[3] Ibid., 1899, 128, 304 and 1395.

[4] See also J. Hopkinson, *Journ. Inst. Elect. Eng.*, 1890, 19, 20, and J. A. Ewing, *Phil. Trans.*, 1889, 180, 239.

[5] Many of the figures which, through an error, were inaccurately stated in the first paper are corrected in the second.

[6] The marked effect of silicon in increasing the permeability of cast iron has also been noticed by F. C. Caldwell, *Elect. World*, 1898, 32, 619.

[7] *Trans. Roy. Dub. Soc.*, 1902–4, 8, 1 and 123.

Magnetic Alloys of Non-Magnetic Metals.—The interesting discovery was made by F. Heusler[2] in 1903 that certain alloys of the non-magnetic metal manganese with other non-magnetic substances were strongly magnetizable, their susceptibility being in some cases equal to that of cast iron. The metals used in different combinations included tin, aluminium, arsenic, antimony, bismuth and boron; each of these, when united in certain proportions with manganese, together with a larger quantity of copper (which appears to serve merely as a menstruum), constituted a magnetizable alloy. So far, the best results have been attained with aluminium, and the permeability was greatest when the percentages of manganese and aluminium were approximately proportional to the atomic weights of the two metals. Thus in an alloy containing 26·5% of manganese and 14·6% of aluminium, the rest being copper, the induction for $H=20$ was 4500, and for $H=150$, 5550. When the proportion of aluminium to manganese was made a little greater or smaller, the permeability was diminished. Next to aluminium, tin was found to be the most effective of the metals enumerated above. In all such magnetizable alloys the presence of manganese appears to be essential, and there can be little doubt that the magnetic quality of the mixtures is derived solely from this component. Manganese, though belonging (with chromium) to the iron group of metals, is commonly classed as a paramagnetic, its susceptibility being very small in comparison with that of the recognized ferromagnetics; but it is remarkable that its atomic susceptibility in solutions of its salts is even greater than that of iron. Now iron, nickel and cobalt all lose their magnetic quality when heated above certain critical temperatures which vary greatly for the three metals, and it was suspected by Faraday[3] as early as 1845 that manganese might really be a ferromagnetic metal having a critical temperature much below the ordinary temperature of the air. He therefore cooled a piece of the metal to −105° C., the lowest temperature then attainable, but failed to produce any change in its magnetic quality. The critical temperature (if there is one) was not reached in Faraday's experiment; possibly even the temperature of −250° C., which by the use of liquid hydrogen has now become accessible, might still be too high.[4] But it has been shown that the critical temperatures of iron and nickel may be changed by the addition of certain other substances. Generally they are lowered, sometimes, however, they are raised[5]; and C. E. Guillaume[6] explains the ferromagnetism of Heusler's alloy by supposing that the naturally low critical temperature of the manganese contained in it is greatly raised by the admixture of another appropriate metal, such as aluminium or tin; thus the alloy as a whole becomes magnetizable at the ordinary temperature. If this view is correct, it may also be possible to prepare magnetic alloys of chromium, the only other paramagnetic metals of the iron group.

J. A. Fleming and R. A. Hadfield[7] have made very careful experiments on an alloy containing 22·42% of manganese, 11·65% of aluminium and 60·49% of copper. The magnetization curve was found to be of the same general form as that of a paramagnetic metal, and gave indications that with a sufficient force magnetic saturation would probably be attained. There was considerable hysteresis, the energy-loss per cycle being fairly represented by $W=0{\cdot}0005495B^{2{\cdot}228}$. The hysteretic exponent is therefore much higher than in the case of iron, nickel and cobalt, for which its value is approximately 1·6.

10. MISCELLANEOUS EFFECTS OF MAGNETIZATION

Electrical Conductivity.—The specific resistance of many electric conductors is known to be temporarily changed by the action of a magnetic field, but except in the case of bismuth the effect is very small.

A. Gray and E. Taylor Jones (*Proc. Roy. Soc.*, 1900, 67, 208) found that the resistance of a soft iron wire was increased by about 1/700 in a field of 320 C.G.S. units. The effect appeared to be closely connected with the intensity of magnetization, being approximately proportional to I. G. Barlow (*Proc. Roy. Soc.*, 1903, 71, 30), experimenting with wires of iron, steel and nickel, showed that in weak fields the change of resistance was proportional to a function $aI^2+bI^4+cI^6$, where a, b and c are constants for each specimen. W. E. Williams (*Phil. Mag.*, 1902, 4, 430) found that for nickel the curves showing changes of resistance in relation to magnetizing force were strikingly similar in form to those showing changes of length. H. Tomlinson (*Phil. Trans.*, 1883, Part I., 153) discovered in 1881 that the resistance of a bismuth rod was slightly increased when the rod was subjected to longitudinal magnetic force, and a year or two later A. Righi (*Atti R. A. Lincei*, 1883–1884, 19, 545) showed that a more considerable alteration was produced when the magnetic force was applied transversely to the bismuth conductor; he also noticed that the effect was largely dependent upon temperature (see also P. Lenard, *Wied. Ann.*, 1890, 39, 619). Among the most important experiments on the influence of magnetic force at different temperatures are those of J. B. Henderson and of Dewar and Fleming. Henderson (*Phil. Mag.*, 1894, 38, 488) used a little spiral of the pure electrolytic bismuth wire prepared by Hartmann and Braun; this was placed between the pole-pieces of an electromagnet and subjected to fields of various strengths up to nearly 39,000 units. At constant temperature the resistance increased with the field; the changes in the resistance of the spiral when the temperature was 18° C. are indicated in the annexed table, from which it will be seen that in the strongest transverse field reached the resistance was increased more than threefold. Other experiments showed the relation of resistance to temperature (from 0° to about 90°) in different constant fields. It appears that as the temperature rises the resistance decreases to a minimum and then increases, the minimum point occurring at a higher temperature the stronger the field. For $H=11{,}500$ the temperature of minimum resistance was about 50°; for much lower or higher values of H the actual minimum did not occur within the range of temperature dealt with. Dewar and Fleming (*Proc. Roy. Soc.*, 1897, 60, 425) worked with a similar specimen of bismuth, and their results for a constant temperature of 19° agree well with those of Henderson. They also experimented with constant temperatures of −79° −185° and −203°, and found that at these low temperatures the effect of magnetization was enormously increased. The following table gives some of their results, the specific resistance of the bismuth being expressed in C.G.S. units.

H.	R.	H.	R.
0	1·000	27450	2·540
6310	1·253	32730	2·846
12500	1·630	38900	3·334
20450	2·160		

Field Strength.	Temp. 19° C.		Temp.−185° C.	
	Spec. Res.	Comp. Res.	Spec. Res.	Comp. Res.
0	116200	1·000	41000	1·00
1375	118200	1·017	103300	2·52
2750	123000	1·059	191500	4·67
8800	149200	1·284	738000	18·0
14150	186200	1·602	1730000	42·2
21800	257000	2·212	6190000	151

At the temperature of liquid air (−185°) the application of a field of 21,800 multiplied the resistance of the bismuth no less than 150 times. Fig. 29 shows the variations of resistance in relation to temperature for fields of different constant values. It will be seen that for $H=2450$ and $H=5500$ the minimum resistance occurs at temperatures of about −80° and −7° respectively.

Hall Effect.—If an electric current is passed along a strip of thin metal, and the two points at opposite ends of an equipotential line are connected with a galvanometer, its needle will of course not be deflected. But the application of a magnetic field at right angles to the plane of the metal causes the equipotential lines to rotate through a small angle, and the points at which the galvanometer is connected being no longer at the same potential, a current is indicated by the galvanometer.[1]

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[1] J. Trowbridge and S. Sheldon, *Phil. Mag.*, 1890, 29, 136; W. H. Preece, *Journ. Inst. Elec. Eng.*, 1890, 19, 62; *Electrician*, 1890, 25, 546; I. Klemençiç, *Wien. Ber.*, 1896, 105, IIa, 635; B. O. Peirce, *Am. Journ. Sci.*, 1896, 2, 347; A. Abt, *Wied. Ann.*, 1898, 66, 116; F. Osmond, *C. R.*, 1899, 128, 1513.

[2] *Deutsch. phys. Gesell. Verh.*, 1903, 5, 220 and 224.

[3] *Exp. Res.*, iii. 440.

[4] No record can be found of experiments with manganese at the temperature of liquid air or hydrogen; probably, however, negative results would not be published.

[5] The critical temperature of iron, for instance, is raised more than 100° by the addition of a little carbon and tungsten.

[6] *Bull. Soc. Int. des Électriciens*, 1906, 6, 301.

[7] *Proc. Roy. Soc.*, 1905, 76A, 271.

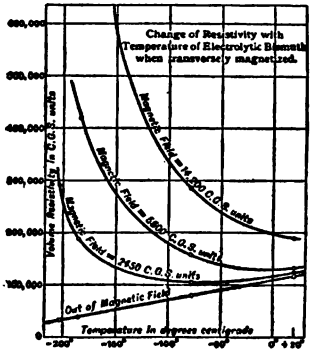


Fig. 29.

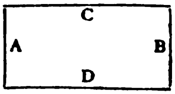
The tranverse electromotive force is equal to KCH/D, where C is the current, H the strength of the field, D the thickness of the metal, and K a constant which has been termed the *rotatory power* or *rotational coefficient*. (See Hopkinson, *Phil. Mag.*, 1880, 10, 430). The following values of K for different metals are given by E. H. Hall, the positive sign indicating that the electromotive force is in the same direction as the mechanical force acting upon the conductor. A. von Ettinghausen and W. Nernst (*Wien. Ber.*, 1886, 94, 560) have found that the rotational coefficient of tellurium is more than fifty times greater than that of bismuth, its sign being positive. Several experimenters have endeavoured to find a Hall effect in liquids, but such results as have been hitherto obtained are by no means free from doubt. E. A. Marx (*Ann. d. Phys.*, 1900, 2, 798) observed a well-defined Hall effect in incandescent gases. A large effect, proportional to the field, has been found by H. A. Wilson (*Cam. Phil. Soc. Proc.*, 1902, 11, pp. 249, 391) in oxygen, hydrogen and air at low pressures, and by C. D. Child (*Phys. Rev.*, 1904, 18, 370) in the electric arc.

Metal.	$K \times 10^{15}$	Metal.	$K \times 10^{15}$
Antimony	+114000	Copper	−520
Steel	+12060	Gold	−660
Iron	+7850	Nickel	−14740
Cobalt	+2460	Bismuth[2]	−8580000
Zinc	+820		

Electro-Thermal Relations.—The Hall electromotive force is only one of several so-called "galvano-magnetic effects" which are observed when a magnetic field acts normally upon a thin plate of metal traversed by an electric current. It is remarkable that if a flow of heat be substituted for a current of electricity a closely allied group of "thermo-magnetic effects" is presented. The two classes of phenomena have been collated by M. G. Lloyd (*Am. Journ. Sci.*, 1901, 12, 57), as follows:—

Galvano-Magnetic Effects.	*Thermo-Magnetic Effects.*
1. A transverse difference of electric potential (Hall effect).	i. A transverse difference of electric potential (Nernst effect).
2. A transverse difference of temperature (Ettinghausen effect).	ii. A transverse difference of temperature (Leduc effect).
3. Longitudinal change of electric conductivity.	iii. Longitudinal change of thermal conductivity.
4. Longitudinal difference of temperature.	iv. Longitudinal difference of electric potential.[3]

If in the annexed diagram ABCD represents the metallic plate through which the current of electricity or heat flows in the direction AB, then effects (1), (2), (i.) and (ii.) are exhibited at C and D, effects (4) and (iv.) at A and B, and effects (3) and (iii.) along AB. The transverse effects are reversed in direction when either the magnetic field or the primary current (electric or thermal) is reversed, but the longitudinal effects are independent of the direction of the field. It has been shown by G. Moreau (*C. R.*, 1900, 130, pp. 122, 412, 562) that if K is the coefficient of the Hall effect (1) and K′ the analogous coefficient of the Nernst effect (i.) (which is constant for small values of H), then $K' = K\sigma/\rho$, σ being the coefficient of the Thomson effect for the metal and ρ its specific resistance. He considers that Hall's is the fundamental phenomenon, and that the Nernst effect is essentially identical with it, the primary electromotive force in the case of the latter being that of the Thomson effect in the unequally heated metal, while in the Hall experiment it is derived from an external source.



Attempts have been made to explain these various effects by the electron theory.[4]

Thermo-electric Quality.—The earliest observations of the effect of magnetization upon thermo-electric power were those of W. Thomson (Lord Kelvin), who in 1856 announced that magnetization rendered iron and steel positive to the unmagnetized metals.[5] It has been found by Chassagny,[6] L. Houllevigue[7] and others that when the magnetizing force is increased, this effect passes a maximum, while J. A. Ewing[8] has shown that it is diminished and may even be reversed by tensile stress. Nickel was believed by Thomson to behave oppositely to iron, becoming negative when magnetized; but though his conclusion was accepted for nearly fifty years, it has recently been shown to be an erroneous one, based, no doubt, upon the result of an experiment with an impure specimen. Nickel when magnetized is always positive to the unmagnetized metal. So also is cobalt, as was found by H. Tomlinson.[9] The curves given by Houllevigue for the relation of thermo-electric force to magnetic field are of the same general form as those showing the relation of change of length to field. E. Rhoads[10] obtained a cyclic curve for iron which indicated thermo-electric hysteresis of the kind exhibited by Nagaoka's curves for magnetic strain. He also experimented with nickel and again found a resemblance to the strain curve. The subject was further investigated by S. Bidwell,[11] who, adopting special precautions against sources of error by which former work was probably affected, measured the changes of thermo-electric force for iron, steel, nickel and cobalt produced by magnetic fields up to 1500 units. In the case of iron and nickel it was found that, when correction was made for mechanical stress due to magnetization, magnetic change of thermo-electric force was, within the limits of experimental error, proportional to magnetic change of length. Further, it was shown that the thermo-electric curves were modified both by tensile stress and by annealing in the same manner as were the change-of-length curves, the modification being sometimes of a complex nature. Thus a close connexion between the two sets of phenomena seems to be established. In the case of cobalt no such relation could be traced; it appeared that the thermo-electric power of the unmagnetized with respect to the magnetized cobalt was proportional to the square of the magnetic induction or of the magnetization. Of nickel six different specimens were tested, all of which became, like iron, thermo-electrically positive to the unmagnetized metals.

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[1] E. H. Hall, *Phil. Mag.*, 1880, 9, 225; 1880, 10, 301; 1881, 12, 157; 1883, 15, 341; 1885, 19, 419.

[2] The large Hall effect in bismuth was discovered by Righi, *Journ. de Phys.*, 1884, 3, 127.

[3] References.—(2) A. von Ettinghausen, *Wied. Ann.*, 1887, 31, 737.—(4) H. W. Nernst, ibid., 784.—(i.) and (iv.); A. von Ettinghausen and H. W. Nernst, *Wied. Ann.*, 1886, 29, 343.—(ii.) and (iii.); A. Righi, *Rend. Acc. Linc.*, 1887, 3 II, 6 and I, 481; and A. Leduc, *Journ. de Phys.*, 1887, 6, 78. Additional authorities are quoted by Lloyd, *loc. cit.*

[4] P. Drude, *Ann. d. Phys.*, 1900, 1, 566; 1900, 3, 369; 1902, 7, 687. See also E. van Everdingen, *Arch. Néerlandaises*, 1901, 4, 371; G. Barlow, *Ann. d. Phys.*, 1903, 12, 897; H. Zahn, ibid. 1904, 14, 886; 1905, 16, 148.

[5] *Phil. Trans.*, 1856, p. 722. According to the nomenclature adopted by the best modern authorities, a metal A is said to be thermo-electrically positive to another metal B when the thermo-current passes from A to B through the cold junction, and from B to A through the hot (see Thermo-Electricity).

[6] *C.R.*, 1893, 116, 997.

[7] *Journ. de Phys.*, 1896, 5, 53.

[8] *Phil. Trans.*, 1887, 177, 373.

[9] *Proc. Roy. Soc.*, 1885, 39, 513.

[10] *Phys. Rev.*, 1902, 15, 321. The sign of the thermo-electric effect for nickel, as given by Rhoads, is incorrect.

[11] *Proc. Roy. Soc.*, 1904, 73, 413.

As to what effect, if any, is produced upon the thermo-electric quality of bismuth by a magnetic field there is still some doubt. E. van Aubel[1] believes that in pure bismuth the thermo-electric force is increased by the field; impurities may neutralize this effect, and in sufficient quantities reverse it.

Elasticity.—The results of experiments as to the effect of magnetization were for long discordant and inconclusive, sufficient care not having been taken to avoid sources of error, while the effects of hysteresis were altogether disregarded. The subject, which is of importance in connexion with theories of magnetostriction, has been investigated by K. Honda and T. Terada in a research remarkable for its completeness and the ingenuity of the experimental methods employed.[2] The results are too numerous to discuss in detail; some of those to which special attention is directed are the following: In Swedish iron and tungsten-steel the change of elastic constants (Young's modulus and rigidity) is generally positive, but its amount is less than 0·5%; changes of Young's modulus and of rigidity are almost identical. In nickel the maximum change of the elastic constants is remarkably large, amounting to about 15% for Young's modulus and 7% for rigidity; with increasing fields the elastic constants first decrease and then increase. In nickel-steels containing about 50 and 70% of nickel the maximum increase of the constants is as much as 7 or 8%. In a 29% nickel-steel, magnetization increases the constants by a small amount. Changes of elasticity are in all cases dependent, not only upon the field, but also upon the tension applied; and, owing to hysteresis, the results are not in general the same when the magnetization follows as when it precedes the application of stress; the latter is held to be the right order.

Chemical and Voltaic Effects.—If two iron plates, one of which is magnetized, are immersed in an electrolyte, a current will generally be indicated by a galvanometer connected with the plates.

As to whether the magnetized plate becomes positive or negative to the other, different experimenters are not in agreement. It has, however, been shown by Dragomir Hurmuzescu (*Rap. du Congrès Int. de Phys.*, Paris, 1900, p. 561) that the true effect of magnetization is liable to be disguised by secondary or parasitic phenomena, arising chiefly from polarization of the electrodes and from local variations in the concentration and magnetic condition of the electrolyte; these may be avoided by working with weak solutions, exposing only a small surface in a non-polar region of the metal, and substituting a capillary electrometer for the galvanometer generally used. When such precautions are adopted it is found that the "electromotive force of magnetization" is, for a given specimen, perfectly definite both in direction and in magnitude; it is independent of the nature of the corrosive solution, and is a function of the field-strength alone, the curves showing the relation of electromotive force to field-intensity bearing a rough resemblance to the familiar I–H curves. The value of the E.M.F. when H = 2000 is of the order of 1/100 volt for iron, 1/1000 volt for nickel and 1/10,000 for bismuth. When the two electrodes are ferro-magnetic, the direction of the current through the liquid is from the unmagnetized to the magnetized electrode, the latter being least attacked; with diamagnetic electrodes the reverse is the case. Hurmuzescu shows that these results are in accord with theory. Applying the principle of the conservation of internal energy, he demonstrates that for iron in a field of 1000 units and upwards the E.M.F. of magnetization is

$$E = \frac{l}{\delta} \cdot \frac{I^2}{2\kappa} \qquad \text{approximately,}$$

l being the electrochemical equivalent and δ the density of the metal. Owing to the difficulty of determining the magnetization I and the susceptibility κ with accuracy, it has not yet been possible to submit this formula to a quantitative test, but it is said to afford an indication of the results given by actual experiment. It has been discovered by E. L. Nichols and W. S. Franklin (*Am. Journ. Sci.*, 1887, 34, 419; 1888, 35, 290) that the transition from the "passive" to the active state of iron immersed in strong nitric acid is facilitated by magnetization, the temperature of transition being lowered. This is attributed to the action of local currents set up between unequally magnetized portions of the iron. Similar results have been obtained by T. Andrews (*Proc. Roy. Soc.*, 1890, 48, 116).

11. FEEBLY SUSCEPTIBLE SUBSTANCES

Water.—The following are recent determinations of the magnetic susceptibility of water:—

Observer.	$\kappa \times 10^6$.	Publication.
G. Quincke	$-0{\cdot}797$ at 18° C.	*Wied. Ann.*, 1885, 24, 387.
H. du Bois	$-0{\cdot}837\,(1-0{\cdot}0025\,t-15°)$	*Wied. Ann.*, 1888, 35, 137.
P. Curie	$-0{\cdot}790$ at 4° C.	*C. R.*, 1893, 116, 136.
J. Townsend	$-0{\cdot}77$	*Phil. Trans.*, 1896, 187, 544.
J. A. Fleming and J. Dewar	$-0{\cdot}74$	*Proc. Roy. Soc.*, 1898, 63, 311.
G. Jäger and S. Meyer	$-0{\cdot}689\,(1-0{\cdot}0016\,t)$	*Wied. Ann.*, 1899, 67, 707.
J. Koenigsberger	$-0{\cdot}781$ at 22° C.	*Ann. d. Phys.*, 1901, 6, 506.
H. D. Stearns	$-0{\cdot}733$ at 22° C.	*Phys. Rev.*, 1903, 16, 1.
A. P. Wills	$-0{\cdot}720$ at 18° C.	*Phys. Rev.*, 1905, 20, 188.

Wills found that the succeptibility was constant in fields ranging from 4200 to 15,000.

Oxygen and Air.—The best modern determinations of the value of κ for gaseous oxygen agree very fairly well with that given by Faraday in 1853 (*Exp. Res.* III, 502). Assuming that for water $\kappa = -0{\cdot}8 \times 10^{-6}$, his value of κ for oxygen at 15° C. reduces to $0{\cdot}15 \times 10^{-6}$. Important experiments on the susceptibility of oxygen at different pressures and temperatures were carried out by P. Curie (*C.R.* 1892, 115, 805; 1893, 116, 136). *Journ. de Phys.*, 1895, 4, 204. He found that the susceptibility for unit of mass, K, was independent of both pressure and magnetizing force, but varied inversely as the absolute temperature, θ, so that $10^6 K = 33700/\theta$. Since the mass of 1 cub. cm. of oxygen at 0° C. and 760 mm. pressure is 0·00141 grm., the mass at any absolute temperature θ is by Charles's law $0{\cdot}00141 \times 273/\theta = 0{\cdot}3849/\theta$ grm.; hence the susceptibility per unit of volume at 760 mm. will be

$$\begin{aligned}\kappa &= 10^{-6} \times 0{\cdot}3849 \times 33700/\theta^2 \\ &= 10^{-6} \times 12970/\theta^2.\end{aligned}$$

At 15° C. $\theta = 273 + 15 = 288$, and therefore $\kappa = 0{\cdot}156 \times 10^{-6}$, nearly the same as the value found by Faraday. At 0° C., $\kappa = 0{\cdot}174 \times 10^{-6}$. For air Curie calculated that the susceptibility per unit mass was $10^6 K = 7830/\theta$; or, taking the mass of 1 c.c. of air at 0° C. and 760 mm. as 0·001291 grm., $\kappa = 10^{-6} \times 2760/\theta^2$ for air at standard atmospheric pressure. It is pointed out that this formula may be used as a temperature correction in magnetic determinations carried out in air.

Fleming and Dewar determined the susceptibility of liquid oxygen (*Proc. Roy. Soc.*, 1896, 60, 283; 1898, 63, 311) by two different methods. In the first experiments it was calculated from observations of the mutual induction of two conducting circuits in air and in the liquid; the results for oxygen at −182° C. were

$$\mu = 1{\cdot}00287,\ \kappa = 228 \times 10^{-6}.$$

In the second series, to which greater importance is attached, measurements were made of the force exerted in a divergent field upon small balls of copper, silver and other substances, first when the balls were in air and afterwards when they were immersed in liquid oxygen. If V is the volume of a ball, H the strength of the field at its centre, and κ' its apparent susceptibility, the force in the direction x is $f = \kappa' VH \times dH/dx$; and if κ'_a and κ'_o are the apparent susceptibilities of the same ball in air and in liquid oxygen, $\kappa'_a - \kappa'_o$ is equal to the difference between the susceptibilities of the two media. The susceptibility of air being known—practically it was negligible in these experiments—that of liquid oxygen can at once be found. The mean of 36 experiments with 7 balls gave

$$\mu = 1{\cdot}00407,\ \kappa = 324 \times 10^{-6}.$$

A small but decided tendency to a decrease of susceptibility in very strong fields was observed. It appears, therefore, that liquid oxygen is by far the most strongly paramagnetic liquid known, its susceptibility being more than four times greater than that of a saturated solution of ferric chloride. On the other hand, its susceptibility is about fifty times less than that of Hadfield's 12% manganese steel, which is commonly spoken of as non-magnetizable.

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[1] *C.R.*, 1903, 136, 1131.

[2] *Journ. Coll. Sci. Tokyo*, 1906, 21, art. 4. The paper contains 40 tables and 85 figures.

Bismuth.—Bismuth is of special interest, as being the most strongly diamagnetic substance known, the mean value of the best determinations of its susceptibility being about -14×10^{-6} (see G Meslin, *C. R.*, 1905, 140, 440) The magnetic properties of the metal at different temperatures and in fields up to 1350 units have been studied by P Curie (*loc cit*), who found that its "specific susceptibility" (K) was independent of the strength of the field, but decreased with rise of temperature up to the melting-point, 273° C His results appear to show the relation

$$-K\times10^6=1\cdot381-0\cdot00155t^\circ$$

Assuming the density of Bi to be 9·8, and neglecting corrections for heat dilatation, his value for the susceptibility at 20° C. is equivalent to $\kappa=-13\cdot23\times10^{-6}$. As the temperature was raised up to 273°, κ gradually fell to $-9\cdot38\times10^{-6}$, rising suddenly when fusion occurred to $-0\cdot37\times10^{-6}$, at which value it remained constant when the fluid metal was further heated. Fleming and Dewar give for the susceptibility the values $-13\cdot7\times10^{-6}$ at 15° C. and $-15\cdot9\times10^{-6}$ at −182°, the latter being approximately equivalent to $K\times10^6=-1\cdot62$. Putting $t^\circ=-182$ in the equation given above for Curie's results, we get $K\times10^6=-1\cdot66$, a value sufficiently near that obtained by Fleming and Dewar to suggest the probability that the diamagnetic susceptibility varies inversely as the temperature between −182° and the melting-point.

Other Diamagnetics.—The following table gives Curie's determinations (*Journ. de Phys.*, 1895, 4, 204) of the specific susceptibility K of other diamagnetic substances at different temperatures. It should be noted that $K=\kappa/\text{density}$.

Substance.	Temp. °C.	$-K\times10^6$.
Water	15−189	0·790
Rock salt	16−455	0·580
Potassium chloride	18−465	0·550
„ sulphate	17−460	0·430
„ nitrate (fusion 350°)	18−420	0·330
Quartz	18−430	0·441
Sulphur, solid or fused	18−225	0·510
Selenium, solid or fused	20−200	0·320
„ fused	240−415	0·307
Tellurium	20−305	0·311
Bromine	20	0·410
Iodine, solid or fused	18−164	0·385
Phosphorus, solid or fused	19−71	0·920
„ amorphous	20−275	0·730
Antimony, electrolytic	20	0·680
„	540	0·470
Bismuth, solid	20	1·350
„ „	273	0·957
„ fused	273−405	0·038

For all diamagnetic substances, except antimony and bismuth, the value of K was found to be independent of the temperature.

Paramagnetic Substances.—Experiments by J S Townsend (*Phil. Trans.*, 1896, 187, 533) show that the susceptibility of solutions of salts of iron is independent of the magnetizing force, and depends only on the quantity of iron contained in unit volume of the liquid. If W is the weight of iron present per c.c. at about 10° C., then for ferric salts

$$10^6\kappa=266W-0\cdot77$$

and for ferrous salts

$$10^6\kappa=206W-0\cdot77,$$

the quantity −0·77 arising from the diamagnetism of the water of solution. Annexed are values of $10^6\kappa$ for the different salts examined, w being the weight of the salt per c.c. of the solution.

Salt.	$10^6\kappa+0\cdot77$	Salt.	$10^6\kappa+0\cdot77$
Fe_2Cl_6	$91\cdot6w$	$FeCl_2$	$90\cdot8w$
$Fe_2(SO_4)_3$	$74\cdot5w$	$FeSO_4$	$74\cdot9w$
$Fe_2(NO_3)_6$	$61\cdot5w$		

Susceptibility was found to diminish greatly with rise of temperature. According to G. Jäger and S. Meyer (*Wien. Akad Sitz*, 1897, 106, II.*a*, p. 623, and 1898, 107, II.*a*, p 5) the atomic susceptibilities k of the metals nickel, chromium, iron, cobalt and manganese in solutions of their salts are as follows:—

Metal.	$k\times10^6$.	Metal.	$k\times10^6$.
Ni	$4\cdot95=2\cdot5\times2$	Co	$10\cdot0=2\cdot5\times4$
Cr	$6\cdot25=2\cdot5\times2\cdot5$	Fe(2)	$12\cdot5=2\cdot5\times5$
Fe(1)	$7\cdot5=2\cdot5\times3$	Mn.	$15\cdot0=2\cdot5\times6$

Fe(1) is iron contained in $FeCl_2$ and Fe(2) iron contained in $Fe_2(NO_3)_6$.

Curie has shown, for many paramagnetic bodies, that the specific susceptibility K is inversely proportional to the absolute temperature θ. Du Bois believes this to be an important general law, applicable to the case of every paramagnetic substance, and suggests that the product $K\theta$ should be known as "Curie's constant" for the substance.

Elementary Bodies and Atomic Susceptibility.—Among a large number of substances the susceptibilities of which have been determined by J Koenigsberger (*Wied. Ann.*, 1898, 66, 698) are the following elements:—

Element.	$\kappa\times10^6$.	Element.	$\kappa\times10^6$
Copper	−0·82	Tellurium	− 2·10
Silver	−1·51	Graphite	+ 2
Gold	−3·07	Aluminium	+ 1·80
Zinc	−0·96	Platinum	+22
Tin	+0·46	Palladium	+50 to 60
Lead	−1·10	Tungsten	+14
Thallium	−4·61	Magnesium	+ 4
Sulphur	−0·86	Sodium	+ 2·2
Selenium (red)	−0·50	Potassium	+ 3·6

In a table accompanying Koenigsberger's paper the elements are arranged upon the periodic system and the atomic susceptibility (product of specific susceptibility into atomic weight) is given for each. It appears that the elements at about the middle of each row are the most strongly paramagnetic, towards the ends of a row the susceptibility decreases, and ultimately becomes negative. Thus a relation between susceptibility and atomic weight is clearly indicated. Tables similarly arranged, but much more complete, have been published by S. Meyer (*Wied. Ann.*, 1899, 68, 325 and 1899, 69, 236), whose researches have filled up many previously existing gaps. The values assigned to the atomic susceptibilities of most of the known elements are appended. According to the notation adopted by Meyer the atomic susceptibility $k=\kappa\times$ atomic-weight/ (density × 1000).

Meyer thinks that the susceptibilities of the metals praseodymium, neodymium, ytterbium, samarium, gadolinium, and erbium, when obtained in a pure form, will be found to equal or even exceed those of the well-known ferromagnetic metals. Many of their compounds are very strongly magnetic, erbium, for example, in Er_2O_3 being four times as strong as iron in the familiar magnetite or lodestone, Fe_3O_4. The susceptibilities of some hundreds of inorganic compounds have also been determined by the same investigator (*loc. cit.*). Among other researches relating to atomic and molecular magnetism are those of O. Liebknecht and A. P. Wills (*Ann. d Phys.*, 1900, 1. 178), H. du Bois and O Liebknecht (ibid p 189), and Meyer (ibid. p. 668). An excellent summary regarding the magnetic properties of matter, with many tables and references, has been compiled by du Bois (*Report to the Congrès Int de Phys*, Paris, 1900, ii 460).

Element	10^6k	*Element*	10^6k	*Element*	10^6k
Be	+0·72	Cu	−0·006	Cs	− 0·03[1]
B	+0·05	Zn	−0·010	Ba	− 0·02[1]
C	−0·05	Ga	−	La	+13·0
N	?	Ge	−	Ce	+34·0
O	+	As	?	Pr	+ } Strong
F	−0·01[1]	Se	−0·025	Nd	+
……		Br	−0·033	Sa	+
Na	−0·005[1]	……		Gd	+
Mg	+0·014	Rb	−0·02[1]	……	
Al	+	Sr	−0·02[1]	Er	+41·8(?)
Si	+0·002	Y	+3·2(?)	……	
P	−0·007	Zr	−0·014	Yb	+ (?)
S	−0·011	Nb	+0·49(?)	Ta	+ 1·02(?)
Cl	−0·02[1]	Mo	+0·024	W	+ 0·1
……		Ru	+	Os	+ 0·074
K	−0·001[1]	Rh	+	Ir	+
Ca	−0·003[1]	Pd	+0·55	Pt	+ 0·227
Sc	?	Ag	−0·016	Au	− 0·031
Ti	+0·09	Cd	−0·015	Hg	− 0·030
V	+0·17	In	−0·01[1]	Tl	− 0·93
Cr	+ } Strong	Sn	+0·004[1]	Pb	− 0·025
Mn	+	Sb	−0·069	Bi	− 0·023
Fe	+	Te	−0·039	……	
Co	+	I	−0·040	Th	+16·0(?)
Ni	+	……		U	+ 0·21

[1] Calculated.

12 Molecular Theory of Magnetism

According to W E Weber's theory, the molecules of a ferromagnetic metal are small permanent magnets, the axes of which under ordinary conditions are turned indifferently in every direction, so that no magnetic polarity is exhibited by the metal as a whole, a magnetic force acting upon the metal tends to turn the axes of the little magnets in one direction, and thus the entire piece acquires the properties of a magnet If, however, the molecules could turn with perfect freedom, it is clear that the smallest magnetizing force would be sufficient to develop the highest possible degree of magnetization, which is of course not the case. Weber therefore supposed each molecule to be acted on by a force tending to preserve it in its original direction, the position actually assumed by the axis being in the direction of the resultant of this hypothetical force and the applied magnetizing force Maxwell (*Electricity and Magnetism*, § 444), recognizing that the theory in this form gave no account of residual magnetization, made the further assumption that if the deflection of the axis of the molecule exceeded a certain angle, the axis would not return to its original position when the deflecting force was removed, but would retain a permanent set. Although the amended theory as worked out by Maxwell is in rough agreement with certain leading phenomena of magnetization, it fails to account for many others, and is in some cases at variance with observed facts

J A Ewing (*Proc Roy Soc*, 1890, 48, 342) has demonstrated that it is quite unnecessary to assume either the directive force of Weber, the permanent set of Maxwell, or any kind of frictional resistance, the forces by which the molecular magnets are constrained being simply those due to their own mutual attractions and repulsions The effect of these is beautifully illustrated by a model consisting of a number of little compass needles pivoted on sharp points and grouped near to one another upon a board, which is placed inside a large magnetizing coil When no current is passing through the coil and the magnetic field is of zero strength, the needles arrange themselves in positions of stable equilibrium under their mutual forces, pointing in many different directions, so that there is no resultant magnetic moment This represents the condition of the molecules in unmagnetized iron If now a gradually increasing magnetizing force is applied, the needles at first undergo a stable deflection, giving to the group a small resultant moment which increases uniformly with the force, and if the current is interrupted while the force is still weak, the needles merely return to their initial positions This illustrates the first stage in the process of magnetization, when the moment is proportional to the field and there is no hysteresis or residual magnetism (see *ante*) A somewhat stronger field will deflect many of the needles beyond the limits of stability, causing them to turn round and form new stable combinations, in which the direction assumed by most of them approximates to that of the field The rearrangement is completed within a comparatively small range of magnetizing force, a rapid increase of the resultant moment being thus brought about. When the field is removed, many of the newly formed combinations are but slightly disturbed, and the group may consequently retain a considerable resultant moment This corresponds to the second stage of magnetization, in which the susceptibility is large and permanent magnetization is set up A still stronger magnetizing force has little effect except in causing the direction of the needles to approach still more nearly to that of the field; if the force were infinite, every member of the group would have exactly the same direction and the greatest possible resultant moment would be reached; this illustrates "magnetic saturation"—the condition approached in the third stage of magnetization. When the strong magnetizing field is gradually diminished to zero and then reversed, the needles pass from one stable position of rest to another through a condition of instability; and if the field is once more reversed, so that the cycle is completed, the needles again pass through a condition of instability before a position of stable equilibrium is regained. Now the unstable movements of the needles are of a mechanically irreversible character; the energy expended in dissociating the members of a combination and placing them in unstable positions assumes the kinetic form when the needles turn over, and is ultimately frittered down into heat. Hence in performing a cycle there is a waste of energy corresponding to what has been termed hysteresis-loss.

Supposing Ewing's hypothesis to be correct, it is clear that if the magnetization of a piece of iron were reversed by a strong rotating field instead of by a field alternating through zero, the loss of energy by hysteresis should be little or nothing, for the molecules would rotate with the field and no unstable movements would be possible[1] Some experiments by F G Baily (*Phil. Trans*, 1896, 187, 715) show that this is actually the case With small magnetizing forces the hysteresis was indeed somewhat larger than that obtained in an alternating field, probably on account of the molecular changes being forced to take place in one direction only, but at an induction of about 16,000 units in soft iron and 15,000 in hard steel the hysteresis reached a maximum and afterwards rapidly diminished In one case the hysteresis loss per cubic centimetre per cycle was 16,100 ergs for B = 15,900, and only 1200 ergs for B = 20,200, the highest induction obtained in the experiment, possibly it would have vanished before B had reached 21,000[2] These experiments prove that actual friction must be almost entirely absent, and, as Baily remarks, the agreement of the results with the previously suggested deduction affords a strong verification of Ewing's form of the molecular theory Ewing has himself also shown how satisfactorily this theory accords with many other obscure and complicated phenomena, such as those presented by coercive force, differences of magnetic quality, and the effects of vibration, temperature and stress; while as regards simplicity and freedom from arbitrary assumptions it leaves little to be desired

The fact being established that magnetism is essentially a molecular phenomenon, the next step is to inquire what is the constitution of a magnetic molecule, and why it is that some molecules are ferromagnetic, others paramagnetic, and others again diamagnetic The best known of the explanations that have been proposed depend upon the magnetic action of an electric current. It can be shown that if a current i circulates in a small plane circuit of area S, the magnetic action of the circuit for distant points is equivalent to that of a short magnet whose axis is perpendicular to the plane of the circuit and whose moment is iS, the direction of the magnetization being related to that of the circulating current as the thrust of a right-handed screw to its rotation Ferromagnetism was explained by Ampère on the hypothesis that the magnetization of the molecule is due to an electric current constantly circulating within it. The theory now most in favour is merely a development of Ampère's hypothesis, and applies not only to ferromagnetics, but to paramagnetics as well. To account for diamagnetism, Weber supposed that there exist within the molecules of diamagnetic substances certain channels around which an electric current can circulate without any resistance. The creation of an external magnetic field H will, in accordance with Lenz's law, induce in the molecule an electric current so directed that the magnetization of the equivalent magnet is opposed to the direction of the field. The strength of the induced current is $-HS\cos\theta/L$, where θ is the inclination of the axis of the circuit to the direction of the field, and L the coefficient of self-induction, the resolved part of the magnetic moment in the direction of the field is equal to $-HS^2\cos^2\theta/L$, and if there are n molecules in a unit of volume, their axes being distributed indifferently in all directions, the magnetization of the substance will be $-\frac{1}{3}nHS^2/L$, and its susceptibility $-\frac{1}{3}S^2/L$ (Maxwell, *Electricity and Magnetism*, § 838). The susceptibility is therefore constant and independent of the field, while its negative sign indicates that the substance is diamagnetic. There being no resistance, the induced current will continue to circulate round the molecule until the field is withdrawn, when it will be stopped by the action of an electro-motive force tending to induce an exactly equal current in the opposite direction. The principle of Weber's theory, with the modification necessitated by lately acquired knowledge, is the basis of the best modern explanation of diamagnetic phenomena.

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[1] This deduction from Ewing's theory appears to have been first suggested by J. Swinburne. See *Industries*, 1890, 289.

[2] R. Beattie (*Phil. Mag.*, 1901, 1, 642) has found similar effects in nickel and cobalt.

There are strong reasons for believing that magnetism is a phenomenon involving rotation, and as early as 1876 Rowland, carrying out an experiment which had been proposed by Maxwell, showed that a revolving electric charge produced the same magnetic effects as a current. Since that date it has more than once been suggested that the molecular currents producing magnetism might be due to the revolution of one or more of the charged atoms or "ions" constituting the molecule. None of the detailed hypotheses which were based on this idea stood the test of criticism, but towards the end of the 19th century the researches of J. J. Thomson and others once more brought the conception of moving electric charges into prominence. Thomson has demonstrated the existence under many different conditions of particles more minute than anything previously known to science. The mass of each is about $\frac{1}{1700}$th part of that of a hydrogen atom, and with each is indissolubly associated a charge of negative electricity equal to about $3 \cdot 1 \times 10^{-10}$ C.G.S. electrostatic unit. These particles, which were termed by their discoverer *corpuscles*, are more commonly spoken of as *electrons*,[1] the particle thus being identified with the charge which it carries. An electrically neutral atom is believed to be constituted in part, or perhaps entirely, of a definite number of electrons in rapid motion within a "sphere of uniform positive electrification" not yet explained. One or more of the electrons may be detached from the system by a finite force, the number so detachable depending on the valency of the atom; if the atom loses an electron, it becomes positively electrified; if it receives additional electrons, it is negatively electrified. The process of electric conduction in metals consists in the movement of detached electrons, and many other phenomena, both electrical and thermal, can be more or less completely explained by their agency. It has been supposed that certain electrons revolve like satellites in orbits around the atoms with which they are associated, a view which receives strong support from the phenomena of the Zeeman effect, and on this assumption a theory has been worked out by P. Langevin,[2] which accounts for many of the observed facts of magnetism. As a consequence of the structure of the molecule, which is an aggregation of atoms, the planes of the orbits around the latter may be oriented in various positions, and the direction of revolution may be right-handed or left-handed with respect to the direction of any applied magnetic field. For those orbits whose projection upon a plane perpendicular to the field is right-handed, the period of revolution will be accelerated by the field (since the electron current is negative), and the magnetic moment consequently increased; for those which are left-handed, the period will be retarded and the moment diminished. The effect of the field upon the speed of the revolving electrons, and therefore upon the moments of the equivalent magnets, is necessarily a very small one. If S is the area of the orbit described in time τ by an electron of charge e, the moment of the equivalent magnet is $M = eS\tau$; and the change in the value of M due to an external field H is shown to be $\Delta M = -He^2S/4\pi m$, m being the mass of the electron. Whence

$$\frac{\Delta M}{M} = -\frac{H\tau}{4\pi}\frac{e}{m}$$

According to the best determinations the value of e/m does not exceed $1 \cdot 8 \times 10^7$, and τ is of the order of 10^{-15} second, the period of luminous vibrations; hence $\Delta M/M$ must always be less than $10^{-9}H$, and therefore the strongest fields yet reached experimentally, which fall considerably short of 10^5, could not change the magnetic moment M by as much as a ten-thousandth part. If the structure of the molecule is so perfectly symmetrical that, in the absence of any external field, the resultant magnetic moment of the circulating electrons is zero, then the application of a field, by accelerating the right-handed (negative) revolutions, and retarding those which are left-handed, will induce in the substance a resultant magnetization opposite in direction to the field itself; a body composed of such symmetrical molecules is therefore diamagnetic. If however the structure of the molecule is such that the electrons revolving around its atoms do not exactly cancel one another's effects, the molecule constitutes a little magnet, which under the influence of an external field will tend to set itself with its axis parallel to the field. Ordinarily a substance composed of asymmetrical molecules is paramagnetic, but if the elementary magnets are so conditioned by their strength and concentration that mutual action between them is possible, then the substance is ferromagnetic. In all cases however it is the diamagnetic condition that is initially set up—even iron is diamagnetic—though the diamagnetism may be completely masked by the superposed paramagnetic or ferromagnetic condition. Diamagnetism, in short, is an atomic phenomenon; paramagnetism and ferromagnetism are molecular phenomena. Hence may be deduced an explanation of the fact that, while the susceptibility of all known diamagnetics (except bismuth and antimony) is independent of the temperature, that of paramagnetics varies inversely as the absolute temperature, in accordance with the law of Curie.

13. HISTORICAL AND CHRONOLOGICAL NOTES

The most conspicuous property of the lodestone, its attraction for iron, appears to have been familiar to the Greeks at least as early as 800 B.C., and is mentioned by Homer, Plato, Aristotle, Theophrastus and others. A passage in *De rerum natura* (vi 910–915) by the Roman poet, Lucretius (96–55 B.C.), in which it is stated that the stone can support a chain of little rings, each adhering to the one above it, indicates that in his time the phenomenon of magnetization by induction had also been observed. The property of orientation, in virtue of which a freely suspended magnet points approximately to the geographical north and south, is not referred to by any European writer before the 12th century, though it is said to have been known to the Chinese at a much earlier period. The application of this property to the construction of the mariner's compass is obvious, and it is in connexion with navigation that the first references to it occur (see COMPASS). The needles of the primitive compasses, being made of iron, would require frequent re-magnetization, and a "stone" for the purpose of "touching the needle" was therefore generally included in the navigator's outfit. With the constant practice of this operation it is hardly possible that the repulsion acting between like poles should have entirely escaped recognition; but though it appears to have been noticed that the lodestone sometimes repelled iron instead of attracting it, no clear statement of the fundamental law that unlike poles attract while like poles repel was recorded before the publication in 1581 of the *New Attractive* by Robert Norman, a pioneer in accurate magnetic work. The same book contains an account of Norman's discovery and correct measurement of the dip (1576). The downward tendency of the north pole of a magnet pivoted in the usual way had been observed by G. Hartmann of Nüremberg in 1544, but his observation was not published till much later.

The foundations of the modern science of magnetism were laid by William Gilbert (*q.v.*). His *De magnete magneticisque corporibus et de magno magnete tellure physiologia nova* (1600), contains many references to the expositions of earlier writers from Plato down to those of the author's own age. These show that the very few facts known with certainty were freely supplemented by a number of ill-founded conjectures, and sometimes even by "figments and falsehoods, which in the earliest times, no less than nowadays, used to be put forth by raw smatterers and copyists to be swallowed of men."[1] Thus it was taught that "if a lodestone be anointed with garlic, or if a diamond be near, it does not attract iron," and that "if pickled in the salt of a sucking fish, there is power to pick up gold which has fallen into the deepest wells." There were said to be "various kinds of magnets, some of which attract gold, others silver, brass, lead; even some which attract flesh, water, fishes;" and stories were told about "mountains in the north of such great powers of attraction that ships are built with wooden pegs, lest the iron nails should be drawn from the timber." Certain occult powers were also attributed to the stone. It was "of use to thieves by its fume and sheen, being a stone born, as it were, to aid theft," and even opening bars and locks, it was effective as a love potion, and possessed "the power to reconcile husbands to their wives, and to recall brides to their husbands." And much more of the same kind, which, as Gilbert says, had come down "even to [his] own day through the writings of a host of men, who, to fill out their volumes to a proper bulk, write and copy out pages upon pages on this, that and the other subject, of which they know almost nothing for certain of their own experience." Gilbert himself absolutely disregarded authority, and accepted nothing at second-hand. His title to be honoured as the "Father of Magnetic Philosophy" is based even more largely upon the scientific method which he was the first to inculcate and practise than upon the importance of his actual discoveries. Careful experiment and observation, not the inner consciousness, are, he insists, the only foundations of true science. Nothing has been set down in his book "which hath not been explored and many times performed and repeated" by himself. "It is very easy for men of acute intellect, apart from experiment and practice, to slip and err." The greatest of Gilbert's discoveries was that the globe of the earth was magnetic and a magnet; the evidence by which he supported this view was derived chiefly from ingenious experiments made with a spherical lodestone or *terrella*, as he termed it, and from his original observation that an iron bar could be magnetized by the earth's force. He also carried out some new experiments on the effects of heat, and of screening by magnetic substances, and investigated the influence of shape upon the magnetization of iron. But the bulk of his work consisted in imparting scientific definiteness to what was already vaguely known, and in demolishing the errors of his predecessors.

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[1] The charge associated with a corpuscle is the same as that carried by a hydrogen atom. G. J. Stoney in 1881 (*Phil. Mag.*, 1881, 11, 387) pointed out that this latter constituted the indivisible "atom of electricity" or natural unit charge. Later he proposed (*Trans. Roy. Dub. Soc.*, 1891, 4, 583) that such unit charge should be called an "electron." The application of this term to Thomson's corpuscle implies, rightly or wrongly, that notwithstanding its apparent mass, the corpuscle is in fact nothing more than an atom of electricity. The question whether a corpuscle actually has a material gravitating nucleus is undecided, but there are strong reasons for believing that its mass is entirely due to the electric charge.

[2] *Jour. de Phys.*, 1905, 4, 678; translated in *Electrician*, 1905, 56, 108 and 141.

No material advance upon the knowledge recorded in Gilbert's book was made until the establishment by Coulomb in 1785 of the law of magnetic action. The difficulties attending the experimental investigation of the forces acting between magnetic poles have already been referred to, and indeed a rigorously exact determination of the mutual action could only be made under conditions which are in practice unattainable. Coulomb,[2] however, by using long and thin steel rods, symmetrically magnetized, and so arranged that disturbing influences became negligibly small, was enabled to deduce from his experiments with reasonable certainty the law that the force of attraction or repulsion between two poles varies inversely as the square of the distance between them. Several previous attempts had been made to discover the law of force, with various results, some of which correctly indicated the inverse square; in particular the German astronomer, J. Tobias Mayer (*Gött. Anzeiger*, 1760), and the Alsatian mathematician, J. Heinrich Lambert (*Hist. de l'Acad. Roy. Berlin*, 1766, p. 22), may fairly be credited with having anticipated the law which was afterwards more satisfactorily established by Coulomb. The accuracy of this law was in 1832 confirmed by Gauss,[3] who employed an indirect but more perfect method than that of Coulomb, and also, as Maxwell remarks, by all observers in magnetic observatories, who are every day making measurements of magnetic quantities, and who obtain results which would be inconsistent with each other if the law of force had been erroneously assumed.

Coulomb's researches provided data for the development of a mathematical theory of magnetism, which was indeed initiated by himself, but was first treated in a complete form by Poisson in a series of memoirs published in 1821 and later.[4] Poisson assumed the existence of two dissimilar magnetic fluids, any element of which acted upon any other distant element in accordance with Coulomb's law of the inverse square, like repelling and unlike attracting one another. A magnetizable substance was supposed to consist of an indefinite number of spherical particles, each containing equivalent quantities of the two fluids, which could move freely within a particle, but could never pass from one particle to another. When the fluids inside a particle were mixed together, the particle was neutral; when they were more or less completely separated, the particle became magnetized to an intensity depending upon the magnetic force applied; the whole body therefore consisted of a number of little spheres having north and south poles, each of which exerted an elementary action at a distance. On this hypothesis Poisson investigated the forces due to bodies magnetized in any manner, and also originated the mathematical theory of magnetic induction. The general confirmation by experiment of Poisson's theoretical results created a tendency to regard his hypothetical magnetic fluids as having a real existence; but it was pointed out by W. Thomson (afterwards Lord Kelvin) in 1849 that while no physical evidence could be adduced in support of the hypothesis, certain discoveries, especially in electromagnetism, rendered it extremely improbable (*Reprint*, p. 344). Regarding it as important that all reasoning with reference to magnetism should be conducted without any uncertain assumptions, he worked out a mathematical theory upon the sole foundation of a few well-known facts and principles. The results were substantially the same as those given by Poisson's theory, so far as the latter went, the principal additions including a fuller investigation of magnetic distribution, and the theory of magnetic induction in aeolotropic or crystalline substances. The mathematical theory which was constructed by Poisson, and extended and freed from doubtful hypotheses by Kelvin, has been elaborated by other investigators, notably F. E. Neumann, G. R. Kirchhoff, and Maxwell. The valuable work of Gauss on magnetic theory and measurements, especially in relation to terrestrial magnetism, was published in his *Intensitas vis magneticae terrestris*, 1833, and in memoirs communicated to the *Resultate aus den Beobachtungen des magnetischen Vereins*, 1838 and 1839, which, with others, are contained in vol. 5 of the collected *Werke*. Weber's molecular theory, which has already been referred to, appeared in 1852.[5]

An event of the first importance was the discovery made in 1819 by H. C. Oersted[6] that a magnet placed near a wire carrying an electric current tended to set itself at right angles to the wire, a phenomenon which indicated that the current was surrounded by a magnetic field. This discovery constituted the foundation of electromagnetism, and its publication in 1820 was immediately followed by A. M. Ampère's experimental and theoretical investigation of the mutual action of electric currents,[7] and of the equivalence of a closed circuit to a polar magnet, the latter suggesting his celebrated hypothesis that molecular currents were the cause of magnetism. In the same year D. F. Arago[8] succeeded in magnetizing a piece of iron by the electric current, and in 1825 W. Sturgeon[9] publicly exhibited an apparatus "acting on the principle of powerful magnetism and feeble galvanism" which is believed to have constituted the first actual electromagnet. Michael Faraday's researches were begun in 1831 and continued for more than twenty years. Among the most splendid of his achievements was the discovery of the phenomena and laws of magneto-electric induction, the subject of two papers communicated to the Royal Society in 1831 and 1832. Another was the magnetic rotation of the plane of polarization of light, which was effected in 1845, and for the first time established a relation between light and magnetism. This was followed at the close of the same year by the discovery of the magnetic condition of all matter, a discovery which initiated a prolonged and fruitful study of paramagnetic and diamagnetic phenomena, including magnecrystallic action and "magnetic conducting power," now known as permeability. Throughout his researches Faraday paid special regard to the medium as the true seat of magnetic action, being to a large extent guided by his pregnant conception of "lines of force," or of induction, which he considered to be "closed curves passing in one part of the course through the magnet to which they belong, and in the other part through space," always tending to shorten themselves, and repelling one another when they were side by side (*Exp. Res.* §§ 3266–8, 3271). In 1873 James Clerk Maxwell published his classical *Treatise on Electricity and Magnetism*, in which Faraday's ideas were translated into a mathematical form. Maxwell explained electric and magnetic forces, not by the action at a distance assumed by the earlier mathematicians, but by stresses in a medium filling all space, and possessing qualities like those attributed to the old luminiferous ether. In particular, he found that the calculated velocity with which it transmitted electromagnetic disturbances was equal to the observed velocity of light; hence he was led to believe, not only that his medium and the ether were one and the same, but, further, that light itself was an electromagnetic phenomenon. Since the experimental confirmation of Maxwell's views by H. R. Hertz in 1888 (*Weid. Ann.*, 1888, 34, 155, 551, 609; and later vols.) they have commanded universal assent, and his methods are adopted in all modern work on electricity and magnetism.

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[1] The quotations are from the translation published by the Gilbert Club, London, 1900.

[2] C. A. Coulomb, *Mem. Acad. Roy. Paris*, 1785, p. 578.

[3] *Intensitas vis magneticae*, § 21, C. F. Gauss's *Werke*, 5, 79. See also J. J. Thomson, *Electricity and Magnetism*, § 132.

[4] S. D. Poisson, *Mém. de l'Institut*, 1821 and 1822, 5, 247, 488; 1823, 6, 441; 1838, 16, 479.

[5] For outlines of the mathematical theory of magnetism and references see H. du Bois, *Magnetic Circuit*, chs. iii. and iv.

[6] Gilbert's *Ann. d. phys.*, 1820, 6, 295.

[7] *Ann. de chim. et de phys.*, 1820, 15, 59, 170; *Recueil d'observations électrodynamiques*, 1822; *Théories des phénomènes électro-dynamiques*, 1826.

[8] *Ann. de chim. et de phys.*, 1820, 15, 93.

[9] *Trans. Soc. Arts*, 1825, 43, 38.

The practice of measuring magnetic induction and permeability with scientific accuracy was introduced in 1873 by H. A. Rowland,[1] whose careful experiments led to general recognition of the fact previously ignored by nearly all investigators, that magnetic susceptibility and permeability are by no means constants (at least in the case of the ferromagnetic metals) but unctions of the magnetizing force. New light was thrown upon many important details of magnetic science by J. A. Ewing's *Experimental Researches* of 1885; throughout the whole of his work special attention was directed to that curious lagging action o which the author applied the now familiar term "hysteresis."[2] His well-known modification[3] of Weber's molecular theory, published in 1890, presented for the first time a simple and suffiient explanation of hysteresis and many other complexities of magnetic quality. The amazing discoveries made by J. J. Thomson in 1897 and 1898[4] resulted in the establishment of the lectron theory, which has already effected developments of an lmost revolutionary character in more than one branch of cience. The application of the theory by P. Langevin to the ase of molecular magnetism has been noticed above, and there an be little doubt that in the near future it will contribute to he solution of other problems which are still obscure.

See W. Gilbert, *De magnete* (London, 1600; trans. by P. F. Motte-y, New York, 1893, and for the Gilbert Club, London, 1900); M. araday, *Experimental Researches in Electricity*, 3 vols. (London, 839, 1844 and 1855); W. Thomson (Lord Kelvin), *Reprint of Papers* *Electrostatics and Magnetism* (London, 1884, containing papers magnetic theory originally published between 1844 and 1855, ith additions); J. C. Maxwell, *Treatise on Electricity and Magnetism* rd ed., Oxford, 1892); E. Mascart and J. Joubert, *Leçons sur lectricité et le magnétisme* (2nd ed., Paris, 1896–1897; trans., not free om errors, by E. Atkinson, London, 1883); J. A. Ewing, *Magnetic Induction in Iron and other Metals* (3rd ed., London, 1900); J. J. Thomson, *Recent Researches in Electricity and Magnetism* (Oxford, 1893); *Elements of Mathematical Theory of Electricity and Magnetism* 3rd ed., Cambridge, 1904); H. du Bois, *The Magnetic Circuit* (trans. by E. Atkinson, London, 1896); A. Gray, *Treatise on Magnetism and Electricity*, vol. i. (London, 1898); J. A. Fleming, *Magnets and Electric Currents* (London, 1898); C. Maurain, *Le magnétisme du fer* (Paris, 1899; a lucid summary of the principal facts and laws, with special regard to their practical application); *Rapports présentés au Congrès international de physique*, vol. ii. (Paris, 1900); G. C. Foster and A. W. Porter, *Treatise on Electricity and Magnetism* (London, 1903); A. Winkelmann, *Handbuch der Physik*, vol. v. part i. (2nd ed., Leipzig, 1905; the most exhaustive compendium of magnetic science yet published, containing references to all important works and papers on every branch of the subject). (S. Bi.)

MAGNETISM, TERRESTRIAL, the science which has for its province the study of the magnetic phenomena of the earth.

Historical.

§ 1. Terrestrial magnetism has a long history. Its early growth was slow, and considerable uncertainty prevails as to its earliest developments. The properties of the magnet (see MAGNETISM) were to some small extent known to the Greeks and Romans before the Christian era, and compasses (see COMPASS) of an elementary character seem to have been employed in Europe at least as early as the 12th century. In China and Japan compasses of a kind seem to have existed at a much earlier date, and it is even claimed that the Chinese were aware of the declination of the compass needle from the true north before the end of the 11th century. Early scientific knowledge was usually, however, a mixture of facts, very imperfectly ascertained, with philosophical imaginings. When an early writer makes a statement which to a modern reader suggests a knowledge of the declination of the compass, he may have had no such definite idea in his mind. So far as Western civilization is concerned, Columbus is usually credited with the discovery—in 1492 during his first voyage to America—that the pointing of the compass needle to the true north represents an exceptional state of matters, and that a *declination* in general exists, varying from place to place. The credit of these discoveries is not, however, universally conceded to Columbus. G. Hellmann[6*] considers it almost certain that the departure of the needle from the true north was known in Europe before the time of Columbus. There is indirect evidence that the declination of the compass was not known in Europe in the early part of the 15th century, through the peculiarities shown by early maps believed to have been drawn solely by regard to the compass. Whether Columbus was the first to observe the declination or not, his date is at least approximately that of its discovery.

The next fundamental discovery is usually ascribed to Robert Norman, an English instrument maker. In *The Newe Attractive* (1581) Norman describes his discovery made some years before of the *inclination* or *dip*. The discovery was made more or less by accident, through Norman's noticing that compass needles which were truly balanced so as to be horizontal when unmagnetized, ceased to be so after being stroked with a magnet. Norman devised a form of dip-circle, and found a value for the inclination in London which was at least not very wide of the mark.

Another fundamental discovery, that of the secular change of the declination, was made in England by Henry Gellibrand, professor of mathematics at Gresham College, who described it in his *Discourse Mathematical on the Variation of the Magneticall Needle together with its Admirable Diminution lately discovered* (1635). The history of this discovery affords a curious example of knowledge long delayed. William Borough, in his *Discourse on the Variation of the Compas or Magneticall Needle* (1581), gave for the declination at Limehouse in October 1580 the value 11°¾ E. approximately. Observations were repeated at Limehouse, Gellibrand tells us, in 1622 by his colleague Edmund Gunter, professor of astronomy at Gresham College, who found the much smaller value 6° 13′. The difference seems to have been ascribed at first to error on Borough's part, and no suspicion of the truth seems to have been felt until 1633, when some rough observations gave a value still lower than that found by Gunter.

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[1] *Phil. Mag.*, 1873, 46, 140; 1874, 48, 321.
[2] *Phil. Trans.*, 1885, 176, 523; *Magnetic Induction*, 1900.
[3] *Proc. Roy. Soc.*, 1890, 48, 342.
[4] *Phil. Mag.*, 1897, 44, 293; 1898, 46, 528.

[*] For explanation of these numbers, see end of article.

It was not until midsummer 1634 that Gellibrand felt sure of his facts, and yet the change of declination since 1580 exceeded 7°. The delay probably arose from the strength of the preconceived idea, apparently universally held, that the declination was absolutely fixed. This idea, it would appear, derived some of its strength from the positive assertion made on the point by Gilbert of Colchester in his *De magnete* (1600).

A third fundamental discovery, that of the diurnal change in the declination, is usually credited to George Graham (1675–1751), a London instrument maker. Previous observers, *e.g.* Gellibrand, had obtained slightly different values for the declination at different hours of the day, but it was natural to assign them to instrumental uncertainties. In those days the usual declination instrument was the compass with pivoted needles, and Graham himself at first assigned the differences he observed to friction. The observations on which he based his conclusions were made in 1722; an account of them was communicated to the Royal Society and published in the *Philosophical Transactions* for 1724.

The movements of the compass needle throughout the average day represent partly a regular diurnal variation, and partly irregular changes in the declination. The distinction, however, was not at first very clearly realized. Between 1756 and 1759 J. Canton observed the declination-changes on some 600 days, and was thus able to deduce their general character. He found that the most prominent part of the regular diurnal change in England consisted of a westerly movement of the north-pointing pole from 8 or 9 a.m. to 1 or 2 p.m., followed by a more leisurely return movement to the east. He also found that the amplitude of the movement was considerably larger in summer than in winter. Canton further observed that in a few days the movements were conspicuously irregular, and that aurora was then visible. This association of magnetic disturbance and aurora had, however, been observed somewhat before this time, a description of one conspicuous instance being contributed to the Royal Society in 1750 by Pehr Vilhelm Wargentin (1717–1783), a Swede.

Another landmark in the history of terrestrial magnetism was the discovery towards the end of the 18th century that the intensity of the resultant magnetic force varies at different parts of the earth. The first observations clearly showing this seem to be those of a Frenchman, Paul de Lamanon, who observed in 1785–1787 at Teneriffe and Macao, but his results were not published at the time. The first published observations seem to be those made by the great traveller Humboldt in tropical America between 1798 and 1803. The delay in this discovery may again be attributed to instrumental imperfections. The method first devised for comparing the force at different places consisted in taking the time of oscillation of the dipping needle, and even with modern circles this is hardly a method of high precision. Another discovery worth chronicling was made by Arago in 1827. From observations made at Paris he found that the inclination of the dipping needle and the intensity of the horizontal component of the magnetic force both possessed a diurnal variation.

§ 2. Whilst Italy, England and France claim most of the early observational discoveries, Germany deserves a large share of credit for the great improvement in instruments and methods during the first half of the 19th century. Measurements of the intensity of the magnetic force were somewhat crude until Gauss showed how absolute results could be obtained, and not merely relative data based on observations with some particular needle. Gauss also devised the bifilar magnetometer, which is still largely represented in instruments measuring changes of the horizontal force; but much of the practical success attending the application of his ideas to instruments seems due to Johann von Lamont (1805–1879), a Jesuit of Scottish origin resident in Germany.

The institution of special observatories for magnetic work is largely due to Humboldt and Gauss. The latter's observatory at Göttingen, where regular observations began in 1834, was the centre of the Magnetic Union founded by Gauss and Weber for the carrying out of simultaneous magnetic observations and it was long customary to employ Göttingen time in schemes of international co-operation.

In the next decade, mainly through the influence of Sir Edward Sabine (1788–1883), afterwards president of the Royal Society, several magnetic observatories were established in the British colonies, at St Helena, Cape of Good Hope, Hobarton (now Hobart) and Toronto. These, with the exception of Toronto, continued in full action for only a few years; but their records—from their widely distributed positions—threw much fresh light on the differences between magnetic phenomena in different regions of the globe. The introduction of regular magnetic observatories led ere long to the discovery that there are notable differences between the amplitudes of the regular daily changes and the frequency of magnetic disturbances in different years. The discovery that magnetic phenomena have a period closely similar to, if not absolutely identical with, the "eleven year" period in sunspots, was made independently and nearly simultaneously about the middle of the 19th century by Lamont, Sabine and R. Wolf.

The last half of the 19th century showed a large increase in the number of observatories taking magnetic observations. After 1890 there was an increased interest in magnetic work. One of the contributory causes was the magnetic survey of the British Isles made by Sir A. Rücker and Sir T. E. Thorpe, which served as a stimulus to similar work elsewhere; another was the institution by L. A. Bauer of a magazine, *Terrestrial Magnetism*, specially devoted to the subject. This increased activity added largely to the stock of information, sometimes in forms of marked practical utility; it was also manifested in the publication of a number of papers of a speculative character. For historical details the writer is largely indebted to the works of E. Walker[1] and L. A. Bauer.[2]

Observational Methods and Records.

§ 3. All the more important magnetic observatories are provided with instruments of two kinds. Those of the first kind give the absolute value of the magnetic elements at the time of observation. The unifilar magnetometer (*q.v.*), for instance, gives the absolute values of the declination and horizontal force, whilst the inclinometer (*q.v.*) or dip circle gives the inclination of the dipping needle. Instruments of the second kind, termed magnetographs (*q.v.*), are differential and self-recording, and show the changes constantly taking place in the magnetic elements. The ordinary form of magnetograph records photographically. Light reflected from a fixed mirror gives a base line answering to a constant value of the element in question; the light is cut off every hour or second hour so that the base line also serves to make the time. Light reflected from a mirror carried by a magnet gives a curved line answering to the changes in position of the magnet. The length of the ordinate or perpendicular drawn from any point of the curved line on to the base line is proportional to the extent of departure of the magnet from a standard position. If then we know the absolute value of the element which corresponds to the base line, and the equivalent of 1 cm. of ordinate, we can deduce the absolute value of the element answering to any given instant of time. In the case of the declination the value of 1 cm. of ordinate is usually dependent almost entirely on the distance of the mirror carried by the magnet from the photographic paper, and so remains invariable or very nearly so. In the case of the horizontal force and vertical force magnetographs—these being the two force components usually recorded—the value of 1 cm. of ordinate alters with the strength of the magnet. It has thus to be determined from time to time by observing the deflection shown on the photographic paper when an auxiliary magnet of known moment, at a measured distance, deflects the magnetograph magnet. Means are provided for altering the sensitiveness, for instance, by changing the effective distance in the bifilar suspension of the horizontal force magnet, and by altering the height of a small weight carried by the vertical force magnet. It is customary to aim at keeping the sensitiveness as constant as possible. A very common standard is to have 1 cm. of ordinate corresponding to 10′ of arc in the declination and to 50γ ($1\gamma \equiv 0{\cdot}00001$ C.G.S.) in the horizontal and vertical force magnetographs.

As an example of how the curves are standardized, suppose that absolute observations of declination are taken four times a month, and that in a given month the mean of the observed values is 16° 34′·6 W. The curves are measured at the places which correspond to the times of the four observations, and the mean length of the four ordinates is, let us say, 2·52 cms. If 1 cm. answers to 10′, then 2·52 cms. represents 25′·2, and thus the value of the base line—*i.e.* the value which the declination would have if the curve came down to the base line—is for the month in question 16° 34′·6 less 25′·2 or

16° 9′·4. If now we wish to know the declination at any instant in this particular month all we have to do is to measure the corresponding ordinate and add its value, at the rate of 10′ per cm., to the base value 16° 9′·4 just found. Matters are a little more complicated in the case of the horizontal and vertical force magnetographs. Both instruments usually possess a sensible temperature coefficient, *i.e.* the position of the magnet is dependent to some extent on the temperature it happens to possess, and allowance has thus to be made for the difference from a standard temperature. In the case of the vertical force an "observed" value is derived by combining the observed value of the inclination with the simultaneous value of the horizontal force derived from the horizontal force magnetograph after the base value of the latter has been determined. In themselves the results of the absolute observations are of minor interest. Their main importance is that they provide the means of fixing the value of the base line in the curves. Unless they are made carefully and sufficiently often the information derivable from the curves suffers in accuracy, especially that relating to the secular change. It is from the curves that information is derived as to the regular diurnal variation and irregular changes. In some observatories it is customary to publish a complete record of the values of the magnetic elements at every hour for each day of the year. A useful and not unusual addition to this is a statement of the absolutely largest and smallest values of each element recorded during each day, with the precise times of their occurrence. On days of large disturbance even hourly readings give but a very imperfect idea of the phenomena, and it is customary at some observatories, *e.g.* Greenwich, to reproduce the more disturbed curves in the annual volume. In calculating the regular diurnal variation it is usual to consider each month separately. So far as is known at present, it is entirely or almost entirely a matter of accident at what precise hours specially high or low values of an element may present themselves during an individual highly disturbed day; whilst the range of the element on such a day may be 5, 10 or even 20 times as large as on the average undisturbed day of the month. It is thus customary when calculating diurnal inequalities to omit the days of largest disturbance, as their inclusion would introduce too large an element of uncertainty. Highly disturbed days are more than usually common in some years, and in some months of the year, thus their omission may produce effects other than that intended. Even on days of lesser disturbance difficulties present themselves. There may be to and fro movements of considerable amplitude occupying under an hour, and the hour may come exactly at the crest or at the very lowest part of the trough. Thus, if the reading represents in every case the ordinate at the precise hour a considerable element of chance may be introduced. If one is dealing with a mean from several hundred days such "accidents" can be trusted to practically neutralize one another, but this is much less fully the case when the period is as short as a month. To meet this difficulty it is customary at some observatories to derive hourly values from a freehand curve of continuous curvature, drawn so as to smooth out the apparently irregular movements. Instead of drawing a freehand curve it has been proposed to use a planimeter, and to accept as the hourly value of the ordinate the mean derived from a consideration of the area included between the curve, the base line and ordinates at the thirty minutes before and after each hour.

§ 4. Partly on account of the uncertainties due to disturbances, and partly with a view to economy of labour, it has been the practice at some observatories to derive diurnal inequalities from a comparatively small number of undisturbed or *quiet* days. Beginning with 1890, five days a month were selected at Greenwich by the astronomer royal as conspicuously quiet. In the selection regard was paid to the desirability that the arithmetic mean of the five dates should answer to near the middle of the month. In some of the other English observatories the routine measurement of the curves was imited to these selected quiet days. At Greenwich itself diurnal nequalities were derived regularly from the quiet days alone and also rom all the days of the month, excluding those of large disturbance. f a quiet day differed from an ordinary day only in that the diurnal ariation in the latter was partly obscured by irregular disturbances, hen supposing enough days taken to smooth out irregularities, one vould get the same diurnal inequality from ordinary and from quiet lays. It was found, however, that this was hardly ever the case see §§ 29 and 30). The quiet day scheme thus failed to secure xactly what was originally aimed at; on the other hand, it led to the iscovery of a number of interesting results calculated to throw aluable sidelights on the phenomena of terrestrial magnetism.

The idea of selecting quiet days seems due originally to H. Wild. Iis selected quiet days for St Petersburg and Pavlovsk were ery few in number, in some months not even a single day eaching his standard of freedom from disturbance. In later years e International Magnetic Committee requested the authorities f each observatory to arrange the days of each month in three roups representing the quiet, the moderately disturbed and the ighly disturbed. The statistics are collected and published on ehalf of the committee, the first to undertake the duty being I. Snellen. The days are in all cases counted from Greenwich midight, so that the results are strictly synchronous. The results romise to be of much interest.

§ 5. The intensity and direction of the resultant magnetic force at a spot—*i.e.* the force experienced by a unit magnetic pole—are known if we know the three components of force parallel to any set of orthogonal axes. It is usual to take for these axes the vertical at the spot and two perpendicular axes in the horizontal plane; the latter are usually taken in and perpendicular to the geographical meridian. The usual notation in mathematical work is X to the north, Y to the west or east, and Z vertically downwards. The international magnetic committee have recommended that Y be taken positive to the east, but the fact that the declination is westerly over most of Europe has often led to the opposite procedure, and writers are not always as careful as they should be in stating their choice. Apart from mathematical calculations, the more usual course is to define the force by its horizontal and vertical components —usually termed H and V—and by the declination or angle which the horizontal component makes with the astronomical meridian. The declination is sometimes counted from 0° to 360°, 0° answering to the case when the so-called north pole (or north seeking pole) is directed towards geographical north, 90° to the case when it is directed to the east, and so on. It is more usual, however, to reckon declination only from 0° to 180°, characterizing it as easterly or westerly according as the north pole points to the east or to the west of the geographical meridian. The force is also completely defined by H *or* V, together with D the declination, and I the inclination to the horizon of the dipping needle. Instead of H and D some writers make use of N the northerly component, and W the westerly (or E the easterly). The resultant force itself is denoted sometimes by R, sometimes by T (total force). The following relationships exist between the symbols

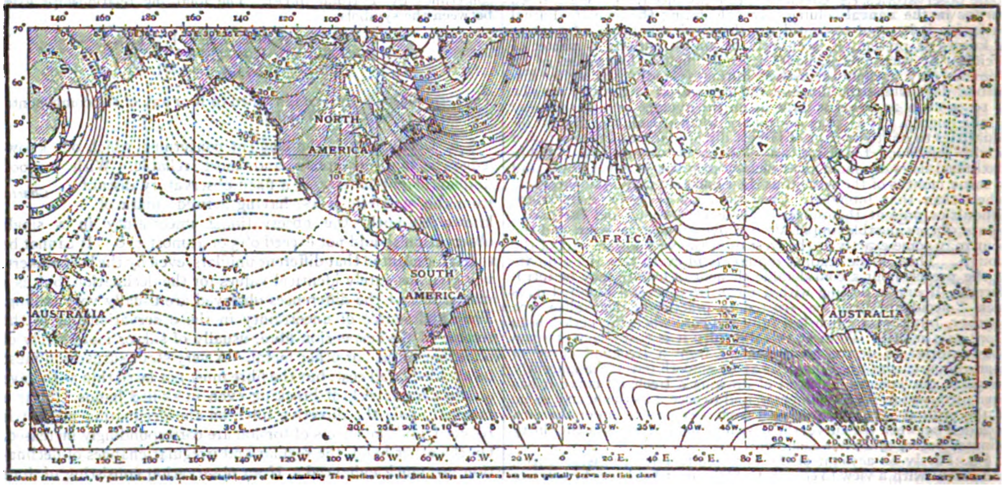
$$X=N,\ Y=W \text{ or } E,\ Z=V,\ R=T,$$
$$H=\surd(X^2+Y^2),\ R=\surd(X^2+Y^2+Z^2),$$
$$\tan D=Y/X,\ \tan I=V/H.$$

The term *magnetic element* is applied to R or any of the components, and even to the angles D and I.

Charts.

§ 6. Declination is the element concerning which our knowledge is most complete and most reliable. With a good unifilar magnetometer, at a fixed observatory distant from the magnetic poles, having a fixed mark of known azimuth, the observational uncertainty in a single observation should not exceed 0′·5 or at most 1′·0. It cannot be taken for granted that different unifilars, even by the best makers, will give absolutely identical values for the declination, but as a matter of fact the differences observed are usually very trifling. The chief source of uncertainty in the observation lies in the torsion of the suspension fibre, usually of silk or more rarely of phosphor bronze or other metal. A very stout suspension must be avoided at all cost, but the fibre must not be so thin as to have a considerable risk of breaking even in skilled hands. Near a magnetic pole the directive force on the declination magnet is reduced, and the effects of torsion are correspondingly increased. On the other hand, the regular and irregular changes of declination are much enhanced. If an observation consisting of four readings of declination occupies twelve minutes, the chances are that in this time the range at an English station will not exceed 1′, whereas at an arctic or antarctic station it will frequently exceed 10′. Much greater uncertainty thus attaches to declination results in the Arctic and Antarctic than to those in temperate latitudes. In the case of secular change data one important consideration is that the observations should be taken at an absolutely fixed spot, free from any artificial source of disturbance. In the case of many of the older observations of which records exist, the precise spot cannot be very exactly fixed, and not infrequently the site has become unsuitable through the erection of buildings not free from iron. Apart from buildings, much depends on whether the neighbourhood is free from basaltic and other magnetic rocks. If there are no local disturbances of this sort, a few yards difference is usually without appreciable influence, and even a few miles difference is of minor importance when one is calculating the mean secular change for a long period of years. When, however, local disturbances exist, even a few feet difference in the site may be important, and in the absence of positive knowledge to the contrary it is only prudent to act as if the site were disturbed. Near a magnetic pole the declination naturally changes very rapidly when one travels in the direction perpendicular to the lines of equal declination, so that the exact position of the site of observation is there of special importance.

The usual method of conveying information as to the value of the declination at different parts of the earth's surface is to draw curves on a map—the so-called *isogonals*—such that at all points on any one curve the declination at a given specified epoch has the same value. The information being of special use to sailors, the preparation of magnetic charts has been largely the work of naval authorities—more especially of the hydrographic department of the British admiralty. The object of the admiralty world charts—four of which are reproduced here, on a reduced scale, by the kind permission of the Hydrographer—is rather to show the general features boldly than to indicate minute details. Apart from the immediate necessities of the case, this is a counsel of prudence. The observations used have mostly been taken at dates considerably anterior to that to which the chart is intended to apply. What the sailor wants is the declination now or for the next few years, not what it was five, ten or twenty years ago. Reliable secular change data, for reasons already indicated, are mainly obtainable from fixed observatories, and there are enormous areas outside of Europe where no such observatories exist. Again, as we shall see presently, the rate of the secular change sometimes alters greatly in the course of a comparatively few years. Thus, even when the observations themselves are thoroughly reliable, the prognostication made for a future date by even the most experienced of chart makers may be occasionally somewhat wide of the mark. Fig. 1 is a reduced copy of the British admiralty-declination chart for the epoch 1907. It shows the isogonals between 70° N. and 65° S. latitude. Beyond the limits of this chart, the number of exact measurements of declination is somewhat limited, but the general nature of the phenomena is easily inferred. The geographical and the magnetic poles—where the dipping needle is vertical—are fundamental points. The north magnetic pole is situated in North America near the edge of the chart. We have no reason to suppose that the magnetic pole is really a fixed point, but for our present purpose we may regard it as such. Let us draw an imaginary circle round it, and let us travel round the circle in the direction, west, north, east, south, starting from a point where the north pole of a magnet (*i.e.* the pole which in Europe or the United States points to the north) is directed exactly towards the astronomical north. The point we start from is to the geographical south of the magnetic pole. As we go round the circle the needle keeps directed to the magnetic pole, and so points first slightly to the east of geographical north, then more and more to the east, then directly east, then to south of east, then to due south, to west of south, to west, to north-west, and finally when we get round to our original position due north once more. Thus, during our course round the circle the needle will have pointed in all possible directions. In other words, isogonals answering to all possible values of the declination have their origin in the north magnetic pole. The same remark applies of course to the south magnetic pole.



Reduced from a chart, by permission of the Lords Commissioners of the Admiralty. The portion over the British Isles and France has been specially drawn for this chart. Emery Walker sc.

FIG. 1.—Isogonals, or lines of equal magnetic declination.

Now, suppose ourselves at the north geographical pole of the earth. Neglecting as before diurnal variation and similar temporary changes, and assuming no abnormal local disturbance, the compass needle at and very close to this pole will occupy a fixed direction relative to the ground underneath. Let us draw on the ground through the pole a straight line parallel to the direction taken there by the compass needle, and let us carry a compass needle round a *small* circle whose centre is the pole. At all points on the circle the positions of the needle will be parallel; but whereas the north pole of the magnet will point exactly towards the centre of the circle at one of the points where the straight line drawn on the ground cuts the circumference, it will at the opposite end of the diameter point exactly away from the centre. The former part is clearly on the isogonal where the declination is 0°, the latter on the isogonal where it is 180°. Isogonals will thus radiate out from the north geographical pole (and similarly of course from the south geographical pole) in all directions. If we travel along an isogonal, starting from the north magnetic pole, our course will generally take us, often very circuitously, to the north geographical pole. If, for example, we select the isogonal of 10° E., we at first travel nearly south, but then more and more westerly, then north-westerly across the north-east of Asia; the direction then gets less northerly, and makes a dip to the south before finally making for the north geographical pole. It is possible, however, according to the chart, to travel direct from the north magnetic to the south geographical pole, provided we select an isogonal answering to a small westerly or easterly declination (from about 19° W. to 7° E.).

Special interest attaches to the isogonals answering to declination 0°. These are termed *agonic lines*, but sailors often call them *lines of no variation*, the term *variation* having at one time been in common use in the sense of declination. If we start from the north magnetic pole the agonic line takes us across Canada, the United States and South America in a fairly straight course to the south geographical pole. A curve continuous with this can be drawn from the south geographical to the south magnetic pole at every point of which the needle points in the geographical meridian; but here the north pole of the needle is pointing south, not north, so that this portion of curve is really an isogonal of 180°. In continuation of this there emanates from the south magnetic pole a second isogonal of 0°, or agonic line, which traverses Australia, Arabia and Russia, and takes us to the north geographical pole. Finally, we have an isogonal of 180°, continuous with this second isogonal of 0° which takes us to the north magnetic pole, from which we started. Throughout the whole area included within these isogonals of 0° and 180°—excluding locally disturbed areas—the declination is westerly; outside this area the declination is in general easterly. There is, however, as shown in the chart, an isogonal of 0° enclosing an area in eastern Asia inside which the declination is westerly though small.

§ 7. Fig. 2 is a reduced copy of the admiralty chart of inclination or dip for the epoch 1907. The places where the dip has the same value lie on curves called *isoclinals*. The dip is northerly (north pole dips) or southerly (south pole dips) according as the place is north or south of the isoclinal of 0°. At places actually on this isoclinal the dipping needle is horizontal. The isoclinal of 0° is nowhere very far from the geographical equator, but lies to the north of it in Asia and Africa, and to the south of it in South America. As we travel north from the isoclinal of 0° along the meridian containing the magnetic pole the dipping needle's north pole dips more and more, until when we reach the magnetic pole the needle is vertical. Going still farther north, we have the dip diminishing. The northerly inclination is considerably less in Europe than in the same latitudes of North America; and correspondingly the southerly inclination is less in South America than in the same latitudes of Africa.

Fig. 3 is a reduced copy of the admiralty horizontal force chart for 1907. The curves, called *isomagnetics*, connect the places where the horizontal force has the same value; the force is expressed in C.G.S. units. The horizontal force vanishes of course at the magnetic poles. The chart shows a maximum value of between 0·39 and 0·40 in an oval including the south of Siam and the China Sea. The horizontal force is smaller in North America than in corresponding latitudes in Europe.

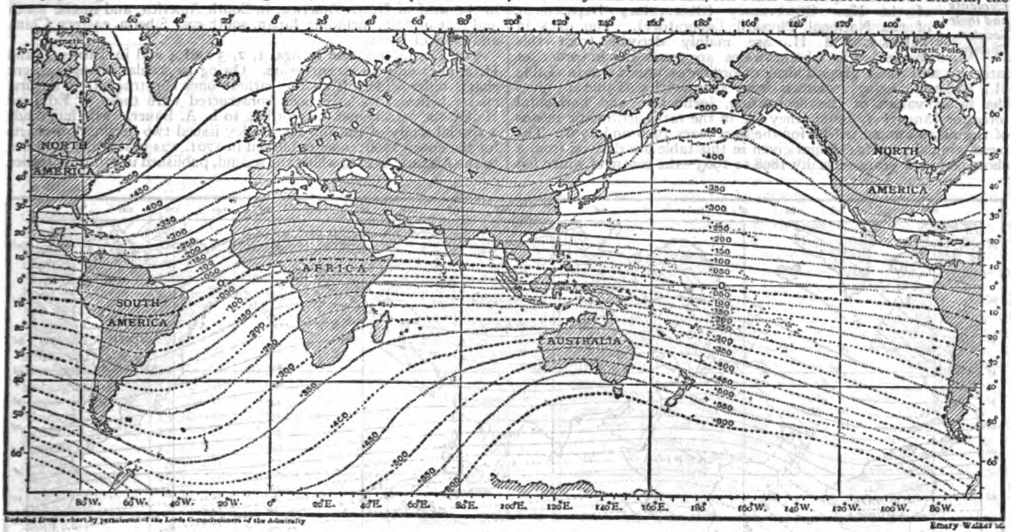

Magnetic Pole
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA
NORTH AMERICA
Magnetic Pole
80°W. 60°W. 40°W. 20°W. 0° 20°E. 40°E. 60°E. 80°E. 100°E. 120°E. 140°E. 160°E. 180° 160°W. 140°W. 120°W. 100°W. 80°W.

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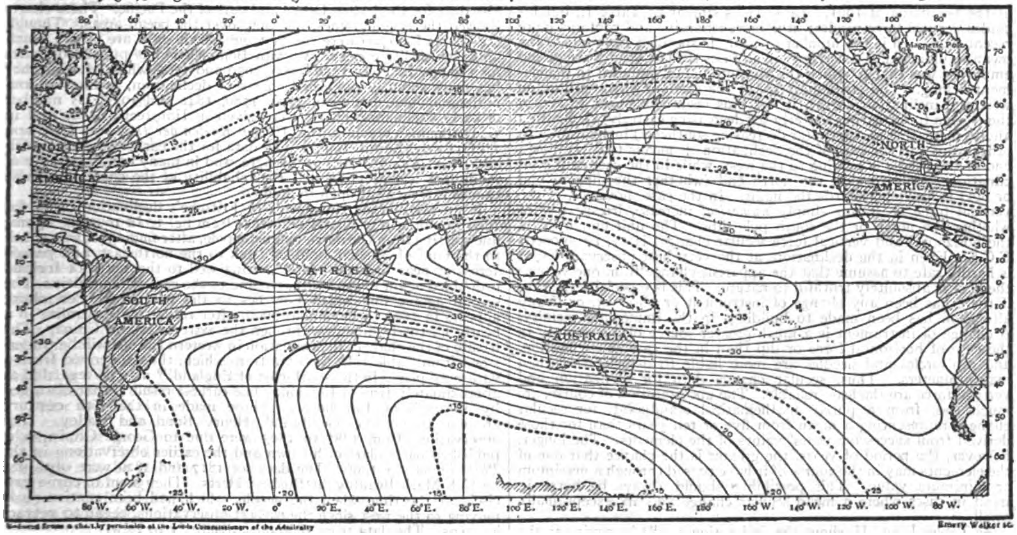
FIG. 2—Isoclinals, or lines of equal magnetic dip.

Charts are sometimes drawn for other magnetic elements, especially vertical force (fig. 4) and total force. The isomagnetic of zero vertical force coincides necessarily with that of zero dip, and there is in general considerable resemblance between the forms of lines of equal vertical force and those of equal dip. The highest values of the vertical force occur in areas surrounding the magnetic poles, and are fully 50% larger than the largest values of the horizontal force. The total force is least in equatorial regions, where values slightly under 0·4 C.G.S. are encountered. In the northern hemisphere there are two distinct maxima of total force. One of these so-called *foci* is in Canada, the other in the north-east of Siberia, the former having the higher value of the force. There are, however, higher values of the total force than at either of these *foci* throughout a considerable area to the south of Australia. In the northern hemisphere the lines of equal total force—called *isodynamic* lines—form two sets more or less distinct, consisting of closed ovals, one set surrounding the Canadian the other the Siberian focus.

§ 8. As already explained, magnetic charts for the world or for large areas give only a general idea of the values of the elements. If the region is undisturbed, very fairly approximate values are derivable from the charts, but when the highest accuracy is necessary the only thing to do is to observe at the precise spot. In disturbed areas local values often depart somewhat widely from what one would infer from the chart, and occasionally there are large differences


Magnetic Pole
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA
NORTH AMERICA
Magnetic Pole
80°W. 60°W. 40°W. 20°W. 0° 20°E. 40°E. 60°E. 80°E. 100°E. 120°E. 140°E. 160°E. 180° 160°W. 140°W. 120°W. 100°W. 80°W.

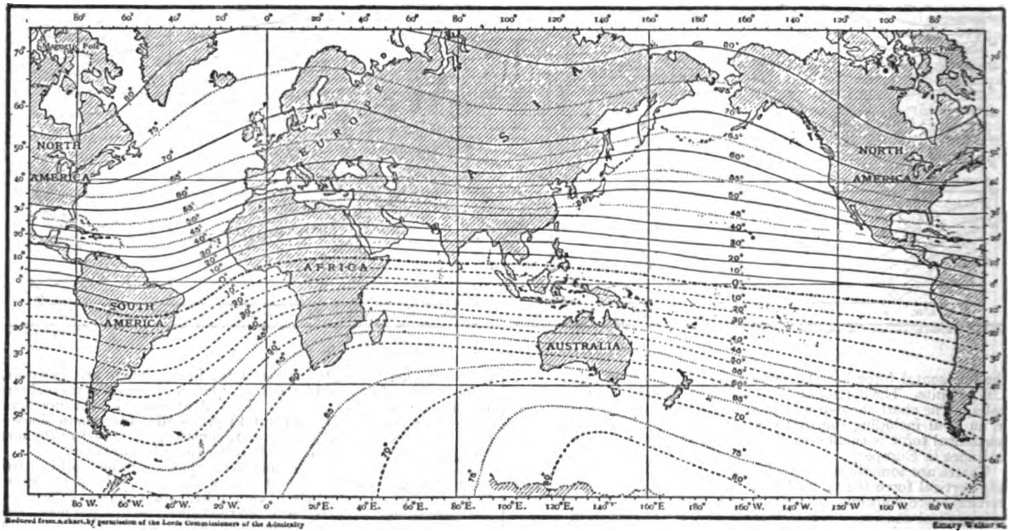
Reduced from a chart by permission of the Lords Commissioners of the Admiralty

Emery Walker sc.

FIG. 3.—Isomagnetics, lines of equal horizontal force.

between places only a few miles apart. Magnetic observatories usually publish the mean value for the year of their magnetic elements. It has been customary for many years to collect and publish these results in the annual report of the Kew Observatory (Observatory Department of the National Physical Laboratory). The data in Tables I. and II. are mainly derived from this source. The observatories are arranged in order of latitude, and their geographical co-ordinates are given in Table II., longitude being reckoned from Greenwich. Table I. gives the mean values of the declination, inclination and horizontal force for January 1, 1901; they are in the main arithmetic means of the mean annual values for the two years 1900 and 1901. The mean annual secular changes given in this table are derived from a short period of years—usually 1898 to 1903—the centre of which fell at the beginning of 1901. Table II. is similar to Table I., but includes vertical force results; it is more extensive and contains more recent data. In it the number of years is specified from which the mean secular change is derived; in all cases the last year of the period employed was that to which the absolute values assigned to the element belong. The great majority of the stations have declination west and inclination north; it has thus been convenient to attach the + sign to increasing westerly (or decreasing easterly) declination and to increasing northerly (or decreasing southerly) inclination. In other words, in the case of the declination + means that the north end of the needle is moving to the west, while in the case of the inclination + means that the north end (whether the dipping end or not) is moving towards the nadir. In the case, however, of the vertical force + means simply *numerical* increase, irrespective of whether the north or the south pole dips. The unit employed in the horizontal and vertical force secular changes is 1γ, *i.e.* 0·00001 C.G.S. Even in the declination, at the very best observatories, it is hardly safe to assume that the apparent change from one year to the next is absolutely truthful to nature. This is especially the case if there has been any change of instrument or observer, or if any alteration has been made to buildings in the immediate vicinity. A change of instrument is a much greater source of uncertainty in the case of horizontal force or dip than in the case of declination, and dip circles and needles are more liable to deterioration than magnetometers. Thus, secular change data for inclination and vertical force are the least reliable. The uncertainties, of course, are much less, from a purely mathematical standpoint, for secular changes representing a mean from five or ten years than for those derived from successive years' values of the elements. The longer, however, the period of years, the greater is the chance that one of the elements may in the course of it have passed through a maximum or minimum value. This possibility should always be borne in mind in cases where a mean secular change appears exceptionally small.

Magnetic Elements and their Secular Change.



Reduced from a chart by permission of the Lords Commissioners of the Admiralty. Emery Walker sc.

FIG. 4.—Isomagnetics, lines of equal vertical force.

As Tables I. and II. show, the declination needle is moving to the east all over Europe, and the rate at which it is moving seems not to vary much throughout the continent. The needle is also moving to the east throughout the western parts of Asia, the north and east of Africa, and the east of North America. It is moving to the west in the west of North America, in South America, and in the south and east of Asia, including Japan, south-east Siberia, eastern China and most of India.

§ 9. The information in figs. 1, 2, 3 and 4 and in Tables I. and II. applies only to recent years. Owing to secular change, recent charts differ widely from the earliest ones constructed. The first charts believed to have been constructed were those of Edmund Halley the astronomer. According to L. A. Bauer,[7] who has made a special study of the subject, Halley issued two declination charts for the epoch 1700; one, published in 1701, was practically confined to the Atlantic Ocean, whilst the second, published in 1702, contained also data for the Indian Ocean and part of the Pacific. These charts showed the isogonic lines, but only over the ocean areas. Though the charts for 1700 were the first published, there are others which apply to earlier epochs. W. van Bemmelen[8] has published charts for the epochs 1500, 1550, 1600, 1650 and 1700, whilst H. Fritsche[9] has more recently published charts of declination, inclination and horizontal force for 1600, 1700, 1780, 1842 and 1915. A number of early declination charts were given in Hansteen's *Atlas* and in G. Hellmann's reprints, *Die Altesten Karten der Isogonen, Isoklinen, Isodynamen* (Berlin, 1895). The data for the earlier epochs, especially those prior to 1700, are meagre, and in many cases probably of indifferent accuracy, so that the reliability of the charts for these epochs is somewhat open to doubt.

If we take either Hansteen's or Fritsche's declination chart for 1600 we notice a profound difference from fig. 1. In 1600 the agonic line starting from the north magnetic pole, after finding its way south to the Gulf of Mexico, doubled back to the north-east, and passed across or near Iceland. After getting well to the north of Iceland it doubled again to the south, passing to the east of the Baltic. The second agonic line which now lies to the west of St Petersburg appears in 1600 to have continued, after traversing Australia, in a nearly northerly direction through the extreme east of China. The nature of the changes in declination in western Europe will be understood from Table III., the data from which, though derived from a variety of places in the south-east of England,[10] may be regarded as approximately true of London. The earliest result is that obtained by Borough at Limehouse. Those made in the 16th century are due to Gunter, Gellibrand, Henry Bond and Halley. The observations from 1787 to 1805 were due to George Gilpin, who published particulars of his own and the earlier observations in the *Phil. Trans.* for 1806. The data for 1817 and 1820 were obtained by Col. Mark Beaufoy, at Bushey, Herts. They seem to come precisely at the time when the needle, which had been continuously moving to the west since the earliest observations, began to retrace its steps. The data from 1860 onwards apply to Kew.

Table I.—Magnetic Elements and their Rate of Secular Change for January 1, 1901.

Place.	Absolute values.			Secular change.		
	D.	I.	H.	D.	I.	H.
	° ′	° ′		′	′	γ
Pavlovsk . .	0 39·8E	70 36·8N	·16553	− 4·1	−0·8	+ 7
Ekatarinburg .	10 6·3E	70 40·5N	·17783	− 4·6	+0·5	−13
Copenhagen .	10 10·4W	68 38·5N	·17525			
Stonyhurst . .	18 10·3W	68 48·0N	·17330	− 4·0		+22
Wilhelmshaven.	12 26·0W	67 39·7N	·18108	− 4·1	−2·1	+20
Potsdam . .	9 54·2W	66 24·5N	·18852	− 4·2	−1·6	+16
Irkutsk . . .	2 1·0E	70 15·8N	·20122	+ 0·5	+1·6	−14
de Bilt . . .	13 48·3W	66 55·5N	·18516	− 4·4	−2·2	+14
Kew. . . .	16 50·8W	67 10·6N	·18440	− 4·2	−2·2	+25
Greenwich . .	16 27·5W	67 7·3N	·18465	− 4·0	−2·2	+23
Uccle . . .	14 11·0W	66 8·8N	·18954	− 4·2	−2·1	+23
Falmouth . .	18 27·3W	66 44·0N	·18705	− 3·8	−2·7	+26
Prague . . .	9 4·4W		·19956	− 4·4		+20
St Helier . .	16 58·1W	65 44·1N		− 3·5	−2·7	
Parc St Maur .	14 43·4W	64 52·3N	·19755	− 4·0	−2·2	+23
Val Joyeux. .	15 13·7W	65 0·0N	·19670			
Munich. . .	10 25·8W	63 18·1N	·20629	− 4·8	−2·7	+21
O'Gyalla . .	7 26·1W		·21164	− 4·8		+13
Pola. . . .	9 22·7W	60 14·5N	·22216	− 4·0		+23
Toulouse . .	14 16·4W	60 55·9N	·21945	− 3·9	−2·5	+25
Perpignan . .	13 34·7W	59 57·6N	·22453			
Capo di Monte.	9 8·0W	56 22·3N		− 5·2	−2·3	
Madrid . . .	15 39·0W					
Coimbra . .	17 18·1W	59 22·0N	·22786	− 3·7	−4·3	+34
Lisbon . . .	17 15·7W	57 53·0N	·23548			
Athens . . .	5 38·2W	52 7·5N	·26076			
San Fernando .	15 57·5W	55 8·8N	·24648			
Tokyo . . .	4 34·9W	49 0·3N	·29932			
Zi-ka-wei . .	2 23·5W	45 43·5N	·32875	+ 1·5	−1·5	+37
Helwan . . .	3 39·7W	40 30·8N	·30136	− 7·0	−0·4	− 7
Hong-Kong. .	0 17·5E	31 22·8N	·36753	+ 1·8	−4·3	+45
Kolaba . . .	0 23·2E	21 26·5N	·37436	+ 2·2	+7·0	− 9
Manila . . .	0 52·2E	16 13·5N	·38064	+ 0·1	−5·3	+47
Batavia. . .	1 7·3E	30 35·5S	·36724	+ 3·0	−7·3	−11
Mauritius . .	9 25·2W	54 9·4S	·23820	− 4·7	+4·6	−39
Rio de Janeiro.	8 2·9W	13 20·1S	·2501	+10·4	−2·3	
Melbourne . .	8 25·6E	67 24·6S	·23295			

The rate of movement of the needle to the east at London—and throughout Europe generally—fell off markedly subsequent to 1880. The change of declination in fact between 1880 and 1895 was only about 75% of that between 1865 and 1880, and the mean annual change from 1895 to 1900 was less than 75% of the mean annual change of the preceding fifteen years. Thus in 1902 it was at least open to doubt whether a change in the sign of the secular change were not in immediate prospect. Subsequent, however, to that date there was little further decline in the rate of secular change, and since 1905 there has been very distinct acceleration. Thus, if we derive a mean value from the eighteen European stations for which declination secular changes are given in Tables I. and II. we find

mean value from table I. −4·18
„ „ „ „ II. −5·21

The epoch to which the data in Table II. refer is somewhat variable, but is in all cases more recent than the epoch, January 1, 1901, for Table I., the mean difference being about 5 years.

§ 10. At Paris there seems to have been a maximum of easterly declination (about 9°) about 1580; the needle pointed to true north about 1662, and reached its extreme westerly position between 1812 and 1814. The phenomena at Rome resembled those at Paris and London, but the extreme westerly position is believed to have been attained earlier. The rate of change near the turning point seems to have been very slow, and as no fixed observatories existed in those days, the precise time of its occurrence is open to some doubt.

Perhaps the most complete observations extant as to the declination phenomena near a turning point relate to Kolaba observatory at Bombay; they were given originally by N. A. F. Moos,[11] the director of the observatory. Some of the more interesting details are given in Table IV.; here W denotes movement to be west, and so answers to a numerical diminution in the declination, which is easterly.

Prior to 1880 the secular change at Kolaba was unmistakably to the east, and subsequent to 1883 it was clearly to the west; but between these dates opinions will probably differ as to what actually happened. The fluctuations then apparent in the sign of the annual change may be real, but it is at least conceivable that they are of instrumental origin. From 1870 to 1875 the mean annual change was −1′·2; from 1885 to 1890 it was +1′·5, from 1890 to 1895 it was +2′·0, while from 1895 to 1905 it was +2′·35, the + sign denoting movement to the west. Thus, in this case the rate of secular change has increased fairly steadily since the turning point was reached.

Table V. contains some data for St Helena and the Cape of Good Hope,[12] both places having a long magnetic history. The remarkable feature at St Helena is the uniformity in the rate of secular change. The figures for the Cape show a reversal in the direction of the secular change about 1840, but after a few years the arrested movement to the west again became visible. According, however, to J. C. Beattie's *Magnetic Survey of South Africa* the movement to the west ceased shortly after 1870. A persistent movement to the east then set in, the mean annual change increasing from 1′·8 between 1873 and 1890 to 3′·8 between 1890 and 1900.

§ 11. Secular changes of declination have been particularly interesting in the United States, an area about which information is unusually complete, thanks to the labours and publications of the United States Coast and Geodetic Survey.[13] At present the agonic line passes in a south-westerly direction from Lake Superior to South Carolina. To the east of the agonic line the declination is westerly, and to the west it is easterly. In 1905 the declination varied from about 21° W. in the extreme north-east to about 24° E. in the extreme north-west. At present the motion of the agonic line seems to be towards the west, but it is very slow. To the east of the agonic line westerly declination is increasing, and to the west of the line, with the exception of a narrow strip immediately adjacent to it, easterly declination is increasing. The phenomena in short suggest a motion southwards in the north magnetic pole. Since 1750 declination has always been westerly in the extreme east of the States, and always easterly in the extreme west, but the position of the agonic line has altered a good deal. It was to the west of Richmond, Virginia, from 1750 to about 1772, then to the east of it until about 1838 when it once more passed to the west; since that time it has travelled farther to the west. Table VI. is intended to show the nature of the secular change throughout the whole country. As before, + denotes that the north pole of the magnet is moving to the west,—that it is moving to the east.

The data in Table VI. represent the mean change of declination per annum, derived from the period (ten years, except for 1900–1905) which ended in the year put at the top of the column. The stations are arranged in four groups, the first group representing the extreme eastern, the last group the extreme western states, the other two groups being intermediate. In each group the stations are arranged, at least approximately, in order of latitude. The data are derived from the values of the declination given in the Geodetic Survey's *Report* for 1906, appendix 4, and *Magnetic Tables and Magnetic Charts* by L. A. Bauer, 1908. The values seem, in most cases, based to some extent on calculation, and very probably the secular change was not in reality quite so regular as the figures suggest. For the Western States the earliest data are comparatively recent, but for some of the eastern states data earlier than any in the table appear in the *Report of the Coast and Geodetic Survey* for 1902. These data indicate that the easterly movement of the magnet, visible in all the earlier figures for the Eastern States in Table VI., existed in all of them at least as far back as 1700. There is not very much evidence as to the secular change between 1700 and 1650, the earliest date to which the Coast and Geodetic Survey's figures refer. The figures show a maximum of westerly declination about 1670 in New Jersey and about 1675 in Maryland. They suggest that this maximum was experienced all along the Atlantic border some time in the 17th century, but earlier in the extreme north-east than in New York or Maryland.

Examination of Table VI. shows that the needle continued to move to the east for some time after 1750 even in the Eastern States. But the rate of movement was clearly diminishing, and about 1765 the extreme easterly position was reached in Eastport, Maine, the needle then beginning to retrace its steps to the west. The phenomena visible at Maine are seen repeating themselves at places more and more to the west, in Boston about 1785, in Albany about 1800, in Washington, D.C., about 1805, in Columbus (Ohio) about 1815, in Montgomery (Alabama) about 1825, in Bloomington (Ill.) about 1830, in Des Moines (Iowa) about 1840, in Santa Rosa (New Mexico) about 1860 and in Salt Lake about 1870. In 1885 the needle was moving to the west over the whole United States with the exception of a comparatively narrow strip along the Pacific coast. Even an acute observer would have been tempted to prophesy in 1885 that at no distant date the secular change would be pronouncedly westerly right up to the Pacific. But in a few years a complete change took place. The movement to the east, which had become exceedingly small, if existent, in the Pacific states, began to accelerate; the movement to the west continued in the central, as in the eastern states, but perceptibly slackened. In 1905 the area throughout which the movement to the west still continued had greatly contracted and lay to the east of a line drawn from the west end of Lake Superior to the west of Georgia. If we take a station like Little Rock (Arkansas), we have the secular change to the

TABLE II.—Recent Values of the Magnetic Elements and their Rate of Secular Change.

Place.	Geographical position.		Absolute Values of Elements.					Secular change (mean per annum).				
	Latitude.	Longitude.	Year.	D.	I.	H.	V.	Interval in years.	D.	I.	H.	V.
	° ′	° ′		° ′	° ′				′	′		
Pavlovsk . . .	59 41N	30 29E	1906	1 4·2E	70 36·6N	·16528	·46963	5	−4·5	+0·1	− 6	−14
Sitka (Alaska) . .	57 3N	135 20W	1906	30 3·3E	74 41·7N	·15502	·56646	4	−3·0	−1·6	+18	−38
Ekatarinburg . .	56 49N	60 38E	1906	10 31·0E	70 49·5N	·17664	·50796	5	−4·5	+1·7	−23	+18
Rude Skov (Copenhagen)	55 51N	12 27E	1908	9 43·3W	68 45N	·17406	·44759					
Stonyhurst . . .	53 51N	2 28W	1909	17 28·6W	68 42·8N	·17424	·44722	5	−5·9	−1·1	+ 6	−25
Hamburg . . .	53 33N	9 59E	1903	11 10·2W	67 23·5N	·18126	·43527					
Wilhelmshaven. .	53 32N	8 9E	1909	11 46·8W		·18129		5	−5·2		− 7	
Potsdam. . . .	52 23N	13 4E	1909	9 10·6W	66 20·0N	·18834	·42971	5	−5·8	+0·1	− 9	−19
Irkutsk	52 16N	104 16E	1905	1 58·1E	70 25·0N	·20011	·56250	5	+0·6	+2·0	−24	+39
de Bilt	52 5N	5 11E	1907	13 19·0W	66 49·9N	·18559	·43368	5	−4·7	−0·6	+ 2	−16
Valencia. . . .	51 56N	10 15W	1909	20 50·3W	68 15·1N	·17877	·44812	5	−5·0	−1·2	+ 7	−25
Kew	51 28N	0 19W	1909	16 10·8W	66 59·7N	·18506	·43588	5	−5·4	−1·1	+ 2	−35
Greenwich . . .	51 28N	0 0	1909	15 47·6W	66 53·9N	·18526	·43432	5	−5·5	−0·7	+ 1	−20
Uccle	50 48N	4 21E	1908	13 36·7W	66 1·6N	·19061	·42867	4	−5·3	−0·8	− 3	−35
Falmouth . . .	50 9N	5 5W	1909	17 48·4W	66 30·6N	·18802	·43266	5	−4·7	−1·4	+ 9	−30
Prague	50 5N	14 25E	1908	8 20·9W				5	−6·5			
Cracow	50 4N	19 58E	1909	5 35·1W	64 18N			3	−7·3			
St Helier . . .	49 12N	2 5W	1907	16 27·4W	65 34·5N			5	−5·3	−1·2		
Val Joyeux . . .	48 49N	2 1E	1909	14 32·9W	64 43·9N	·19727	·41792	5	−5·4	−1·7	+ 1	−51
Vienna	48 15N	16 21E	1898	8 24·1W								
Munich	48 9N	11 37E	1906	9 59·5W	63 10·0N	·20657	·40835	5	−4·8	−1·3	+ 4	−31
O'Gyalla . . .	47 53N	18 12E	1909	6 43·9W		·21094		5	−5·0		−10	
Odessa	46 26N	30 46E	1899	4 36·7W	62 18·2N	·21869	·41660					
Pola	44 52N	15 51E	1908	8 43·2W	60 6·8N	·22207	·38640	5	−5·5	−0·6	− 4	−23
Agincourt (Toronto)	43 47N	79 16W	1906	5 45·3W	74 35·6N	·16397	·59502	4	+3·4	+0·9	−23	−24
Nice	43 43N	7 16E	1899	12 4·0W	60 11·7N	·22390	·39087					
Toulouse . . .	43 37N	1 28E	1905	13 56·3W	60 49·1N	·22025	·39439	5	−4·5	−1·5	+ 2	− 2
Perpignan . . .	42 42N	2 53E	1907	13 4·4W				7	−4·7			
Tiflis.	41 43N	44 48E	1905	2 41·6E	56 2·8N	·25451	·37799	7	−5·2	+1·7	−26	+ 2
Capo di Monte. .	40 52N	14 15E	1906	8 40·3W	56 13·5N			5	−5·1	−1·5		
Madrid	40 25N	3 40W	1901	15 35·6W								
Coimbra. . . .	40 12N	8 25W	1908	16 46·2W	58 57·3N	·22946	·38120	5	−4·6	−2·9	+17	−45
Baldwin (Kansas) .	38 47N	95 10W	1906	8 30·1E	68 45·1N	·21807	·56081	4	−1·7	+1·8	−36	− 8
Cheltenham (Maryland)	38 44N	76 50W	1906	5 22·0W	70 27·3N	·20035	·56436	4	+3·8	+1·2	−38	−45
Lisbon	38 43N	9 9W	1900	17 18·0W	57 54·8N	·23516	·37484					
Athens	37 58N	21 23E	1908	4 52·9W	52 11·7N	·26197	·33613	5	−5·5			
San Fernando . .	36 28N	6 12W	1908	15 25·6W	54 48·4N	·24829	·35206	5	−4·6	−2·8	+26	−24
Tokyo	35 41N	139 45E	1901	4 36·1W	49 0·0N	·29954	·34459					
Zi-ka-wei . . .	31 12N	121 26E	1906	2 32·0W	45 35·3N	·33040	·33726	5	+1·5	−1·3	+30	+ 6
Dehra Dun . . .	30 19N	78 3E	1907	2 38·3E	43 36·1N	·33324	·31736	4	+0·8	+5·5	−26	+77
Helwan	29 52N	31 21E	1909	2 49·2W	40 40·4N	·30031	·25804	5	−5·7	+1·2	− 6	+13
Havana	23 8N	82 25W	1905	2 25·0E	52 57·4N	·30531	·40452					
Barrackpore . .	22 46N	88 22E	1907	1 9·9E	30 30·2N	·37288	·21967	3	+4·2	+3·4	+21	+62
Hong-Kong. . .	22 18N	114 10E	1908	0 5·9E	31 2·5N	·37047	·22292	5	+1·9	−1·8	+43	− 1
Honolulu . . .	21 19N	158 4W	1906	9 21·7E	40 1·8N	·29220	·24545	4	−0·9	−3·2	−19	−62
Kolaba	18 54N	72 49E	1905	0 14·0E	21 58·5N	·37382	·15084	5	+2·1	+7·2	−11	+86
Alibagh	18 39N	72 52E	1909	1 0·3E	23 29·0N	·36845	·16008	3	+1·7	+6·8	−10	+82
Vieques (Porto Rico)	18 9N	65 26W	1906	1 33·2W	49 47·7N	·28927	·34224	2	+7·2	+6·8	−49	+66
Manila	14 35N	120 59E	1904	0 51·4E	16 0·2N	·38215	·10960	5	+0·1	−3·9	+47	−34
Kodaikánal . . .	10 14N	77 28E	1907	0 40·7W	3 27·2N	·37431	·02259	4	+4·3	+5·5	+16	+61
Batavia	6 11S	106 49E	1906	0 54·1E	30 48·5S	·36708	·21889	4	+2·1	−7·7	− 2	+110
Dar es Salaam . .	6 49S	39 18E	1903	7 35·2W								
Mauritius . . .	20 6S	57 33E	1908	9 14·3W	53 44·9S	·23415	·31932	5	−0·3	+2·9	−53	−131
Rio de Janeiro . .	22 55S	43 11W	1906	8 55·3W	13 57·1S	·24772	·06164	5	+9·1	−6·8	−42	+44
Santiago (Chile) .	33 27S	70 42W	1906	14 18·7E	30 11·8S			3	+6·1	+9·9		
Melbourne . . .	37 50S	144 58E	1901	8 26·7E	67 25·0S	·23305	·56024					
Christchurch, N.Z.	43 32S	172 37E	1903	16 18·4E	67 42·3S	·22657	·55259					

west lasting for about sixty years. Further west the period shortens. At Pueblo (Colorado) it is about forty years, at Salt Lake under thirty years, at Prescott (Arizona) about twenty years. Considering how fast the area throughout which the secular change is easterly has extended to the east since 1885, one would be tempted to infer that at no distant date it will include the whole of the United States. In the extreme north-east, however, the movement of the needle to the west, which had slackened perceptibly after 1860 or 1870, is once more accelerating. Thus the auspices do not all point one way, and the future is as uncertain as it is interesting.

§ 12. Table VII. gives particulars of the secular change of horizontal force and northerly inclination at London. Prior to the middle of the 19th century information as to the value of H is of uncertain value. The earlier inclination data[14] are due to Norman, Gilbert, Bond, Graham, Heberden and Gilpin. The data from 1857 onwards, both for H and I, refer to Kew. "London" is rather a vague term, but the differences between the values of H and I at Kew and Greenwich—in the extreme west and east—are almost nil. For some time after its discovery by Robert Norman inclination at London increased. The earlier observations are not sufficient to admit of the date of the maximum inclination or its absolute value being determined with precision. Probably the date was near 1723. This view is supported by the fact that at Paris the inclination fell from 72° 15′ in 1754 to 71° 48′ in 1780. The

TABLE III.—Declination at London.

Date.	Declination.	Date.	Declination.	Date.	Declination.
	° ′		° ′		° ′
1580	11 15E	1773	21 9W	1860	21 38·9W
1622	6 0	1787	23 19	1865	20 58·7
1634	4 6	1795	23 57	1870	20 18·3
1657	0 0	1802	24 6	1875	19 35·6
1665	1 22W	1805	24 8	1880	18 52·1
1672	2 30	1817	24 36	1885	18 19·2
1692	6 0	1818	24 38	1890	17 50·6
1723	14 17	1819	24 36	1895	17 16·8
1748	17 40	1820	24 34	1900	16 52·7
				1905	16 32·9

earlier observations in London were probably of no very high accuracy, and the rates of secular change deducible from them are correspondingly uncertain. It is not improbable that the average annual change 0′·8 derived from the thirteen years 1773–1786 is too small, and the value 6′·2 derived from the fifteen years 1786–1801 too large. There is, however, other evidence of unusually rapid secular change of inclination towards the end of the 18th century in western Europe; for observations in Paris show a fall of 56′ between 1780 and 1791, and of 90′ between 1791 and 1806. Between 1801 and 1901 inclination in London diminished by 3° 26′·5, or on the average by 2′·1 per annum, while between 1857 and 1900 H increased on the average by 22γ a year. These values differ but little from the secular changes given in Table I. as applying at Kew for the epoch Jan. 1, 1901. Since the beginning, however, of the 20th century a notable change has set in, which seems shared by the whole of western Europe. This is shown in a striking fashion by contrasting the data from European stations in Tables I. and II. There are fifteen of these stations which give secular change data for H in both tables, while thirteen give secular data for I. The mean values of the secular changes derived from these stations are as follows:—

TABLE IV.—Declination at Kolaba (Bombay).

Year.	Declination East.	Change since previous year.	Year.	Declination East.	Change since previous year.
	° ′ ″	′ ″		° ′ ″	′ ″
1876	0 55 58	0 37 E	1881	0 57 12	0 3 E
1877	56 39	0 41 E	1882	0 56 50	0 22 W
1878	57 6	0 27 E	1883	57 2	0 12 E
1879	57 30	0 24 E	1884	55 39	1 23 W
1880	57 9	0 21 W	1885	55 3	0 36 W

	I	H
From Table I.	−2′·35	+21·07γ
From Table II.	−1·12	+1·67γ

The difference in epoch between the two sets of results is only about 5 years, and yet in that short time the mean rate of annual increase in H fell to a thirteenth of its original value. During 1908–1909 H diminished throughout all Europe except in the extreme west. Whether we have to do with merely a temporary phase, or whether a general and persistent diminution in the value of H is about to set in over Europe it is yet hardly possible to say.

§ 13. It is often convenient to obtain a formula to express the mean annual change of an element during a given period throughout an area of some size. The usual method is to assume that the change at a place whose latitude is l and longitude λ is given by an expression of the type $c+a(l-l_0)+b(\lambda-\lambda_0)$, where a, b, c are constants, l_0 and λ_0 denoting some fixed latitude and longitude which it is convenient to take as point of departure. Supposing observational data available from a series of stations throughout the area, a, b and c can be determined by least squares. As an example, we may take the following slightly modified formula given by Ad. Schmidt [15] as applicable to Northern Europe for the period 1890 to 1900. ΔD, ΔI and ΔH represent the mean annual changes during this period in westerly declination, in inclination and in horizontal force:—

$$\Delta D = -5{\cdot}24-0{\cdot}071(l-50)+0{\cdot}033(\lambda-10),$$
$$\Delta I = -1{\cdot}58+0{\cdot}010(l-50)+0{\cdot}036(\lambda-10),$$
$$\Delta H = +23{\cdot}5-0{\cdot}59\,(l-50)-0{\cdot}35\,(\lambda-10).$$

Longitude λ is here counted positive to the east. The central position assumed here (lat. 50°, long. 10° E.) falls in the north of Bavaria. In the case of the horizontal force unity represents 1γ. Schmidt found the above formulae to give results in very close agreement with the data at the eight stations which he had employed in determining the constants. These stations ranged from Pavlovsk to Perpignan, and from Stonyhurst to Ekaterinburg in Siberia. Formulae involving the second as well as the first powers of $l-l_0$ and $\lambda-\lambda_0$ have also been used, *e.g.*, by A. Tanakadate in the Magnetic Survey of Japan.

TABLE V.—Declination at St Helena and Cape of Good Hope.

St Helena.		Cape of Good Hope.	
Date.	Declination.	Date.	Declination.
	° ′		° ′
1610	7 13 E	1605	0 30 E
1677	0 40	1609	0 12 W
1691	1 0 W	1675	8 14
1724	7 30	1691	11 0
1775	12 18	1775	21 14
1789	15 30	1792	24 31
1796	15 48	1818	26 31
1806	17 18	1839	29 9
1839	22 17	1842	29 6
1840	22 53	1846	29 9
1846	23 11	1850	29 19
1890	23 57	1857	29 34
		1874	30 4
		1890	29 32
		1903	28 44

TABLE VI.—Secular Change of Declination in the United States (+ to the West).

Place.	Epoch	1760	70	80	90	1800	10	20	30	40	50	60	70	80	90	1900	50
		′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
Eastport, Maine		−1·2	0·0	+1·2	+2·1	+3·2	+4·0	+4·5	+4·9	+5·0	+5·6	+4·5	+3·0	+2·1	+1·0	+1·8	+2·4
Boston, Mass.		−2·7	−1·9	−1·0	0·0	+1·1	+1·9	+2·7	+3·5	+4·2	+4·4	+4·0	+3·3	+3·1	+3·0	+3·2	+3·4
Albany, New York		−4·2	−3·6	−2·7	−1·6	−0·6	+0·6	+1·6	+2·7	+3·6	+4·6	+4·6	+3·9	+4·7	+2·3	+3·4	+3·6
Philadelphia, Penn.		−4·6	−4·2	−3·5	−2·3	−1·3	+0·1	+1·3	+2·5	+3·4	+4·3	+4·2	+4·6	+4·4	+3·4	+3·5	+3·4
Baltimore, Maryland		−3·9	−3·4	−2·7	−2·0	−0·9	0·0	+0·9	+2·0	+2·7	+3·4	+3·9	+4·0	+3·9	+3·6	+3·5	+3·2
Richmond, Virginia		−3·6	−3·2	−2·5	−1·8	−0·9	0·0	+0·9	+1·8	+2·5	+3·1	+3·6	+3·9	+3·8	+3·7	+3·4	+3·2
Columbia, S. Carolina		−3·7	−3·4	−2·9	−2·2	−1·3	−0·5	+0·5	+1·3	+2·2	+2·9	+3·4	+3·8	+3·8	+3·8	+3·6	+1·8
Macon, Georgia		−3·7	−3·6	−3·2	−2·5	−1·8	−0·9	0·0	+0·9	+1·8	+2·5	+3·2	+3·6	+3·9	+3·5	+3·1	+1·2
Tampa, Florida		−3·0	−2·5	−2·0	−1·1	−0·4	+0·4	+1·1	+2·0	+2·5	+3·0	+3·2	+3·5	+3·7	+2·8	+2·9	+1·6
Marquette, Michigan									0·0	+1·4	+2·6	+3·7	+4·7	+5·1	+4·9	+3·8	+2·4
Columbus, Ohio							−0·9	0·0	+0·9	+2·0	+2·9	+3·4	+3·6	+3·7	+3·9	+4·0	+2·4
Bloomington, Illinois							−2·4	−1·5	−0·4	+0·4	+1·5	+2·4	+2·8	+4·2	+3·9	+2·9	+1·0
Lexington, Kentucky							−0·9	0·0	+0·9	+1·8	+2·5	+3·2	+3·6	+3·8	+3·8	+3·4	+1·8
Chattanooga, Tennessee							−0·9	0·0	+0·9	+1·8	+2·5	+3·2	+3·6	+4·0	+3·5	+3·1	+1·6
Little Rock, Arkansas							−2·3	−1·5	−0·9	+0·1	+0·8	+1·7	+2·0	+3·6	+3·7	+2·3	−1·2
Montgomery, Alabama		−3·6	−3·5	−3·1	−2·8	−2·2	−1·5	−0·8	+0·1	+0·8	+1·6	+2·2	+2·8	+3·8	+3·9	+2·6	+0·2
Alexandria, Louisiana							−2·1	−1·6	−0·8	+0·1	+0·8	+1·6	+2·2	+3·6	+3·3	+2·0	−1·4
Northome, Minnesota									−1·7	−0·6	+0·6	+1·7	+2·8	+4·2	+4·4	+3·5	0·0
Jamestown, N. Dakota												+1·0	+1·9	+3·1	+4·8	+1·9	−2·2
Des Moines, Iowa.									−1·5	−0·6	+0·6	+1·5	+2·5	+3·8	+4·5	+2·7	−0·6
Douglas, Wyoming												−0·8	0·0	+1·2	+2·3	+0·5	−1·6
Emporia, Kansas												+0·6	+1·6	+2·7	+3·8	+1·7	−1·8
Pueblo, Colorado												−0·3	+0·4	+1·5	+3·1	+0·7	−2·2
Okmulgee, Oklahoma												+0·9	+1·5	+2·7	+3·9	+1·4	−2·4
Santa Rosa, New Mexico												−0·4	+0·4	+1·4	+2·6	+0·4	−2·4
San Antonio, Texas										−1·1	−0·5	−0·5	+1·1	+1·8	+2·7	+0·9	−2·4
Seattle, Washington					−3·3	−3·5	−3·7	−3·7	−3·5	−3·3	−3·0	−2·6	−2·1	−1·3	−1·9	−2·0	−3·2
Wilson Creek, Washington												−2·1	−1·5	−0·4	−1·0	−1·6	−3·2
Detroit, Oregon							−3·8	−3·9	−3·9	−3·7	−3·4	−2·9	−2·5	−1·8	−0·8	−1·8	−3·8
Salt Lake, Utah												−1·1	−0·4	+1·0	+1·0	−0·8	−2·8
Prescott, Arizona												−1·4	−0·7	+0·4	+0·4	−1·2	−3·2
San José, California					−2·6	−2·9	−2·9	−2·9	−2·7	−2·5	−2·3	−2·0	−1·5	−0·8	−0·4	−1·9	−3·8
Los Angeles, ,,					−3·4	−3·4	−3·5	−3·2	−3·0	−2·7	−2·1	−1·6	−1·1	−0·9	−0·3	−1·6	−3·6

Formulae are also wanted to show how the value of an element, or the rate of change of an element, at a particular place has varied throughout a long period. For comparatively short periods it is best to use formulae of the type $E=a+bt+ct^2$, where E denotes the value of an element t years subsequent to some convenient epoch; a, b, c are constants to be determined from the observational data. For longer periods formulae of the type $E=a+b\sin(mt+n)$, where a, b, m and n are constants, have been used by Schott [16] and others with considerable success. The following examples, due to G. W. Littlehales, [17] for the Cape of Good Hope, will suffice for illustration:

$$\text{Declination (West)}=14^\circ{\cdot}63+15^\circ{\cdot}00\sin\{0{\cdot}61(t-1850)+77^\circ{\cdot}8\}$$

$$\text{Inclination (South)}=49^\circ{\cdot}11+\ 8^\circ{\cdot}75\sin\{0{\cdot}8\ \ (t-1850)+34^\circ{\cdot}3\}.$$

Here t denotes the date. It is perhaps hardly necessary to point out that the extension of any of these empirical formulae—whether to places outside the surveyed area, or to times not included in the period of observation—is fraught with danger, which increases rapidly the further the extra-polation is pushed.

Table VII.—Inclination (northerly) and Horizontal Force at London.

Date.	I.	Date.	I.	Date.	I.	H.	Date.	I.	H.
	° ′		° ′		° ′			° ′	
1576	71 50	1801	70 36·0	1857	68 24·9	·17474	1891	67 33·2	·18193
1600	72 0	1821	70 3·4	1860	69 19·8	·17550	1895	67 25·4	·18278
1676	73 30	1830	69 38·0	1865	68 8·7	·17662	1900	67 11·8	·18428
1723	74 42	1838	69 17·3	1870	67 58·6	·17791	1905	67 3·8	·18510
1773	72 19	1854	68 31·1	1874	67 50·0	·17903	1908	67 0·9	·18515
1786	72 9								

Bauer has employed a convenient graphical method of illustrating secular change. Radii are drawn from the centre of a sphere parallel to the direction of the freely dipping needle, and are produced to intersect the tangent plane drawn at the point which answers to the mean position of the needle during the epoch under consideration. The curve formed by the points of intersection shows the character of the secular change. Fig. 5 (slightly modified from *Nature*, vol. 57, p. 181) applies to London. The curve is being described in the clockwise direction. This, according to Bauer's [18] own investigation, is the normal mode of description. Schott and Littlehales have found, however, a considerable number of cases where it is difficult to say whether the motion is clockwise or not, while in some stations on both the east and west shores of the Pacific it was clearly anti-clockwise. Fritsche [19] dealing with the secular changes from 1600 to 1885—as given by his calculated values of the magnetic elements—at 204 points of intersection of equidistant lines of latitude and longitude, found only sixty-three cases in which the motion was unmistakably clockwise, while in twenty-one cases it was clearly the opposite.

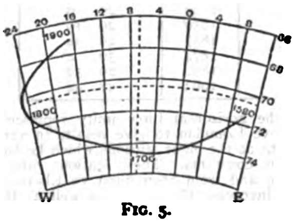


FIG. 5.

Diurnal Variations.

§ 14. All the magnetic elements at any ordinary station show a regular variation in the solar day. To separate this from the irregular changes, means of the hourly readings must be formed making use of a number of days. The amplitude of the diurnal change usually varies considerably with the season of the year. Thus a diurnal inequality derived from all the days of the year combined, or from a smaller number of days selected equally from all the months of the year, can give only the average effect throughout the year. Also unless the hours of maxima and minima at a given station are but slightly variable with the season, the result obtained by combining data from all the months of the year may be a hybrid which does not very closely resemble the phenomena in the majority of individual months. This remark applies in particular to the declination at places within the tropics. One consequence is obviously to make the range of a diurnal inequality which answers to the year as a whole less than the arithmetic mean of the twelve ranges obtained for the constituent months. At stations in temperate latitudes, whilst minor differences of type do exist between the diurnal inequalities for different months of the year, the difference is mainly one of amplitude, and the mean diurnal inequality from all the months of the year gives a very fair idea of the nature of the phenomena in any individual month.

Tables VIII. to XI. give mean diurnal inequalities derived from all the months of the year combined, the figures representing the algebraic excess of the hourly value over the mean for the twenty-four hours. The + sign denotes in Table VIII. that the north end of the needle is to the west of its mean position for the day; in Tables IX. to XI. it denotes that the element—the dip being the north or south as indicated—is numerically in excess of the twenty-four hour mean. The letter "a" denotes that all days have been included except, as a rule, those characterized by specially large disturbances. The letter "q" denotes that the results are derived from a limited number of days selected as being specially quiet,

Table VIII.—Diurnal Inequality of Declination, mean from whole year (+ to West).

Station.	Jan Mayen.		St Petersburg and Pavlovsk.		Greenwich.	Kew.		Parc St Maur.	Tiflis.	Kolaba.	Batavia.	Mauritius.	South Victoria Land.	
Latitude. Longitude.	71° 0′ N. 8° 28′ W.		59° 41′ N. 30° 29′ E.		51° 28′ N. 0° 0′.	51° 28′ N. 0° 19′ W.		48° 49′ N. 2° 29′ E.	41° 43′ N. 44° 48′ E.	18° 54′ N. 72° 49′ E.	6° 11′ S. 106° 49′ E.	20° 6′ S. 57° 33′ E.	77° 51′ S. 166° 45′ E.	
Period.	1882-1883.		1873-1885.		1890-1900.	1890-1900.		1883-1897.	1888-1898.	1894-1901.	1883-1894.	1876-1890.	1902-1903.	
	a.	q.	a.	q.	a.	a.	q.	a.	a.	q.	a.	a.	a.	q.
Hour.	′	′	′	′	′	′	′	′	′	′	′	′	′	′
1	−6·6	−4·2	−1·3	−0·7	−1·4	−1·5	−0·9	−1·4	−0·7	−0·2	+0·1	+0·1	+2·0	+0·9
2	−10·5	−6·4	−1·2	−0·8	−1·3	−1·4	−0·9	−1·2	−0·6	−0·1	−0·1	+0·1	−2·1	−1·8
3	−15·2	−7·8	−1·2	−1·0	−1·3	−1·5	−1·0	−1·2	−0·6	−0·1	−0·1	+0·1	−5·2	−4·5
4	−16·9	−8·4	−1·4	−1·3	−1·4	−1·7	−1·3	−1·2	−0·5	−0·1	0·0	+0·2	−9·4	−6·8
5	−17·0	−8·1	−1·7	−1·8	−1·7	−2·1	−1·8	−1·6	−0·7	−0·1	0·0	+0·3	−12·2	−9·0
6	−13·7	−7·0	−1·9	−2·3	−2·1	−2·4	−2·3	−1·9	−1·2	−0·6	+0·1	+0·4	−15·3	−11·7
7	−9·3	−5·1	−2·2	−2·8	−2·4	−2·7	−2·8	−2·4	−1·9	−1·0	+0·5	+0·6	−17·2	−15·0
8	−6·8	−3·2	−2·5	−3·2	−2·5	−2·8	−3·1	−2·7	−2·4	−1·2	+1·3	+1·1	−21·5	−17·3
9	−3·7	−0·6	−2·3	−3·0	−1·9	−2·1	−2·5	−2·3	−2·3	−0·7	+1·7	+1·8	−23·5	−18·1
10	−2·4	+2·1	−1·0	−1·7	−0·2	−0·3	−0·7	−0·5	−0·9	0·0	+1·5	+1·9	−21·2	−15·8
11	−0·5	+4·6	+1·0	+0·4	+2·1	+2·2	+1·7	+2·0	+1·0	+0·9	+0·9	+1·3	−15·3	−9·2
Noon	+2·5	+6·5	+3·1	+2·7	+4·2	+4·3	+3·9	+4·2	+2·6	+1·4	+0·1	0·0	−9·8	−4·9
1	+3·7	+7·3	+4·6	+4·3	+5·1	+5·3	+4·8	+5·3	+3·3	+1·2	−0·6	−1·1	−3·2	−0·1
2	+6·4	+7·1	+4·9	+4·5	+4·7	+4·9	+4·4	+4·9	+3·1	+0·6	−1·1	−2·0	+3·8	+5·9
3	+7·4	+5·9	+4·1	+3·6	+3·6	+3·7	+3·1	+3·7	+2·3	+0·1	−1·3	−2·3	+11·1	+9·5
4	+8·5	+4·3	+2·7	+2·3	+2·2	+2·4	+1·8	+2·3	+1·3	−0·2	−1·2	−1·8	+16·6	+12·9
5	+10·6	+3·0	+1·5	+1·3	+1·1	+1·2	+0·7	+1·1	+0·6	−0·1	−0·9	−0·9	+19·9	+14·6
6	+14·2	+2·3	+0·6	+0·7	+0·3	+0·4	+0·2	+0·2	+0·2	0·0	−0·6	−0·1	+22·0	+15·5
7	+15·2	+2·2	0·0	+0·4	−0·3	−0·2	−0·1	−0·4	+0·1	+0·1	−0·4	+0·1	+22·0	+15·9
8	+15·8	+2·6	−0·4	+0·2	−0·9	−0·6	−0·3	−0·9	−0·1	+0·2	−0·2	+0·1	+19·9	+14·6
9	+13·2	+2·6	−1·0	0·0	−1·2	−1·0	−0·5	−1·3	−0·4	+0·1	0·0	+0·1	+16·0	+10·6
10	+7·4	+2·0	−1·4	−0·2	−1·5	−1·3	−0·7	−1·5	−0·6	0·0	+0·1	+0·1	+11·6	+7·2
11	+1·1	+0·5	−1·6	−0·4	−1·6	−1·4	−0·8	−1·6	−0·7	0·0	+0·1	+0·1	+7·6	+4·2
12	−3·6	−1·8	−1·5	−0·6	−1·6	−1·5	−0·9	−1·6	−0·8	−0·1	+0·1	+0·1	+3·3	+1·9
Range	32·8	15·7	7·4	7·7	7·6	8·1	7·9	8·0	5·7	2·6	3·0	4·2	45·5	34·0

TABLE IX.—Diurnal Inequality of Horizontal Force, mean from whole year (Unit 1γ = ·00001 C.G.S.)

Station.	Jan Mayen.		St Petersburg and Pavlovsk.		Greenwich.	Kew.	Parc St Maur.	Tiflis.	Kolaba.	Batavia.	Mauritius.	S. Victoria Land.
Period.	1882–1883.		1873–1885.		1890–1900.	1890–1900.	1883–1897.	1888–1898.	1894–1901.	1883–1894.	1883–1890.	1902–1903.
	a.	q.	a.	q.	a.	q.	a.	a.	q.	a.	a.	a.
Hour.												
1	−57	−22	+ 4	+ 5	+ 4	+ 4	+ 5	+ 3	−10	−11	− 3	−12
2	−64	−24	+ 4	+ 4	+ 3	+ 4	+ 5	+ 3	− 9	−10	− 1	−13
3	−74	−25	+ 4	+ 4	+ 3	+ 4	+ 5	+ 3	− 9	− 8	+ 1	−14
4	−69	−24	+ 4	+ 4	+ 3	+ 4	+ 5	+ 4	− 9	− 7	+ 2	−15
5	−60	−22	+ 5	+ 4	+ 3	+ 4	+ 6	+ 4	− 9	− 5	+ 3	−15
6	−37	−19	+ 4	+ 4	+ 1	+ 2	+ 4	+ 4	− 7	− 1	+ 4	−12
7	−15	−15	+ 2	+ 2	− 3	− 1	+ 1	+ 2	− 1	+ 5	+ 7	− 9
8	− 1	−13	− 3	− 4	− 9	− 7	− 5	− 3	+ 8	+14	+ 9	− 7
9	+ 8	−12	−10	−10	−16	−13	−12	− 8	+19	+24	+ 9	− 3
10	+17	−12	−16	−16	−20	−18	−17	−10	+26	+31	+ 9	+ 3
11	+32	−10	−19	−20	−19	−18	−16	− 7	+30	+35	+ 9	+ 7
Noon	+49	− 4	−17	−18	−13	−12	−12	− 1	+26	+31	+ 8	+12
1	+65	+ 8	−12	−13	− 7	− 7	− 7	+ 4	+19	+22	+ 7	+18
2	+78	+22	− 6	− 6	− 1	− 2	− 4	+ 5	+10	+10	+ 2	+20
3	+89	+37	0	0	+ 2	+ 1	− 1	+ 3	+ 2	− 1	− 2	+19
4	+83	+43	+ 3	+ 3	+ 5	+ 3	0	− 1	− 3	− 9	− 6	+18
5	+68	+49	+ 5	+ 5	+ 7	+ 5	+ 2	− 4	− 7	−13	− 7	+15
6	+37	+43	+ 6	+ 6	+ 9	+ 7	+ 4	− 6	− 8	−14	− 7	+11
7	+13	+30	+ 7	+ 7	+10	+ 8	+ 6	− 4	− 9	−15	− 7	+ 5
8	−11	+15	+ 8	+ 8	+10	+ 8	+ 7	− 1	−10	−16	− 8	+ 0
9	−33	+ 1	+ 9	+ 9	+ 8	+ 7	+ 7	+ 1	−11	−16	− 8	− 4
10	−36	−10	+ 8	+ 9	+ 7	+ 6	+ 6	+ 2	−11	−16	− 8	− 7
11	−40	−16	+ 7	+ 8	+ 6	+ 6	+ 6	+ 3	−10	−15	− 7	− 9
12	−51	−20	+ 6	+ 6	+ 5	+ 5	+ 6	+ 3	−10	−13	− 5	−11
Range	163	74	28	29	30	26	24	15	41	51	17	35

i.e. free from disturbance. In all cases the aperiodic or non-cyclic element—indicated by a difference between the values found for the first and second midnights of the day—has been eliminated in the usual way, *i.e.* by treating it as accumulating at a uniform rate throughout the twenty-four hours. The years from which the data were derived are indicated. The algebraically greatest and least of the hourly values are printed in heavy type; the range thence derived is given at the foot of the tables.

When comparing results from different stations, it must be remembered that the disturbing forces required to cause a change of 1′ in declination and in dip vary directly, the former as the horizontal force, the latter as the total force. Near a magnetic pole the horizontal force is relatively very small, and this accounts, at least partly, for the difference between the declination phenomena at Jan Mayen and South Victoria Land on the one hand and at Kolaba, Batavia and Mauritius on the other. There is, however, another cause, already alluded to, viz. the variability in the type of the diurnal inequality in tropical stations. With a view to illustrating this point Table XII. gives diurnal inequalities of declination for June and December for a number of stations lying between 45° N. and 45° S. latitude. Some of the results are represented graphically in fig. 6, plus ordinates representing westerly deflection. At the northmost station, Toronto, the difference between the two months is mainly a matter of amplitude, the range being much larger at midsummer than at midwinter. The conspicuous phenomenon at both seasons is the rapid swing to the west from 8 or 9 a.m. to

TABLE X.—Diurnal Inequality of Vertical Force, mean from whole year (Unit 1γ).

Station.	Jan Mayen.		St Petersburg and Pavlovsk.		Greenwich.	Kew.	Parc St Maur.	Tiflis.	Kolaba.	Batavia.	Mauritius.	South Victoria Land.
Period.	1882–1883.		1873–1885.		1890–1900.	1891–1900.	1883–1897.	1888–1898.	1894–1901.	1883–1894.	1884–1890.	1902–1903.
	a.	q.	a.	q.	a.	q.	a.	a.	q.	a.	a.	a.
Hour												
1	+65	+ 3	− 7	− 1	− 3	+ 1	0	+ 2	+ 4	+ 7	+ 2	+13
2	+65	+ 2	− 7	− 1	− 4	+ 1	0	+ 2	+ 4	+ 5	+ 2	+12
3	+56	− 1	− 7	− 1	− 4	0	− 1	+ 1	+ 3	+ 4	+ 2	+10
4	+37	− 5	− 6	0	− 3	0	0	+ 1	+ 3	+ 3	+ 2	+ 8
5	+16	− 7	− 5	0	− 2	+ 1	0	+ 2	+ 5	+ 2	+ 2	+ 3
6	− 7	− 8	− 4	0	− 1	+ 1	+ 1	+ 3	+ 7	+ 1	+ 2	0
7	−17	− 6	− 3	0	0	0	+ 1	+ 3	+ 6	0	+ 3	0
8	−14	− 4	− 2	0	0	− 1	0	+ 3	0	− 3	+ 4	− 2
9	− 9	0	− 3	− 1	− 3	− 4	− 4	− 1	− 8	−11	+ 5	− 6
10	− 6	+ 5	− 2	− 2	− 6	− 8	− 8	− 7	−14	−20	+ 3	−13
11	− 6	+10	− 3	− 4	− 9	−11	−12	−11	−15	−26	0	−17
Noon	−10	+16	− 3	− 5	−10	−11	−12	−11	−10	−27	− 4	−20
1	−13	+21	− 1	− 4	− 6	− 8	− 9	− 9	− 3	−21	− 7	−20
2	−24	+23	+ 2	− 1	0	− 3	− 3	− 5	+ 1	−13	− 9	−16
3	−31	+20	+ 8	+ 2	+ 5	+ 2	+ 2	− 1	+ 4	− 4	− 8	−12
4	−40	+13	+ 9	+ 3	+ 8	+ 5	+ 6	+ 1	+ 3	+ 4	− 5	− 6
5	−48	+ 2	+10	+ 3	+ 9	+ 6	+ 7	+ 3	0	+10	− 3	− 1
6	−53	− 9	+10	+ 3	+10	+ 7	+ 8	+ 4	0	+13	0	+ 3
7	−47	−18	+ 9	+ 3	+ 9	+ 6	+ 7	+ 3	0	+14	0	+ 6
8	−36	−20	+ 8	+ 3	+ 7	+ 5	+ 6	+ 3	+ 1	+14	+ 1	+ 9
9	− 7	−19	+ 6	+ 2	+ 5	+ 5	+ 5	+ 3	+ 2	+14	+ 2	+11
10	+18	−13	+ 3	+ 2	+ 3	+ 4	+ 3	+ 3	+ 3	+13	+ 2	+12
11	+42	− 5	− 2	0	0	+ 3	+ 2	+ 3	+ 3	+11	+ 2	+12
12	+54	0	− 5	− 1	− 2	+ 2	+ 1	+ 2	+ 3	+ 9	+ 2	+13
Range	118	43	17	8	20	18	20	15	22	41	14	33

TABLE XI.—Diurnal Inequality of Inclination mean from whole year.

Station.	Jan Mayen.		St. Petersburg and Pavlovsk.		Greenwich.	Kew.	Parc St Maur.	Tiflis.	Kolaba.	Batavia.	Mauritius.	South Victoria Land.
End Dipping.	North.		North.		North.	North.	North.	North.	North.	South.	South.	South.
Period.	1882–1883.		1873–1885.		1890–1900.	1891–1900.	1883–1897.	1888–1898.	1894–1901.	1883–1894.	1884–1890.	1902–1903.
	a.	q.	a.	q.	a.	q.	a.	a.	q.	a.	a.	a.
Hour	′	′	′	′	′	′	′	′	′	′	′	′
1	+4·6	+1·5	−0·5	−0·3	−0·4	−0·3	−0·3	−0·1	+0·6	+0·9	+0·3	+0·6
2	+5·0	+1·6	−0·5	−0·3	−0·3	−0·2	−0·3	−0·1	+0·6	+0·8	+0·2	+0·7
3	+5·6	+1·6	−0·5	−0·3	−0·3	−0·2	−0·3	−0·1	+0·5	+0·6	0·0	+0·7
4	+5·0	+1·5	−0·4	−0·3	−0·3	−0·2	−0·4	−0·2	+0·5	+0·5	0·0	+0·7
5	+4·2	+1·4	−0·5	−0·3	−0·2	−0·2	−0·4	−0·2	+0·7	+0·3	−0·1	+0·7
6	+2·4	+1·2	−0·4	−0·3	−0·1	−0·1	−0·3	−0·1	+0·8	+0·1	−0·2	+0·5
7	+0·7	+0·9	−0·2	−0·1	+0·2	+0·1	0·0	0·0	+0·5	−0·2	−0·3	+0·4
8	−0·1	+0·8	+0·1	+0·3	+0·6	+0·4	+0·4	+0·3	−0·2	−0·8	−0·4	+0·3
9	−0·7	+0·8	+0·6	+0·6	+1·0	+0·8	+0·7	+0·5	−1·2	−1·7	−0·4	+0·1
10	−1·2	+0·9	+1·0	+1·0	+1·1	+1·0	+0·9	+0·3	−1·9	−2·7	−0·5	−0·2
11	−2·2	+0·8	+1·2	+1·2	+1·0	+0·9	+0·7	0·0	−2·1	−3·3	−0·6	−0·4
Noon	−3·4	+0·4	+1·1	+1·1	+0·6	+0·6	+0·4	−0·5	−1·6	−3·1	−0·7	−0·7
1	−4·5	−0·2	+0·7	+0·7	+0·3	+0·2	+0·2	−0·6	−0·8	−2·4	−0·8	−0·9
2	−5·6	−1·2	+0·4	+0·4	+0·1	+0·1	+0·2	−0·5	−0·2	−1·3	−0·6	−1·0
3	−6·3	−2·2	+0·2	+0·1	0·0	0·0	+0·2	−0·3	+0·3	−0·2	−0·3	−1·0
4	−6·1	−2·9	0·0	−0·1	−0·1	−0·1	+0·2	+0·1	+0·3	+0·7	+0·1	−0·9
5	−5·1	−3·2	−0·1	−0·3	−0·2	−0·2	+0·1	+0·4	+0·2	+1·3	+0·4	−0·7
6	−3·1	−2·9	−0·2	−0·3	−0·3	−0·3	0·0	+0·5	+0·2	+1·5	+0·5	−0·5
7	−1·7	−2·2	−0·3	−0·4	−0·4	−0·4	−0·2	+0·4	+0·3	+1·6	+0·5	−0·2
8	+0·3	−1·3	−0·3	−0·5	−0·4	−0·4	−0·3	+0·2	+0·4	+1·6	+0·6	0·0
9	+2·0	−0·3	−0·4	−0·6	−0·4	−0·4	−0·3	+0·1	+0·5	+1·6	+0·6	+0·2
10	+2·5	+0·5	−0·5	−0·6	−0·4	−0·3	−0·3	0·0	+0·6	+1·5	+0·6	+0·4
11	+3·0	+1·0	−0·5	−0·6	−0·4	−0·3	−0·3	0·0	+0·6	+1·4	+0·5	+0·5
12	+4·0	+1·3	−0·5	−0·4	−0·4	−0·3	−0·3	−0·1	+0·6	+1·2	+0·4	+0·6
Range	11·9	4·8	1·7	1·8	1·5	1·4	1·3	1·1	2·9	4·9	1·4	1·7

1 or 2 p.m. At the extreme southern station, Hobart—at nearly equal latitude—the rapid diurnal movement is to the east, and so in the opposite direction to that in the northern hemisphere, but it again takes place at nearly the same hours in June (midwinter) as in December. If, however, we take a tropical station such as Trivandrum or Kolaba, the phenomena in June and December are widely different in type. At Trivandrum—situated near the magnetic equator in India—we have in June the conspicuous forenoon swing to the west seen at Toronto, occurring it is true slightly earlier in the day; but in December at the corresponding hours the needle is actually swinging to the east, just as it is doing at Hobart. In June the diurnal inequality of declination at tropical stations—whether to the north of the equator like Trivandrum, or to the south of it like Batavia—is on the whole of the general type characteristic of temperate regions in the northern hemisphere; whereas in December the inequality at these stations resembles that of temperate regions in the southern hemisphere. Comparing the inequalities for June in Table XII. amongst themselves, and those for December amongst themselves, one can trace a gradual transformation from the phenomena seen at Toronto to those seen at Hobart. At a tropical station the change from the June to the December type is probably in all cases more or less gradual, but at some stations the transition seems pretty rapid.

§ 15. In the case of the horizontal force there are, as Table IX. shows, two markedly different types of diurnal inequality. In the one type, exemplified by Pavlovsk or Greenwich, the force is below its mean value in the middle of the day; it has a principal minimum about 10 or 11 a.m., and morning and evening maxima, the latter usually the largest. In the other type, exemplified by Kolaba or Batavia, the horizontal force is above its mean in the middle of the

TABLE XII.—Diurnal Inequality of Declination (+ to West).

Station.	Toronto.		Kolaba.		Trivandrum.		Batavia.		St Helena.		Mauritius.		Cape.		Hobart.	
Month.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.
Hour	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
1	−0·4	−0·1	−0·3	0·0	−0·3	−0·1	+0·1	+0·1	−0·1	−0·4	0·0	+0·1	−0·4	−0·7	+0·8	+1·1
2	−0·2	+0·4	−0·3	+0·1	−0·4	+0·1	−0·1	+0·1	−0·2	−0·1	−0·2	+0·2	−0·5	−0·4	+0·3	+1·1
3	−0·2	−0·1	−0·3	+0·1	−0·4	+0·3	−0·2	+0·2	−0·2	+0·1	−0·2	+0·4	−0·7	−0·1	−0·1	+1·0
4	−1·2	−0·4	−0·3	+0·3	−0·5	+0·5	−0·3	+0·3	−0·3	+0·3	−0·2	+0·7	−0·6	+0·3	−0·1	+1·1
5	−2·9	−0·6	−0·7	+0·4	−0·7	+0·7	−0·3	+0·5	−0·5	+0·6	−0·3	+1·0	−0·7	+1·0	0·0	+1·7
6	−5·2	−0·6	−1·6	+0·5	−1·6	+1·1	−0·5	+1·2	−1·0	+0·9	−0·4	+1·7	−1·0	+2·2	0·0	+2·7
7	−6·2	−0·9	−2·2	+0·7	−1·7	+1·4	−1·1	+2·0	−2·2	+1·9	−1·1	+2·6	−1·6	+3·3	−0·1	+4·4
8	−6·0	−1·2	−2·1	+0·2	−1·1	+0·9	−0·4	+2·3	−1·5	+2·2	−1·0	+2·4	−0·8	+3·6	+0·1	+5·6
9	−4·4	−1·8	−1·1	−0·1	−0·2	+0·5	+0·5	+2·0	−0·3	+1·3	+0·2	+2·0	+0·7	+3·1	+0·6	+5·6
10	−1·5	−1·1	0·0	−0·2	+0·6	+0·3	+0·9	+1·3	+0·3	+0·2	+1·2	+1·1	+1·6	+1·6	+1·2	+3·6
11	+2·1	+0·6	+1·2	0·0	+1·2	+0·1	+1·0	+0·4	+0·5	−1·0	+1·4	0·0	+1·5	+0·1	+1·0	+0·7
Noon	+4·8	+2·2	+2·1	0·0	+1·4	−0·4	+0·7	−0·6	+0·3	−1·4	+1·0	−1·4	+0·8	−1·0	−0·1	−2·6
1	+6·1	+3·2	+2·0	−0·2	+1·1	−0·8	+0·3	−1·4	+0·3	−1·2	+0·1	−2·2	+0·3	−1·8	−1·4	−5·1
2	+6·1	+3·2	+1·6	−0·3	+0·7	−0·9	−0·2	−1·8	+0·2	−0·4	−0·9	−2·5	−0·3	−1·9	−2·2	−6·2
3	+5·2	+2·4	+0·9	−0·3	+0·3	−0·9	−0·7	−1·9	+0·2	+0·4	−1·5	−2·2	−0·3	−1·4	−2·4	−5·8
4	+3·6	+1·5	+0·2	−0·3	+0·1	−0·8	−0·8	−1·6	+0·7	+0·6	−1·3	−1·6	+0·2	−0·8	−1·6	−4·8
5	+1·8	+0·5	0·0	−0·2	0·0	−0·4	−0·5	−1·2	+1·1	+0·4	−0·3	−1·0	+0·5	−0·8	−0·7	−3·3
6	+0·7	−0·1	+0·1	−0·2	+0·2	−0·4	−0·1	−0·7	+1·0	+0·1	+0·5	−0·5	+0·5	−0·6	−0·4	−1·9
7	0·0	−0·8	+0·3	−0·2	+0·5	−0·4	+0·1	−0·6	+0·6	−0·4	+0·7	−0·3	+0·4	−0·8	0·0	−1·0
8	0·0	−1·2	+0·4	−0·1	+0·5	−0·3	+0·2	−0·5	+0·5	−0·7	+0·7	−0·3	+0·3	−0·9	+0·5	−0·3
9	−0·5	−1·4	+0·3	−0·1	+0·4	−0·2	+0·4	−0·3	+0·4	−0·9	+0·6	−0·2	+0·2	−0·9	+1·1	0·0
10	−0·5	−1·7	+0·1	0·0	+0·2	−0·1	+0·4	−0·1	+0·2	−1·0	+0·4	−0·1	+0·1	−1·0	+1·3	+0·6
11	−0·7	−1·1	−0·1	−0·1	0·0	−0·1	+0·3	0·0	+0·1	−0·8	+0·3	0·0	0·0	−1·0	+1·3	+0·9
12	−0·6	−0·7	−0·2	−0·1	−0·2	−0·1	+0·2	+0·1	−0·1	−0·6	+0·1	+0·1	−0·2	−1·0	+1·1	+1·2
Range	12·3	5·0	4·3	1·0	3·1	2·3	2·1	4·2	3·3	3·6	2·9	5·1	3·2	5·5	3·7	11·8

day, and has a maximum about 11 a.m. The second type may be regarded as the tropical type. At tropical stations, such as Kolaba, Batavia, Manila and St Helena, the type is practically the same in summer as in winter, and is the same whether the station is north or south of the equator. Similarly, what we may call the temperate type is seen—with comparatively slight modifications—both in summer and winter at stations such as Greenwich or Pavlovsk. In winter, it is true, the pronounced daily minimum is a little later and the early morning maximum is relatively more important than in summer. There is not, as in the case of the declination, any essential difference between the phenomena at temperate stations in the northern and southern hemispheres.

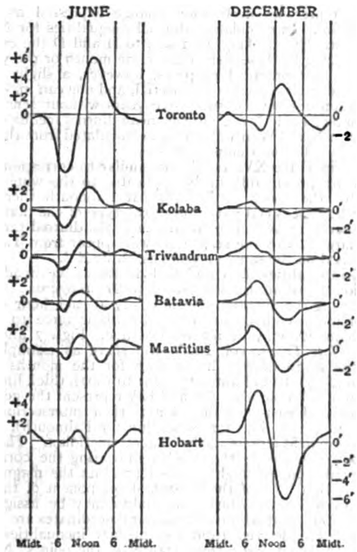


FIG. 6.

With diminishing latitude, there is a gradual transition from the temperate to the tropical type of horizontal force diurnal variation, and at stations whose latitude is under 45° there is a very appreciable variation in type with the season. The mean diurnal variation for the year at Tiflis in Table IX. really represents a struggle between the two types, in which on the whole the temperate type prevails. If we take the diurnal variations at Tiflis for midsummer and midwinter, we find the former essentially of the temperate, the latter essentially of the tropical type. A similar conflict may be seen in the mean diurnal inequality for the year at the Cape of Good Hope, but there the tropical type on the whole predominates, and it prevails more at midwinter than at midsummer. Toronto and Hobart, though similar in latitude to Tiflis, show a closer approach to the temperate type. Still at both stations the hours during which the force is below its mean value tend to extend back towards midnight, especially at midsummer. The amplitude of the horizontal force range appears less at intermediate stations, such as Tiflis, than at stations in either higher or lower latitudes. There is a very great difference in this respect between the north and the south of India.

§ 16. In the case of the vertical force in higher temperate latitudes—at Pavlovsk for instance—the diurnal inequalities from "all" and from "quiet" days differ somewhat widely in amplitude and slightly even in type. In mean latitudes, *e.g.* at Tiflis, there is often a well marked double period in the mean diurnal inequality for the whole year; but even at Tiflis this is hardly, if at all, apparent in the winter months. In the summer months the double period is distinctly seen at Kew and Greenwich, though the evening maximum is always pre-eminent. Speaking generally, the time of the minimum, or principal minimum, varies much less with the season than that of the maximum. At Kew, for instance, on quiet days the minimum falls between 11 a.m. and noon in almost all the months of the year, but the time of the maximum varies from about 4 p.m. in December to 7 p.m. in June. At Kolaba the time of the minimum is nearly independent of the season; but the changes from positive to negative in the forenoon and from negative to positive in the afternoon are some hours later in winter than in summer. At Batavia the diurnal inequality varies very little in type with the season, and there is little evidence of more than one maximum and minimum in the day. At Batavia, as at Kolaba, negative values occur near noon; but it must be remembered that while at Kolaba and more northern stations vertical force urges the north pole of a magnet downwards, the reverse is true of Batavia, as the dip is southerly. At St Helena vertical force is below its mean value in the forenoon, but the change from − to + occurs at noon, or but little later, both in winter and summer. At the Cape of Good Hope the phenomena at midsummer are similar to those at Kolaba, the force being below its mean value from about 9 a.m. to 3 p.m. and above it throughout the rest of the day; but at midwinter there is a conspicuous double period, the force being below its mean from 1 a.m. to 7 a.m. as well as from 11 a.m. to 3 p.m., and thus resembling the all-day annual results at Greenwich. At Hobart vertical force is below its mean value from 1 a.m. to 9 a.m. at midsummer, and from 4 a.m. to noon at midwinter; while the force is above its mean persistently throughout the afternoon both in summer and winter, there is at midwinter a well marked secondary minimum about 6 p.m., almost the same hour as that at which the maximum for the day is observed in summer.

§ 17. Variations of inclination are connected with those of horizontal and vertical force by the relation

$$\delta I = \tfrac{1}{2} \sin 2I\{V^{-1}\,\delta V - H^{-1}\,\delta H\}.$$

Thus in temperate latitudes where V is considerably in excess of H, whilst diurnal changes in V are usually less than those in H, it is the latter which chiefly dominate the diurnal changes in inclination. When the H influence prevails, I has its highest values at hours when H is least. This explains why the dip is above its mean value near midday at stations in Table XI. from Pavlovsk to Parc St Maur. Near the magnetic equator the vertical force has the greater influence. This alone would tend to make a minimum dip in the late forenoon, and this minimum is accentuated owing to the altered type of the horizontal force diurnal variation, whose maximum now coincides closely with the minimum in the vertical force. This accounts for the prominence of the minimum in the diurnal variation of the inclination at Kolaba and Batavia, and the large amplitude of the range. Tiflis shows an intermediate type of diurnal variation; there is a minimum near noon, as in tropical stations, but inclination is also below its mean for some hours near midnight. The type really varies at Tiflis according to the season of the year. In June—as in the mean equality from the whole year—there is a well marked double period; there is a principal minimum at 2 p.m. and a secondary one about 4 a.m.; a principal maximum about 9 a.m. and a secondary one about 6 p.m. In December, however, only a single period is recognizable, with a minimum about 8 a.m. and a maximum about 7 p.m. The type of diurnal inequality seen

TABLE XIII.—Range of the Diurnal Inequality of Declination.

Place.	Period.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
		′	′	′	′	′	′	′	′	′	′	′	′
Pavlovsk	1890–1900 a	4·93	6·15	8·58	10·93	12·18	12·27	11·82	11·38	8·70	6·87	5·54	4·63
"	" q	2·96	4·20	8·73	11·28	12·89	13·28	12·31	11·70	9·37	6·91	3·95	2·66
Ekatarinburg	1890–1900 a	3·33	4·32	7·63	11·19	11·82	11·58	11·09	10·45	8·13	5·60	3·73	3·14
Greenwich	1865–1896 a	5·87	7·07	9·40	11·42	10·55	10·90	10·82	10·93	9·66	8·15	6·41	5·15
Kew	1890–1900 a	4·92	6·06	9·08	10·95	10·66	10·92	10·59	11·01	9·49	7·73	5·37	4·46
"	" q	4·07	4·76	8·82	10·57	10·92	10·62	10·18	11·01	9·76	7·51	4·75	3·34
Toronto	1842–1848 a	5·96	6·05	9·18	9·94	11·55	12·34	12·21	13·14	10·76	6·96	6·32	4·97
Manila	1890–1900 a	1·79	1·09	2·13	3·02	3·84	3·94	4·21	4·89	4·53	1·83	0·85	1·33
Trivandrum	1853–1864 a	2·06	1·48	0·79	1·67	2·90	3·06	3·06	3·64	3·31	1·27	2·14	2·33
Batavia	1884–1899 a	4·18	4·64	3·57	2·93	2·38	2·03	2·31	3·16	3·80	4·51	4·50	4·19
St Helena	1842–1847 a	3·72	5·19	4·93	3·30	2·64	3·24	3·42	3·59	2·40	4·43	4·05	3·54
Mauritius	1876–1890 a	5·2	6·1	6·3	4·7	4·1	2·9	3·4	4·9	5·0	5·5	5·6	5·1
Cape	1841–1846 a	5·14	8·21	7·27	5·00	3·91	3·21	3·54	4·98	4·33	5·96	6·36	5·47
Hobart	1841–1848 a	11·66	11·80	9·50	7·26	4·56	3·70	4·61	5·89	8·24	11·01	12·05	11·81

at the Cape of Good Hope does not differ much from that seen at Batavia. Only a single period is clearly shown. The maximum occurs about 8 or 9 p.m. throughout the year. The time of the minimum is more variable; at midsummer it occurs about 11 a.m., but at midwinter three or four hours later. At Hobart the type varies considerably with the season. In June (midwinter) a double period is visible. The principal minimum occurs about 8 a.m., as at the Cape. But, corresponding to the evening maximum seen at the Cape, there is now only a secondary maximum, the principal maximum occurring about 1 p.m. At midsummer the principal maximum is found—as at Kew or Greenwich—about 10 or 11 a.m., the principal minimum about 4 p.m.

§ 18. Even at tropical stations a considerable seasonal change is usually seen in the amplitude of the diurnal inequality in at least one of the magnetic elements. At stations in Europe, and generally in temperate latitudes, the amplitude varies notably in all the elements. Table XIII. gives particulars of the inequality range of declination derived from hourly readings at selected stations, arranged in order of latitude from north to south. The letters "a" and "q" are used in the same sense as before. At temperate stations in either hemisphere—*e.g.* Pavlovsk, Greenwich or Hobart—the range is conspicuously larger in summer than in winter. In northern temperate stations a decided minimum is usually apparent in December. There is, on the other hand, comparatively little variation in the range from April to August. Sometimes, as at Kew and Greenwich, there is at least a suggestion of a secondary minimum at midsummer. Manila and Trivandrum show a transition from the December minimum, characteristic of the northern stations, to the June minimum characteristic of the southern, there being two conspicuous minima in February or March and in November or October. At St Helena there are two similar minima in May and September, while a third apparently exists in December. It will be noticed that at both Pavlovsk and Kew the annual variation in the range is specially prominent in the quiet day results.

Table XIV. gives a smaller number of data analogous to those of Table XIII., comprising inequality ranges for horizontal force, vertical force and inclination. In some cases the number of years from which the data were derived seems hardly sufficient to give a smooth annual variation. It should also be noticed that unless the same group of years is employed the data from two stations are not strictly comparable. The difference between the all and quiet day vertical force data at Pavlovsk is remarkably pronounced. The general tendency in all the elements is to show a reduced range at midwinter; but in some cases there is also a distinct reduction in the range at midsummer. This double annual period is particularly well marked at Batavia.

§ 19. When discussing diurnal inequalities it is sometimes convenient to consider the components of the horizontal force in and perpendicular to the astronomical meridian, rather than the horizontal force and declination. If N and W be the components of H to astronomical north and west, and D the westerly declination, $N = H \cos D$, $W = H \sin D$. Thus corresponding small variations in N, W, H and D are connected by the relations:—

$$\delta N = \cos D \delta H - H \sin D \delta D, \quad \delta W = \sin D \delta H + H \cos D \delta D.$$

If δH and δD denote the departures of H and D at any hour of the day from their mean values, then δN and δW represent the corresponding departures of N and W from their mean values. In this way diurnal inequalities may be calculated for N and W when those for H and D are known. The formulae suppose δD to be expressed in absolute measure, *i.e.* 1′ of arc has to be replaced by 0·0002909. If we take as an example a station at which H is ·185 then $H\delta D = \cdot 0000538$(number of minutes in δD). In other words, employing 1γ as unit of force, one replaces $H\delta D$ by $5{\cdot}38\delta D$, where δD represents declination change expressed as usual in minutes of arc. In calculating diurnal inequalities for N and W, one ought, strictly speaking, to assign to H and D the exact mean values belonging to these elements for the month or the year being dealt with. For practical purposes, however, a slight departure from the true mean values is immaterial, and one can make use of a constant value for several successive years without sensible error. As an example, Table XV. gives the mean diurnal inequality for the whole year in N and W at Falmouth, as calculated from the 12 years 1891 to 1902. The unit employed is 1γ.

The data in Table XV. are closely similar to corresponding Kew data, and are presumably fairly applicable to the whole south of England for the epoch considered. At Falmouth there is comparatively little seasonal variation in the type of the diurnal variation in either N or W. The amplitude of the diurnal range varies, however, largely with the season, as will appear from Table XVI., which is based on the same 12 years as Table XV.

Diurnal inequalities in N and W lend themselves readily to the construction of what are known as *vector diagrams.* These are curves showing the direction and intensity at each hour of the day of the horizontal component of the disturbing force to which the diurnal inequality may be regarded as due. Figs. 7 and 8, taken from the *Phil. Trans.* vol. 204A, will serve as examples. They refer to the mean diurnal inequalities for the months stated at Kew (1890 to 1900) and Falmouth (1891 to 1902), thick lines relating to Kew, thin to Falmouth. NS and EW represent the geographical north-south and east-west directions; their intersection answers to the origin (thick lines for Kew, thin for Falmouth). The line from the origin to M represents the magnetic meridian. The line from the origin to any cross—the number indicating the corresponding hour counted from midnight as 0—represents the magnitude and direction at that hour of the horizontal component of the disturbing force to which the diurnal inequality may be assigned. The cross marks the point whose rectangular co-ordinates are the values of δN and δW derived from the diurnal inequalities of these elements. In figs. 7 and 8 the distances of the points N, E, S, W from their corresponding origin represents 10γ. The tendency to form a loop near midnight, seen in the November and December

TABLE XIV.—Ranges in the Diurnal Inequalities.

			Jan.	Feb.	March.	April.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
H (unit 1γ)														
Pavlovsk	1890–1900	a	12	20	32	46	47	49	49	44	39	32	17	11
"	"	q	12	17	31	42	45	45	42	40	37	31	17	10
Ekatarinburg	"	a	11	15	29	37	40	40	39	36	33	27	13	9
Kew	"	q	15	17	26	36	38	39	38	38	35	27	20	11
Toronto	1843–1848	a	23	21	24	28	29	29	26	28	41	25	21	20
Batavia	1883–1898	a	49	47	54	60	51	48	50	53	58	52	43	40
St Helena	1843–1847	a	43	41	48	53	46	40	40	45	41	40	40	32
Mauritius	1883–1890	a	21	15	21	23	20	21	20	22	20	21	21	20
Cape of Good Hope	1841–1846	a	13	10	13	13	15	16	14	18	21	14	17	20
Hobart	1842–1848	a	42	43	34	28	19	17	22	23	23	35	39	42
V (unit 1γ)														
Pavlovsk	1890–1900	a	15	27	29	24	26	20	23	19	23	20	18	14
"	"	q	4	5	9	13	13	12	13	10	9	7	5	4
Ekatarinburg	"	a	10	15	17	21	22	19	20	16	14	13	11	9
Kew	1891–1900	q	7	10	20	25	31	27	28	23	20	15	9	6
Toronto	1843–1848	a	12	14	17	23	26	14	27	32	34	25	19	18
Batavia	1883–1898	a	42	48	48	45	31	31	32	29	41	50	40	33
St Helena	1843–1847	a	16	13	12	14	13	11	17	11	17	11	15	18
Mauritius	1884–1890	a	12	16	18	15	14	13	15	21	20	16	13	11
Cape of Good Hope	1841–1846	a	29	47	41	38	21	12	14	19	19	35	33	28
Hobart	1842–1848	a	25	27	22	23	24	21	22	28	26	22	23	27
Inclination			′	′	′	′	′	′	′	′	′	′	′	′
Pavlovsk	1890–1900	a	0·97	1·24	2·07	2·79	2·72	2·88	2·85	2·64	2·52	2·18	1·20	0·89
Ekatarinburg	"	a	0·79	0·94	1·70	2·08	2·25	2·19	2·18	2·08	2·00	1·70	0·88	0·69
Kew	"	q	0·98	1·01	1·38	1·86	2·05	2·02	2·05	2·15	1·98	1·57	1·27	0·63
Toronto	1843–1848	a	1·15	0·94	1·19	1·23	1·31	1·37	1·13	1·26	1·87	1·16	1·09	1·05
Batavia	1883–1898	a	4·88	5·22	5·56	5·62	4·21	4·05	4·24	4·17	5·13	5·58	4·51	3·85
Cape of Good Hope	1842–1846	a	1·55	2·29	2·23	2·23	1·60	1·41	1·54	1·70	1·86	2·03	1·55	2·04
Hobart	1842–1848	a	1·95	2·16	1·72	1·62	1·23	1·16	1·28	1·42	1·39	1·75	2·04	2·10

Table XV.—Diurnal Inequalities in N. and W. at Falmouth (unit 1γ).

Hour.		1	2	3	4	5	6	7	8	9	10	11	12
N.	a.m.	+ 6	+ 5	+ 5	+ 5	+ 6	+ 6	+ 5	+ 1	− 6	−14	−20	−20
	p.m.	−17	−12	− 6	− 1	+ 3	+ 6	+ 9	+ 9	+ 9	+ 8	+ 7	+ 7
W.	a.m.	− 2	− 2	− 3	− 4	− 6	− 9	−13	−17	−19	−13	− 3	+11
	p.m.	+20	+22	+17	+11	+ 6	+ 4	+ 2	+ 1	0	− 1	− 2	− 2

curves, is characteristic of the winter months at Kew and Falmouth. The shape is less variable in summer than in winter; but even in summer the portion answering to the hours 6 p.m. to 6 a.m. varies a good deal. The object of presenting the Kew and Falmouth curves side by side is to emphasize the close resemblance between the magnetic phenomena at places in similar latitudes, though over 200 miles apart and exhibiting widely different ranges for their meteorological elements. With considerable change of latitude however the shape of vector diagrams changes largely.

Fourier Series.

§ 20. Any diurnal inequality can be analysed into a series of harmonic terms whose periods are 24 hours and submultiples thereof. The series may be expressed in either of the equivalent forms:—

$$a_1 \cos t + b_1 \sin t + a_2 \cos 2t + b_2 \sin 2t + \dots \qquad \text{(i)}$$

$$c_1 \sin (t+\alpha_1) + c_2 \sin (2t+\alpha_2) + \dots \qquad \text{(ii)}$$

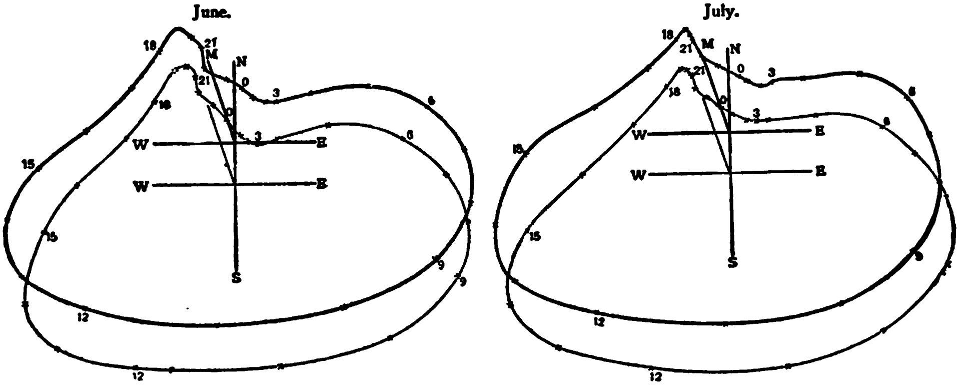
Table XVI.—Ranges in Diurnal Inequalities at Falmouth (unit 1γ).

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
N.	21	23	30	39	39	37	37	39	36	32	24	15
W.	20	24	46	54	55	55	54	56	51	39	24	15

In both forms t denotes time, counted usually from midnight, one hour of time being interpreted as 15° of angle. Form (i) is that utilized in actually calculating the constants a, b, ... Once the a, b, ... constants are known, the c, α, ... constants are at once derivable from the formulae:—

$$\tan \alpha_n = a_n/b_n;\ c_n = a_n/\sin \alpha_n = b_n/\cos \alpha_n = \sqrt{(a_n^2+b_n^2)}.$$

The a, b, c, α constants are called sometimes Fourier, sometimes Bessel coefficients.



(From Phil Trans.)

Fig. 7.

By taking a sufficient number of terms a series can always be obtained which will represent any set of diurnal inequality figures; but unless one can obtain a close approach to the observational figures from the terms possessing the periods 24, 12, 8 and 6 hours the physical significance and general utility of the analysis is somewhat problematical. In the case of the magnetic elements, the 24 and 12 hour terms are usually much the more important; the 24-hour term is generally, but by no means always, the larger of the two. The c constants give the amplitudes of the harmonic terms or waves, the α constants the phase angles. An advance of 1 hour in the time of occurrence of the first (and subsequent, if any) maximum and minimum answers to an *increase* of 15° in α_1 of 30° in α_2, of 45° in α_3, of 60° in α_4 and so on. In the case of magnetic elements the phase angles not infrequently possess a somewhat large annual variation. It is thus essential for a minute study of the phenomena at any station to carry out the analysis for the different seasons of the year, and preferably for the individual months. If the a and b constants are known for all the individual months of one year, or for all the Januarys of a series of years, we have only to take their arithmetic means to obtain the corresponding constants for the mean diurnal inequality of the year, or for the diurnal inequality of the average January of the series of years. This, however, is obviously not true of the c or α constants, unless the phase angle is absolutely unchanged throughout the contributory months or years. This is a point requiring careful attention, because when giving values of c and α for the whole year some authorities give the arithmetic mean of the c's and α's calculated from the diurnal inequalities of the individual months of the year, others give the values obtained for c and α from the mean diurnal inequality of the whole year. The former method inevitably supplies a larger value for c than the latter, supposing α to vary with the season. At some observatories, *e.g.* Greenwich and Batavia, it has long been customary to publish every year values of the Fourier coefficients for each month, and to include other elements besides the declination. For a thoroughly satisfactory comparison of different stations, it is necessary to have data from one and the same epoch; and preferably that epoch should include at least one 11-year period. There are, however, few stations which can supply the data required for such a comparison and we have to make the best of what is available. Information is naturally most copious for the declination. For this element E. Engelenburg[20] gives values of c_1, c_2, c_3, c_4, and of α_1, α_2, α_3, α_4 for each month of the year for about 50 stations, ranging from Fort Rae (62° 6′ N. lat.) to Cape Horn (55° 5′ S. lat.). From the results for individual stations, Engelenburg derives a series of means which he regards as representative of 11 different zones of latitude. His data for individual stations refer to different epochs, and some are based on only one year's observations. The original observations also differ in reliability; thus the results are of somewhat unequal value. The mean results for Engelenburg's zones must naturally have some of the sources of uncertainty reduced; but then the fundamental idea represented by the arrangement in zones is open to question. The majority of the data in Table XVII. are taken from Engelenburg, but the phase angles have been altered so as to apply to westerly declination. The stations are arranged in order of latitude from north to south; in a few instances results are given for quiet days. The figures represent in all cases arithmetic means derived from the 12 monthly values. In the table, so far as is known, the local mean time of the observatory has been employed. This is a point requiring attention, because most observatories employ Greenwich time, or time based on Greenwich or some other national observatory, and any departure from local time enters into the values of the constants. The data for Victoria Land refer to the "Discovery's" 1902–1903 winter quarters, where the declination, taken westerly, was about 207°·5.

As an example of the significance of the phase angles in Table XVII., take the ordinary day data for Kew. The times of occurrence of the maxima are given by $t+234° = 450°$ for the 24-hour term, $2t+39°·7 = 90°$ or $= 450°$ for the 12-hour term, and so on, taking an hour in t as equivalent to 15°

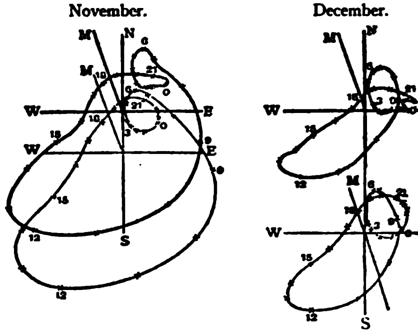
Thus the times of the maxima are—

24-hour term, 2 h. 24 m. p.m., 12-hour term, 1 h. 41 m. a.m and p.m.

8-hour term, 4 h. 41 m. a.m., 0 h. 41 m. p.m., and 8 h 41 m. p.m.

6-hour term, 0 h. 33 m. a.m. and p.m., and 6 h. 33 m. a.m. and p.m.

The minima, or extreme easterly positions in the waves, lie midway between successive maxima. All four terms, it will be seen, have maxima at some hour between 0h. 30m. and 2h. 30m. p.m. They thus reinforce one another strongly from 1 to 2 p.m., accounting for the prominence of the maximum in the early afternoon.


November.

December.

(From *Phil. Trans.*) FIG. 8.

The utility of a Fourier analysis depends largely on whether the several terms have a definite physical significance. If the 24-hour and 12-hour terms, for instance, represent the action of forces whose distribution over the earth or whose seasonal variation is essentially different, then the analysis helps to distinguish these forces, and may assist in their being tracked to their ultimate source. Suppose, for example, one had reason to think the magnetic diurnal variation due to some meteorological phenomenon, *e.g.* heating of the earth's atmosphere, then a comparison of Fourier coefficients, if such existed, for the two sets of phenomena would be a powerful method of investigation.

TABLE XVII.—Amplitudes and Phase Angles for Diurnal Inequality of Declination.

Place.	Epoch.	c_1.	c_2.	c_3.	c_4.	a_1.	a_2.	a_3.	a_4.
		′	′	′	′	°	°	°	°
Fort Rae (all)	1882–1883	18·49	8·22	1·99	2·07	156·5	41·9	308	104
" (quiet)	"	9·09	4·51	1·32	0·73	166·5	37·5	225	350
Ekatarinburg	1841–1862	2·57	1·81	0·73	0·22	223·3	7·4	204	351
Potsdam	1890–1899	2·81	1·90	0·83	0·31	239·9	32·6	237	49
Kew (ordinary)	1890–1900	2·91	1·79	0·79	0·27	234·0	39·7	239	57
Kew (quiet)	"	2·37	1·82	0·90	0·30	227·3	42·1	240	55
Falmouth (quiet)	1891–1902	2·18	1·82	0·91	0·29	226·2	40·5	238	56
Parc St Maur	1883–1899	2·70	1·87	0·85	0·30	238·6	32·5	235	95
Toronto	1842–1848	2·65	2·34	1·00	0·33	213·7	34·9	238	350
Washington	1840–1842	2·38	1·86	0·65	0·33	223·0	26·6	223	53
Manila	1890–1900	0·53	0·58	0·43	0·17	266·3	50·7	226	89
Trivandrum	1853–1864	0·54	0·46	0·29	0·10	289·0	49·6		114
Batavia	1883–1899	0·80	0·88	0·43	0·13	332·0	163·2	5	236
St. Helena	1842–1847	0·68	0·61	0·63	0·34	275·8	171·4	27	244
Mauritius	1876–1890	0·86	1·11	0·76	0·22	21·6	172·7	350	161
C. of G. Hope	1841–1846	1·15	1·13	0·80	0·35	287·7	156·0	351	193
Melbourne	1858–1863	2·52	2·45	1·23	0·35	27·4	176·7	9	193
Hobart	1841–1848	2·29	2·15	0·87	0·32	33·6	170·8	349	185
S. Georgia	1882–1883	2·13	1·28	0·76	0·31	30·3	185·3	7	180
Victoria Land (all)	1902–1903	20·51	4·81	1·21	1·32	158·7	306·9	292	303
" (quieter)	"	15·34	4·05	1·24	1·18	163·8	312·9	261	

§ 21. Fourier coefficients of course often vary much with the season of the year. In the case of the declination this is especially true of the phase angles at tropical stations. To enter on details for a number of stations would unduly occupy space. A fair idea of the variability in the case of declination in temperate latitudes may be derived from Table XVIII., which gives monthly values for Kew derived from ordinary days of an 11-year period 1890–1900.

Fourier analysis has been applied to the diurnal inequalities of the other magnetic elements, but more sparingly. Such results are illustrated by Table XIX., which contains data derived from quiet days at Kew from 1890 to 1900. *Winter* includes November to February, *Summer* May to August, and *Equinox* the remaining four months. In this case the data are derived from mean diurnal inequalities for the season specified. In the case of the c or amplitude coefficients the unit is 1′ for I (inclination), and 1γ for H and V (horizontal and vertical force). At Kew the seasonal variation in the amplitude is fairly similar for all the elements. The 24-hour and 12-hour terms tend to be largest near midsummer, and least near midwinter; but the 8-hour and 6-hour terms have two well-marked maxima near the equinoxes, and a clearly marked minimum near midsummer, in addition to one near midwinter. On the other hand, the phase angle phenomena vary much for the different elements. The 24-hour term, for instance, has its maximum earlier in winter than in summer in the case of the declination and vertical force, but the exact reverse holds for the inclination and the horizontal force.

TABLE XVIII.—Kew Declination: Amplitudes and Phase Angles (local mean time).

Month.	c_1.	c_2.	c_3.	c_4.	a_1.	a_2.	a_3.	a_4.
		′	′	′	°	°	°	°
January	1·79	0·86	0·41	0·27	251·2	29·8	254	64
February	2·41	1·11	0·57	0·30	242·0	27·7	235	39
March	3·05	1·98	1·11	0·45	233·2	36·1	223	49
April	3·35	2·48	1·17	0·39	224·8	39·2	228	61
May	3·57	2·38	0·87	0·17	221·3	50·8	245	89
June	3·83	2·39	0·74	0·05	212·6	46·7	239	72
July	3·72	2·30	0·77	0·11	214·6	48·1	233	8
August	3·64	2·43	1·05	0·18	228·2	57·2	244	51
September	3·35	2·02	1·04	0·35	236·9	55·3	245	70
October	2·69	1·69	0·92	0·48	240·1	35·6	235	65
November	1·94	1·06	0·51	0·32	248·3	28·3	247	61
December	1·61	0·81	0·35	0·20	255·1	22·0	243	56

Annual inequality.

§ 22. If secular change proceeded uniformly throughout the year, the value E_n of any element at the middle of the nth month of the year would be connected with $\bar{E}$, the mean value for the whole year, by the formula $E_n = \bar{E} + (2n-13)s/24$, where s is the secular change per annum. For the present purpose, difference in the lengths of the months may be neglected. If one applies to $E_n - \bar{E}$ the correction $-(2n-13)s/24$ one eliminates a regularly progressive secular change; what remains is known as the *annual inequality*. If only a short period of years is dealt with, irregularities in the secular change from year to year, or errors of observation, may obviously simulate the effect of a real annual inequality. Even when a long series of years is included, there is always a possibility of a spurious inequality arising from annual variation in the instruments, or from annual change in the conditions of observation. J. Liznar,[21] from a study of data from a number of stations, arrived at certain mean results for the annual inequalities in declination and inclination in the northern and southern hemispheres, and J. Hann[22] has more recently dealt with Liznar's and newer results. Table XX. gives a variety of data, including the mean results given by Liznar and Hann. In the case of declination + denotes westerly position; in the case of inclination it denotes a larger dip (whether the inclination be north or south). According to Liznar declination in summer is to the west of the normal position in both hemispheres. The phenomena, however, at Parc St Maur are, it will be seen, the exact opposite of what Liznar regards as normal; and whilst the Potsdam results resemble his mean in type, the range of the inequality there, as at Parc St Maur, is relatively small. Of the three sets of data given for Kew the first two are derived in a similar way to those for other stations; the first set are based on quiet days only, the second on all but highly disturbed days. Both these sets of results are fairly similar in type to the Parc St Maur results, but give larger ranges; they are thus even more opposed to Liznar's normal type. The last set of data for Kew is of a special kind. During the 11 years 1890 to 1900 the Kew declination magnetograph showed to within 1′ the exact secular change as derived from the absolute observations; also, if any annual variation existed in the position of the base lines of the curves it was exceedingly small. Thus the accumulation of the daily non-cyclic changes shown by the curves should closely represent the combined

TABLE XIX.—Kew Diurnal Inequality: Amplitudes and Phase Angles (local mean time).

		c_1.	c_2.	c_3.	c_4.	a_1.	a_2.	a_3.	a_4.
						°	°	°	°
I	Winter	0·240	0·222	0·104	0·076	250·0	91·8	344	194
	Equinox	0·601	0·290	0·213	0·127	290·3	135·5	4	207
	Summer	0·801	0·322	0·172	0·070	312·5	155·5	39	238
H	Winter	3·62	3·86	1·81	1·13	82·9	277·3	154	6
	Equinox	10·97	5·87	3·32	1·84	109·6	303·5	167	16
	Summer	14·85	6·23	2·35	0·95	130·3	316·5	199	41
V	Winter	2·46	1·67	0·86	0·42	153·9	300·8	108	280
	Equinox	6·15	4·70	2·51	0·94	117·2	272·3	99	289
	Summer	8·63	6·45	2·24	0·55	122·0	272·4	100	285

effects of secular change and annual inequality. Eliminating the secular change, we arrive at an annual inequality, based on all days of the year including the highly disturbed. It is this annual inequality which appears under the heading *s*. It is certainly very unlike the annual inequality derived in the usual way. Whether the difference is to be wholly assigned to the fact that highly disturbed days contribute in the one case, but not in the other, is a question for future research.

In the case of the inclination, Liznar found that in both hemispheres the dip (north in the northern, south in the southern hemisphere) was larger than the normal when the sun was in perihelion, corresponding to an enhanced value of the horizontal force in summer in the northern hemisphere.

In the case of annual inequalities, at least that of the declination, it is a somewhat suggestive fact that the range seems to become less as we pass from older to more recent results, or from shorter to longer periods of years. Thus for Paris from 1821 to 1830 Arago deduced a range of 2′ 9″. Quiet days at Kew from 1890 to 1894 gave a range of 1′·2, while at Potsdam Ludeling got a range 30% larger than that in Table XX. when considering the shorter period 1891–1899. Up to the present, few individual results, if any, can claim a very high degree of certainty. With improved instruments and methods it may be different in the future.

TABLE XX.—Annual Inequality.

	Declination.								Inclination.			
	Liznar, N. Hemisphere.	Potsdam, 1891–1906.	Parc St Maur, 1888-1897	Kew (1890–1900).			Batavia, 1883-1893.	Mauritius.	Liznar & Hann's mean.	Potsdam.	Parc St. Maur.	Kew.
				q.	*o*.	*s*.						
	′	′	′	′	′	′	′	′	′	′	′	′
January	−0·25	+0·04	+0·01	+0·08	+0·03	+0·32	+0·23	+0·06	+0·49	+0·32	+0·44	−0·03
February	−0·54	−0·11	0·00	+0·48	+0·25	−0·20	+0·19	+0·29	+0·39	+0·56	+0·29	−0·07
March	−0·27	+0·04	+0·17	+0·03	+0·05	−1·02	−0·12	+0·27	+0·20	+0·38	+0·13	+0·53
April	−0·03	+0·10	+0·12	−0·31	−0·14	−0·90	−0·11	+0·30	−0·08	−0·02	−0·13	+0·18
May	+0·19	+0·07	−0·11	−0·39	−0·28	+0·29	−0·30	+0·08	−0·43	−0·29	−0·37	−0·15
June	+0·46	+0·13	−0·14	−0·47	−0·39	+0·78	−0·13	−0·19	−0·70	−0·77	−0·59	−0·35
July	+0·48	+0·14	−0·17	−0·30	−0·13	+0·44	−0·08	−0·44	−0·72	−0·67	−0·27	−0·13
August	+0·47	+0·11	+0·01	+0·08	+0·05	+0·52	−0·18	−0·38	−0·47	−0·23	−0·05	−0·19
September	+0·31	+0·01	0·00	+0·29	+0·24	−0·02	+0·06	−0·06	−0·06	+0·16	+0·01	+0·20
October	−0·07	−0·11	+0·09	+0·06	+0·01	−0·26	+0·03	−0·04	+0·31	+0·27	+0·19	0·00
November	−0·30	−0·28	−0·05	+0·17	+0·11	−0·02	+0·08	−0·01	+0·51	+0·30	+0·43	+0·18
December	−0·36	−0·14	+0·05	+0·26	+0·23	+0·05	+0·35	+0·06	+0·55	+0·19	+0·24	−0·29
Range	1·02	0·42	0·34	0·95	0·64	1·80	0·65	0·74	1·27	1·33	1·03	0·88

Annual Variation Fourier Coefficients.

§ 23. The inequalities in Table XX. may be analysed—as has in fact been done by Hann—in a series of Fourier terms, whose periods are the year and its submultiples. Fourier series can also be formed representing the annual variation in the amplitudes of the regular diurnal inequality, and its component 24-hour, 12-hour, &c. waves, or of the amplitude of the absolute daily range (§ 24). To secure the highest theoretical accuracy, it would be necessary in calculating the Fourier coefficients to allow for the fact that the "months" from which the observational data are derived are not of uniform length. The mid-times, however, of most months of the year are but slightly displaced from the position they would occupy if the 12 months were exactly equal, and these displacements are usually neglected. The loss of accuracy cannot be but trifling, and the simplification is considerable.

The Fourier series may be represented by

$$P_1 \sin (t+\theta_1)+P_2 \sin (2t+\theta_2)+\ldots,$$

where t is time counted from the beginning of the year, one month being taken as the equivalent of 30°, P_1, P_2 represent the amplitudes, and θ_1, θ_2 the phase angles of the first two terms, whose periods are respectively 12 and 6 months. Table XXI. gives the values of these coefficients in the case of the range of the regular diurnal inequality for certain specified elements and periods at Kew[23] and Falmouth.[23a] In the case of P_1 and P_2 the unit is 1′ for D and I, and 1γ for H and V. M denotes the mean value of the range for the 12 months. The letters *q* and *o* represent quiet and ordinary day results. S max. means the years 1892–1895, with a mean sun spot frequency of 75·0. S min. for Kew means the years 1890, 1899 and 1900 with a mean sun spot frequency of 9·6; for Falmouth it means the years 1899–1902 with a mean sun spot frequency of 7·25.

Increase in θ_1 or θ_2 means an earlier occurrence of the maximum or maxima, 1° answering roughly to one day in the case of the 12-month term, and to half a day in the case of the 6-month term. P_1/M and P_2/M both increase decidedly as we pass from years of many to years of few sun spots; i.e. *relatively* considered the range of the regular diurnal inequality is more variable throughout the year when sun spots are few than when they are many.

The tendency to an earlier occurrence of the maximum as we pass from quiet days to ordinary days, or from years of sun spot minimum to years of sun spot maximum, which appears in the table, appears also in the case of the horizontal force—at least in the case of the annual term—both at Kew and Falmouth. The phenomena at the two stations show a remarkably close parallelism. At both, and this is true also of the absolute ranges, the maximum of the annual term falls in all cases near midsummer, the minimum near midwinter. The maxima of the 6-month terms fall near the equinoxes.

Absolute Range.

§ 24. Allusion has already been made in § 14 to one point which requires fuller discussion. If we take a European station such as Kew, the general character of, say, the declination does not vary very much with the season, but still it does vary. The principal minimum of the day, for instance, occurs from one to two hours earlier in summer than in winter. Let us suppose for a moment that all the days of a month are exactly alike, the difference in type between successive months coming in *per saltum*. Suppose further that having formed twelve diurnal inequalities from the days of the individual months of the year, we deduce a mean diurnal inequality for the whole year by combining these twelve inequalities and taking the mean. The hours of maximum and minimum being different for the twelve constituents, it is obvious that the resulting maximum will normally be less than the arithmetic mean of the twelve maxima, and the resulting minimum (arithmetically) less than the arithmetic mean of the twelve minima. The range—or algebraic excess of the maximum over the minimum—in the mean diurnal inequality for the year is thus normally less than the arithmetic mean of the twelve ranges from diurnal inequalities for the individual months. Further, as we shall see later, there are differences in type not merely between the different months of the year, but even between the same months in different years. Thus the range of the mean diurnal inequality for, say, January based on the combined observations of, say, eleven Januarys may be and generally will be slightly less than the arithmetic mean of the ranges obtained from the Januarys separately. At Kew, for instance, taking the ordinary days of the 11 years 1890–1900, the arithmetic mean of the diurnal inequality ranges of declination from the 132 months treated independently was 8′·52, the mean range from the 12 months of the year (the eleven Januarys being combined into one, and so on) was 8′·44, but the mean range from the whole 4,000 odd days superposed was only 8′·03. Another consideration is this: a diurnal inequality is usually based on hourly readings, and the range deduced is thus an under-estimate unless the absolute maximum and minimum both happen to come exactly at an hour. These considerations would alone suffice to show that the *absolute range* in individual days, *i.e.* the difference between the algebraically largest and least values of the element found any time during the 24 hours, must on the average exceed the

TABLE XXI.—Annual Variation of Diurnal Inequality Range. Fourier Coefficients.

		P_1.	P_2.	θ_1.	θ_2.	P_1/M	P_2/M.
Kew 1890–1900	D_q	3·36	0·94	279°	280°	0·40	0·11
	D_o	3·81	1·22	275°	273°	0·47	0·15
	I_o	0·67	0·16	264°	269°	0·42	0·10
	H_o	13·6	3·0	269°	261°	0·48	0·11
	V_o	11·7	2·2	282°	242	0·63	0·12
S max. D_o	Kew	4·50	1·26	277°	282°	0·47	0·13
	Falmouth	4·10	1·40	277°	286°	0·43	0·15
S min. D_o	Kew	3·35	1·10	274°	269°	0·49	0·16
	Falmouth	3·19	1·14	275°	277°	0·49	0·17

range in the mean diurnal inequality for the year, however this latter is formed. Other causes, moreover, are at work tending in the same direction. Even in central Europe, the magnetic curves for individual days of an ordinary month often differ widely amongst themselves, and show maxima and minima at different times of the day. In high latitudes, the variation from day to day is sometimes so great that mere eye inspection of magnetograph curves may leave one with but little idea as to the probable shape of the resultant diurnal curve for the month. Table XXII. gives the arithmetic mean of the absolute daily ranges from a few stations. The values which it assigns to the year are the arithmetic means of the 12 monthly values. The Mauritius data are for different periods, viz. declination 1875, 1880 and 1883 to 1890, horizontal force 1883 to 1890, vertical force 1884 to 1890. The other data are all for the period 1890 to 1900.

A comparison of the absolute ranges in Table XXII. with the inequality ranges for the same stations derivable from Tables VIII. to X. is most instructive. At Mauritius the ratio of the absolute to the inequality range is for D 1·38, for H 1·76, and for V 1·19. At Pavlovsk the corresponding ratios are much larger, viz. 2·16 for D, 2·43 for H, and 2·05 for V. The declination data for Kew in Table XXII. illustrate other points. The first set of data are derived from all days of the year. The second omit the highly disturbed days. The third answer to the 5 days a month selected as typically quiet. The yearly mean absolute range from ordinary days at Kew in Table XXII. is 1·49 times the mean inequality range in Table VIII.; comparing individual months the ratio of the absolute to the inequality range varies from 2·06 in January to 1·21 in June. Even confining ourselves to the quiet days at Kew, which are free from any but the most trifling disturbances, we find that the mean absolute range for the year is 1·20 times the arithmetic mean of the inequality ranges for the individual months of the year, and 1·22 times the range from the mean diurnal inequality for the year. In this case the ratio of the absolute to the inequality range varies from 1·55 in December to only 1·09 in May.

TABLE XXII.—Mean Absolute Daily Ranges (Units 1′ for Declination, 1γ for H and V).

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Declination.													
Pavlovsk	13·42	17·20	18·22	17·25	17·76	15·91	16·89	16·57	16·75	15·70	13·87	12·37	15·99
Ekatarinburg	7·33	9·54	11·90	12·89	13·63	13·03	12·78	12·21	11·23	9·44	7·86	6·85	10·72
Kew. All days'	11·16	13·69	15·93	15·00	14·90	13·65	14·13	14·22	14·57	14·07	11·71	9·80	13·57
„ Ordinary days	10·14	11·87	14·19	14·24	13·85	13·26	13·47	13·67	13·71	13·10	10·40	9·00	12·58
„ Quiet „	6·12	7·57	10·59	11·84	12·09	11·95	11·60	11·93	10·86	9·16	6·54	5·08	9·61
Zi-ka-wei	3·88	3·25	6·22	7·04	7·15	7·40	7·77	8·06	6·73	4·68	2·91	2·52	5·63
Mauritius	6·93	7·79	7·11	5·75	4·87	4·03	4·36	6·00	6·28	6·71	6·99	6·78	6·13
Horizontal force.													
Pavlovsk	52·4	74·5	79·1	80·1	86·2	79·0	86·7	77·6	76·7	67·3	55·7	45·9	71·8
Ekatarinburg	33·2	43·1	48·4	51·7	56·2	54·1	56·7	51·7	49·3	44·1	34·1	29·3	46·0
Mauritius	37·9	35·0	36·2	37·6	35·0	34·1	33·8	34·5	36·6	37·4	37·8	35·3	35·9
Vertical force.													
Pavlovsk	27·0	50·4	54·7	43·2	45·3	34·8	42·1	35·5	42·5	37·5	33·5	25·5	39·3
Ekatarinburg	17·4	26·6	29·2	30·1	29·6	27·6	29·6	26·1	25·2	22·1	19·6	16·4	24·9
Mauritius	17·1	19·5	20·1	17·3	16·5	15·5	17·1	22·0	22·7	19·4	16·7	15·2	18·2

§ 25. The variability of the absolute daily range of declination is illustrated by Table XXIII., which contains data for Kew[24] derived from all days of the 11-year period 1890–1900. It gives the total number of times during the 11 years when the absolute range lay within the limits specified at the heads of the first nine columns of figures. The two remaining columns give the arithmetic means of the five largest and the five least absolute ranges encountered each month. The mean of the twelve monthly diurnal inequality ranges from ordinary days was only 8′·44, but the absolute range during the 11 years exceeded 20′ on 492 days, 15′ on 1196 days, and 10′ on 2784 days, *i.e.* on 69 days out of every 100.

Relations to Sun-spot Frequency.

§ 26. Magnetic phenomena, both regular and irregular, at any station vary from year to year. The extent of this variation is illustrated in Tables XXIV. and XXV., both relating to the period 1890 to 1900.[25] Table XXIV. gives the amplitudes of the regular diurnal inequality in the elements stated at the head of the columns. The ordinary day declination data (D_o) for Kew represent arithmetic means from the twelve months of the year; the other data all answer to the mean diurnal inequality for the whole year. Table XXV. gives the arithmetic means for each year of the absolute daily range, of the monthly range (or difference between the highest and lowest values in the month), and of the yearly range (or difference between the highest and lowest values of the year). The numerals attached to the years in these tables indicate their order as regards sun-spot frequency according to Wolf and Wolfer (see AURORA POLARIS), 1893 being the year of largest frequency, and 1890 that of least. The difference in sun-spot frequency between 1897 and 1898 was microscopic; the differences between 1890, 1900 and 1899 were small, and those between 1893, 1894 and 1892 were not very large.

The years 1892–1895 represent high sun-spot frequency, while 1890, 1899 and 1900 represent low frequency. Table XXIV. shows that 1892 to 1895 were in all cases distinguished by the large size of the inequality ranges, and 1890, 1899 and 1900 by the small size. The range in 1893 is usually the largest, and though the H and V

TABLE XXIII.—Absolute Daily Range of Declination at Kew.

	Number of occasions during 11 years when absolute range was:—									Means from the 5 largest and 5 least ranges of the month on the average of 11 years.	
	0′ to 5′.	5′ to 10′.	10′ to 15′.	15′ to 20′.	20′ to 25′.	25′ to 30′.	30′ to 35′.	35′ to 40′.	over 40′.	5 largest.	5 least.
										′	′
January	51	145	69	37	24	7	4	3	1	22·90	5·07
February	26	99	84	51	26	10	4	2	8	27·21	6·55
March	1	72	138	61	32	21	8	1	7	29·87	8·93
April	0	43	167	73	27	10	6	3	1	23·69	10·31
May	0	57	157	85	20	12	3	0	7	25·36	9·50
June	0	56	185	67	15	1	3	1	2	19·92	9·89
July	0	59	185	70	14	5	2	2	4	22·49	9·96
August	0	37	202	75	22	1	2	0	2	21·27	10·05
September	1	68	153	71	19	5	4	5	4	24·55	9·52
October	3	103	111	67	34	10	11	2	0	23·92	8·01
November	42	140	81	28	14	9	8	5	3	23·58	5·64
December	64	166	56	29	14	7	1	1	3	20·43	4·36
Totals	188	1045	1588	714	261	98	56	25	42		

ranges at Ekaterinburg are larger in 1892 than in 1893, the excess is trifling. The phenomena apparent in Table XXIV. are fairly representative; other stations and other periods associate large inequality ranges with high sun-spot frequency. The diurnal inequality range it should be noticed is comparatively little influenced by irregular disturbances. Coming to Table XXV., we have ranges of a different character. The absolute range at Kew on quiet days is almost as little influenced by irregularities as is the range of the diurnal inequality, and in its case the phenomena are very similar to those observed in Table XXIV. As we pass from left to right in Table XXV., the influence of disturbance increases. Simultaneously with this, the parallelism with sun-spot frequency is less close. The entries relating to 1892 and 1894 become more and more prominent compared to those for 1893. The yearly range may depend on but a single magnetic storm, the largest disturbance of the year possibly far outstripping any other. But taking even the monthly ranges the values for 1893 are, speaking roughly, only half those for 1892 and 1894, and very similar to those of 1898, though the sun-spot frequency in the latter year was less than a third of that in 1893. Ekatarinburg data exactly analogous to those for Pavlovsk show a similar prominence in 1892 and 1894 as compared to 1893. The retirement of 1893 from first place, seen in the absolute ranges at Kew, Pavlovsk and Ekatarinburg, is not confined to the northern hemisphere. It is visible, for instance, in the amplitudes of the Batavia disturbance results. Thus though the variation from year to year in the amplitude of the absolute ranges is relatively not less but greater than that of the inequality ranges, and though the general tendency is for all ranges to be larger in years of many than in years of few sun-spots, still the parallelism between the changes in sun-spot frequency and in magnetic range is not so close for the absolute ranges and for disturbances as for the inequality ranges.

Table XXIV.—Ranges of Diurnal Inequalities.

	Pavlovsk.			Ekatarinburg.				Kew.			
	D.	I.	H.	D.	I.	H.	V.	D_q.	I_q.	H_q.	D_a.
	′	′	γ	′	′	γ	γ	′	′	γ	′
1890_{11}	6·32	1·33	22	5·83	1·05	18	9	6·90		20	7·32
1891_{6}	7·31	1·79	30	6·85	1·38	25	14	8·04	1·52	28	8·48
1892_{3}	8·75	2·21	37	7·74	1·72	32	19	9·50	1·66	31	9·85
1893_{1}	9·64	2·24	38	8·83	1·80	31	17	10·06	1·96	35	10·74
1894_{2}	8·58	2·17	38	7·80	1·73	30	17	9·32	1·94	34	9·80
1895_{4}	8·22	2·08	33	7·29	1·64	28	15	8·59	1·66	30	9·54
1896_{5}	7·39	1·77	29	6·50	1·38	25	15	7·77	1·31	25	8·50
1897_{8}	6·79	1·59	26	6·01	1·16	21	12	6·71	1·14	22	7·76
1898_{7}	6·25	1·56	26	5·76	1·19	21	11	6·85	1·07	21	7·59
1899_{9}	6·02	1·44	24	5·33	1·12	20	11	6·69	1·01	21	7·30
1900_{10}	6·20	1·28	22	5·88	0·93	17	8	6·52	1·06	21	6·83

Table XXV.—Absolute Ranges.

	Kew Declination. Daily.			Pavlovsk.								
				Daily.			Monthly.			Yearly.		
	q.	*o*.	*a*.	D.	H.	V.	D.	H.	V.	D.	H.	V.
	′	′	′	′	γ	γ	′	γ	γ	′	γ	γ
1890_{11}	8·3	10·5	10·7	12·1	49	21	28·2	118	80	42·1	169	179
1891_{6}	10·0	12·8	13·7	16·0	70	39	46·3	218	233	92·3	550	614
1892_{3}	12·3	15·4	17·7	21·0	111	73	93·6	698	575	194·0	2416	1385
1893_{1}	11·8	15·2	15·6	17·8	79	41	48·3	241	210	87·1	514	457
1894_{2}	11·3	14·7	16·5	20·4	97	62	84·1	493	493	145·6	1227	878
1895_{4}	10·6	14·8	15·6	18·1	80	46	47·4	220	223	73·9	395	534
1896_{5}	9·5	12·9	14·5	17·5	74	43	52·4	232	236	88·7	574	608
1897_{8}	8·2	11·5	12·1	14·6	61	30	43·8	201	170	101·1	449	480
1898_{7}	8·2	11·2	12·3	14·7	67	35	46·6	276	242	118·9	1136	888
1899_{9}	7·9	10·5	11·3	13·1	58	27	38·3	178	150	63·8	382	527
1900_{10}	7·4	8·9	9·2	10·5	44	16	32·8	134	89	94·2	457	365
Means	9·6	12·6	13·6	16·0	72	39	51·1	274	246	100·2	752	629

§ 27. The relationship between magnetic ranges and sun-spot frequency has been investigated in several ways. W. Ellis[26] has employed a graphical method which has advantages, especially for tracing the general features of the resemblance, and is besides independent of any theoretical hypothesis. Taking time for the axis of abscissae, Ellis drew two curves, one having for its ordinates the sun-spot frequency, the other the inequality range of declination or of horizontal force at Greenwich. The value assigned in the magnetic curve to the ordinate for any particular month represents a mean from 12 months of which it forms a central month, the object being to eliminate the regular annual variation in the diurnal inequality. The sun-spot data derived from Wolf and Wolfer were similarly treated. Ellis originally dealt with the period 1841 to 1877, but subsequently with the period 1878 to 1896, and his second paper gives curves representing the phenomena over the whole 56 years. This period covered five complete sun-spot periods, and the approximate synchronism of the maxima and minima, and the general parallelism of the magnetic and sun-spot changes is patent to the eye. Ellis[27] has also applied an analogous method to investigate the relationship between sun-spot frequency and the number of days of magnetic disturbance at Greenwich. A decline in the number of the larger magnetic storms near sun-spot minimum is recognizable, but the application of the method is less successful than in the case of the inequality range. Another method, initiated by Professor Wolf of Zurich, lends itself more readily to the investigation of numerical relationships. He started by supposing an exact proportionality between corresponding changes in sun-spot frequency and magnetic range. This is expressed mathematically by the formula

$$R = a + bS \equiv a\{1 + (b/a)S\},$$

where R denotes the magnetic range, S the corresponding sun-spot frequency, while *a* and *b* are constants. The constant *a* represents the range for zero sun-spot frequency, while *b*/*a* is the proportional increase in the range accompanying unit rise in sun-spot frequency. Assuming the formula to be true, one obtains from the observed values of R and S numerical values for *a* and *b*, and can thus investigate whether or not the sun-spot influence is the same for the different magnetic elements and for different places. Of course, the usefulness of Wolf's formula depends largely on the accuracy with which it represents the facts. That it must be at least a rough approximation to the truth in the case of the diurnal inequality at Greenwich might be inferred from Ellis's curves. Several possibilities should be noticed. The formula may apply with high accuracy, *a* and *b* having assigned values, for one or two sun-spot cycles, and yet not be applicable to more remote periods. There are only three or four stations which have continuous magnetic records extending even 50 years back, and, owing to temperature correction uncertainties, there is perhaps no single one of these whose earlier records of horizontal and vertical force are above criticism. Declination is less exposed to uncertainty, and there are results of eye observations of declination before the era of photographic curves. A change, however, of 1′ in declination has a significance which alters with the intensity of the horizontal force. During the period 1850–1900 horizontal force in England increased about 5%, so that the force requisite to produce a declination change of 19′ in 1900 would in 1850 have produced a deflection of 20′. It must also be remembered that secular changes of declination must alter the angle between the needle and any disturbing force acting in a fixed direction. Thus secular alteration in *a* and *b* is rather to be anticipated, especially in the case of the declination. Wolf's formula has been applied by Rajna[28] to the yearly mean diurnal declination ranges at Milan based on readings taken twice daily from 1836 to 1894, treating the whole period together, and then the period 1871 to 1894 separately. During two sub-periods, 1837–1850 and 1854–1867, Rajna's calculated values for the range differ very persistently in one direction from those observed; Wolf's formula was applied by C. Chree[29] to these two periods separately. He also applied it to Greenwich inequality ranges for the years 1841 to 1896 as published by Ellis, treating the whole period and the last 32 years of it separately, and finally to all (*a*) and quiet (*q*) day Greenwich ranges from 1889 to 1896. The results of these applications of Wolf's formula appear in Table XXVI.

The Milan results are suggestive rather of heterogeneity in the material than of any decided secular change in *a* or *b*. The Greenwich data are suggestive of a gradual fall in *a*, and rise in *b*, at least in the case of the declination.

Table XXVII. gives values of *a*, *b* and *b*/*a* in Wolf's formula calculated by Chree[29] for a number of stations. There are two sets of data, the first set relating to the range from the mean diurnal inequality for the year, the second to the arithmetic mean of the ranges in the mean diurnal inequalities for the twelve months. It is specified whether the results were derived from all or from quiet days.

Table XXVI.—Values of *a* and *b* in Wolf's Formula.

Milan.			Greenwich.				
Epoch.	Declination (unit 1′).		Epoch.	Declination (unit 1′).		Horizontal Force (unit 1γ).	
	a.	*b*.		*a*.	*b*.	*a*.	*b*.
1836–94	5·31	·047	1841–96	7·29	·0377	26·4	·190
1871–94	5·39	·047	1865–96	7·07	·0396	23·6	·215
1837–50	6·43	·041	1889–96(*a*)	6·71	·0418	23·7	·218
1854–67	4·62	·047	1889–96(*q*)	6·36	·0415	25·0	·213

As explained above, *a* would represent the range in a year of no sun-spots, while 100 *b* would represent the excess over this shown by the range in a year when Wolfer's sun-spot frequency is 100. Thus

Table XXVII.—Values of *a* and *b* in Wolf's Formula.

	Declination (unit 1′).			Inclination (unit 1′).			Horizontal Force (unit 1γ).			Vertical Force (unit 1γ).		
Diurnal Inequality for the Year.	*a*.	*b*.	100 *b*/*a*.	*a*.	*b*.	100 *b*/*a*.	*a*.	*b*.	100 *b*/*a*.	*a*.	*b*.	100 *b*/*a*.
Pavlovsk, 1890–1900 . . . . . . all	5·74	·0400	·70	1·24	·0126	1·01	20·7	·211	1·02	8·1	·265	3·26
Pavlovsk, 1890–1900 , ... quiet	6·17	·0424	·69	..	..	..	20·6	·195	0·95	5·9	·027	0·46
Ekatarinburg, 1890–1900 . . . . . all	5·29	·0342	·65	0·93	·0105	1·13	16·8	·182	1·09	8·6	·117	1·37
Irkutsk " " . . . . all	4·82	·0358	·74	0·97	·0087	0·90	18·2	·190	1·04	6·5	·071	1·09
Kew " " . . . . quiet	6·10	·0433	·71	0·87	·0125	1·45	18·1	·194	1·07	14·3	·081	0·56
Falmouth, 1891–1902 . . . . . quiet	5·90	·0451	·76	..	..	..	20·1	·233	1·16	..	..	..
Kolaba, 1894–1901 . . . . . quiet	2·37	·0066	·28	..	..	..	31·6	·281	0·89	19·4	·072	0·37
Batavia, 1887–1898 . . . . . all	2·47	·0179	·72	3·60	·0218	0·61	38·7	·274	0·71	30·1	·156	0·52
Mauritius {1875–1880 1883–1890} . . . . all	4·06	·0164	·40	..	..	..	15·0	·096	0·64	11·9	·069	0·58
Mean from individual months:—												
Pavlovsk, 1890–1900 . . . . . all	6·81	·0446	·66	1·44	·0151	1·05	22·8	·243	1·07	9·7	·287	2·97
" " " . . . . . quiet	6·52	·0442	·68	..	..	..	22·2	·208	0·94	7·0	·044	0·63
Ekatarinburg, 1890–1900 . . . . all	6·18	·0355	·58	1·12	·0120	1·06	19·2	·195	1·01	9·2	·156	1·70
Greenwich, 1865–1896 . . . . all	7·07	·0396	·56	..	..	.	23·6	·215	0·91	..	..	..
Kew, 1890–1900 . . . . . . all	6·65	·0428	·64	..	..	..	..	..	..	..	..	..
" " " . . . . quiet	6·49	·0410	·63	1·17	·0130	1·11	21·5	·191	0·89	16·0	·072	0·45
Falmouth, 1891–1902 . . . . . quiet	6·16	·0450	·73	..	..	..	20·9	·236	1·13	..	..	..

b/*a* seems the most natural measure of sun-spot influence. Accepting it, we see that sun-spot influence appears larger at most places for inclination and horizontal force than for declination. In the case of vertical force there is at Pavlovsk, and probably in a less measure at other northern stations, a large difference between all and quiet days, which is not shown in the other elements. The difference between the values of *b*/*a* at different stations is also exceptionally large for vertical force. Whether this last result is wholly free from observational uncertainties is, however, open to some doubt, as the agreement between Wolf's formula and observation is in general somewhat inferior for vertical force. In the case of the declination, the mean numerical difference between the observed values and those derived from Wolf's formula, employing the values of *a* and *b* given in Table XXVII., represented on the average about 4% of the mean value of the element for the period considered, the probable error representing about 6% of the difference between the highest and lowest values observed. The agreement was nearly, if not quite, as good as this for inclination and horizontal force, but for vertical force the corresponding percentages were nearly twice as large.

Applying Wolf's formula to the diurnal ranges for different months of the year, Chree found, as was to be anticipated, that the constant *a* had an annual period, with a conspicuous minimum at midwinter; but whilst *b* also varied, it did so to a much less extent, the consequence being that *b*/*a* showed a minimum at midsummer. The annual variation in *b*/*a* alters with the place, with the element, and with the type of day from which the magnetic data are derived. Thus, in the case of Pavlovsk declination, whilst the mean value of 100 *b*/*a* for the 12 months is, as shown in Table XXVII., 0·66 for all and 0·68 for quiet days—values practically identical—if we take the four midwinter and the four midsummer months separately, we have 100 *b*/*a*, varying from 0·81 in winter to 0·52 in summer on all days, but from 1·39 in winter to 0·52 in summer on quiet days. In the case of horizontal force at Pavlovsk the corresponding figures to these are for all days—winter 1·77, summer 0·98, but for quiet days—winter 1·83, summer 0·71.

Wolf's formula has also been applied to the absolute daily ranges, to monthly ranges, and to various measures of disturbance. In these cases the values found for *b*/*a* are usually larger than those found for diurnal inequality ranges, but the accordance between observed values and those calculated from Wolf's formula is less good. If instead of the range of the diurnal inequality we take the sum of the 24-hourly differences from the mean for the day—or, what comes to the same thing, the average departure throughout the 24 hours from the mean value for the day—we find that the resulting Wolf's formula gives at least as good an agreement with observation as in the case of the inequality range itself. The formulae obtained in the case of the 24 differences, at places as wide apart as Kew and Batavia, agreed in giving a decidedly larger value for *b*/*a* than that obtained from the ranges. This indicates that the inequality curve is relatively less peaked in years of many than in years of few sunspots.

§ 28. The applications of Ellis's and Wolf's methods relate directly only to the amplitude of the diurnal changes. There is, however, a change not merely in amplitude but in type. This is clearly seen when we compare the values found in years of many and of few sunspots for the Fourier coefficients in the diurnal inequality. Such a comparison is carried out in Table XXVIII. for the declination on ordinary days at Kew. Local mean time is used. The heading S max. (sun-spot maximum) denotes mean average results from the four years 1892–1895, having a mean sun-spot frequency of 75·0, whilst S min. (sun-spot minimum) applies similarly to the years 1890, 1899 and 1900, having a mean sun-spot frequency of only 9·6. The data relate to the mean diurnal inequality for the whole year or for the season stated. It will be seen that the difference between the *c*, or amplitude, coefficients in the S max. and S min. years is greater for the 24-hour term than for the 12-hour term, greater for the 12-hour than for the 8-hour term, and hardly apparent in the 6-hour term. Also, *relatively considered*, the difference between the amplitudes in S max. and S min. years is greatest in winter and least in summer. Except in the case of the 6-hour term, where the differences are uncertain, the phase angle is larger, *i.e.* maxima and minima occur earlier in the day, in years of S min. than in years of S max. Taking the results for the whole year in Table XXVIII., this advance of phase in the S min. years represents in time 15·6 minutes for the 24-hour term, 9·4 minutes for the 12-hour term, and 14·7 minutes for the 8-hour term. The difference in the phase angles, as in the amplitudes, is greatest in winter. Similar phenomena are shown by the horizontal force, and at Falmouth[24] as well as Kew.

Table XXVIII.—Fourier Coefficients in Years of many and few Sun-spots.

	Year.		Winter.		Equinox.		Summer.	
	S max.	S min.	S max.	S min.	S max.	S min.	S max.	S min.
	′	′	′	′	′	′	′	′
c_1	3·47	2·21	2·41	1·43	3·76	2·41	4·38	2·98
c_2	2·04	1·51	1·15	0·78	2·33	1·71	2·73	2·06
c_3	0·89	0·72	0·55	0·42	1·16	0·97	0·97	0·77
c_4	0·28	0·27	0·30	0·27	0·42	0·42	0·11	0·11
	°	°	°	°	°	°	°	°
a_1	228·5	232·4	243·0	256·0	231·3	233·7	218·2	220·3
a_2	41·7	46·6	23·5	36·9	40·6	43·9	50·6	52·5
a_3	232·6	243·6	234·0	257·6	228·4	236·2	236·8	245·4
a_4	58·0	57·3	52·3	60·8	62·0	58·2	57·4	45·2

Quiet Day Phenomena.

§ 29. There have already been references to *quiet* days, for instance in the tables of diurnal inequalities. It seems to have been originally supposed that quiet days differed from other days only in the absence of irregular disturbances, and that mean annual values, or secular change data, or diurnal inequalities, derived from them might be regarded as truly normal or representative of the station. It was found, however, by P. A. Müller[29] that mean annual values of the magnetic elements at St Petersburg and Pavlovsk from 1873 to 1885 derived from quiet days alone differed in a systematic fashion from those derived from all days, and analogous results were obtained by Ellis[30] at Greenwich for the period 1889–1896. The average excesses for the quiet-day over the all-day means in these two cases were as follows:—

	Westerly Declination.	Inclination.	Horizontal Force.	Vertical Force.
St Petersburg	+0·24	−0·23	+3·2γ	−0·8γ
Greenwich	+0·08		+3·3γ	−0·9γ

The sign of the difference in the case of D, I and H was the same in each year examined by Müller, and the same was true of H at Greenwich. In the case of V, and of D at Greenwich, the differences are small and might be accidental. In the case of D at Greenwich 1891 differed from the other years, and of two more recent years examined by Ellis[31] one, 1904, agreed with 1891. At Kew, on the average of the 11 years 1890 to 1900, the quiet-day mean annual value of declination exceeded the ordinary day value, but the apparent excess 0′·02 is too small to possess much significance.

Another property more recently discovered in quiet days is the non-cyclic change. The nature of this phenomenon will be readily understood from the following data from the 11-year period 1890 to 1900 at Kew[32]. The mean daily change for all days is calculated from the observed annual change.

Non-cyclic Change.

	D.	I.	H.	V.
	′	′		
Mean annual change	−5·79	−2·38	+25·9γ	−22·6γ
Mean daily change, all days	−0·016	−0·007	+0·07γ	−0·06γ
Mean daily change, quiet days	+0·044	−0·245	+3·34γ	−0·84γ

Thus the changes during the representative quiet day differed from those of the average day. Before accepting such a phenomenon as natural, instrumental peculiarities must be carefully considered: The secular change is really based on the absolute instruments, the diurnal changes on the magnetographs, and the first idea likely to occur to a critical mind is that the apparent abnormal change on quiet days represents in reality change of zero in the magnetographs. If, however, the phenomenon were instrumental, it should appear equally on days other than quiet days, and we should thus have a shift of zero amounting in a year to over 1,200γ in H, and to about 90′ in I. Under such circumstances the curve would be continually drifting off the sheet. In the case of the Kew magnetographs, a careful investigation showed that if any instrumental change occurred in the declination magnetograph during the 11 years it did not exceed a few tenths of a minute. In the case of the H and V magnetographs at Kew there is a slight drift, of instrumental origin, due to weakening of the magnets, but it is exceedingly small, and in the case of H is in the opposite direction to the non-cyclic change on quiet days. It only remains to add that the hypothesis of instrumental origin was positively disproved by measurement of the curves on ordinary days.

It must not be supposed that every quiet day agrees with the average quiet day in the order of magnitude, or even in the sign, of the non-cyclic change. In fact, in not a few months the sign of the non-cyclic change on the mean of the quiet days differs from that obtained for the average quiet day of a period of years. At Kew, between 1890 and 1900, the number of months during which the mean non-cyclic change for the five quiet days selected by the astronomer royal (Sir W. H. M. Christie) was plus, zero, or minus, was as follows:—

Element.	D.	I.	H.	V.
Number +	63	13	112	47
„ 0	14	16	11	9
„ −	55	101	9	74

The + sign denotes westerly movement in the declination, and increasing dip of the north end of the needle. In the case of I and H the excess in the number of months showing the normal sign is overwhelming. The following mean non-cyclic changes on quiet days are from other sources:—

Element.	Greenwich (1890–1895).	Falmouth (1898–1902).	Kolaba (1894–1901).
	′	′	′
D	+ 0·03	+ 0·05	+ 0·07
H	+ 4·3γ	+ 3·0γ	+ 3·9γ

The results are in the same direction as at Kew, + meaning in the case of D movement to the west. At Falmouth[33], as at Kew, the non-cyclic change showed a tendency to be small in years of few sun-spots.

§ 30. In calculating diurnal inequalities from quiet days the non-cyclic effect must be eliminated, otherwise the result would depend on the hour at which the "day" is supposed to commence. If the value recorded at the second midnight of the average day exceeds that at the first midnight by N, the elimination is effected by applying to each hourly value the correction N(12-n)/24, where n is the hour counted from the first midnight (0 hours). This assumes the change to progress uniformly throughout the 24 hours. Unless this is practically the case—a matter difficult either to prove or disprove—the correction may not secure exactly what is aimed at. This method has been employed in the previous tables. The fact that differences do exist between diurnal inequalities derived from quiet days and all ordinary days was stated explicitly in § 4, and is obvious in Tables VIII. to XI. An extreme case is represented by the data for Jan Mayen in these tables. Figs. 9 and 10 are vector diagrams for this station, for all and for quiet days during May, June and July 1883, according to data got out by Lüdeling. As shown by the arrows, fig. 10 (quiet days) is in the main described in the normal or clockwise direction, but fig. 9 (all days) is described in the opposite direction. Lüdeling found this peculiar difference between all and quiet days at all the north polar stations occupied in 1882–1883 except Kingua Fjord, where both diagrams were described clockwise.

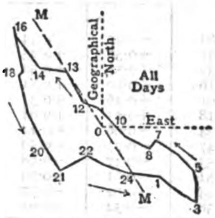


FIG. 9.

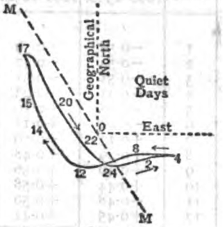


FIG. 10.

In temperate latitudes the differences of type are much less, but still they exist. A good idea of their ordinary size and character in the case of declination may be derived from Table XXIX., containing data for Kew, Greenwich and Parc St Maur.

The data for Greenwich are due to W. Ellis[30], those for Parc St Maur to T. Moureaux[33]. The quantity tabulated is the algebraic excess of the all or ordinary day mean hourly value over the corresponding quiet day value in the mean diurnal inequality for the year. At Greenwich and Kew days of extreme disturbance have been excluded from the ordinary days, but apparently not at Parc St Maur. The number of highly disturbed days at the three stations is, however, small, and their influence is not great. The differences disclosed by Table XXIX. are obviously of a systematic character, which would not tend to disappear however long a period was utilized. In short, while the diurnal inequality from quiet days may be that most truly representative of undisturbed conditions, it does not represent the average state of conditions at the station. To go into full details respecting the differences between all and quiet days would occupy undue space, so the following brief summary of the differences observed in declination at Kew must suffice. While the inequality range is but little different for the two types of days, the mean of the hourly differences from the mean for the day is considerably reduced in the quiet days. The 24-hour term in the Fourier analysis is of smaller amplitude in the quiet days, and its phase angle is on the average about 6°·75 smaller than on ordinary days, implying a retardation of about 27 minutes in the time of maximum. The diurnal inequality range is more variable throughout the year in quiet days than on ordinary days, and the same is true of the absolute ranges. The tendency to a secondary minimum in the range at midsummer is considerably more decided on ordinary than on quiet days. When the variation throughout the year in the diurnal inequality range is expressed in Fourier series, whose periods are the year and its submultiples, the 6-month term is notably larger for ordinary than for quiet days. Also the date of the maximum in the 12-month term is about three days earlier for ordinary than for quiet days. The exact size of the differences between ordinary and quiet day phenomena must depend to some extent on the criteria employed in selecting quiet days and in excluding disturbed days. This raises difficulties when it comes to comparing results at different stations. For stations near together the difficulty is trifling. The astronomer royal's quiet days have been used for instance at Parc St. Maur, Val Joyeux, Falmouth and Kew, as well as at Greenwich. But when stations are wide apart there are two obvious difficulties: first, the difference of local time; secondly, the fact that a day may be typically quiet at one station but appreciably disturbed at the other.

If the typical quiet day were simply the antithesis of a disturbed day, it would be natural to regard the non-cyclic change on quiet days as a species of recoil from some effect of disturbance. This view derives support from the fact, pointed out long ago by Sabine[34], that the horizontal force usually, though by no means always, is lowered by magnetic disturbances. Dr van Bemmelen[35] who has examined non-cyclic phenomena at a number of stations, seems disposed to regard this as a sufficient explanation. There are, however, difficulties in accepting this view. Thus, whilst the non-cyclic effect in horizontal force and inclination at Kew and Falmouth appeared on the whole enhanced in years of sun-spot maximum, the difference between years such as 1892 and 1894 on the one hand, and 1890 and 1900 on the other, was by no means proportional to the excess of disturbance in the former years. Again, when the average non-cyclic change of declination was calculated at Kew for 207 days, selected as those of most marked irregular disturbance between 1890 and 1900, the sign actually proved to be the same as for the average quiet day of the period.

Table XXIX.—All or Ordinary, less Quiet Day Hourly Values (+ to the West).

Hour.	Forenoon.			Afternoon.		
	Kew 1890–1900.	Greenwich 1890–1894.	Parc St Maur 1883–1897.	Kew 1890–1900.	Greenwich 1890–1894.	Parc St Maur 1893–1897.
	′	′	′	′	′	′
1	−0·58	−0·59	−0·63	+0·42	+0·44	+0·40
2	−0·54	−0·47	−0·47	+0·52	+0·45	+0·50
3	−0·51	−0·31	−0·32	+0·57	+0·52	+0·59
4	−0·41	−0·23	−0·16	+0·60	+0·51	+0·55
5	−0·28	−0·10	−0·01	+0·46	+0·34	+0·38
6	−0·08	+0·12	+0·18	+0·21	+0·04	+0·07
7	+0·13	+0·30	+0·34	−0·06	−0·24	−0·25
8	+0·29	+0·48	+0·47	−0·27	−0·50	−0·54
9	+0·40	+0·56	+0·53	−0·47	−0·68	−0·74
10	+0·44	+0·58	+0·51	−0·61	−0·78	−0·79
11	+0·48	+0·50	+0·44	−0·62	−0·77	−0·79
12	+0·45	+0·44	+0·38	−0·54	−0·61	−0·67

Magnetic Disturbances.

§ 31. A satisfactory definition of magnetic disturbance is about as difficult to lay down as one of heterodoxy. The idea in its generality seems to present no difficulty, but it is a very different matter when one comes to details. Amongst the chief disturbances recorded since 1890 are those of February 13–14 and August 12, 1892; July 20 and August 20, 1894; March 15–16, and September 9, 1898; October 31, 1903; February 9–10, 1907; September 11–12, 1908 and September 25, 1909. On such days as these the oscillations shown by the magnetic curves are large and rapid, aurora is nearly always visible in temperate latitudes, earth currents are prominent, and there is interruption—sometimes very serious—in the transmission of telegraph messages both in overhead and underground wires. At the other end of the scale are days on which the magnetic curves show practically no movement beyond the slow regular progression of the regular diurnal inequality. But between these two extremes there are an infinite variety of intermediate cases. The first serious attempt at a precise definition of disturbance seems due to General Sabine [35a]. His method had once an extensive vogue, and still continues to be applied at some important observatories. Sabine regarded a particular observation as disturbed when it differed from the mean of the observations at that hour for the whole month by not less than a certain limiting value. His definition takes account only of the extent of the departure from the mean, whether the curve is smooth at the time or violently oscillating makes no difference. In dealing with a particular station Sabine laid down separate limiting values for each element. These limits were the same, irrespective of the season of the year or of the sun-spot frequency. A departure, for example, of 3′·3 at Kew from the mean value of declination for the hour constituted a disturbance, whether it occurred in December in a year of sun-spot minimum, or in June in a year of sun-spot maximum, though the regular diurnal inequality range might be four times as large in the second case as in the first. The limiting values varied from station to station, the size depending apparently on several considerations not very clearly defined. Sabine subdivided the disturbances in each element into two classes: the one tending to increase the element, the other tending to diminish it. He investigated how the numbers of the two classes varied throughout the day and from month to month. He also took account of the aggregate value of the disturbances of one sign, and traced the diurnal and annual variations in these aggregate values. He thus got two sets of diurnal variations and two sets of annual variations of disturbance, the one set depending only on the number of the disturbed hours, the other set considering only the aggregate value of the disturbances. Generally the two species of disturbance variations were on the whole fairly similar. The aggregates of the + and − disturbances for a particular hour of the day were seldom equal, and thus after the removal of the disturbed values the mean value of the element for that hour was generally altered. Sabine's complete scheme supposed that after the criterion was first applied, the hourly means would be recalculated from the undisturbed values and the criterion applied again, and that this process would be repeated until the disturbed observations all differed by not less than the accepted limiting value from the final mean based on undisturbed values alone. If the disturbance limit were so small that the disturbed readings formed a considerable fraction of the whole number, the complete execution of Sabine's scheme would be exceedingly laborious. As a matter of fact, his disturbed readings were usually of the order of 5% of the total number, and unless in the case of exceptionally large magnetic storms it is of little consequence whether the first choice of disturbed readings is accepted as final or is reconsidered in the light of the recalculated hourly means.

Sabine applied his method to the data obtained during the decade 1840 to 1850 at Toronto, St Helena, Cape of Good Hope and Hobart, also to data for Pekin, Nertchinsk, Point Barrow, Port Kennedy and Kew. C. Chambers [36] applied it to data from Bombay. The yearly publication of the Batavia observatory gives corresponding results for that station, and Th. Moureaux [37] has published similar data for Parc St Maur. Tables XXX. to XXXII. are based on a selection of these data. Tables XXX. and XXXI. show the annual variation in Sabine's disturbances, the monthly values being expressed as percentages of the arithmetic mean value for the 12 months. The Parc St Maur and Batavia data, owing to the long periods included, are especially noteworthy. Table XXX. deals with the east (E) and west (W) disturbances of declination separately. Table XXXI., dealing with disturbances in horizontal and vertical force, combines the + and − disturbances, treated numerically. At Parc St Maur the limits required to qualify for disturbance were 3′·0 in D, 20γ in H, and 12γ in V; the corresponding limits for Batavia were 1′·3, 11γ and 11γ. The limits for D at Toronto, Bombay and Hobart were respectively 3′·6, 1′·4 and 2′·4.

At Parc St Maur the disturbance data from all three elements give distinct maxima near the equinoxes; a minimum at midwinter is clearly shown, and also one at midsummer, at least in D and H. A decline in disturbance at midwinter is visible at all the stations, but at Batavia the equinoctial values for D and V are inferior to those at midsummer.

Table XXXII. shows in some cases a most conspicuous diurnal variation in Sabine's disturbances. The data are percentages of the totals for the whole 24 hours. But whilst at Batavia the easterly and westerly disturbances in D vary similarly, at Parc St Maur they follow opposite laws, the easterly showing a prominent maximum near noon, the westerly a still more prominent maximum near midnight. The figures in the second last line of the table, if divided by 0·24, will give the percentage of hours which show the species of disturbance indicated. For instance, at Parc St Maur, out of 100 hours, 3 show disturbances to the west and 3·7 to the east; or in all 6·7 show disturbances of declination. The last line gives the average size of a disturbance of each type, the unit being 1′ in D and 1γ in H and V.

Table XXX.—Annual Variation of Disturbances (Sabine's numbers).

	Parc St Maur 1883–97.		Toronto 1841–48.		Bombay 1859–65.		Batavia 1883–99.		Hobart 1843–48.	
Month.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.
January .	78	60	55	66	89	89	180	223	165	182
February.	116	92	75	86	94	67	138	144	121	116
March .	126	107	92	94	129	97	102	87	114	104
April . .	105	113	115	114	106	129	67	73	110	102
May . .	101	118	101	101	63	99	72	71	62	53
June . .	77	89	95	72	78	81	45	27	32	37
July . .	82	104	140	126	121	173	62	46	50	49
August .	88	113	137	133	154	131	69	69	86	78
September	134	137	163	139	111	108	135	144	135	114
October .	119	115	101	111	140	128	95	88	124	123
November	99	94	73	85	43	43	106	91	79	111
December	75	58	51	72	72	55	124	137	123	130

At Batavia disturbances increasing and decreasing the element are about equally numerous, but this is exceptional. Easterly disturbances of declination predominated at Toronto, Point Barrow, Fort Kennedy, Kew, Parc St Maur, Bombay and the Falkland Islands whilst the reverse was true of St Helena, Cape of Good Hope, Pekin and Hobart. At Kew and Parc St Maur the ratios borne by the

Table XXXI.—Annual Variation of Disturbances.

	Parc St Maur.		Toronto.		Batavia.			
Month.	Numbers.		Aggregates.		Numbers.		Aggregates.	
	H.	V.	H.	V.	H.	V.	H.	V.
January . .	81	51	58	56	96	151	89	154
February .	96	133	94	74	105	123	110	125
March . .	126	118	94	108	116	105	117	103
April . . .	94	111	150	149	104	76	105	73
May . . .	108	133	90	112	101	92	105	95
June . . .	90	85	36	50	82	69	79	66
July . . .	99	128	61	71	90	83	95	81
August . .	113	92	75	108	91	91	98	91
September .	119	122	171	160	113	111	114	115
October . .	101	94	148	129	114	89	104	86
November .	104	81	98	75	99	102	100	101
December .	70	51	128	100	89	108	84	110

TABLE XXXII.—Diurnal Variation of Disturbances (Sabine's numbers).

Hour.	Parc St Maur.						Batavia.					
	D.		H.		V.		D.		H.		V.	
	E.	W.	+	−	+	−	E.	W.	+	−	+	−
0−3	10·1	20·3	9·0	8·3	5·7	9·2	1·1	5·8	13·1	6·6	4·0	7·4
3−6	12·3	8·2	8·4	8·0	6·4	10·4	7·6	7·3	14·2	4·8	6·3	10·0
6−9	15·7	3·8	14·1	12·5	7·2	9·0	24·9	16·8	12·1	9·9	21·2	21·7
9−noon	16·2	5·1	18·0	15·6	12·9	15·4	38·5	33·0	8·6	15·8	19·8	16·4
noon−3	19·3	6·7	15·3	16·5	18·2	18·3	18·8	24·7	16·8	21·1	23·5	22·1
3−6	14·8	9·7	12·5	15·4	22·9	21·8	6·4	5·4	13·3	16·9	12·6	12·7
6−9	5·7	21·2	11·4	13·2	18·9	11·2	2·3	3·4	9·9	13·6	7·1	4·1
9−12	5·9	25·0	11·2	10·5	7·8	4·7	0·4	3·8	12·0	11·1	5·6	5·4
Mean number per day	0·88	0·72	1·15	1·56	1·04	0·96	0·46	0·44	1·62	1·61	1·19	1·13
Mean size	..	..	..	..	..	..	1·72	1·69	18·0	19·5	16·7	15·5

eastern to the western disturbances were 1·19 and 1·23 respectively, and so not much in excess of unity; but the preponderance of easterly disturbances at the North American [27] stations was considerably larger than this.

§ 32. From the point of view of the surveyor there is a good deal to be said for Sabine's definition of disturbance, but it is less satisfactory from other standpoints. One objection has been already indicated, viz. the arbitrariness of applying the same limiting value at a station irrespective of the size of the normal diurnal range at the time. Similarly it is arbitrary to apply the same limit between 10 a.m. and noon, when the regular diurnal variation is most rapid, as between 10 p.m. and midnight, when it is hardly appreciable. There seems a distinct difference of phase between the diurnal inequalities on different types of days at the same season; also the phase angles in the Fourier terms vary continuously throughout the year, and much more rapidly at some stations and at some seasons than at others. Thus there may be a variety of phenomena which one would hesitate to regard as disturbances which contribute to the annual and diurnal variations in Tables XXX. to XXXII.

Sabine, as we have seen, confined his attention to the departure of the hourly reading from the mean for that hour. Another and equally natural criterion is the apparent character of the magnetograph curve. At Potsdam curves are regarded as "1" quiet, "2" moderately disturbed, or "3" highly disturbed. Any hourly value to which the numeral 3 is attached is treated as disturbed, and the annual Potsdam publication contains tables giving the annual and diurnal variations in the number of such disturbed hours for D, H and V. According to this point of view, the extent to which the hourly value departs from the mean for that hour is immaterial to the results. It is the greater or less sinuosity and irregularity of the curve that counts. Tables XXXIII. and XXXIV. give an abstract of the mean Potsdam results from 1892 to 1901. The data are percentages: in Table XXXIII. of the mean monthly total, in Table XXXIV. of the total for the day. So far as the annual variation is concerned, the results in Table XXXIII. are fairly similar to those in Table XXX. for Parc St Maur. There are pronounced maxima near the equinoxes, especially the spring equinox. The diurnal variations, however, in Tables XXXII. and XXXIV. are dissimilar. Thus in the case of H the largest disturbance numbers at Parc St Maur occurred between 6 a.m. and 6 p.m., whereas in Table XXXIV. they occur between 4 p.m. and midnight. Considering the comparative proximity of Parc St Maur and Potsdam, one must conclude that the apparent differences between the results for these two stations are due almost entirely to the difference in the definition of disturbance.

TABLE XXXIII.—Annual Variation of Potsdam Disturbances.

Element.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
D	129	170	149	90	86	57	62	64	99	118	94	82
H	109	133	131	102	109	82	94	91	89	101	75	84
V	106	171	170	108	121	56	64	74	93	87	78	70
Mean	115	158	150	100	105	65	73	76	94	102	82	79

TABLE XXXIV.—Diurnal Variation of Potsdam Disturbances.

Hours.	1–3.	4–6.	7–9.	10–noon.	1–3.	4–6.	7–9.	10–12.
D	14·9	11·1	8·0	5·2	5·7	13·1	22·5	19·5
H	10·5	8·4	8·0	8·5	11·3	17·6	19·2	16·5
V	13·5	9·7	5·7	4·7	8·5	17·2	21·5	19·2
Mean	13·0	9·7	7·2	6·1	8·5	16·0	21·1	18·4

TABLE XXXV.—Disturbed Day less ordinary Day Inequality (Unit 1′, + to West).

Hour.	1	2	3	4	5	6	7	8	9	10	11	12
a.m.	−3·4	−2·6	−2·0	−0·3	+1·6	+1·9	+2·3	+2·0	+2·1	+2·0	+1·6	+1·8
p.m.	+1·8	+2·2	+2·1	+1·7	+1·4	0·0	−1·3	−2·8	−3·5	−2·6	−3·5	−2·4

One difficulty in the Potsdam procedure is the maintenance of a uniform standard. Unless very frequent reference is made to the curves of some standard year there must be a tendency to enter under "3" in quiet years a number of hours which would be entered under "2" in a highly disturbed year. Still, such a source of uncertainty is unlikely to have much influence on the diurnal, or even on the annual, variation.

§ 33. A third method of investigating a diurnal period in disturbances is to form a diurnal inequality from disturbed days alone, and compare it with the corresponding inequalities from ordinary or from quiet days. Table XXXV. gives some declination data for Kew, the quantity tabulated being the algebraic excess of the disturbed day hourly value over that for the ordinary day in the mean diurnal inequality for the year, as based on the 11 years 1890 to 1900.

The disturbed day inequality was corrected for non-cyclic change in the usual way. Fig. 11 shows the results of Table XXXV. graphically. The irregularities are presumably due to the limited number, 209, of disturbed days employed; to get a smooth curve would require probably a considerably longer period of years. The differences between disturbed and ordinary days at Kew are of the same general character as those between ordinary and quiet days in Table XXIX.; they are, however, very much larger, the range in Table XXXV. being fully 5½ times that in Table XXIX. If quiet days had replaced ordinary days in Table XXXV., the algebraic excess of the disturbed day would have varied from +2′·7 at 2 p.m. to −4′·1 at 11 p.m., or a range of 6′·8.

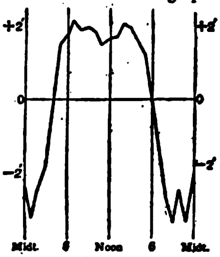


FIG. 11.

§ 34. When the mean diurnal inequality in declination for the year at Kew is analysed into Fourier waves, the chief difference, it will be remembered, between ordinary and quiet days was that the amplitude of the 24-hour term was enhanced in the ordinary days, whilst its phase angle indicated an earlier occurrence of the maximum. Similarly, the chief difference between the Fourier waves for the disturbed and ordinary day inequalities at Kew is the increase in the amplitude of the 24-hour term in the former by over 70%, and the earlier occurrence of its maximum by about 1 hour 50 minutes. It is clear from these results for Kew, and it is also a necessary inference from the differences obtained by Sabine's method between east and west or + and − disturbances, that there is present during disturbances some influence which affects the diurnal inequality in a regular systematic way, tending to make the value of the element higher during some hours and lower during others than it is on days relatively free from disturbance. At Kew the consequence is a notable increase in the range of the regular diurnal inequality on disturbed days; but whether this is the general rule or merely a local peculiarity is a subject for further research.

§ 35. There are still other ways of attacking the problem of disturbances. W. Ellis [27] made a complete list of disturbed days at Greenwich from 1848 onwards, arranging them in classes according to the amplitude of the disturbance shown on the curves. Of the 18,000 days which he considered, Ellis regarded 2,119, or only about 12%, as undisturbed. On 11,898 days, or 66%, the disturbance movement in declination was under 10′; on 3614, or 20%, the disturbance, though exceeding 10′, was under 30′; on 294 days it lay between 30′ and 60′; while on 75 days it exceeded 60′. Taking each class of disturbances separately, Ellis found, except in the case of his "minor" disturbances—those under 10′—a distinct double annual period, with maxima towards the equinoxes. Subsequently C. W. Maunder,[38] making use of these same data, and of subsequent data up to 1902, put at his disposal by Ellis, came to similar conclusions. Taking all the days with disturbances of declination over 10′, and dealing with 15-day periods, he found the maxima of frequency to occur the one a little before the spring equinox, the other apparently after the autumnal equinox; the two minima were found to occur early in June and in January. When the year is divided into three seasons—winter (November to February), summer (May to August), and equinox—Maunder's figures lead to the results assigned to Greenwich disturbed days in Table XXXVI. The frequency in winter, it will be noticed, though less than at equinox, is considerably greater than in summer. This greater frequency in winter is only slightly apparent in the disturbances over 60′, but their number is so small that this may be accidental. The next figures in Table XXXVI. relate to highly disturbed days at Kew. The larger relative frequency at Kew in winter as compared to summer probably indicates no real difference from Greenwich, but is simply a matter of definition. The chief criterion at Kew for classifying the days was not so much the mere amplitude of the largest movement, as the general character of the day's curve and its departure from the normal form. The data in Table XXXVI. as to magnetic storms at Greenwich are based on the lists given by Maunder[39] in the *Monthly Notices*, R.A.S. A storm may last for any time from a few hours to several days, and during part of its duration the disturbance may not be very large; thus it does not necessarily follow that the frequencies of magnetic storms and of disturbed days will follow the same laws. The table shows, however, that so far as Greenwich is concerned the annual variations in the two cases are closely alike. In addition to mean data for the whole 56 years, 1848 to 1903, Table XXXVI. contains separate data for the 14 years of that period which represented the highest sun-spot frequency, and the 15 years which represented lowest sun-spot frequency. It will be seen that relatively considered the seasonal frequencies of disturbance are more nearly equal in the years of many than in those of few sun-spots. Storms are more numerous as a whole in the years of many sun-spots, and this preponderance is especially true of storms of the largest size. This requires to be borne in mind in any comparisons between larger and smaller storms selected promiscuously from a long period. An unduly large proportion of the larger storms will probably come from years of large sun-spot frequency, and there is thus a risk of assigning to differences between the laws obeyed by large and small storms phenomena that are due in whole or in part to differences between the laws followed in years of many and of few sun-spots. The last data in Table XXXVI. are based on statistics for Batavia given by W. van Bemmelen,[40] who considers separately the storms which commence suddenly and those which do not. These sudden movements are recorded over large areas, sometimes probably all over the earth, if not absolutely simultaneously, at least too nearly so for differences in the time of occurrence to be shown by ordinary magnetographs. It is ordinarily supposed that these sudden movements, and the storms to which they serve as precursors, arise from some source extraneous to the earth, and that the commencement of the movement intimates the arrival, probably in the upper atmosphere, of some form of energy transmitted through space. In the storms which commence gradually the existence of a source external to the earth is not so prominently suggested, and it has been sometimes supposed that there is a fundamental difference between the two classes of storms. Table XXXVI. shows, however, no certain difference in the annual variation at Batavia. At the same time, this possesses much less significance than it would have if Batavia were a station like Greenwich, where the annual variation in magnetic storms is conspicuous.

Besides the annual period, there seems to be also a well-marked diurnal period in magnetic disturbances. This is apparent in Tables XXXVII. and XXXVIII., which contain some statistics for Batavia due to van Bemmelen, and some for Greenwich derived from the data in Maunder's papers referred to above. Table XXXVII. gives the relative frequency of occurrence for two hour intervals, starting with midnight, treating separately the storms of gradual (g) and sudden (s) commencement. In Table XXXVIII. the day is subdivided into three equal parts. Batavia and Greenwich agree in showing maximum frequency of beginnings about the time of minimum frequency of endings and conversely; but the hours at which the respective maxima and minima occur at the two places differ rather notably.

§ 36. There are peculiarities in the sudden movements ushering in magnetic storms which deserve fuller mention. According to van Bemmelen the impulse consists usually at some stations of a sudden slight jerk of the magnet in one direction, followed by a larger decided movement in the opposite direction, the former being often indistinctly shown. Often we have at the very commencement but a faint outline, and thereafter a continuous movement which is only sometimes distinctly indicated, resulting after some minutes in the displacement of the trace by a finite amount from the position it occupied on the paper before the disturbance began. This may mean, as van Bemmelen supposes, a small preliminary movement in the opposite direction to the clearly shown displacement; but it may only mean that the magnet is initially set in vibration, swinging on both sides of the position of equilibrium, the real displacement of the equilibrium position being all the time in the direction of the displacement apparent after a few minutes. To prevent misconception, the direction of the displacement apparent after a few minutes has been termed the direction of the first *decided* movement in Table XXXIX., which contains some data as to the direction given by Ellis[41] and van Bemmelen.[40] The + sign means an increase, the − sign a decrease of the element. The sign is not invariably the same, it will be understood, but there are in all cases a marked preponderance of changes in the direction shown in the table. The fact that all the stations indicated an increase in horizontal force is of special significance.

TABLE XXXVI.—Disturbances, and their Annual Distribution.

	Total Number.	Percentages.		
		Winter.	Equinox.	Summer.
Greenwich disturbed days, all, 1848–1902 . . .	4,214	33·9	39·2	26·9
Greenwich disturbed days, range 10′ to 30′, 1848–1902	3,830	33·9	39·0	27·1
Greenwich disturbed days, range 30′ to 60′, 1848–1902	307	34·5	41·0	24·4
Greenwich disturbed days, range over 60′, 1848–1902	77	29·9	41·6	28·6
Kew highly disturbed days, 1890–1900	209	38·3	41·6	20·1
Greenwich magnetic storms, all, 1848–1903 .	726	32·1	42·3	25·6
Greenwich magnetic storms, range 20′ to 30′, 1848–1903	392	30·1	43·6	26·3
Greenwich magnetic storms, range over 30′, 1848–1903	334	34·4	40·7	24·9
Greenwich magnetic storms, all, 14 years of S. max.	258	35·3	38·0	26·7
Greenwich magnetic storms, all, 15 years of S. min.	127	28·4	48·0	23·6
Batavia magnetic storms, all, 1883–1899 . . .	1,008	32·9	34·9	32·2
Batavia magnetic storms of gradual commencement.	679	32·4	34·8	32·8
Batavia magnetic storms of sudden commencement.	329	33·7	35·3	31·0

TABLE XXXVII.—Batavia Magnetic Storms, Diurnal Distribution (percentages).

Hour.		0	2	4	6	8	10	12	14	16	18	20	22
Beginning	g	5	5	5	6	20	16	7	5	6	9	8	8
	s	7	5	7	10	10	11	10	8	8	9	8	7
Maximum	g	12	10	6	5	4	9	9	6	6	6	12	15
	s	14	7	5	2	2	9	9	5	8	10	13	16
End	all	15	16	19	13	5	3	6	5	4	5	4	5

TABLE XXXVIII.—Greenwich Magnetic Storms, Diurnal Distribution.

Epoch.		Class.	Total Number.	Percentages.		
				1–8 p.m.	9 p. m.–4 a.m.	5 a.m.–noon.
Beginning	1848–1903	all	721	60·1	21·9	18·0
	1882–1903	„	276	58·0	18·8	23·2
	„ „	sudden	77	45·4	27·3	27·3
End	1848–1903	all	720	9·4	44·6	46·0
	1882–1903	„	276	7·2	41·7	51·1
	„ „	sudden	77	11·7	35·1	53·2

§ 37. That large magnetic disturbances occur simultaneously over large areas was known in the time of Gauss, on whose initiative observations were taken at 5-minute intervals at a number of stations on prearranged *term days*. During March 1879 and August 1880 some large magnetic storms occurred, and the magnetic curves showing these at a number of stations fitted with Kew pattern magnetographs were compared by W. G. Adams.[42] He found the more characteristic movements to be, so far as could be judged, simultaneous at all the stations. At comparatively near stations such as Stonyhurst and Kew, or Coimbra and Lisbon, the curves were in general almost duplicates. At Kew and St Petersburg there were usually considerable differences in detail, and the movements were occasionally in opposite directions. The differences between Toronto, Melbourne or Zi-ka-wei and the European stations were still more pronounced. In 1896, on the initiative of M. Eschenhagen,[43] eye observations of declination and horizontal force were taken at 5-second intervals during prearranged hours at Batavia, Manila, Melbourne and nine European stations. The data from one of these occasions when appreciable disturbance prevailed were published by Eschenhagen, and were subsequently analysed by Ad. Schmidt.[44] Taking the stations in western Europe, Schmidt drew several series of lines, each series representing the disturbing forces at one instant of time as deduced from the departure of the elements at the several stations from their undisturbed value. The lines answering to any one instant had a general sameness of direction with more or less divergence or convergence, but their general trend varied in a way which suggested to Schmidt the passage of a species of vortex with large but finite velocity.

TABLE XXXIX.—Direction of First Decided Movement.

Place.	Declination.	Horizontal Force.	Vertical Force.
Pavlovsk	West	+	+
Potsdam	West	+	−
Greenwich	West	+	+
Zi-ka-wei	East	+	−
Kolaba	East	+	−
Batavia	West	+	−
Mauritius	East	+	+
Cape Horn	West	+	−

The conclusion that magnetic disturbances tend to follow one another at nearly equal intervals of time has been reached by several independent observers. J. A. Broun[45] pronounced for a period of about 26 days, and expressed a belief that a certain zone, or zones, of the sun's surface might exert a prepotent influence on the earth's magnetism during several solar rotations. Very similar views were advanced in 1904 by E. W. Maunder,[39] who was wholly unaware of Broun's work. Maunder concluded that the period was 27·28 days, coinciding with the sun's rotation period relative to an observer on the earth. Taking magnetic storms at Greenwich from 1882 to 1903, he found the interval between the commencement of successive storms to approach closely to the above period in a considerably larger number of instances than one would have expected from mere chance. He found several successions of three or four storms, and in one instance of as many as six storms, showing his interval. In a later paper Maunder reached similar results for magnetic storms at Greenwich from 1848 to 1881. Somewhat earlier than Maunder, Arthur Harvey[46] deduced a period of 27·246 days from a consideration of magnetic disturbances at Toronto. A. Schuster,[47] examining Maunder's data mathematically, concluded that they afforded rather strong evidence of a period of about ½ (27·28) or 13·6 days. Maunder regarded his results as *demonstrating* that magnetic disturbances originate in the sun. He regarded the solar action as arising from active areas of limited extent on the sun's surface, and as propagated along narrow, well defined streams. The active areas he believed to be also the seats of the formation of sun-spots, but believed that their activity might precede and outlive the visible existence of the sun-spot.

Maunder did not discuss the physical nature of the phenomenon, but his views are at least analogous to those propounded somewhat earlier by Svante Arrhenius,[48] who suggested that small negatively charged particles are driven from the sun by the repulsion of light and reach the earth's atmosphere, setting up electrical currents, manifest in aurora and magnetic disturbances. Arrhenius's calculations, for the size of particle which he regarded as most probable, make the time of transmission to the earth slightly under two days. Amongst other theories which ascribe magnetic storms to direct solar action may be mentioned that of Kr. Birkeland,[49] who believes the vehicle to be cathode rays. Ch. Nordmann[50] similarly has suggested Röntgen rays. Supposing the sun the ultimate source, it would be easier to discriminate between the theories if the exact time of the originating occurrence could be fixed. For instance, a disturbance that is propagated with the velocity of light may be due to Röntgen rays, but not to Arrhenius's particles. In support of his theory, Nordmann mentions several cases when conspicuous visual phenomena on the sun have synchronized with magnetic movements on the earth—the best known instance being the apparent coincidence in time of a magnetic disturbance at Kew on the 1st of September 1859 with a remarkable solar outburst seen by R. C. Carrington. Presumably any electrical phenomenon on the sun will set up waves in the aether, so transmission of electric and magnetic disturbances from the sun to the earth with the velocity of light is a certainty rather than a hypothesis; but it by no means follows that the energy thus transmitted can give rise to sensible magnetic disturbances. Also, when considering Nordmann's coincidences, it must be remembered that magnetic movements are so numerous that it would be singular if no apparent coincidences had been noticed. Another consideration is that the movements shown by ordinary magnetographs are seldom very rapid. During some storms, especially those accompanied by unusually bright and rapidly varying auroral displays, large to and fro movements follow one another in close succession, the changes being sometimes too quick to be registered distinctly on the photographic paper. This, however, is exceptional, even in polar regions where disturbances are largest and most numerous. As a rule, even when the change in the direction of movement in the declination needle seems quite sudden, the movement in one direction usually lasts for several minutes, often for 10, 15 or 30 minutes. Thus the cause to which magnetic disturbances are due seems in many cases to be persistent in one direction for a considerable time.

§ 38. Attempts have been made to discriminate between the theories as to magnetic storms by a critical examination of the phenomena. A general connexion between sun-spot frequency and the amplitude of magnetic movements, regular and irregular, is generally admitted. If it is a case of cause and effect, and the interval between the solar and terrestrial phenomena does not exceed a few hours, then there should be a sensible connexion between corresponding daily values of the sun-spot frequency and the magnetic range. Even if only some sun-spots are effective, we should expect when we select from a series of years two groups of days, the one containing the days of most sun-spots, the other the days of least, that a prominent difference will exist between the mean values of the absolute daily magnetic ranges for the two groups. Conversely, if we take out the days of small and the days of large magnetic range, or the days that are conspicuously quiet and those that are highly disturbed, we should expect a prominent difference between the corresponding mean sun-spot areas. An application of this principle was made by Chree[23] to the five quiet days a month selected by the astronomer royal between 1890 and 1900. These days are very quiet relative to the average day and possess a much smaller absolute range. One would thus have expected on Birkeland's or Nordmann's theory the mean sun-spot frequency derived from Wolfer's provisional values for these days to be much below his mean value, 41·22, for the eleven years. It proved, however, to be 41·28. This practical identity was as visible in 1892 to 1895, the years of sun-spot maximum, as it was in the years of sun-spot minimum. Use was next made of the Greenwich *projected* sun-spot areas, which are the result of exact measurement. The days of each month were divided into three groups, the first and third—each normally of ten days—containing respectively the days of largest and the days of least sun-spot area. The mean sun-spot area from group 1 was on the average about five times that for group 3. It was then investigated how the astronomer royal's quiet days from 1890 to 1900, and how the most disturbed days of the period selected from the Kew[24] magnetic records, distributed themselves among the three groups of days. Nineteen months were excluded, as containing more than ten days with no sun-spots. The remaining 113 months contained 565 quiet and 191 highly disturbed days, whose distribution was as follows:

	Group 1.	Group 2.	Group 3.
Quiet days	179	195	191
Disturbed days	68	65	58

The group of days of largest sun-spot area thus contained slightly under their share of quiet days and slightly over their share of disturbed days. The differences, however, are not large, and in three years, viz. 1895, 1897 and 1899, the largest number of disturbed days actually occurred in group 3, while in 1895, 1896 and 1899 there were fewer quiet days in group 3 than in group 1. Taking the same distribution of days, the mean value of the absolute daily range of declination at Kew was calculated for the group 1 and the group 3 days of each month. The mean range from the group 1 days was the larger in 57% of the individual months as against 43% in which it was the smaller. When the days of each month were divided into groups according to the absolute declination range at Kew, the mean sun-spot area for the group 1 days (those of largest range) exceeded that for the group 3 days (those of least range) in 55% of the individual months, as against 45% of cases in which it was the smaller.

Taking next the five days of largest and the five days of least range in each month, sun-spot areas were got out not merely for these days themselves, but also for the next subsequent day and the four immediately preceding days in each case. On Arrhenius's theory we should expect the magnetic range to vary with the sun-spot area, not on the actual day but two days previously. The following figures give the percentage excess or deficiency of the mean sun-spot area for the respective groups of days, relative to the average value for the whole epoch dealt with. *n* denotes the day to which the magnetic range belongs, *n*+1 the day after, *n*−1 the day before, and so on. Results are given for 1894 and 1895, the years which were on the whole the most favourable and the least favourable for Arrhenius's hypothesis, as well as for the whole eleven years.

TABLE XL.

Day.		$n-4$	$n-3$	$n-2$	$n-1$	n	$n+1$
Five days of largest range	1894	+12	+ 9	+11	+12	+11	+6
	1895	−16	−17	−15	−12	−11	−10
	11 yrs.	+ 9	+ 8	+ 8	+ 7	+ 5	+ 0·5
Five days of least range	1894	−15	−17	−19	−21	−21	−19
	1895	+17	+10	+ 1	− 2	− 2	− 4
	11 yrs.	− 4	− 4	− 7	− 7	− 7	− 6

Taking the 11-year-means we have the sun-spot area practically normal on the day subsequent to the representative day of large magnetic range, but sensibly above its mean on that day and still more so on the four previous days. This suggests an emission from the sun taking a highly variable time to travel to the earth. The 11-year mean data for the five days of least range seem at first sight to point to the same conclusion, but the fact that the deficiency in sun-spot area is practically as prominent on the day after the representative day of small magnetic range as on that day itself, or the previous days, shows that the phenomenon is probably a secondary one. On the whole, taking into account the extraordinary differences between the results from individual years, we seem unable to come to any very positive conclusion, except that in the present state of our knowledge little if any clue is afforded by the extent of the sun's spotted area on any particular day as to the magnetic conditions on the earth on that or any individual subsequent day. Possibly some more definite information might be extracted by considering the extent of spotted area on different zones of the sun. On theories such as those of Arrhenius or Maunder, effective bombardment of the earth would be more or less confined to spotted areas in the zones nearest the centre of the visible hemisphere, whilst all spots on this hemisphere contribute to the total spotted area. Still the *projected* area of a spot rapidly diminishes as it approaches the edge of the visible hemisphere, *i.e.* as it recedes from the most effective position, so that the method employed above gives a preponderating weight to the central zones. One rather noteworthy feature in Table XL. is the tendency to a sequence in the figures in any one row. This seems to be due, at least in large part, to the fact that days of large and days of small sun-spot area tend to occur in groups. The same is true to a certain extent of days of large and days of small magnetic range, but it is unusual for the range to be much above the average for more than 3 or 4 successive days.

Pulsations.

§ 39. The records from ordinary magnetographs, even when run at the usual rate and with normal sensitiveness, not infrequently show a repetition of regular or nearly regular small rhythmic movements, lasting sometimes for hours. The amplitude and period on different occasions both vary widely. Periods of 2 to 4 minutes are the most common. W. van Bemmelen[51] has made a minute examination of these movements from several years' traces at Batavia, comparing the results with corresponding statistics sent him from Zi-ka-wei and Kew. Table XLI. shows the diurnal variation in the frequency of occurrence of these small movements—called *pulsations* by van Bemmelen—at these three stations. The Batavia results are from the years 1885 and 1892 to 1898. Of the two sets of data for Zi-ka-wei (i) answers to the years 1897, 1898 and 1900, as given by van Bemmelen, while (ii) answers to the period 1900–1905, as given in the Zi-ka-wei *Bulletin* for 1905. The Kew data are for 1897. The results are expressed as percentages of the total for the 24 hours. There is a remarkable contrast between Batavia and Zi-ka-wei on the one hand and Kew on the other, pulsations being much more numerous by night than by day at the two former stations, whereas at Kew the exact reverse holds. Van Bemmelen decided that almost all the occasions of pulsation at Zi-ka-wei were also occasions of pulsations at Batavia. The hours of commencement at the two places usually differed a little, occasionally by as much as 20 minutes; but this he ascribed to the fact that the earliest oscillations were too small at one or other of the stations to be visible on the trace. Remarkable coincidence between pulsations at Potsdam and in the north of Norway has been noted by Kr. Birkeland.[52]

With magnetographs of greater sensitiveness and more open time scales, waves of shorter period become visible. In 1882 F. Kohlrausch[53] detected waves with a period of about 12 seconds. Eschenhagen[53] observed a great variety of short period waves, 30 seconds being amongst the most common. Some of the records he obtained suggest the superposition of regular sine waves of different periods. Employing a very sensitive galvanometer to record changes of magnetic induction through a coil traversed by the earth's lines of force, H. Ebert[54] has observed vibrations whose periods are but a small fraction of a second. The observations of Kohlrausch and Eschenhagen preceded the recent great development of applications of electrical power, while longer period waves are shown in the Kew curves of 50 years ago, so that the existence of natural waves with periods of from a few seconds up to several minutes can hardly be doubted. Whether the much shorter period waves of Ebert are also natural is more open to doubt, as it is becoming exceedingly difficult in civilized countries to escape artificial disturbances.

TABLE XLI.—Diurnal Distribution of Pulsations.

Hours.	0–3.	3–6.	6–9.	9–Noon.	Noon–3.	3–6.	6–9.	9–12.
Batavia	28	9	2	6	8	6	13	28
Zi-ka-wei (i)	33	5	2	7	4	4	10	35
" (ii)	23	6	8	11	7	5	14	26
Kew	4	8	19	14	22	18	11	4

Lunar Influence.

§ 40. The fact that the moon exerts a small but sensible effect on the earth's magnetism seems to have been first discovered in 1841 by C. Kreil. Subsequently Sabine[55] investigated the nature of the lunar diurnal variation in declination at Kew, Toronto, Pekin, St Helena, Cape of Good Hope and Hobart. The data in Table XLII. are mostly due to Sabine. They represent the mean lunar diurnal inequality in declination for the whole year. The unit employed is 0′·001, and as in our previous tables + denotes movement to the *west*. By "mean departure" is meant the arithmetic mean of the 24 hourly departures from the mean value for the lunar day; the range is the difference between the algebraically greatest and least of the hourly values. Not infrequently the mean departure gives the better idea of the importance of an inequality, especially when as in the present case two maxima and minima occur in the day. This double daily period is unusually prominent in the case of the lunar diurnal inequality, and is seen in the other elements as well as in the declination.

Lunar action has been specially studied in connexion with observations from India and Java. Broun[56] at Trivandrum and C. Chambers[57] at Kolaba investigated lunar action from a variety of aspects. At Batavia van der Stok[58] and more recently S. Figee[59] have carried out investigations involving an enormous amount of computation. Table XLIII. gives a summary of Figee's results for the mean lunar diurnal inequality at Batavia, for the two half-yearly periods April to September (Winter or W.), and October to March (S.). The + sign denotes movement to the west in the case of declination, but numerical increase in the case of the other elements. In the case of H and T (total force) the results for the two seasons present comparatively small differences, but in the case of D, I and V the amplitude and phase both differ widely. Consequently a mean lunar diurnal variation derived from all the months of the year gives at Batavia, and presumably at other

TABLE XLII.—Lunar Diurnal Inequality of Declination (unit 0′·001).

Lunar Hour.	Kew. 1858–1862.	Toronto. 1843–1848.	Batavia. 1883–1899.	St Helena. 1843–1847.	Cape. 1842–1846.	Hobart. 1841–1848.
0	+103	+315	−70	− 43	−148	− 98
1	+160	+275	−63	− 5	−107	−138
2	+140	+158	−39	+ 37	− 35	−142
3	+ 33	+ 2	− 8	+ 70	+ 43	−107
4	+ 10	−153	+38	+ 85	+108	− 45
5	− 67	−265	+63	+ 77	+140	+ 27
6	−150	−302	+87	+ 48	+132	+ 88
7	−188	−255	+77	+ 5	+ 82	+122
8	−160	−137	+40	− 43	+ 5	+120
9	− 78	+ 7	− 4	− 82	− 78	+ 82
10	+ 2	+178	−45	−102	−143	+ 17
11	+ 92	+288	−80	− 98	−177	− 57
12	+160	+323	−87	− 73	−165	−120
13	+188	+272	−68	− 32	−112	−152
14	+158	+148	−43	+ 13	− 30	−147
15	+ 90	− 17	− 8	+ 52	+ 58	−105
16	+ 10	−180	+30	+ 73	+132	− 35
17	− 85	−297	+62	+ 73	+172	+ 45
18	−142	−337	+72	+ 52	+168	+112
19	−163	−290	+68	+ 17	+122	+152
20	−147	−170	+52	− 25	+ 45	+152
21	−123	− 7	+ 8	− 58	− 40	+113
22	− 40	+155	−28	− 73	−112	+ 47
23	+ 27	+265	−56	− 68	−153	− 30
Mean Departure	105	200	50	54	104	93
Range	376	660	174	187	349	304

TABLE XLIII.—Lunar Diurnal Inequality at Batavia in Winter and Summer.

	Declination (unit 0′·001).		Inclination, S. (unit 0′·001).		H. (unit 0·01γ).		V. (unit 0·01γ).		T. (unit 0·01γ).	
Lunar Hour.	W.	S.	W.	S.	W.	S.	W.	S.	W.	S.
0	+30	−170	− 1	+25	−15	− 56	− 9	+ 4	− 17	−47
1	+21	−147	−23	+49	−40	− 87	−54	+20	− 61	−67
2	+ 5	− 83	−49	+69	−25	−107	−83	+37	− 62	−76
3	− 5	− 12	−51	+47	−21	− 76	−83	+24	− 59	−55
4	+ 1	+ 76	−37	+43	−13	− 59	−58	+18	− 39	−38
5	− 8	+134	−23	+12	+10	− 9	−27	+11	− 4	− 3
6	− 7	+181	− 2	−21	+21	+ 43	+ 9	− 6	+ 23	+35
7	−10	+164	+30	−12	+23	+ 45	+55	+ 8	+ 47	+43
8	− 7	+ 86	+36	−21	+38	+ 52	+71	− 1	+ 68	+45
9	− 8	0	+28	−23	+46	+ 30	+64	−16	+ 71	+19
10	− 5	− 85	+34	−20	+13	+ 13	+54	−21	+ 38	+ 1
11	−15	−144	+27	−11	−12	− 6	+31	−19	+ 5	−15
12	− 9	−164	+19	− 5	−47	− 23	0	−19	− 41	−29
13	+ 1	−136	− 3	+17	−59	− 46	−36	− 2	− 69	−41
14	− 7	− 79	−13	+27	−66	− 44	−55	+14	− 84	−32
15	− 8	− 8	−32	+25	−53	− 37	−74	+14	− 82	−26
16	−12	+ 72	−37	+25	−34	− 17	−70	+26	− 64	− 2
17	−13	+137	−33	+ 4	− 1	+ 28	−47	+21	− 24	+35
18	−21	+165	− 2	−10	+20	+ 47	+ 8	+12	+ 21	+47
19	−12	+147	+21	−42	+44	+ 81	+53	−14	+ 64	+64
20	+10	+ 95	+21	−62	+75	+107	+71	−28	+100	+80
21	+13	+ 4	+26	−70	+65	+ 98	+72	−44	+ 92	+65
22	+25	− 82	+35	−41	+35	+ 35	+68	−38	+ 64	+12
23	+36	−147	+34	− 4	− 7	− 14	+44	−13	+ 15	−19
Mean Departure	12	150	26	29	33	48	50	18	51	37
Range	57	351	87	139	141	214	155	81	184	156

tropical stations, an inadequate idea of the importance of the lunar influence. In January Figee finds for the range of the lunar diurnal inequality 0′·62 in D, 3·1γ in H and 3·5γ in V, whereas the corresponding ranges in June are only 0′·13, 1·1γ and 2·2γ respectively. The difference between summer and winter is essentially due to solar action, thus the lunar influence on terrestrial magnetism is clearly a somewhat complex phenomenon. From a study of Trivandrum data, Broun concluded that the action of the moon is largely dependent on the solar hour at the time, being on the average about twice as great for a day hour as for a night hour. Figee's investigations at Batavia point to a similar conclusion. Following a method suggested by Van der Stok, Figee arrives at a numerical estimate of the "lunar activity" for each hour of the solar day, expressed in terms of that at noon taken as 100. In summer, for instance, in the case of D he finds the "activity" varying from 114 at 10 a.m. to only 8 at 9 p.m.; the corresponding extremes in the case of H are 139 at 10 a.m. and 54 at 6 a.m.

The question whether lunar influence increases with sun-spot frequency is obviously of considerable theoretical interest. Balfour Stewart in the 9th edition of this encyclopaedia gave some data indicating an appreciably enhanced lunar influence at Trivandrum during years of sun-spot maximum, but he hesitated to accept the result as finally proved. Figee recently investigated this point at Batavia, but with inconclusive results. Attempts have also been made to ascertain how lunar influence depends on the moon's declination and phase, and on her distance from the earth. The difficulty in these investigations is that we are dealing with a small effect, and a very long series of data would be required satisfactorily to eliminate other periodic influences.

Planetary Influence.

§ 41. From an analysis of seventeen years data at St Petersburg and Pavlovsk, Leyst[60] concluded that all the principal planets sensibly influence the earth's magnetism. According to his figures, all the planets except Mercury—whose influence he found opposite to that of the others—when nearest the earth tended to deflect the declination magnet at St Petersburg to the west, and also increased the range of the diurnal inequality of declination, the latter effect being the more conspicuous. Schuster,[61] who has considered the evidence advanced by Leyst from the mathematical standpoint, considers it to be inconclusive.

Magnetic Surveys.

§ 42. The best way of carrying out a magnetic survey depends on where it has to be made and on the object in view. The object that probably still comes first in importance is a knowledge of the declination, of sufficient accuracy for navigation in all navigable waters. One might thus infer that magnetic surveys consist mainly of observations at sea. This cannot however be said to be true of the past, whatever it may be of the future, and this for several reasons. Observations at sea entail the use of a ship, specially constructed so as to be free from disturbing influence, and so are inherently costly; they are also apt to be of inferior accuracy. It might be possible in quiet weather, in a large vessel free from vibration, to observe with instruments of the highest precision such as a unifilar magnetometer, but in the ordinary surveying ship apparatus of less sensitiveness has to be employed. The declination is usually determined with some form of compass. The other elements most usually found directly at sea are the inclination and the total force, the instrument employed being a special form of inclinometer, such as the Fox circle, which was largely used by Ross in the Antarctic, or in recent years the Lloyd-Creak. This latter instrument differs from the ordinary dip-circle fitted for total force observations after H. Lloyd's method mainly in that the needles rest in pivots instead of on agate edges. To overcome friction a projecting pin on the framework is scratched with a roughened ivory plate.

The most notable recent example of observations at sea is afforded by the cruises of the surveying ships "Galilee" and "Carnegie" under the auspices of the Carnegie Institution of Washington, which includes in its magnetic programme a general survey. To see where the ordinary land survey assists navigation, let us take the case of a country with a long sea-board. If observations were taken every few miles along the coast results might be obtained adequate for the ordinary wants of coasting steamers, but it would be difficult to infer what the declination would be 50 or even 20 miles off shore at any particular place. If, however, the land area itself is carefully surveyed, one knows the trend of the lines of equal declination, and can usually extend them with considerable accuracy many miles out to sea. One also can tell what places if any on the coast suffer from local disturbances, and thus decide on the necessity of special observations. This is by no means the only immediately useful purpose which is or may be served by magnetic surveys on land. In Scandinavia use has been made of magnetic observations in prospecting for iron ore. There are also various geological and geodetic problems to whose solution magnetic surveys may afford valuable guidance. Among the most important recent surveys may be mentioned those of the British Isles by A. Rücker and T. E. Thorpe,[62] of France and Algeria by Moureaux,[63] of Italy by Chistoni and Palazzo,[64] of the Netherlands by Van Ryckevorsel,[65] of South Sweden by Carlheim Gyllenskiöld,[66] of Austria-Hungary by Liznar,[67] of Japan by Tanakadate,[68] of the East Indies by Van Bemmelen, and South Africa by J. C. Beattie. A survey of the United States has been proceeding for a good many years, and many results have appeared in the publications of the U.S. Coast and Geodetic Survey, especially Bauer's *Magnetic Tables and Magnetic Charts*, 1908. Additions to our knowledge may also be expected from surveys of India, Egypt and New Zealand.

For the satisfactory execution of a land survey, the observers must have absolute instruments such as the unifilar magnetometer and dip circle, suitable for the accurate determination of the magnetic elements, and they must be able to fix the exact positions of the spots where observations are taken. If, as usual, the survey occupies several years, what is wanted is the value of the elements not at the actual time of observation, but at some fixed epoch, possibly some years earlier or later. At a magnetic observatory, with standardized records, the difference between the values of a magnetic element at any two specified instants can be derived from the magnetic curves. But at an ordinary survey station, at a distance from an observatory, the information is not immediately available. Ordinarily the reduction to a fixed epoch is done in at least two stages, a correction being applied for secular change, and a second for the departure from the mean value for the day due to the regular diurnal inequality and to disturbance.

The reduction to a fixed epoch is at once more easy and more accurate if the area surveyed contains, or has close to its borders, a well distributed series of magnetic observatories, whose records are comparable and trustworthy. Throughout an area of the size of France or Germany, the secular change between any two specified dates can ordinarily be expressed with sufficient accuracy by a formula of the type

$$\delta = \delta_0 + a(l - l_0) + b(\lambda - \lambda_0) \qquad \text{(i)},$$

where δ denotes secular change, l latitude and λ longitude, the letters with suffix o relating to some convenient central position. The constants δ_0, a, b are to be determined from the observed secular changes at the fixed observatories whose geographical co-ordinates are accurately known. Unfortunately, as a rule, fixed observatories are few in number and not well distributed for survey purposes; thus the secular change over part at least of the area has usually to be found by repeating the observations after some years at several of the field stations. The success attending this depends on the exactitude with which the sites can be recovered, on the accuracy of the observations, and on the success with which allowance is made for diurnal changes, regular and irregular. It is thus desirable that the observations at repeat stations should be taken at hours when the regular diurnal changes are slow, and that they should not be accepted unless taken on days that prove to be magnetically quiet. Unless the secular change is exceptionally rapid, it will usually be most convenient in practice to calculate it from or to the middle of the month, and then to allow for the difference between the mean value for the month and the value at the actual hour of observation. There is here a difficulty, inasmuch as the latter part of the correction depends on the diurnal inequality, and so on the local time of the station. No altogether satisfactory method of surmounting this difficulty has yet been proposed. Rücker and Thorpe in their British survey assumed that the divergence from the mean value at any hour at any station might be regarded as made up of a regular diurnal inequality, identical with that at Kew when both were referred to *local* time, and of a disturbance element identical with that existing at the same absolute time at Kew. Suppose, for instance, that at hour h G.M.T. the departure at Kew from the mean value for the month is d, then the corresponding departure from the mean at a station λ degrees west of Kew is $d-e$, where e is the increase in the element at Kew due to the regular diurnal inequality between hour $h-\lambda/15$ and hour h. This procedure is simple, but is exposed to various criticisms. If we define a diurnal inequality as the result obtained by combining hourly readings from all the days of a month, we can assign a definite meaning to the diurnal inequality for a particular month of a particular year, and after the curves have been measured we can give exact numerical figures answering to this definition. But the diurnal inequality thus obtained differs, as has been pointed out, from that derived from a limited number of the quietest days of the month, not merely in amplitude but in phase, and the view that the diurnal changes on any individual day can be regarded as made up of a regular diurnal inequality of definite character and of a disturbance element is an hypothesis which is likely at times to be considerably wide of the mark. The extent of the error involved in assuming the regular diurnal inequality the same in the north of Scotland, or the west of Ireland, as in the south-east of England remains to be ascertained. As to the disturbance element, even if the disturbing force were of given magnitude and direction all over the British Isles—which we now know is often very far from the case—its effects would necessarily vary very sensibly owing to the considerable variation in the direction and intensity of the local undisturbed force. If observations were confined to hours at which the regular diurnal changes are slow, and only those taken on days of little or no disturbance were utilized, corrections combining the effects of regular and irregular diurnal changes could be derived from the records of fixed observations, supposed suitably situated, combined in formulae of the same type as (1).

§ 43. The field results having been reduced to a fixed epoch, it remains to combine them in ways likely to be useful. In most cases the results are embodied in charts, usually of at least two kinds, one set showing only general features, the other the chief local peculiarities. Charts of the first kind resemble the world charts (figs. 1 to 4) in being free from sharp twistings and convolutions. In these the declination for instance at a fixed geographical position on a particular isogonal is to be regarded as really a mean from a considerable surrounding area.

Various ways have been utilized for arriving at these *terrestrial isomagnetics*—as Rücker and Thorpe call them—of which an elaborate discussion has been made by E. Mathias.[67] From a theoretical standpoint the simplest method is perhaps that employed by Liznar for Austria-Hungary. Let l and λ represent latitude and longitude relative to a certain central station in the area. Then assume that throughout the area the value E of any particular magnetic element is given by a formula

$$E=E_0+al+b\lambda+cl^2+d\lambda^2+el\lambda,$$

where E_0, a, b, c, d, e are absolute constants to be determined from the observations. When determining the constants, we write for E in the equation the observed value of the element (corrected for secular change, &c.) at each station, and for l and λ the latitude and longitude of the station relative to the central station. Thus each station contributes an equation to assist in determining the six constants. They can thus be found by least squares or some simpler method. In Liznar's case there were 195 stations, so that the labour of applying least squares would be considerable. This is one objection to the method. A second is that it may allow undesirably large weight to a few highly disturbed stations. In the case of the British Isles, Rücker and Thorpe employed a different method. The area was split up into *districts*. For each district a mean was formed of the observed values of each element, and the mean was assigned to an imaginary central station, whose geographical co-ordinates represented the mean of the geographical co-ordinates of the actual stations. Want of uniformity in the distribution of the stations may be allowed for by weighting the results. Supposing E_0 the value of the element found for the central station of a district, it was assumed that the value E at any actual station whose latitude and longitude exceeded those of the central station by l and λ was given by $E=E_0+al+b\lambda$, with a and b constants throughout the district. Having found E_0, a and b, Rücker and Thorpe calculated values of the element for points defined by whole degrees of longitude (from Greenwich) and half degrees of latitude. Near the common border of two districts there would be two calculated values, of which the arithmetic mean was accepted.

The next step was to determine by interpolation where isogonals—or other isomagnetic lines—cut successive lines of latitude. The curves formed by joining these successive points of intersection were called *district* lines or curves. Rücker and Thorpe's next step was to obtain formulae by trial, giving smooth curves of continuous curvature—terrestrial isomagnetics—approximating as closely as possible to the district lines. The curves thus obtained had somewhat complicated formulae. For instance, the isogonals south of 54°·5 latitude were given for the epoch Jan. 1, 1891 by

$$\begin{aligned}D=18^\circ\,37'+18'{\cdot}5(l-49{\cdot}5)-3'{\cdot}5\cos\{45^\circ(l-49{\cdot}5)\}\\+\{26'{\cdot}3+1'{\cdot}5(l-49{\cdot}5)\}(\lambda-4)+0'{\cdot}01(\lambda-4)^2(l-54{\cdot}5)^2,\end{aligned}$$

where D denotes the westerly declination. Supposing, what is at least approximately true, that the secular change in Great Britain since 1891 has been uniform south of lat. 54°·5, corresponding formulae for the epochs Jan. 1, 1901, and Jan. 1, 1906, could be obtained by substituting for 18° 37′ the values 17° 44′ and 17° 24′ respectively. In their very laborious and important memoir E. Mathias and B. Baillaud[68] have applied to Rücker and Thorpe's observations a method which is a combination of Rücker and Thorpe's and of Liznar's. Taking Rücker and Thorpe's nine districts, and the magnetic data found for the nine imaginary central stations, they employed these to determine the six constants of Liznar's formula. This is an immense simplification in arithmetic. The declination formula thus obtained for the epoch Jan. 1, 1891, was

$$\begin{aligned}D=20^\circ\,45'{\cdot}89+{\cdot}53474\lambda+{\cdot}34716l+{\cdot}000021\lambda^2\\+{\cdot}000343l\lambda-{\cdot}000239l^2,\end{aligned}$$

where $l+(53^\circ\ 30'{\cdot}5)$ represents the latitude, and $(\lambda+5^\circ\ 35'{\cdot}2)$ the west longitude of the station. From this and the corresponding formulae for the other elements, values were calculated for each of Rücker and Thorpe's 882 stations, and these were compared with the observed values. A complete record is given of the differences between the observed and calculated values, and of the corresponding differences obtained by Rücker and Thorpe from their own formulae. The mean numerical (calculated ~ observed) differences from the two different methods are almost exactly the same—being approximately 10′ for declination, 5′½ for inclination, and 70γ for horizontal force. The applications by Mathias[69] of his method to the survey data of France obtained by Moureaux, and those of the Netherlands obtained by van Rijckevorsel, appear equally successful. The method dispenses entirely with district curves, and the parabolic formulae are perfectly straightforward both to calculate and to apply; they thus appear to possess marked advantages. Whether the method could be applied equally satisfactorily to an area of the size of India or the United States actual trial alone would show.

Local Disturbances.

§ 44. Rücker and Thorpe regarded their terrestrial isomagnetics and the corresponding formulae as representing the normal field that would exist in the absence of disturbances peculiar to the neighbourhood. Subtracting the forces derived from the formulae from those observed, we obtain forces which may be ascribed to regional disturbance.

When the vertical disturbing force is downwards, or the observed vertical component larger than the calculated, Rücker and Thorpe regard it as positive, and the loci where the largest positive values occur they termed *ridge lines*. The corresponding loci where the largest negative values occur were called *valley lines*. In the British Isles Rücker and Thorpe found that almost without exception, in the neighbourhood of a ridge line, the horizontal component of the disturbing force pointed towards it, throughout a considerable area on both sides. The phenomena are similar to what would occur if ridge lines indicated the position of the summits of underground masses of magnetic material, magnetized so as to attract the north-seeking pole of a magnet. Rücker and Thorpe were inclined to believe in the real existence of these subterranean magnetic mountains, and inferred that they must be of considerable extent, as theory and observation alike indicate that thin basaltic sheets or dykes, or limited masses of trap rock, produce no measurable magnetic effect except in their immediate vicinity. In support of their conclusions, Rücker and Thorpe dwell on the fact that in the United Kingdom large masses of basalt such as occur in Skye, Mull, Antrim, North Wales or the Scottish coalfield, are according to their survey invariably centres of attraction for the north-seeking pole of a magnet. Various cases of repulsion have, however, been described by other observers in the northern hemisphere.

§ 45. Rücker and Thorpe did not make a very minute examination of disturbed areas, so that purely local disturbances larger than any noticed by them may exist in the United Kingdom. But any that exist are unlikely to rival some that have been observed elsewhere, notably those in the province of Kursk in Russia described by Moureaux [70] and by E. Leyst.[71] In Kursk Leyst observed declinations varying from 0° to 360°, inclinations varying from 39°·1 to 90°; he obtained values of the horizontal force varying from 0 to 0·856 C.G.S., and values of the vertical force varying from 0·371 to 1·836. Another highly disturbed Russian district Krivoi Rog

(48° N. lat. 33° E. long.) was elaborately surveyed by Paul Passalsky.[72] The extreme values observed by him differed, the declination by 282° 40′, the inclination by 41° 53′, horizontal force by 0·658, and vertical force by 1·358. At one spot a difference of 116°½ was observed between the declinations at two positions only 42 metres apart. In cases such as the last mentioned, the source of disturbance comes presumably very near the surface. It is improbable that any such enormously rapid changes of declination can be experienced anywhere at the surface of a deep ocean. But in shallow water disturbances of a not very inferior order of magnitude have been met with. Possibly the most outstanding case known is that of an area, about 3 m. long by 1½ m. at its widest, near Port Walcott, off the N.W. Australian coast. The results of a minute survey made here by H.M.S. "Penguin" have been discussed by Captain E. W. Creak.[73] Within the narrow area specified, declination varied from 26° W. to 56° E., and inclination from 50° to nearly 80°, the observations being taken some 80 ft. above sea bottom. Another noteworthy case, though hardly comparable with the above, is that of East Loch Roag at Lewis in the Hebrides. A survey by H.M.S. "Research" in water about 100 ft. deep—discussed by Admiral A. M. Field[74]—showed a range of 11° in declination. The largest observed disturbances in horizontal and vertical force were of the order 0·02 and 0·05 C.G.S. respectively. An interesting feature in this case was that vertical force was reduced, there being a well-marked valley line.

In some instances regional magnetic disturbances have been found to be associated with geodetic anomalies. This is true of an elongated area including Moscow, where observations were taken by Fritsche.[75] Again, Eschenhagen [76] detected magnetic anomalies in an area including the Harz Mountains in Germany, where deflections of the plumb line from the normal had been observed. He found a magnetic ridge line running approximately parallel to the line of no deflection of the plumb line.

§ 46. A question of interest, about which however not very much is known, is the effect of local disturbance on secular change and on the diurnal inequality. The determination of secular change in a highly disturbed locality is difficult, because an unintentional slight change in the spot where the observations are made may wholly falsify the conclusions drawn. When the disturbed area is very limited in extent, the magnetic field may reasonably be regarded as composed of the normal field that would have existed in the absence of local disturbance, plus a disturbance field arising from magnetic material which approaches nearly if not quite to the surface. Even if no sensible change takes place in the disturbance field, one would hardly expect the secular change to be wholly normal. The changes in the rectangular components of the force may possibly be the same as at a neighbouring undisturbed station, but this will not give the same change in declination and inclination. In the case of the diurnal inequality, the presumption is that at least the declination and inclination changes will be influenced by local disturbance. If, for example, we suppose the diurnal inequality to be due to the direct influence of electric currents in the upper atmosphere, the declination change will represent the action of the component of a force of given magnitude which is perpendicular to the position of the compass needle. But when local disturbance exists, the direction of the needle and the intensity of the controlling field are both altered by the local disturbance, so it would appear natural for the declination changes to be influenced also. This conclusion seems borne out by observations made by Passalsky[72] at Krivoi Rog, which showed diurnal inequalities differing notably from those experienced at the same time at Odessa, the nearest magnetic observatory. One station where the horizontal force was abnormally low gave a diurnal range of declination four times that at Odessa; on the other hand, the range of the horizontal force was apparently reduced. It would be unsafe to draw general conclusions from observations at two or three stations, and much completer information is wanted, but it is obviously desirable to avoid local disturbance when selecting a site for a magnetic observatory, assuming one's object is to obtain data reasonably applicable to a large area. In the case of the older observatories this consideration seems sometimes to have been lost sight of. At Mauritius, for instance, inside of a circle of only 56 ft. radius, having for centre the declination pillar of the absolute magnetic hut of the Royal Alfred Observatory, T. F. Claxton[77] found that the declination varied from 4° 56′ to 13° 45′ W., the inclination from 50° 21′ to 58° 34′ S., and the horizontal force from 0·197 to 0·244 C.G.S. At one spot he found an alteration of 1°½ in the declination when the magnet was lowered from 4 ft. above the ground to 2. Disturbances of this order could hardly escape even a rough investigation of the site.

Gaussian Potential and Constants.

§ 47. If we assume the magnetic force on the earth's surface derivable from a potential V, we can express V as the sum of two series of solid spherical harmonics, one containing negative, the other positive integral powers of the radius vector r from the earth's centre. Let λ denote east longitude from Greenwich, and let $\mu=\cos(\frac{1}{2}\pi-l)$, where l is latitude; and also let

$$H_n^m=(1-\mu^2)^{\frac{1}{2}m}\left[\mu^{n-m}-\frac{(n-m)(n-m-1)}{2(2n-1)}\mu^{n-m-2}+\dots\right]$$

where n and m denote any positive integers, m being not greater than n. Then denoting the earth's radius by R, we have

$$V/R=\Sigma(R/r)^{n+1}[H_n^m(g_n^m\cos m\lambda+h_n^m\sin m\lambda)]$$
$$+\Sigma(r/R)^n[H_n^m(g_{-n}^m\cos m\lambda+h_{-n}^m\sin m\lambda)],$$

where Σ denotes summation of m from 0 to n, followed by summation of n from 0 to ∞. In this equation g_n^m, &c. are constants, those with positive suffixes being what are generally termed *Gaussian constants*. The series with negative powers of r answers to forces with a source internal to the earth, the series with positive powers to forces with an external source. Gauss found that forces of the latter class, if existent, were very small, and they are usually left out of account. There are three Gaussian constants of the first order, g_1^0, g_1^1, h_1^1, five of the second order, seven of the third, and so on. The coefficient of a Gaussian constant of the n^{th} order is a spherical harmonic of the n^{th} degree. If R be taken as unit length, as is not infrequent, the first order terms are given by

$$V_1=r^{-2}[g_1^0\sin l+(g_1^1\cos\lambda+h_1^1\sin\lambda)\cos l].$$

The earth is in reality a spheroid, and in his elaborate work on the subject J. C. Adams [78] develops the treatment appropriate to this case. Here we shall as usual treat it as spherical. We then have for the components of the force at the surface

$X=-R^{-1}(1-\mu^2)^{\frac{1}{2}}(dV/d\mu)$ towards the astronomical north,
$Y=-R^{-1}(1-\mu^2)^{-\frac{1}{2}}(dV/d\lambda)$ " " " west,
$Z=-dV/dr$ vertically downwards.

Supposing the Gaussian constants known, the above formulae would give the force all over the earth's surface. To determine the Gaussian constants we proceed of course in the reverse direction, equating the observed values of the force components to the theoretical values involving g_n^m, &c. If we knew the values of the component forces at regularly distributed stations all over the earth's surface, we could determine each Gaussian constant independently of the others. Our knowledge however of large regions, especially in the Arctic and Antarctic, is very scanty, and in practice recourse is had to methods in which the constants are not determined independently. The consequence is unfortunately that the values found for some of the constants, even amongst the lower orders, depend very sensibly on how large a portion of the polar regions is omitted from the calculations, and on the number of the constants of the higher orders which are retained.

Table XLIV.—Gaussian Constants of the First Order.

	1829 Erman-Petersen.	1830 Gauss.	1845 Adams.	1880 Adams.	1885 Neumayer.	1885 Schmidt.	1885 Fritsche.
g_1^0	+·32007	+·32348	+·32187	+·31684	+·31572	+·31735	+·31635
g_1^1	+·02835	+·03111	+·02778	+·02427	+·02481	+·02356	+·02414
h_1^1	−·06011	−·06246	−·05783	−·06030	−·06026	−·05984	−·05914

Table XLIV. gives the values obtained for the Gaussian constants of the first order in some of the best-known computations, as collected by W. G. Adams.[79]

§ 48. Allowance must be made for the difference in the epochs, and for the fact that the number of constants assumed to be worth retaining was different in each case. Gauss, for instance, assumed 24 constants sufficient, whilst in obtaining the results given in the table J. C. Adams retained 48. Some idea of the uncertainty thus arising may be derived from the fact that when Adams assumed 24 constants sufficient, he got instead of the values in the table the following:—

	g_1^0	g_1^1	h_1^1
1842–1845	+·32173	+·02833	−·05820
1880	+·31611	+·02470	−·06071

Some of the higher constants were relatively much more affected. Thus, on the hypotheses of 48 and of 24 constants respectively, the values obtained for g_3^0 in 1842–1845 were −·00127 and −·00057, and those obtained for h_3^1 in 1880 were +·00748 and +·00573. It must also be remembered that these values assume that the series in positive powers of r, with coefficients having negative suffixes, is absolutely non-existent. If this be not assumed, then in any equation determining X or Y, g_n^m must be replaced by $g_n^m+g_{-n}^m$, and in any equation determining Z by $g_n^m-\{n/(n+1)\}\,g_{-n}^m$; similar remarks apply to h_n^m and h_{-n}^m. It is thus theoretically possible to check the truth of the assumption that the positive power series is non-existent by comparing the values obtained for g_n^m and h_n^m from the X and Y or from the Z equations, when g_{-n}^m and h_{-n}^m are assumed zero. If the values so found differ, values can be found for g_{-n}^m and h_{-n}^m which will harmonize the two sets of equations. Adams gives the values obtained from the X, Y and the Z equations separately for the

Gaussian constants. The following are examples of the values thence deducible for the coefficients of the positive power series:—

	g_{-1}^{0}	g_{-1}^{1}	h_{-1}^{1}	g_{-4}^{0}	g_{-6}^{0}	g_{-8}^{0}
1842–1845	+·0018	−·0002	−·0014	+·0064	+·0072	+·0124
1880	−·0002	−·0012	+·0015	−·0043	−·0021	−·0013

Compared to g_4^0, g_6^0 and g_8^0 the values here found for g_{-4}^0, g_{-6}^0 and g_{-8}^0 are far from insignificant, and there would be no excuse for neglecting them if the observational data were sufficient and reliable. But two outstanding features claim attention, first the smallness of g_{-1}^0, g_{-1}^1 and h_{-1}^1, the coefficients least likely to be affected by observational deficiencies, and secondly the striking dissimilarity between the values obtained for the two epochs. The conclusion to which these and other facts point is that observational deficiencies, even up to the present date, are such that no certain conclusion can be drawn as to the existence or non-existence of the positive power series. It is also to be feared that considerable uncertainties enter into the values of most of the Gaussian constants, at least those of the higher orders. The introduction of the positive power series necessarily improves the agreement between observed and calculated values of the force, but it is more likely than not to be disadvantageous physically, if the differences between observed values and those calculated from the negative power series alone arise in large measure from observational deficiencies.

Table XLV.—Axis and Moment of First Order Gaussian Coefficients.

Epoch.	Authority for Constants.	North Latitude.	West Longitude.	M/R^3 in G.C.S. units.
		° ′	° ′	
1650	H. Fritsche . . .	82 50	42 55	·3260
1836	,,	78 27	63 35	·3262
1845	J. C. Adams . . .	78 44	64 20	·3282
1880	,,	78 24	68 4	·3234
1885	Neumayer-Petersen and Bauer . . .	78 3	67 3	·3224
1885	Neumayer Schmidt	78 34	68 31	·3230

§ 49. The first order Gaussian constants have a simple physical meaning. The terms containing them represent the potential arising from the uniform magnetization of a sphere parallel to a fixed axis, the moment M of the spherical magnet being given by

$$M = R^3\{(g_1^0)^2+(g_1^1)^2+(h_1^1)^2\}^{\frac{1}{2}},$$

where R is the earth's radius. The position of the north end of the axis of this uniform magnetization and the values of M/R^3, derived from the more important determinations of the Gaussian constants, are given in Table XLV. The data for 1650 are of somewhat doubtful value. If they were as reliable as the others, one would feel greater confidence in the reality of the apparent movement of the north end of the axis from east to west. The table also suggests a slight diminution in M since 1845, but it is open to doubt whether the apparent change exceeds the probable error in the calculated values. It should be carefully noticed that the data in the table apply only to the first order Gaussian terms, and so only to a portion of the earth's magnetization, and that the Gaussian constants have been calculated on the assumption that the negative power series alone exists. The field answering to the first order terms—or what Bauer has called the *normal* field—constitutes much the most important part of the whole magnetization. Still what remains is very far from negligible, save for rough calculations. It is in fact one of the weak points in the Gaussian analysis that when one wishes to represent the observed facts with high accuracy one is obliged to retain so many terms that calculation becomes burdensome.

Earth-air Currents.

§ 50. The possible existence of a positive power series is not the only theoretical uncertainty in the Gaussian analysis. There is the further possibility that part of the earth's magnetic field may not answer to a potential at all. Schmidt[80] in his calculation of Gaussian constants regarded this as a possible contingency, and the results he reached implied that as much as 2 or 3% of the entire field had no potential. If the magnetic force F on the earth's surface comes from a potential, then the line integral $\int F ds$ taken round any closed circuit s should vanish. If the integral does not vanish, it equals $4\pi I$, where I is the total electric current traversing the area bounded by s. A + sign in the result of the integration means that the current is downwards (*i.e.* from air to earth) or upwards, according as the direction of integration round the circuit, as viewed by an observer above ground, has been clockwise or anti-clockwise. In applications of the formula by W. von Bezold [81] and Bauer [82] the integral has been taken along parallels of latitude in the direction west to east. In this case a + sign indicates a resultant upward current over the area between the parallel of latitude traversed and the north geographical pole. The difference between the results of integration round two parallels of latitude gives the total vertical current over the zone between them. Schmidt's final estimate of the average intensity of the earth-air current, irrespective of sign, for the epoch 1885 was 0·17 ampere per square kilometre. Bauer employing the same observational data as Schmidt, reached somewhat similar conclusions from the differences between integrals taken round parallels of latitude at 5° intervals from 60° N. to 60° S. H. Fritsche [83] treating the problem similarly, but for two epochs, 1842 and 1885, got conspicuously different results for the two epochs. Bauer [84] has more recently repeated his calculations, and for three epochs, 1842–1845 (Sabine's charts), 1880 (Creak's charts), and 1885 (Neumayer's charts), obtaining the mean value of the current per sq. km. for 5° zones. Table XLVI. is based on Bauer's figures, the unit being 0·001 ampere, and + denoting an *upwardly* directed current.

Table XLVI.—Earth-air Currents, after Bauer.

Latitude.	Northern Hemisphere.			Southern Hemisphere.		
	1842–5.	1880.	1885.	1842–5.	1880.	1885.
0° to 15°	− 1	−32	−34	+66	+ 30	+ 36
15° ,, 30°	−70	−59	−68	+ 2	− 62	− 63
30° ,, 45°	+ 3	+14	−22	+26	− 11	− 14
45° ,, 60°	−31	−21	+78	+ 5	+276	+213

In considering the significance of the data in Table XLVI., it should be remembered that the currents must be regarded as mean values derived from all hours of the day, and all months of the year. Currents which were upwards during certain hours of the day, and downwards during others, would affect the diurnal inequality; while currents which were upwards during certain months, and downwards during others, would cause an annual inequality in the absolute values. Thus, if the figures be accepted as real, we must suppose that between 15° N. and 30° N. there are preponderatingly downward currents, and between 0° S. and 15° S. preponderatingly upward currents. Such currents might arise from meteorological conditions characteristic of particular latitudes, or be due to the relative distribution of land and sea; but, whatever their cause, any considerable real change in their values between 1842 and 1885 seems very improbable. The most natural cause to which to attribute the difference between the results for different epochs in Table XLVI. is unquestionably observational deficiencies. Bauer himself regards the results for latitudes higher than 45° as very uncertain, but he seems inclined to accept the reality of currents of the average intensity of 1/30 ampere per sq. km. between 45° N. and 45° S.

Currents of the size originally deduced by Schmidt, or even those of Bauer's latest calculations, seem difficult to reconcile with the results of atmospheric electricity (*q.v.*).

§ 51. There is no single parallel of latitude along the whole of which magnetic elements are known with high precision. Thus results of greater certainty might be hoped for from the application of the line integral to well surveyed countries. Such applications have been made, *e.g.* to Great Britain by Rücker,[85] and to Austria by Liznar,[86] but with negative results. The question has also been considered in detail by Tanakadate[87] in discussing the magnetic survey of Japan. He makes the criticism that the taking of a line integral round the *boundary* of a surveyed area amounts to utilizing the values of the magnetic elements where least accurately known, and he thus considers it preferable to replace the line integral by the surface integral.

$$4\pi I = \iint (dY/dx - dX/dy)\,dx\,dy.$$

He applied this formula not merely to his own data for Japan, but also to British and Austrian data of Rücker and Thorpe and of Liznar. The values he ascribes to X and Y are those given by the formulae calculated to fit the observations. The result reached was "a line of no current through the middle of the country; in Japan the current is upward on the Pacific side and downward on the Siberian side; in Austria it is upward in the north and downward in the south; in Great Britain upward in the east and downward in the west." The results obtained for Great Britain differed considerably according as use was made of Rücker and Thorpe's own district equations or of a series of general equations of the type subsequently utilized by Mathias. Tanakadate points out that the fact that his investigations give in each case a line of no current passing through the middle of the surveyed area, is calculated to throw doubt on the reality of the supposed earth-air currents, and he recommends a suspension of judgment.

§ 52. A question of interest, and bearing a relationship to the Gaussian analysis, is the law of variation of the magnetic elements with height above sea-level. If F represent the value at sea-level, and $F+\delta F$ that at height h, of any component of force answering to Gaussian constants of the n^{th} order, then $1+\delta F/F = (1+h/R)^{-n-2}$, where R is the earth's radius. Thus at heights of only a few miles we have very approximately $\delta F/F = -(n+2)h/R$. As we have seen, the constants of the first order are much the most important, thus we should expect as a first approximation $\delta X/X = \delta Y/Y = \delta Z/Z = -3h/R$. This equation gives the same rate of decrease in all three components, and so no change in declination or inclination. Liznar [86] (ᵃ) compared this equation with the observed results of his Austrian survey, subdividing his stations into three groups according to altitude. He considered the agreement not satisfactory. It must be remembered that the Gaussian analysis, especially when only lower order terms are retained, applies only to the earth's field freed from local disturbances. Now observations at individual high level stations may be seriously influenced not merely by regional disturbances common to low level stations, but by magnetic material in the mountain itself. A method of arriving at the vertical change in the elements, which theoretically seems less open to criticism, has been employed by A. Tanakadate.[86] If we assume that a potential exists, or if admitting the possibility of earth-air currents we assume their effort negligible, we have $dX/dz = dZ/dx$, $dY/dz = dZ/dy$. Thus from the observed rates of change of the vertical component of force along the parallels of latitude and longitude, we can deduce the rate of change in the vertical direction of the two rectangular components of horizontal force, and thence the rates of change of the horizontal force and the declination. Also we have $dZ/dz = 4\pi\rho - (dX/dx + dY/dy)$, where ρ represents the density of free magnetism at the spot. The spot being above ground we may neglect ρ, and thus deduce the variation in the vertical direction of the vertical component from the observed variations of the two horizontal components in their own directions. Tanakadate makes a comparison of the vertical variations of the magnetic elements calculated in the two ways, not merely for Japan, but also for Austria-Hungary and Great Britain. In each country he took five representative points, those for Great Britain being the central stations of five of Rücker and Thorpe's districts. Table XLVII. gives the mean of the five values obtained. By method (i.) is meant the formula involving $3h/R$, by method (ii.) Tanakadate's method as explained above. H, V, D, and I are used as defined in § 5. In the case of H and V unity represents 1γ.

Table XLVII.—Change per Kilometre of Height.

	Great Britain.		Austria-Hungary.		Japan.	
Method.	(i.)	(ii.)	(i.)	(ii.)	(i.)	(ii.)
H . .	− 8·1	− 6·7	−10·1	− 8·7	−13·9	−14·0
V . .	−21·2	−19·4	−19·0	−18·1	−17·1	−17·4
D (west)	..	− 0′·04	..	+ 0′·10	..	− 0′·27
I . .	..	− 0′·05	..	− 0′·06	..	− 0′·01

The − sign in Table XLVII. denotes a decrease in the numerical values of H, V and I, and a diminution in westerly declination. If we except the case of the westerly component of force—not shown in the table—the accordance between the results from the two methods in the case of Japan is extraordinarily close, and there is no very marked tendency for the one method to give larger values than the other. In the case of Great Britain and Austria the differences between the two sets of calculated values though not large are systematic, the $3h/R$ formula invariably showing the larger reduction with altitude in both H and V. Tanakadate was so satisfied with the accordance of the two methods in Japan, that he employed his method to reduce all observed Japanese values to sea-level. At a few of the highest Japanese stations the correction thus introduced into the value of H was of some importance, but at the great majority of the stations the corrections were all insignificant.

Schuster's Diurnal Variation Potential.

§ 53. Schuster[87] has calculated a potential analogous to the Gaussian potential, from which the regular diurnal changes of the magnetic elements all over the earth may be derived. From the mean summer and winter diurnal variations of the northerly and easterly components of force during 1870 at St Petersburg, Greenwich, Lisbon and Bombay, he found the values of 8 constants analogous to Gaussian constants; and from considerations as to the hours of occurrence of the maxima and minima of vertical force, he concluded that the potential, unlike the Gaussian, must proceed in positive powers of r, and so answer to forces external to the earth. Schuster found, however, that the calculated amplitudes of the diurnal vertical force inequality did not accord well with observation; and his conclusion was that while the original cause of the diurnal variation is external, and consists probably of electric currents in the atmosphere, there are induced currents inside the earth, which increase the horizontal components of the diurnal inequality while diminishing the vertical. The problem has also been dealt with by H. Fritsche,[88] who concludes, in opposition to Schuster, that the forces are partly internal and partly external, the two sets being of fairly similar magnitude. Fritsche repeats the criticism (already made in the last edition of this encyclopaedia) that Schuster's four stations were too few, and contrasts their number with the 27 from which his own data were derived. On the other hand, Schuster's data referred to one and the same year, whereas Fritsche's are from epochs varying from 1841 to 1896, and represent in some cases a single year's observations, in other cases means from several years. It is clearly desirable that a fresh calculation should be made, using synchronous data from a considerable number of well distributed stations; and it should be done for at least two epochs, one representing large, the other small sun-spot frequency. The year 1870 selected by Schuster had, as it happened, a sun-spot frequency which has been exceeded only once since 1750; so that the magnetic data which he employed were far from representative of average conditions.

Magnetization of Vases, &c.

§ 54. It was discovered by Folgheraiter[89] that old vases from Etruscan and other sources are magnetic, and from combined observation and experiment he concluded that they acquired their magnetization when cooling after being baked, and retained it unaltered. From experiments, he derived formulae connecting the magnetization shown by new clay vases with their orientation when cooling in a magnetic field, and applying these formulae to the phenomena observed in the old vases he calculated the magnetic dip at the time and place of manufacture. His observations led him to infer that in Central Italy inclination was actually southerly for some centuries prior to 600 B.C., when it changed sign. In 400 B.C. it was about 20° N.; since 100 B.C. the change has been relatively small. L. Mercanton[90] similarly investigated the magnetization of baked clay vases from the lake dwellings of Neuchatel, whose epoch is supposed to be from 600 to 800 B.C. The results he obtained were, however, closely similar to those observed in recent vases made where the inclination was about 63° N., and he concluded in direct opposition to Folgheraiter that inclination in southern Europe has not undergone any very large change during the last 2500 years. Folgheraiter's methods have been extended to natural rocks. Thus B. Brunhes[91] found several cases of clay metamorphosed by adjacent lava flows and transformed into a species of natural brick. In these cases the clay has a determinate direction of magnetization agreeing with that of the volcanic rock, so it is natural to assume that this direction coincided with that of the dip when the lava flow occurred. In drawing inferences, allowance must of course be made for any tilting of the strata since the volcanic outburst. From one case in France in the district of St Flour, where the volcanic action is assigned to the Miocene Age, Brunhes inferred a southerly dip of some 75°. Until a variety of cases have been critically dealt with, a suspension of judgment is advisable, but if the method should establish its claims to reliability it obviously may prove of importance to geology as well as to terrestrial magnetism.

Polar Phenomena.

§ 55. Magnetic phenomena in the polar regions have received considerable attention of late years, and the observed results are of so exceptional a character as to merit separate consideration. One feature, the large amplitude of the regular diurnal inequality, is already illustrated by the data for Jan Mayen and South Victoria Land in Tables VIII. to XI. In the case, however, of declination allowance must be made for the small size of H. If a force F perpendicular to the magnetic meridian causes a change ΔD in D then $\Delta D = F/H$. Thus at the "Discovery's" winter quarters in South Victoria Land, where the value of H is only about 0·36 of that at Kew, a change of 45′ in D would be produced by a force which at Kew would produce a change of only 16′. Another feature, which, however, may not be equally general, is illustrated by the data for Fort Rae and South Victoria Land in Table XVII. It will be noticed that it is the 24-hour term in the Fourier analysis of the regular diurnal inequality which is specially enhanced. The station in South Victoria Land—the winter quarters of the "Discovery" in 1902–1904—was at 77° 51′ S. lat.; thus the sun did not set from November to February (midsummer), nor rise from May to July (midwinter). It might not thus have been surprising if there had been an outstandingly large seasonal variation in the type of the diurnal inequality. As a matter of fact, however, the type of the inequality showed exceptionally small variation with the season, and the amplitude remained large throughout the whole year. Thus, forming diurnal inequalities for the three midsummer months and for the three midwinter months, we obtain the following amplitudes for the range of the several elements[92]:—

	D.	H.	V.	I.
Midsummer	64′·1	57γ	58γ	2′·87
Midwinter	26′·8	25γ	18γ	1′·23

The most outstanding phenomenon in high latitudes is the frequency and large size of the disturbances. At Kew, as we saw in § 25, the absolute range in D exceeds 20′ on only 12 % of the total number of days. But at the "Discovery's" winter quarters, about sun-spot minimum, the range exceeded 1° on 70 %, 2° on 37 %, and 3° on fully 15 % of the total number of days. One day in 25 had a range exceeding 4°. During the three midsummer months, only one day out of 111 had a range under 1°, and even at midwinter only one day in eight had a range as small as 30′. The H range at the "Discovery's" station exceeded 100γ on 40 % of the days, and the V range exceeded 100γ on 32 % of the days.

The special tendency to disturbance seen in equinoctial months in temperate latitudes did not appear in the "Discovery's" records in the Antarctic. D ranges exceeding 3° occurred on 11 % of equinoctial days, but on 40 % of midsummer days. The preponderance of large movements at midsummer was equally apparent in the other elements. Thus the percentage of days having a V range over 200γ was 21 at midsummer, as against 3 in the four equinoctial months.

At the "Discovery's" station small oscillations of a few minutes' duration were hardly ever absent, but the character of the larger disturbances showed a marked variation throughout the 24 hours.

Those of a very rapid oscillatory character were especially numerous in the morning between 4 and 9 a.m. In the late afternoon and evening disturbances of a more regular type became prominent, especially in the winter months. In particular there were numerous occurrences of a remarkably regular type of disturbance, half the total number of cases taking place between 7 and 9 p.m. This "special type of disturbance" was divisible into two phases, each lasting on the average about 20 minutes. During the first phase all the elements diminished in value, during the second phase they increased. In the case of D and H the rise and fall were about equal, but the rise in V was about 3½ times the preceding fall. The disturbing force—on the north pole—to which the first phase might be attributed was inclined on the average about 5°½ below the horizon, the horizontal projection of its line of action being inclined about 41°½ to the north of east. The amplitude and duration of the disturbances of the "special type" varied a good deal; in several cases the disturbing force considerably exceeded 200γ. A somewhat similar type of disturbance was observed by Kr. Birkeland[93] at Arctic stations also in 1902–1903, and was called by him the "polar elementary" storm. Birkeland's record of disturbances extends only from October 1902 to March 1903, so it is uncertain whether "polar elementary" storms occur during the Arctic summer. Their usual time of occurrence seems to be the evening. During their occurrence Birkeland found that there was often a great difference in amplitude and character between the disturbances observed at places so comparatively near together as Iceland, Nova Zembla and Spitzbergen. This led him to assign the cause to electric currents in the Arctic, at heights not exceeding a few hundred kilometres, and he inferred from the way in which the phenomena developed that the seat of the disturbances often moved westward, as if related in some way to the sun's position. Contemporaneously with the "elementary polar" storms in the Arctic Birkeland found smaller but distinct movements at stations all over Europe; these could generally be traced as far as Bombay and Batavia, and sometimes as far as Christchurch, New Zealand. Chree,[92] on the other hand, working up the 1902–1904 Antarctic records, discovered that during the larger disturbances of the "special type" corresponding but much smaller movements were visible at Christchurch, Mauritius, Kolaba, and even at Kew. He also found that in the great majority of cases the Antarctic curves were specially disturbed during the times of Birkeland's "elementary polar" storms, the disturbances in the Arctic and Antarctic being of the same order of magnitude, though apparently of considerably different type.

Examining the more prominent of the sudden commencements of magnetic disturbances in 1902–1903 visible simultaneously in the curves from Kew, Kolaba, Mauritius and Christchurch, Chree found that these were all represented in the Antarctic curves by movements of a considerably larger size and of an oscillatory character. In a number of cases Birkeland observed small simultaneous movements in the curves of his co-operating stations, which appeared to be at least sometimes decidedly larger in the equatorial than the northern temperate stations. These he described as "equatorial" perturbations, ascribing them to electric currents in or near the plane of the earth's magnetic equator, at heights of the order of the earth's radius. It was found, however, by Chree that in many, if not all, of these cases there were synchronous movements in the Antarctic, similar in type to those which occurred simultaneously with the sudden commencements of magnetic storms, and that these Antarctic movements were considerably larger than those described by Birkeland at the equatorial stations. This result tends of course to suggest a somewhat different explanation from Birkeland's. But until our knowledge of facts has received considerable additions all explanations must be of a somewhat hypothetical character.

Magnetic Poles.

In 1831 Sir James Ross[94] observed a dip of 89° 59′ at 70° 5′ N., 96° 46′ W., and this has been accepted as practically the position of the north magnetic pole at the time. The position of the south magnetic pole in 1840 as deduced from the Antarctic observations made by the "Erebus" and "Terror" expedition is shown in Sabine's chart as about 73° 30′ S., 147° 30′ E. In the more recent chart in J. C. Adams's *Collected Papers*, vol. 2, the position is shown as about 73° 40′ S., 147° 7′ E. Of late years positions have been obtained for the south magnetic pole by the "Southern Cross" expedition of 1898–1900 (A), by the "Discovery" in 1902–1904 (B), and by Sir E. Shackleton's expedition 1908–1909 (C). These are as follow:

(A) 72° 40′ S., 152° 30′ E.
(B) 72° 51′ S., 156° 25′ E.
(C) 72° 25′ S., 155° 16′ E.

Unless the diurnal inequality vanishes in its neighbourhood, a somewhat improbable contingency considering the large range at the "Discovery's" winter quarters, the position of the south magnetic pole has probably a diurnal oscillation, with an average amplitude of several miles, and there is not unlikely a larger annual oscillation. Thus even apart from secular change, no single spot of the earth's surface can probably claim to be a magnetic pole in the sense popularly ascribed to the term. If the diurnal motion were absolutely regular, and carried the point where the needle is vertical round a closed curve, the centroid of that curve—though a spot where the needle is never absolutely vertical—would seem to have the best claim to the title. It should also be remembered that when the dip is nearly 90° there are special observational difficulties. There are thus various reasons for allowing a considerable uncertainty in positions assigned to the magnetic poles. Conclusions as to change of position of the south magnetic pole during the last ten years based on the more recent results (A), (B) and (C) would, for instance, possess a very doubtful value. The difference, however, between these recent positions and that deduced from the observations of 1840–1841 is more substantial, and there is at least a moderate probability that a considerable movement towards the north-east has taken place during the last seventy years.

See publications of individual magnetic observatories, more especially the Russian (*Annales de l'Observatoire Physique Central*), the French (*Annales du Bureau Central Météorologique de France*), and those of Kew, Greenwich, Falmouth, Stonyhurst, Potsdam, Wilhelmshaven, de Bilt, Uccle, O'Gyalla, Prague, Pola, Coimbra, San Fernando, Capo di Monte, Tiflis, Kolaba, Zi-ka-wei, Hong-Kong, Manila, Batavia, Mauritius, Agincourt (Toronto), the observatories of the U.S. Coast and Geodetic Survey, Rio de Janeiro, Melbourne.

In the references below the following abbreviations are used: B.A. = *British Association Reports*; Batavia = *Observations made at the Royal . . . Observatory at Batavia*; M.Z. = *Meteorologische Zeitschrift*, edited by J. Hann and G. Hellman; P.R.S. = *Proceedings of the Royal Society of London*; P.T. = *Philosophical Transactions*; R. = *Repertorium für Meteorologie*, St Petersburg; T.M. = *Terrestrial Magnetism*, edited by L. A. Bauer; R.A.S. Notices = *Monthly Notices of the Royal Astronomical Society*. Treatises are referred to by the numbers attached to them; *e.g.* (1) p. 100 means p. 100 of Walker's *Terrestrial Magnetism.*

[1] E. Walker, *Terrestrial and Cosmical Magnetism* (Cambridge and London, 1866). [1a] H. Lloyd, *A Treatise on Magnetism General and Terrestrial* (London, 1874). [2] E. Mascart, *Traité de magnétisme terrestre* (Paris, 1900). [3] L. A. Bauer, *United States Magnetic Declination Tables and Isogonic Charts, and Principal Facts relating to the Earth's Magnetism* (Washington, 1902). [4] Balfour Stewart, "Terrestrial Magnetism" (under "Meteorology"), *Ency. brit.* 9th ed. [5] C. Chree, "Magnetism, Terrestrial," *Ency. brit.* 10th ed. [6] *M.Z.* 1906, 23, p. 145. [7] (3) p. 62. [8] *K. Akad. van Wetenschappen* (Amsterdam, 1895; Batavia, 1899, &c.). [9] *Atlas des Erdmagnetismus* (Riga, 1903). [10] (1) p. 16, &c. [11] *Kolaba (Colaba) Magnetical and Meteorological Observations*, 1896, Appendix Table II. [12] (1) p. 21. [13] *Report* for 1906, App. 4, see also (3) p. 102. [14] (1) p. 166. [15] *Ergebnisse der mag. Beobachtungen in Potsdam*, 1901, p. xxxvi. [16] *U.S. Coast and Geodetic Survey Report* for 1895, App. 1, &c. [17] *T.M.* 1, pp. 62, 89, and 2, p. 68. [18] (3) p. 45. [19] *Die Elemente des Erdmagnetismus*, pp. 104-108. [20] *Zur täglichen Variation der mag. Deklination (aus Heft II. des Archivs des Erdmagnetismus)* (Potsdam, 1906). [21] *M.Z.* 1888, 5, p. 225. [22] *M.Z.* 1904, 21, p. 129. [23] *P.T.* 202 A, p. 335. [23a] *Camb. Phil. Soc. Trans.* 20, p. 165. [24] *P.T.* 208 A, p. 205. [25] *P.T.* 203 A, p. 151. [26] *P.T.* 171, p. 541; *P.R.S.* 63, p. 64. [27] *R.A.S. Notices* 60, p. 142. [28] *Rendiconti del R. Ist. Lomb.* 1902, Series II. vol. 35. [29] *R.* 1889, vol. 12, no. 8. [30] *B.A. Report*, 1898, p. 80. [31] *P.R.S.* (A) 79, p. 151. [32] *P.T.* 204 A, p. 373. [33] *Ann. du Bureau Central Météorologique, année 1897*, 1 Mem. p. B65. [34] *P.T.* 161, p. 307. [35] *M.Z.* 1895, 12, p. 321. [35a] *P.T.* 1851, p. 123; and 1852, p. 103, see also (4) § 38. [36] *P.T.* 159, p. 363. [37] (1) p. 92. [38] *R.A.S. Notices* 65, p. 666. [39] *R.A.S. Notices*, 65, pp. 2 and 538. [40] *K. Akad. van Wetenschappen* (Amsterdam, 1906) p. 266. [41] *R.A.S. Notices* 65, p. 520. [42] *B.A. Reports*, 1880, p. 201 and 1881, p. 463. [43] *Anhang Ergebnisse der mag. Beob. in Potsdam*, 1896. [44] *M.Z.* 1899, 16, p. 385. [45] *P.T.* 166, p. 387. [46] *Trans. Can. Inst.* 1898–1899, p. 345, and *Proc. Roy. Ast. Soc. of Canada*, 1902–1903, p. 74, 1904, p. xiv., &c. [47] *R.A.S. Notices* 65, p. 186. [48] *T.M.* 10, p. 1. [49] *Expédition norvégienne de 1899–1900* (Christiania, 1901). [50] *Thèses présentées à la Faculté des Sciences* (Paris, 1903). [51] *Nat. Tijdschrift voor Nederlandsch-Indië*, 1902, p. 71. [52] *Wied. Ann.* 1882, p. 336. [53] *Sitz. der k. preuss. Akad. der Wiss.*, 24th June 1897, &c. [54] *T.M.* 12, p. 1. [55] *P.T.* 143, p. 549; *St Helena Observations*, vol. ii., p. cxlvi., &c., (1) § 62. [56] *Trans. R.S.E.* 24, p. 669. [57] *P.T.* 178 A, p. 1. [58] *Batavia*, vol. 16, &c. [59] *Batavia*, Appendix to vol. 26. [60] *R.* vol. 17, no. 1. [61] *T.M.* 3, p. 13, &c. [62] *P.T.* 181 A, p. 53 and 188 A. [63] *Ann. du Bureau Central Mét.* vol. i. for years 1884 and 1887 to 1895. [64] *Ann. dell' Uff. Centrale Met. e Geod.* vol. 14, pt. i. p. 57. [65] *A Magnetic Survey of the Netherlands for the Epoch 1st Jan. 1891* (Rotterdam, 1895). [66] *Kg. Svenska Vet. Akad. Handlingar*, 1895, vol. 27, no. 7. [67] *Denkschriften der math. naturwiss. Classe der k. Akad. des Wiss.* (Wien), vols. 62 and 67. [68] *Journal of the College of Science, Tōkyō*, 1904, vol. 14. [69] *Ann. de l'observatoire . . . de Toulouse*, 1907, vol. 7. [70] *Ann. du Bureau Central Mét.* 1897, I. p. B36. [71] *T.M.* 7, p. 74. [72] *Bull. Imp. Univ. Odessa* 85, p. 1, and *T.M.* 7, p. 67. [73] *P.T.* 187 A, p. 345. [74] *P.R.S.* 76 A, p. 181. [75] *Bull. Soc. Imp. des Naturalistes de Moskau*, 1893, no. 4, p. 381, and *T.M.* 1, p. 50. [76] *Forsch. zur deut. Landes- u. Volkskunde*, 1898, Bd. xi, 1, and *T.M.* 3, p. 77. [77] *P.R.S.* 76 A, p. 507. [78] Adams, *Scientific Papers*, II. p. 446. [79] *B.A. Report* for 1898, p. 109. [80] *Abhand. der bayer. Akad. der Wiss.*, 1895, vol. 19. [81] *Sitz. k. Akad. der Wiss.* (Berlin), 1897, no. xviii., also *T.M.* 3, p. 191. [82] *T.M.* 2, p. 11. [83] *Die Elemente des Erdmagnetismus* (St Petersburg.

1899), p. 103. [84] *T.M.* 9, p. 113. [85] *T.M.* 1, p. 77, and *Nature*, 57, pp. 160 and 180. [86] *M.Z.* 15, p. 175. [86a] *Sits. der k. k. Akad. der Wiss. Wien, math. nat. Classe*, 1898, Bd. cvii., Abth. ii. [87] *P.T.* (A) 180, p. 467. [88] *Die Tägliche Periode der erdmagnetischen Elemente* (St Petersburg, 1902). [89] *R. Accad. Lincei Atti*, viii. 1899, pp. 69, 121, 176, 269 and previous volumes, see also *Séances de la Soc. Franc. de Physique*, 1899, p. 118. [90] *Bull. Soc. Vaud., Sc. Nat.* 1906, 42, p. 225. [91] *Comptes rendus*, 1905, 141, p. 567. [92] *National Antarctic Expedition 1901–1904*, "Magnetic Observations." [93] *The Norwegian Aurora Polaris Expedition 1902–1903*, vol. i. [94] (1) p. 163.
(C. CH.)

MAGNETITE, a mineral forming the natural magnet (see MAGNETISM), and important also as an iron-ore. It is an iron-black, opaque mineral, with metallic lustre; hardness about 6, sp. gr. 4·9 to 5·2. When scratched, it yields a black streak. It is an oxide of iron having the formula Fe_3O_4, corresponding with 72·4% of metal, whence its great value as an ore. It may be regarded as a ferroso-ferric oxide, $FeO.Fe_2O_3$, or as iron ferrate, $Fe''Fe_2'''O_4$. Titanium is often present, and occasionally the mineral contains magnesium, nickel, &c. It is always strongly magnetic. Magnetite crystallizes in the cubic system, usually in octahedra, less commonly in rhombic dodecahedra, and not infrequently in twins of the "spinel type" (fig. 1). The rhombic faces of the dodecahedron are often striated parallel to the longer diagonal. There is no distinct cleavage, but imperfect parting may be obtained along octahedral planes.

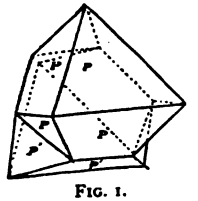


FIG. 1.

Magnetite is a mineral of wide distribution, occurring as grains in many massive and volcanic rocks, like granite, diorite and dolerite. It appears to have crystallized from the magma at a very early period of consolidation. Its presence contributes to the dark colour of many basalts and other basic rocks, and may cause them to disturb the compass. Large ore-bodies of granular and compact magnetite occur as beds and lenticular masses in Archean gneiss and crystalline schists, in various parts of Norway, Sweden, Finland and the Urals; as also in the states of New York, New Jersey, Pennsylvania and Michigan, as well as in Canada. In some cases it appears to have segregated from a basic eruptive magma, and in other cases to have resulted from metamorphic action. Certain deposits appear to have been formed, directly or indirectly, by wet processes. Iron rust sometimes contains magnetite. An interesting deposit of oolitic magnetic ore occurs in the Dogger (Inferior Oolite) of Rosedale Abbey, in Yorkshire; and a somewhat similar pisolitic ore, of Jurassic age, is known on the continent as chamoisite, having been named from Chamoison (or Chamoson) in the Valais, Switzerland. Grains of magnetite occur in serpentine, as an alteration-product of the olivine. In emery, magnetite in a granular form is largely associated with the corundum; and in certain kinds of mica magnetite occurs as thin dendritic enclosures. Haematite is sometimes magnetic, and A. Liversidge has shown that magnetite is probably present. By deoxidation, haematite may be converted into magnetite, as proved by certain pseudomorphs; but on the other hand magnetite is sometimes altered to haematite. On weathering, magnetite commonly passes into limonite, the ferrous oxide having probably been removed by carbonated waters. Closely related to magnetite is the rare volcanic mineral from Vesuvius, called magnoferrite, or magnesioferrite, with the formula $MgFe_2O_4$; and with this may be mentioned a mineral from Jakobsberg, in Vermland, Sweden, called jakobsite, containing $MnFe_2O_4$.
(F. W. R.*)

MAGNETOGRAPH, an instrument for continuously recording the values of the magnetic elements, the three universally chosen being the declination, the horizontal component and the vertical component (see TERRESTRIAL MAGNETISM). In each case the magnetograph only records the variation of the element, the absolute values being determined by making observations in the neighbourhood with the unifilar magnetometer (*q.v.*) and inclinometer (*q.v.*).

Declination.—The changes in declination are obtained by means of a magnet which is suspended by a long fibre and carries a mirror, immediately below which a fixed mirror is attached to the base of the instrument. Both mirrors are usually concave; if plane, a concave lens is placed immediately before them. Light passing through a vertical slit falls upon the mirrors, from which it is reflected, and two images of the slit are produced, one by the movable mirror attached to the magnet and the other by the fixed mirror. These images would be short lines of light; but a plano-cylindrical lens is placed with its axis horizontal just in front of the recording surface. In this way a spot of light is obtained from each mirror. The recording surface is a sheet of photographic paper wrapped round a drum which is rotated at a constant speed by clockwork about a horizontal axis. The light reflected from the fixed mirror traces a straight line on the paper, serving as a base line from which the variations in declination are measured. As the declination changes the spot of light reflected from the magnet mirror moves parallel to the axis of the recording drum, and hence the distance between the line traced by this spot and the base line gives, for any instant, on an arbitrary scale the difference between the declination and a constant angle, namely, the declination corresponding to the base line. The value of this constant angle is obtained by comparing the record with the value for the declination as measured with a magnetometer. The value in terms of arc of the scale of the record can be obtained by measuring the distance between the magnet mirror and the recording drum, and in most observations it is such that a millimetre on the record represents one minute of arc. The time scale ordinarily employed is 15 mm. per hour, but in modern instruments provision is generally made for the time scale to be increased at will to 180 mm. per hour, so that the more rapid variations of the declination can be followed. The advantages of using small magnets, so that their moment of inertia may be small and hence they may be able to respond to rapid changes in the earth's field, were first insisted upon by E. Mascart,[1] while M. Eschenhagen[2] first designed a set of magnetographs in which this idea of small moment of inertia was carried to its useful limit, the magnets only weighing 1·5 gram each, and the suspension consisting of a very fine quartz fibre.

Horizontal Force.—The variation of the horizontal force is obtained by the motion of a magnet which is carried either by a bifilar suspension or by a fairly stiff metal wire or quartz fibre. The upper end of the suspension is turned till the axis of the magnet is at right angles to the magnetic meridian. In this position the magnet is in equilibrium under the action of the torsion of the suspension and the couple exerted by the horizontal component, H, of the earth's field, this couple depending on the product of H into the magnetic moment, M, of the magnet. Hence if H varies the magnet will rotate in such a way that the couple due to torsion is equal to the new value of H multiplied by M. Since the movements of the magnet are always small, the rotation of the magnet is proportional to the change in H, so long as M and the couple, θ, corresponding to unit twist of the suspension system remain constant. When the temperature changes, however, both M and θ in general change. With rise of temperature M decreases, and this alone will produce the same effect as would a decrease in H. To allow for this effect of temperature a compensating system of metal bars is attached to the upper end of the bifilar suspension, so arranged that with rise of temperature the fibres are brought nearer together and hence the value of θ decreases. Since such a decrease in θ would by itself cause the magnet to turn in the same direction as if H had increased, it is possible in a great measure to neutralize the effects of temperature on the reading of the instrument. In the case of the unifilar suspension, the provision of a temperature compensation is not so easy, so that what is generally done is to protect the instrument from temperature variation as much as possible and then to correct the indications so as to allow for the residual changes, a continuous record of the temperature being kept by a recording thermograph attached to the instrument. In the Eschenhagen pattern instrument, in which a single quartz fibre is used for the suspension, two magnets are placed in the vicinity of the suspended magnet and are so arranged that their field partly neutralizes the earth's field; thus the torsion required to hold the magnet with its axis perpendicular to the earth's field is reduced, and the arrangement permits of the sensitiveness being altered by changing the position of the deflecting magnets. Further, by suitably choosing the positions of the deflectors and the coefficient of torsion of the fibre, it is possible to make the temperature coefficient vanish. (See Adolf Schmidt, *Zeits. für Instrumentenkunde*, 1907, 27, 145.) The method of recording the variations in H is exactly the same as that adopted in the case of the declination, and the sensitiveness generally adopted is such that 1 mm. on the record represents a change in H of ·00005 C.G.S., the time scale being the same as that employed in the case of the declination.

Vertical Component.—To record the variations of the vertical component use is made of a magnet mounted on knife edges so that it can turn freely about a horizontal axis at right angles to its length (H. Lloyd, *Proc. Roy. Irish Acad.*, 1839, 1, 334). The magnet is so weighted that its axis is approximately horizontal, and any change in the inclination of the axis is observed by means of an attached mirror, a second mirror fixed to the stand serving to give a base line for the records, which are obtained in the same way as in the case of the declination. The magnet is in equilibrium under the influence of the couple VM due to the vertical component V, and the couple due to the fact that the centre of gravity is slightly on one side of the knife-edge. Hence when, say, V decreases the couple VM decreases, and hence the north end of the balanced magnet rises, and vice versa. The chief difficulty with this form of instrument is that it is very sensitive to changes of temperature, for such changes not only alter M but also in general cause the centre of gravity of the system to be displaced with reference to the knife-edge. To reduce these effects the magnet is fitted with compensating bars, generally of zinc, so adjusted by trial that as far as possible they neutralize the effect of changes of temperature. In the Eschenhagen form of vertical force balance two deflecting magnets are used to partly neutralize the vertical component, so that the centre of gravity is almost exactly over the support. By varying the positions of these deflecting magnets it is possible to compensate for the effects of changes of temperature (A. Schmidt, *loc. cit.*). In order to eliminate the irregularity which is apt to be introduced by dust, &c., interfering with the working of the knife-edge, W. Watson (*Phil. Mag.*, 1904 [6], 7, 393) designed a form of vertical force balance in which the magnet with its mirror is attached to the mid point of a horizontal stretched quartz fibre. The temperature compensation is obtained by attaching a small weight to the magnet, and then bringing it back to the horizontal position by twisting the fibre.

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[1] *Report British Association*, Bristol, 1898, p. 741.

[2] *Verhandlungen der deutschen physikalischen Gesellschaft*, 1899, 1, 147; or *Terrestrial Magnetism*, 1900, 5, 59.

The scale values of the records given by the horizontal and vertical force magnetographs are determined by deflecting the respective needles, either by means of a magnet placed at a known distance or by passing an electric current through circular coils of large diameter surrounding the instruments.

The width of the photographic sheet which receives the spot of light reflected from the mirrors in the above instruments is generally so great that in the case of ordinary changes the curve does not go off the paper. Occasionally, however, during a disturbance such is not the case, and hence a portion of the trace would be lost. To overcome this difficulty Eschenhagen in his earlier type of instruments attached to each magnet two mirrors, their planes being inclined at a small angle so that when the spot reflected from one mirror goes off the paper, that corresponding to the other comes on. In the later pattern a third mirror is added of which the plane is inclined at about 30° to the horizontal. The light from the slit is reflected on to this mirror by an inclined fixed mirror, and after reflection at the movable mirror is again reflected at the fixed mirror and so reaches the recording drum. By this arrangement the angular rotation of the reflected beam is less than that of the magnet, and hence the spot of light reflected from this mirror yields a trace on a much smaller scale than that given by the ordinary mirror and serves to give a complete record of even the most energetic disturbance.

See also Balfour Stewart, *Report of the British Association*, Aberdeen, 1859, 200, a description of the type of instrument used in the older observatories; E. Mascart, *Traité de magnétisme terrestre*, p. 191; W. Watson, *Terrestrial Magnetism*, 1901, 6, 187, describing magnetographs used in India; M. Eschenhagen, *Verhandlungen der deutschen physikalischen Gesellschaft*, 1899, 1, 147; *Terrestrial Magnetism*, 1900, 5, 59; and 1901, 6, 59; *Zeits. für Instrumentenkunde*, 1907, 27, 137; W. G. Cady, *Terrestrial Magnetism*, 1904, 9, 69, describing a declination magnetograph in which the record is obtained by means of a pen acting on a moving strip of paper, so that the curve can be consulted at all times to see whether a disturbance is in progress.

The effects of temperature being so marked on the readings of the horizontal and vertical force magnetographs, it is usual to place the instruments either in an underground room or in a room which, by means of double walls and similar devices, is protected as much as possible from temperature changes. For descriptions of the arrangements adopted in some observatories see the following: U.S. observatories, *Terrestrial Magnetism*, 1903, 8, 11; Utrecht, *Terrestrial Magnetism*, 1900, 5, 49; St Maur, *Terrestrial Magnetism*, 1898, 3, 1; Potsdam, *Veröffentlichungen des k. preuss. meteorol. Instituts*, "Ergebnisse der magnetischen Beobachtungen in Potsdam in den Jahren 1890 und 1891;" Pavlovsk, "Das Konstantinow'sche meteorologische und magnetische Observatorium in Pavlovsk," *Ausgabe der kaiserl. Akad. der Wissenschaften zu St Petersburg*, 1895. (W. WN.)

MAGNETOMETER, a name, in its most general sense, for any instrument used to measure the strength of any magnetic field; it is, however, often used in the restricted sense of an instrument for measuring a particular magnetic field, namely, that due to the earth's magnetism, and in this article the instruments used for measuring the value of the earth's magnetic field will alone be considered.

The elements which are actually measured when determining the value of the earth's field are usually the declination, the dip and the horizontal component (see MAGNETISM, TERRESTRIAL). For the instruments and methods used in measuring the dip see INCLINOMETER. It remains to consider the measurement of the declination and the horizontal component, these two elements being generally measured with the same instrument, which is called a unifilar magnetometer.

Measurement of Declination.—The measurement of the declination involves two separate observations, namely, the determination of (*a*) the magnetic meridian and (*b*) the geographical meridian, the angle between the two being the declination. In order to determine the magnetic meridian the orientation of the magnetic axis of a freely suspended magnet is observed; while, in the absence of a distant mark of which the azimuth is known, the geographical meridian is obtained from observations of the transit of the sun or a star. The geometrical axis of the magnet is sometimes defined by means of a mirror rigidly attached to the magnet and having the normal to the mirror as nearly as may be parallel to the magnetic axis. This arrangement is not very convenient, as it is difficult to protect the mirror from accidental displacement, so that the angle between the geometrical and magnetic axes may vary. For this reason the end of the magnet is sometimes polished and acts as the mirror, in which case no displacement of the reflecting surface with reference to the magnet is possible. A different arrangement, used in the instrument described below, consists in having the magnet hollow, with a small scale engraved on glass firmly attached at one end, while to the other end is attached a lens, so chosen that the scale is at its principal focus. In this case the geometrical axis is the line joining the central division of the scale to the optical centre of the lens. The position of the magnet is observed by means of a small telescope, and since the scale is at the principal focus of the lens, the scale will be in focus when the telescope is adjusted to observe a distant object. Thus no alteration in the focus of the telescope is necessary whether we are observing the magnet, a distant fixed mark, or the sun.

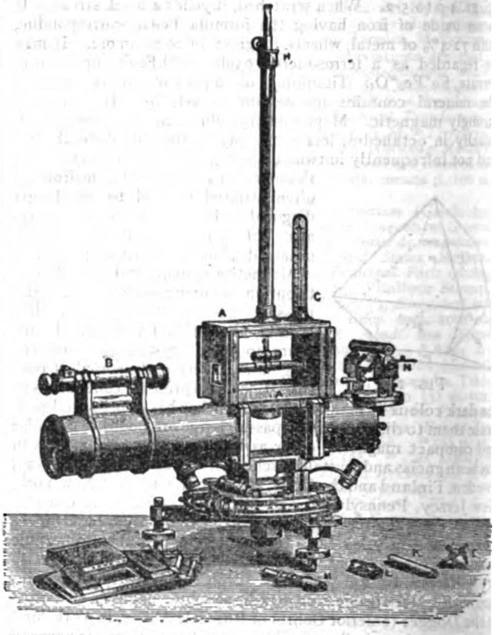

FIG. 1.—Unifilar Magnetometer, arranged to indicate declination.

The Kew Observatory pattern unifilar magnetometer is shown in figs. 1 and 2. The magnet consists of a hollow steel cylinder fitted with a scale and lens as described above, and is suspended by a long thread of unspun silk, which is attached at the upper end to the torsion head H. The magnet is protected from draughts by the box A, which is closed at the sides by two shutters when an observation is being taken. The telescope B serves to observe the scale attached to the magnet when determining the magnetic meridian, and to observe the sun or star when determining the geographical meridian.

When making a determination of declination a brass plummet having the same weight as the magnet is first suspended in its place, and the torsion of the fibre is taken out. The magnet having been attached, the instrument is rotated about its vertical axis till the centre division of the scale appears to coincide with the vertical cross-wire of the telescope. The two verniers on the azimuth circle having been read, the magnet is then inverted, *i.e.* turned through 180° about its axis, and the setting is repeated. A second setting with the magnet inverted is generally made, and then another setting with the magnet in its original position. The mean of all the readings of the verniers gives the reading on the azimuth circle corresponding to the magnetic meridian. To obtain the geographical meridian the box A is removed, and an image of the sun or a star is reflected into the telescope B by means of a small transit mirror N. This mirror can rotate about a horizontal axis which is at right angles to the line of collimation of the telescope, and is parallel to the surface of the mirror. The time of transit of the sun or star across the vertical wire of the telescope having been observed by means of a chronometer of which the error is known, it is possible to calculate the azimuth of the sun or star, if the latitude and longitude of the place of observation are given. Hence if the readings of the verniers on the azimuth circle are made when the transit is observed we can deduce the reading corresponding to the geographical meridian.

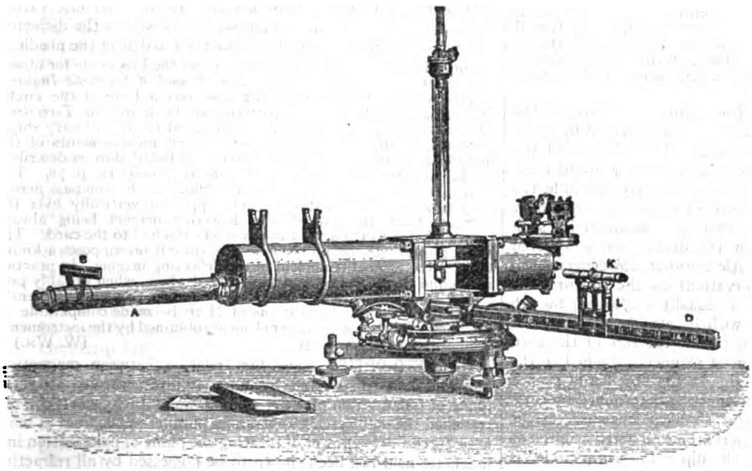

FIG 2.—Unifilar Magnetometer, arranged to show deflexion.

The above method of determining the geographical meridian has the serious objection that it is necessary to know the error of the chronometer with very considerable accuracy, a matter of some difficulty when observing at any distance from a fixed observatory. If, however, a theodolite, fitted with a telescope which can rotate about a horizontal axis and having an altitude circle, is employed, so that when observing a transit the altitude of the sun or star can be read off, then the time need only be known to within a minute or so. Hence in more recent patterns of magnetometer it is usual to do away with the transit mirror method of observing and either to use a separate theodolite to observe the azimuth of some distant object, which will then act as a fixed mark when making the declination observations, or to attach to the magnetometer an altitude telescope and circle for use when determining the geographical meridian.

The chief uncertainty in declination observations, at any rate at a fixed observatory, lies in the variable torsion of the silk suspension, as it is found that, although the fibre may be entirely freed from torsion before beginning the declination observations, yet at the conclusion of these observations a considerable amount of torsion may have appeared. Soaking the fibre with glycerine, so that the moisture it absorbs does not change so much with the hygrometric state of the air, is of some advantage, but does not entirely remove the difficulty. For this reason some observers use a thin strip of phosphor bronze to suspend the magnet, considering that the absence of a variable torsion more than compensates for the increased difficulty in handling the more fragile metallic suspension.

Measurement of the Horizontal Component of the Earth's Field.—The method of measuring the horizontal component which is almost exclusively used, both in fixed observatories and in the field, consists in observing the period of a freely suspended magnet, and then obtaining the angle through which an auxiliary suspended magnet is deflected by the magnet used in the first part of the experiment. By the vibration experiment we obtain the value of the product of the magnetic moment (M) of the magnet into the horizontal component (H), while by the deflexion experiment we can deduce the value of the ratio of M to H, and hence the two combined give both M and H.

In the case of the Kew pattern unifilar the same magnet that is used for the declination is usually employed for determining H, and for the purposes of the vibration experiment it is mounted as for the observation of the magnetic meridian. The time of vibration is obtained by means of a chronometer, using the eye-and-ear method. The temperature of the magnet must also be observed, for which purpose a thermometer C (fig. 1) is attached to the box A.

When making the deflection experiment the magnetometer is arranged as shown in fig. 2. The auxiliary magnet has a plane mirror attached, the plane of which is at right angles to the axis of the magnet. An image of the ivory scale B is observed after reflection in the magnet mirror by the telescope A. The magnet K used in the vibration experiment is supported on a carriage L which can slide along the graduated bar D. The axis of the magnet is horizontal and at the same level as the mirror magnet, while when the central division of the scale B appears to coincide with the vertical cross-wire of the telescope the axes of the two magnets are at right angles. During the experiment the mirror magnet is protected from draughts by two wooden doors which slide in grooves. What is known as the method of sines is used, for since the axes of the two magnets are always at right angles when the mirror magnet is in its zero position, the ratio M/H is proportional to the sine of the angle between the magnetic axis of the mirror magnet and the magnetic meridian. When conducting a deflexion experiment the deflecting magnet K is placed with its centre at 30 cm. from the mirror magnet and to the east of the latter, and the whole instrument is turned till the centre division of the scale B coincides with the cross-wire of the telescope, when the readings of the verniers on the azimuth circle are noted. The magnet K is then reversed in the support, and a new setting taken. The difference between the two sets of readings gives twice the angle which the magnetic axis of the mirror magnet makes with the magnetic meridian. In order to eliminate any error due to the zero of the scale D not being exactly below the mirror magnet, the support L is then removed to the west side of the instrument, and the settings are repeated. Further, to allow of a correction being applied for the finite length of the magnets the whole series of settings is repeated with the centre of the deflecting magnet at 40 cm. from the mirror magnet.

Omitting correction terms depending on the temperature and on the inductive effect of the earth's magnetism on the moment of the deflecting magnet, if θ is the angle which the axis of the deflected magnet makes with the meridian when the centre of the deflecting magnet is at a distance r, then

$$\frac{r^3 H}{2M} \sin\theta = 1 + \frac{P}{r} + \frac{Q}{r^2} + \&c.,$$

in which P and Q are constants depending on the dimensions and magnetic states of the two magnets. The value of the constants P and Q can be obtained by making deflexion experiments at three distances. It is, however, possible by suitably choosing the proportions of the two magnets to cause either P or Q to be very small. Thus it is usual, if the magnets are of similar shape, to make the deflected magnet 0·467 of the length of the deflecting magnet, in which case Q is negligible, and thus by means of deflexion experiments at two distances the value of P can be obtained. (See C. Börgen, *Terrestrial Magnetism*, 1896, i. p. 176, and C. Chree, *Phil. Mag.*, 1904 [6], 7, p. 113.)

In the case of the vibration experiment correction terms have to be introduced to allow for the temperature of the magnet, for the inductive effect of the earth's field, which slightly increases the magnetic moment of the magnet, and for the torsion of the suspension fibre, as well as the rate of the chronometer. If the temperature of the magnet were always exactly the same in both the vibration and deflexion experiment, then no correction on account of the effect of temperature in the magnetic moment would be necessary in either experiment. The fact that the moment of inertia of the magnet varies with the temperature must, however, be taken into account. In the deflexion experiment, in addition to the induction correction, and that for the effect of temperature on the magnetic moment, a correction has to be applied for the effect of temperature on the length of the bar which supports the deflexion magnet.

See also Stewart and Gee, *Practical Physics*, vol. 2, containing a description of the Kew pattern unifilar magnetometer and detailed instructions for performing the experiments; C. Chree, *Phil. Mag.*, 1901 (6), 2, p. 613, and *Proc. Roy. Soc.*, 1899, 65, p. 375, containing a discussion of the errors to which the Kew unifilar instrument is subject; E. Mascart, *Traité de magnetisme terrestre*, containing a description of the instruments used in the French magnetic survey, which are interesting on account of their small size and consequent easy portability; H. E. D. Fraser, *Terrestrial Magnetism*, 1901, 6, p. 65, containing a description of a modified Kew pattern unifilar as used in the Indian survey; H. Wild, *Mém. Acad. imp. sc. St Pétersbourg*, 1896 (viii.), vol. 3, No. 7, containing a description of a most elaborate unifilar magnetometer with which it is claimed results can be obtained of a very high order of accuracy; K. Haufsmann, *Zeits. für Instrumentenkunde*, 1906, 26, p. 2, containing a description of a magnetometer for field use, designed by M. Eschenhagen, which has many advantages.

Measurements of the Magnetic Elements at Sea.—Owing to the fact that the proportion of the earth's surface covered by sea is so much greater than the dry land, the determinaton of the magnetic elements on board ship is a matter of very considerable importance. The movements of a ship entirely preclude the employment of any instrument in which a magnet suspended by a fibre has any part, so that the unifilar is unsuited for such observations. In order to obtain the declination a pivoted magnet is used to obtain the magnetic meridian, the geographical meridian being obtained by observations on the sun or stars. A carefully made ship's compass is usually employed, though in some cases the compass card, with its attached magnets, is made reversible, so that the inclination to the zero of the card of the magnetic axis of the system of magnets attached to the card can be eliminated by reversal. In the absence of such a reversible card the index correction must be determined by comparison with a unifilar magnetometer, simultaneous observations being made on shore, and these observations repeated as often as occasion permits. To determine the dip a Fox's dip circle[1] is used. This consists of an ordinary dip circle (see INCLINOMETER) in which the ends of the axle of the needle are pointed and rest in jewelled holes, so that the movements of the ship do not displace the needle. The instrument is, of course, supported on a gimballed table, while the ship during the observations is kept on a fixed course. To obtain the *strength* of the field the method usually adopted is that known as Lloyd's method.[2] To carry out a determination of the total force by this method the Fox dip circle has been slightly modified by E. W. Creak, and has been found to give satisfactory results on board ship. The circle is provided with two needles in addition to those used for determining the dip, one (*a*) an ordinary dip needle, and the other (*b*) a needle which has been loaded at one end by means of a small peg which fits into one of two symmetrically placed holes in the needle. The magnetism of these two needles is never reversed, and they are as much as possible protected from shock and from approach to other magnets, so that their magnetic state may remain as constant as possible. Attached to the cross-arm which carries the microscopes used to observe the ends of the dipping needle is a clamp, which will hold the needle *b* in such a way that its plane is parallel to the vertical circle and its axis is at right angles to the line joining the two microscopes. Hence, when the microscopes are adjusted so as to coincide with the points of the dipping needle *a*, the axes of the two needles must be at right angles. The needle *a* being suspended between the jewels, and the needle *b* being held in the clamp, the cross-arm carrying the reading microscopes and the needle *b* is rotated till the ends of the needle *a* coincide with the cross-wires of the microscopes. The verniers having been read, the cross-arm is rotated so as to deflect the needle *a* in the opposite direction, and a new setting is taken. Half the difference between the two readings gives the angle through which the needle *a* has been deflected under the action of the needle *b*. This angle depends on the ratio of the magnetic moment of the needle *b* to the total force of the earth's field. It also involves, of course, the distance between the needles and the distribution of the magnetism of the needles; but this factor is determined by comparing the value given by the instrument, at a shore station, with that given by an ordinary magnetometer. Hence the above observation gives us a means of obtaining the *ratio* of the magnetic moment of the needle *b* to the value of the earth's total force. The needle *b* is then substituted for *a*, there being now no needle in the clamp attached to the microscope arm, and the difference between the reading now obtained and the dip, together with the weight added to the needle, gives the product of the moment of the needle *b* into the earth's total force. Hence, from the two observations the value of the earth's total force can be deduced. In an actual observation the deflecting needle would be reversed, as well as the deflected one, while different weights would be used to deflect the needle *b*.

For a description of the method of using the Fox circle for observations at sea consult the *Admiralty Manual of Scientific Inquiry*, p. 116, while a description of the most recent form of the circle, known as the Lloyd-Creak pattern, will be found in *Terrestrial Magnetism*, 1901, 6, p. 119. An attachment to the ordinary ship's compass, by means of which satisfactory measurements of the horizontal component have been made on board ship, is described by L. A. Bauer in *Terrestrial Magnetism*, 1906, 11, p. 78. The principle of the method consists in deflecting the compass needle by means of a horizontal magnet supported vertically over the compass card, the axis of the deflecting magnet being always perpendicular to the axis of the magnet attached to the card. The method is not strictly an absolute one, since it presupposes a knowledge of the magnetic moment of the deflecting magnet. In practice it is found that a magnet can be prepared which, when suitably protected from shock, &c., retains its magnetic moment sufficiently constant to enable observations of H to be made comparable in accuracy with that of the other elements obtained by the instruments ordinarily employed at sea. (W. WN.)

MAGNETO-OPTICS. The first relation between magnetism and light was discovered by Faraday,[1] who proved that the plane of polarization of a ray of light was rotated when the ray travelled through certain substances parallel to the lines of magnetic force. This power of rotating the plane of polarization in a magnetic field has been shown to be possessed by all refracting substances, whether they are in the solid, liquid or gaseous state. The rotation by gases was established independently by H. Becquerel,[2] and Kundt and Röntgen,[3] while Kundt[4] found that films of the magnetic metals, iron, cobalt, nickel, thin enough to be transparent, produced enormous rotations, these being in iron and cobalt magnetized to saturation at the rate of 200,000° per cm. of thickness, and in nickel about 89,000°. The direction of rotation is not the same in all bodies. If we call the rotation positive when it is related to the direction of the magnetic force, like rotation and translation in a right-handed screw, or, what is equivalent, when it is in the direction of the electric currents which would produce a magnetic field in the same direction as that which produces the rotation, then most substances produce positive rotation. Among those that produce negative rotation are ferrous and ferric salts, ferricyanide of potassium, the salts of lanthanum, cerium and didymium, and chloride of titanium.[5]

The magnetic metals iron, nickel, cobalt, the salts of nickel and cobalt, and oxygen (the most magnetic gas) produce positive rotation.

For slightly magnetizable substances the amount of rotation in a space PQ is proportional to the difference between the magnetic potential at P and Q; or if θ is the rotation in PQ, Ω_P, Ω_Q, the magnetic potential at P and Q, then $\theta = R(\Omega_P - \Omega_Q)$, where R is a constant, called Verdet's constant, which depends upon the refracting substance, the wave length of the light, and the temperature. The following are the values of R (when the rotation is expressed in circular measure) for the D line and a temperature of 18° C.:—

Substance.	$R\times10^5$.	Observer.
Carbon bisulphide	1·222	Lord Rayleigh[6] and Köpsel.[7]
	1·225	Rodger and Watson.[8]
Water	·377	Arons.[9]
	·3808	Rodger and Watson.[8]
Alcohol	·330	Du Bois.[10]
Ether	·315	Du Bois.[10]
Oxygen (at 1 atmosphere)	·000179	Kundt and Röntgen (*loc. cit.*)
Faraday's heavy glass	1·738	

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[1] *Annals of Electricity*, 1839, 3, p. 288.

[2] Humphrey Lloyd, *Proc. Roy. Irish Acad.*, 1848, 4, p. 57.

The variation of Verdet's constant with temperature has been determined for carbon bisulphide and water by Rodger and Watson (*loc. cit.*). They find if R_t, R_0 are the values of Verdet's constant at t°C. and 0°C. respectively, then for carbon bisulphide $R_t = R_0 (1 - \cdot0016961)$, and for water $R_t = R_0 (1 - \cdot0000305t - \cdot00000305t^2)$.

For the magnetic metals Kundt found that the rotation did not increase so rapidly as the magnetic force, but that as this force was increased the rotation reached a maximum value. This suggests that the rotation is proportional to the intensity of magnetization, and not to the magnetic force.

The amount of rotation in a given field depends greatly upon the wave length of the light; the shorter the wave length the greater the rotation, the rotation varying a little more rapidly than the inverse square of the wave length. Verdet[11] has compared in the cases of carbon bisulphide and creosote the rotation given by the formula

$$\theta = mc\gamma\frac{c^2}{\lambda^2}\left(c - \lambda\frac{di}{d\lambda}\right)$$

with those actually observed; in this formula θ is the angular rotation of the plane of polarization, m a constant depending on the medium, λ the wave length of the light in air, and i its index of refraction in the medium. Verdet found that, though the agreement is fair, the differences are greater than can be explained by errors of experiment.

Verdet[12] has shown that the rotation of a salt solution is the sum of the rotations due to the salt and the solvent; thus, by mixing a salt which produces negative rotation with water which produces positive rotation, it is possible to get a solution which does not exhibit any rotation. Such solutions are not in general magnetically neutral. By mixing diamagnetic and paramagnetic substances we can get magnetically neutral solutions, which, however, produce a finite rotation of the plane of polarization. The relation of the magnetic rotation to chemical consitution has been studied in great detail by Perkin,[3] Wachsmuth,[4] Jahn[5] and Schönrock.[6]

The rotation of the plane of polarization may conveniently be regarded as denoting that the velocity of propagation of circular-polarized light travelling along the lines of magnetic force depends upon the direction of rotation of the ray, the velocity when the rotation is related to the direction of the magnetic force, like rotation and translation on a right-handed screw being different from that for a left-handed rotation. A plane-polarized ray may be regarded as compounded of two oppositely circularly-polarized rays, and as these travel along the lines of magnetic force with different velocities, the one will gain or lose in phase on the other, so that when they are again compounded they will correspond to a plane-polarized ray, but in consequence of the change of phase the plane of polarization will not coincide with its original position.

Reflection from a Magnet.—Kerr[17] in 1877 found that when plane-polarized light is incident on the pole of an electromagnet, polished so as to act like a mirror, the plane of polarization of the reflected light is rotated by the magnet. Further experiments on this phenomenon have been made by Righi,[18] Kundt,[19] Du Bois,[20] Sissingh,[21] Hall,[22] Hurion,[23] Kaz[24] and Zeeman.[25] The simplest case is when the incident plane-polarized light falls normally on the pole of an electromagnet. When the magnet is not excited the reflected ray is plane-polarized; when the magnet is excited the plane of polarization is rotated through a small angle, the direction of rotation being opposite to that of the currents exciting the pole. Righi found that the reflected light was slightly elliptically polarized, the axes of the ellipse being of very unequal magnitude. A piece of gold-leaf placed over the pole entirely stops the rotation, showing that it is not produced in the air near the pole. Rotation takes place from magnetized nickel and cobalt as well as from iron, and is in the same direction (Hall). Righi has shown that the rotation at reflection is greater for long waves than for short, whereas, as we have seen, the Faraday rotation is greater for short waves than for long. The rotation for different coloured light from iron, nickel, cobalt and magnetite has been measured by Du Bois; in magnetite the direction of rotation is opposite to that of the other metals. When the light is incident obliquely and not normally on the polished pole of an electromagnet, it is elliptically polarized after reflection, even when the plane of polarization is parallel or at right angles to the plane of incidence. According to Righi, the amount of rotation when the plane of polarization of the incident light is perpendicular to the plane of incidence reaches a maximum when the angle of incidence is between 44° and 68°, while when the light is polarized in the plane of incidence the rotation steadily decreases as the angle of incidence is increased. The rotation when the light is polarized in the plane of incidence is always less than when it is polarized at right angles to that plane, except when the incidence is normal, when the two rotations are of course equal.

Reflection from Tangentially Magnetized Iron.—In this case Kerr[26] found: (1) When the plane of incidence is perpendicular to the lines of magnetic force, no rotation of the reflected light is produced by magnetization: (2) no rotation is produced when the light is incident normally; (3) when the incidence is oblique, the lines of magnetic force being in the plane of incidence, the reflected light is elliptically polarized after reflection, and the axes of the ellipse are not in and at right angles to the plane of incidence. When the light is polarized in the plane of incidence, the rotation is at all angles of incidence in the opposite direction to that of the currents which would produce a magnetic field of the same sign as the magnet. When the light is polarized at right angles to the plane of incidence, the rotation is in the same direction as these currents when the angle of incidence is between 0° and 75° according to Kerr, between 0° and 80° according to Kundt, and between 0° and 78° 54′ according to Righi. When the incidence is more oblique than this, the rotation of the plane of polarization is in the opposite direction to the electric currents which would produce a magnetic field of the same sign.

The theory of the phenomena just described has been dealt with by Airy,[27] C. Neumann,[28] Maxwell,[29] Fitzgerald,[30] Rowland,[31] H. A. Lorentz,[32] Voight,[33] Ketteler,[34] van Loghem,[35] Potier,[36] Basset,[37] Goldhammer,[38] Drude,[39] J. J. Thomson,[40] and Leatham;[41] for a critical discussion of many of these theories we refer the reader to Larmor's[42] British Association Report. Most of these theories have proceeded on the plan of adding to the expression for the electromotive force terms indicating a force similar in character to that discovered by Hall (see MAGNETISM) in metallic conductors carrying a current in a magnetic field, *i.e.* an electromotive force at right angles to the plane containing the magnetic force and the electric current, and proportional to the sine of the angle between these vectors. The introduction of a term of this kind gives rotation of the plane of polarization by transmission through all refracting substance, and by reflection from magnetized metals, and shows a fair agreement between the theoretical and experimental results. The simplest way of treating the questions seems, however, to be to go to the equations which represent the propagation of a wave travelling through a medium containing ions. A moving ion in a magnetic field will be acted upon by a mechanical force which is at right angles to its direction of motion, and also to the magnetic force, and is equal per unit charge to the product of these two vectors and the sine of the angle between them. For the sake of brevity we will take the special case of a wave travelling parallel to the magnetic force in the direction of the axis of z.

Then supposing that all the ions are of the same kind, and that there are n of these each with mass m and charge e per unit volume, the equations representing the field are (see ELECTRIC WAVES):—

$$K_0\frac{dX_0}{dt} + 4\pi ne\frac{d\xi}{dt} = \frac{d\beta}{dz};$$

$$\frac{dX_0}{dz} = \frac{d\beta}{dt};$$

$$K_0\frac{dY_0}{dt} + 4\pi ne\frac{d\eta}{dt} = -\frac{d\alpha}{dz}$$

$$\frac{dY_0}{dz} = -\frac{d\alpha}{dt};$$

$$m\frac{d^2\xi}{dt^2} + R_1\frac{d\xi}{dt} + a\xi = \left(X_0 + \frac{4\pi}{3}ne\xi\right)e + He\frac{d\eta}{dt}$$

$$m\frac{d^2\eta}{dt^2} + R_1\frac{d\eta}{dt} + a\eta = \left(Y_0 + \frac{4\pi}{3}ne\eta\right)e - He\frac{d\xi}{dt};$$

where H is the external magnetic field, X_0, Y_0 the components of the part of the electric force in the wave not due to the charges on the atoms, α and β the components of the magnetic force, ξ and η

the co-ordinates of an ion, R_1 the coefficient of resistance to the motion of the ions, and a the force at unit distance tending to bring the ion back to its position of equilibrium, K_0 the specific inductive capacity of a vacuum. If the variables are proportional to $\epsilon^{\iota(pt-qz)}$ we find by substitution that q is given by the equation

$$q^2-K_0p^2-\frac{4\pi ne^2p^2P}{P^2-H^2e^2p^2}=\pm\frac{4\pi ne^3Hp^3}{P^2-H^2e^2p^2},$$

where $P=(a-\frac{4}{3}\pi ne^2)+R_1\iota p-mp^2$,

or, by neglecting R, $P=m(s^2-p^2)$, where s is the period of the free ions. If, q_1^2, q_2^2 are the roots of this equation, then corresponding to q_1 we have $X_0=\iota Y_0$ and to q_2 $X_0=-\iota Y_0$. We thus get two oppositely circular-polarized rays travelling with the velocities p/q_1 and p/q_2 respectively. Hence if v_1, v_2 are these velocities, and v the velocity when there is no magnetic field, we obtain, if we neglect terms in H^2,

$$\frac{1}{v_1^2}=\frac{1}{v^2}+\frac{4\pi ne^3Hp}{m^2(s^2-p^2)^2},$$
$$\frac{1}{v_2^2}=\frac{1}{v^2}-\frac{4\pi ne^3Hp}{m^2(s^2-p^2)^2}.$$

The rotation r of the plane of polarization per unit length

$$=\frac{1}{2}p\left(\frac{1}{v_1}-\frac{1}{v_2}\right)=\frac{2\pi ne^3Hp^2v}{m^2(s^2-p^2)^2}.$$

Since $1/v^2=K_0+4\pi ne^2/m(s^2-p^2)$, we have if μ is the refractive index for light of frequency p, and v_0 the velocity of light in vacuo.

$$\mu^2-1=4\pi ne^2v^2{}_0/m(s^2-p^2) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

So that we may put

$$r=(\mu^2-1)^2p^2H/s\pi\mu nev_0^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Becquerel (*Comptes rendus*, 125, p. 683) gives for r the expression

$$\frac{1}{2}\frac{e}{m}\frac{H}{v_0}\frac{d\mu}{d\lambda},$$

where λ is the wave length. This is equivalent to (2) if μ is given by (1). He has shown that this expression is in good agreement with experiment. The sign of r depends on the sign of e, hence the rotation due to negative ions would be opposite to that for positive. For the great majority of substances the direction of rotation is that corresponding to the negation ion. We see from the equations that the rotation is very large for such a value of p as makes $P=0$: this value corresponds to a free period of the ions, so that the rotation ought to be very large in the neighbourhood of an absorption band. This has been verified for sodium vapour by Macaluso and Corbino.[43]

If plane-polarized light falls normally on a plane face of the medium containing the ions, then if the electric force in the incident wave is parallel to x and is equal to the real part of. $A\epsilon^{\iota(pt-qz)}$, if the reflected beam in which the electric force is parallel to x is represented by $B\epsilon^{\iota(pt+qz)}$ and the reflected beam in which the electric force is parallel to the axis of y by $C\epsilon^{\iota(pt+qz)}$, then the conditions that the magnetic force parallel to the surface is continuous, and that the electric forces parallel to the surface in the air are continuous with Y_0, X_0 in the medium, give

$$\frac{A}{(q+q_1)\,(q+q_2)}=\frac{B}{(q^2-q_1q_2)}=\frac{\iota C}{q(q_2-q_1)}$$

or approximately, since q_1 and q_2 are nearly equal,

$$\frac{\iota C}{B}=\frac{q(q_2-q_1)}{q^2-q_1^2}=\frac{(\mu^2-1)pH}{4\pi\mu neV_0^2}.$$

Thus in transparent bodies for which μ is real, C and B differ in phase by $\pi/2$, and the reflected light is elliptically polarized, the major axis of the ellipse being in the plane of polarization of the incident light, so that in this case there is no rotation, but only elliptic polarization; when there is strong absorption so that μ contains an imaginary term, C/B will contain a real part so that the reflected light will be elliptically polarized, but the major axis is no longer in the plane of polarization of the incident light; we should thus have a rotation of the plane of polarization superposed on the elliptic polarization.

Zeeman's Effect.—Faraday, after discovering the effect of a magnetic field on the plane of polarization of light, made numerous experiments to see if such a field influenced the nature of the light emitted by a luminous body, but without success. In 1885 Fievez,[44] a Belgian physicist, noticed that the spectrum of a sodium flame was changed slightly in appearance by a magnetic field; but his observation does not seem to have attracted much attention, and was probably ascribed to secondary effects. In 1896 Zeeman[45] saw a distinct broadening of the lines of lithium and sodium when the flames containing salts of these metals were between the poles of a powerful electromagnet; following up this observation, he obtained some exceedingly remarkable and interesting results, of which those observed with the blue-green cadmium line may be taken as typical. He found that in a strong magnetic field, when the lines of force are parallel to the direction of propagation of the light, the line is split up into a doublet, the constituents of which are on opposite sides of the undisturbed position of the line, and that the light in the constituents of this doublet is circularly polarized, the rotation in the two lines being in opposite directions. When the magnetic force is at right angles to the direction of propagation of the light, the line is resolved into a triplet, of which the middle line occupies the same position as the undisturbed line; all the constituents of this triplet are plane-polarized, the plane of polarization of the middle line being at right angles to the magnetic force, while the outside lines are polarized on a plane parallel to the lines of magnetic force. A great deal of light is thrown on this phenomenon by the following considerations due to H. A. Lorentz.[46]

Let us consider an ion attracted to a centre of force by a force proportional to the distance, and acted on by a magnetic force parallel to the axis of z: then if m is the mass of the particle and e its charge, the equations of motion are

$$m\frac{d^2x}{dt^2}+ax=-He\frac{dy}{dt};$$
$$m\frac{d^2y}{dt^2}+ay=He\frac{dx}{dt};$$
$$m\frac{d^2z}{dt^2}+az=0.$$

The solution of these equations is

$$x=A\cos(p_1t+\beta)+B\cos(p_2t+\beta_1)$$
$$y=A\sin(p_1t+\beta)-B\sin(p_2t+\beta_1)$$
$$z=C\cos(pt+\gamma)$$

where

$$a-mp_1^2=-Hep_1$$
$$a-mp_2^2=Hep_2$$
$$p^2=a/m,$$

or approximately $p_1=p+\frac{1}{2}\frac{He}{m}$, $p_2=p-\frac{1}{2}\frac{He}{m}$.

Thus the motion of the ion on the xy plane may be regarded as made up of two circular motions in opposite directions described with frequencies p_1 and p_2 respectively, while the motion along z has the period p, which is the frequency for all the vibrations when $H=0$. Now suppose that the cadmium line is due to the motion of such an ion; then if the magnetic force is along the direction of propagation, the vibration in this direction has its period unaltered, but since the direction of vibration is perpendicular to the wave front, it does not give rise to light. Thus we are left with the two circular motions in the wave front with frequencies p_1 and p_2 giving the circularly polarized constituents of the doublet. Now suppose the magnetic force is at right angles to the direction of propagation of the light; then the vibration parallel to the magnetic force being in the wave front produces luminous effects and gives rise to a plane-polarized ray of undisturbed period (the middle line of the triplet), the plane of polarization being at right angles to the magnetic force. The components in the wave-front of the circular orbits at right angles to the magnetic force will be rectilinear motions of frequency p_1 and p_2 at right angles to the magnetic force—so that they will produce plane-polarized light, the plane of polarization being parallel to the magnetic force; these are the outer lines of the triplet.

If Zeeman's observations are interpreted from this point of view, the directions of rotation of the circularly-polarized light in the doublet observed along the lines of magnetic force show that the ions which produce the luminous vibrations are *negatively* electrified, while the measurement of the charge of frequency due to the magnetic field shows that e/m is of the order 10^7. This result is of great interest, as this is the order of the value of e/m in the negatively electrified particles which constitute the Cathode Rays (see CONDUCTION, ELECTRIC III. *Through Gases*). Thus we infer that the "cathode particles" are found in bodies, even where not subject to the action of intense electrical fields, and are in fact an ordinary constituent of the molecule. Similar particles are found near an incandescent wire, and also near a metal plate illuminated by ultra-violet light. The value of e/m deduced from the Zeeman effect ranges from 10^7 to $3{\cdot}4\times10^7$, the value of e/m for the particle in the cathode rays is $1{\cdot}7\times10^7$. The majority of the determinations of e/m from the Zeeman effect give numbers larger than this, the maximum being about twice this value.

A more extended study of the behaviour of the spectroscopic lines has afforded examples in which the effects produced by a magnet are more complicated than those we have described, indeed the simple cases are much less numerous than the more complex. Thus Preston[47] and Cornu[48] have shown that under the action of a transverse magnetic field one of the D lines splits up into four, and the other into six lines; Preston has given many other examples of these quartets and sextets, and has shown that the change in the frequency, which, according to the simple theory indicated, should be the same for all lines, actually varies considerably from one line to another, many lines showing no appreciable displacement. The splitting up of a single line into a quartet or sextet indicates, from the point of view of the ion theory, that the line must have its origin in a system consisting of more than one ion. A single ion having only three degrees of freedom can only have three periods. When there is no magnetic force acting on the ion these periods are equal, but though under the action of a magnetic force they are separated, their number cannot be increased. When therefore we get four or more lines, the inference is that the system giving the lines must have at least four degrees of freedom, and therefore must consist of more than one ion. The theory of a system of ions mutually influencing each other shows, as we should expect, that the effects are more complex than in the case of a single ion, and that the change in the frequency is not necessarily the same for all systems (see J. J. Thomson, *Proc. Camb. Phil. Soc.* 13, p. 39). Preston[49] and Runge and Paschen have proved that, in some cases at any rate, the change in the frequency of the different lines is of such a character that they can be grouped into series such that each line in the series has the same change in frequency for the same magnetic force, and, moreover, that homologous lines in the spectra of different metals belonging to the same group have the same change in frequency.

A very remarkable case of the Zeeman effect has been discovered by H. Becquerel and Deslandres (*Comptes rendus*, 127, p. 18). They found lines in iron when the most deflected components are those polarized in the plane at right angles to the magnetic force. On the simple theory the light polarized in this way is not affected. Thus the behaviour of the spectrum in the magnetic field promises to throw great light on the nature of radiation, and perhaps on the constitution of the elements. The study of these effects has been greatly facilitated by the invention by Michelson[50] of the echelon spectroscope.

There are some interesting phenomena connected with the Zeeman effect which are more easily observed than the effect itself. Thus Cotton[51] found that if we have two Bunsen flames, A and B, coloured by the same salt, the absorption of the light of one by the other is diminished if either is placed between the poles of a magnet: this is at once explained by the Zeeman effect, for the times of vibration of the molecules of the flame in the magnetic field are not the same as those of the other flame, and thus the absorption is diminished. Similar considerations explain the phenomenon observed by Egoroff and Georgiewsky,[52] that the light emitted from a flame in a transverse field is partially polarized in a plane parallel to the magnetic force; and also Righi's[53] observation that if a sodium flame is placed in a longitudinal field between two crossed Nicols, and a ray of white light sent through one of the Nicols, then through the flame, and then through the second Nicol, the amount of light passing through the second Nicol is greater when the field is on than when it is off. Voight and Wiechert (*Wied. Ann.* 67, p. 345) detected the double refraction produced when light travels through a substance exposed to a magnetic field at right angles to the path of the light; this result had been predicted by Voight from theoretical considerations. Jean Becquerel has made some very interesting experiments on the effect of a magnetic field on the fine absorption bands produced by xenotime, a phosphate of yttrium and erbium, and tysonite, a fluoride of cerium, lanthanum and didymium, and has obtained effects which he ascribes to the presence of positive electrons. A very complete account of magneto- and electro-optics is contained in Voight's *Magneto- and Elektro-optik.*

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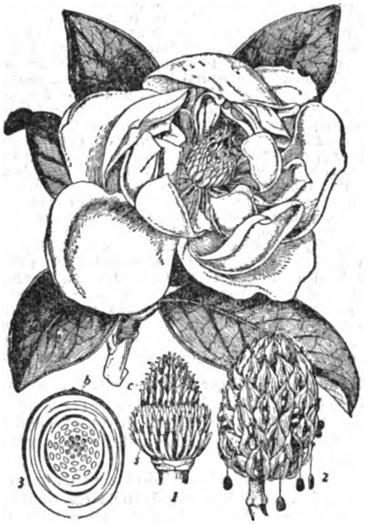
[1] *Experimental Researches*, Series 19. [2] *Comptes rendus*, 88, p. 709. [3] *Wied. Ann.* 6, p. 332; 8, p. 278; 10, p. 257. [4] *Wied. Ann.* 23, p. 228; 27, p. 191. [5] *Wied. Ann.* 31, p. 941. [6] *Phil. Trans.*, A. 1885, Pt. 11, p. 343. [7] *Wied. Ann.* 26, p. 456. [8] *Phil. Trans.*, A. 1895, Pt. 17, p. 621. [9] *Wied. Ann.* 24, p. 161. [10] *Wied. Ann.* 31, p. 970. [11] *Comptes rendus*, 57, p. 670. [12] *Comptes rendus*, 43, p. 529; 44, p. 1209. [13] *Journ. Chem. Soc.* 1884, p. 421; 1886, p. 177; 1887, pp. 362 and 808; 1888, p. 561; 1889, pp. 680 and 750; 1891, p. 981; 1892, p. 800; 1893, pp. 75, 99 and 488. [14] *Wied. Ann.* 44, p. 377. [15] *Wied. Ann.* 43, p. 280. [16] *Zeitschrift f. physikal. Chem.* 11, p. 753. [17] *Phil. Mag.* [5] 3, p. 321. [18] *Ann. de chim. et de phys.* [6] 4, p. 433; 9, p. 65, 10, p. 200. [19] *Wied. Ann.* 23, p. 228; 27, p. 191. [20] *Wied. Ann.* 39, p. 25. [21] *Wied. Ann.* 42, p. 115. [22] *Phil. Mag.* [5] 12, p. 171. [23] *Journ. de Phys.* 1884, p. 360. [24] *Beiblätter zu Wied. Ann.* 1885, p. 275. [25] *Messungen über d. Kerr'sche Erscheinung.* Inaugural Dissert. Leiden, 1893. [26] *Phil. Mag.* [5] 5, p. 161. [27] *Phil. Mag.* [3] 28, p. 469. [28] *Die magn. Drehung d. Polarisationsebene des Lichts*, Halle, 1863. [29] *Electricity and Magnetism*, chap. xxi. [30] *Phil. Trans.* 1880 (2), p. 691. [31] *Phil. Mag.* (5) 11, p. 254, 1881. [32] *Arch. Néerl.* 19, p. 123. [33] *Wied. Ann.* 23, p. 493; 67, p. 345. [34] *Wied. Ann.* 24, p. 119. [35] *Wied. Beiblätter*, 8, p. 869. [36] *Comptes rendus*, 108, p. 510. [37] *Phil. Trans.* 182, A. p. 371, 1892; *Physical Optics*, p. 393. [38] *Wied. Ann.* 46, p. 71; 47, p. 345; 48, p. 740; 50, p. 722. [39] *Wied. Ann.* 46, p. 353; 48, p. 122; 49, p. 690. [40] *Recent Researches*, p. 489 *et seq.* [41] *Phil. Trans.*, A. 1897, p. 89. [42] *Brit. Assoc. Report*, 1893. [43] *Comptes rendus*, 127, p. 548. [44] *Bull. de l'Acad. des Sciences Belg.* (3) 9, pp. 327, 381, 1885; 12 p. 30, 1886. [45] *Communications from the Physical Laboratory*, Leiden, No. 33, 1896; *Phil. Mag.* 43, p. 226; 44, pp. 55 and 255; and 45, p. 197. [46] *Arch. Néerl.* 25, p. 190. [47] *Phil. Mag.* 45, p. 325; 47, p. 165. [48] *Comptes rendus*, 126, p. 181. [49] *Phil. Mag.* 46, p. 187. [50] *Phil. Mag.* 45, p. 348. [51] *Comptes rendus*, 125, p. 865. [52] *Comptes rendus*, pp. 748 and 949, 1897. [53] *Comptes rendus*, 127, p. 216; 128, p. 45. (J. J. T.)

MAGNOLIA, the typical genus of the botanical order Magnoliaceae, named after Pierre Magnol (1638–1715), professor of medicine and botany at Montpellier. It contains about twenty species, distributed in Japan, China and the Himalayas, as well as in North America.

Magnolias are trees or shrubs with deciduous or rarely evergreen foliage. They bear conspicuous and often large, fragrant, white, rose or purple flowers. The sepals are three in number, the petals six to twelve, in two to four series of three in each, the stamens and carpels being numerous. The fruit consists of a number of follicles which are borne on a more or less conical receptacle, and dehisce along the outer edge to allow the scarlet or brown seeds to escape; the seeds however remain suspended by a long slender thread (the funicle). Of the old-world species, the earliest in cultivation appears to have been *M. Yulan* (or *M. conspicua*) of China, of which the buds were preserved, as well as used medicinally and to season rice; together with the greenhouse species, *M. fuscata*, it was transported to Europe in 1789, and thence to North America, and is now cultivated in the Middle States. There are many fine forms of *M. conspicua*, the best being *Soulangeana*, white tinted with purple, *Lennê* and *stricta*. Of the Japanese magnolias, *M. Kobus* and the purple-flowered *M. obovata* were met with by Kaempfer in 1690, and were introduced into England in 1709 and 1804 respectively. *M. pumila*, the dwarf magnolia, from the mountains of Amboyna, is nearly evergreen, and bears deliciously scented flowers; it was introduced in 1786. The Indian species are three in number, *M. globosa*, allied to *M. conspicua* of Japan, *M. sphenocarpa*, and, the most magnificent of all magnolias, *M. Campbellii*, which forms a conspicuous feature in the scenery and vegetation of Darjeeling. It was discovered by Dr Griffith in Bhutan, and is a large forest tree, abounding on the outer ranges of Sikkim, 80 to 150 ft. high, and from 6 to 12 ft. in girth. The flowers are 6 to 10 in. across, appearing before the leaves, and vary from white to a deep rose colour.

The first of the American species brought to Europe (in 1688 by John Banister) was *M. glauca*, a beautiful evergreen species about 15 ft. high with obtuse leathery leaves, blue-green above, silvery underneath, and globular flowers varying from creamy white to pale yellow with age. It is found in low situations near the sea from Massachusetts to Louisiana—more especially in New Jersey and the Carolinas. *M. acuminata*, the so-called "cucumber tree," from the resemblance of the young fruits to small cucumbers, ranges from Pennsylvania to Carolina. The wood is yellow, and used for bowls; the flowers, 3 to 4 in. across, are glaucous green tinted with yellow. It was introduced into England from Virginia about 1736. *M. tripetala* (or *M. umbrella*), is known as the "umbrella tree" from the arrangement of the leaves at the ends of the branches resembling somewhat that of the ribs of an umbrella. The flowers, 5 to 8 in. across, are white and have a strong but not disagreeable scent. It was brought to England in 1752. *M. Fraseri* (or *M. auriculata*), discovered by John Bartram in 1773, is a native of the western parts of the Carolinas and Georgia, extending southward to western Florida and southern Alabama. It grows 30 to 50 ft. high, has leaves a foot or more long, heart-shaped and bluntly auricled at the base, and fragrant pale yellowish-white flowers, 3 to 4 in. across. The most beautiful species of North America is *M. grandiflora*, the "laurel magnolia," a native of the south-eastern States, and introduced into England in 1734. It grows a straight trunk, 2 ft. in diameter and upwards of 70 ft. high, bearing a profusion of large, powerfully lemon-scented creamy-white flowers. It is an evergreen tree, easily recognized by its glossy green oval oblong leaves with a rusty-brown under surface. In England it is customary to train it against a wall in the colder parts, but it does well as a bush tree; and the original species is surpassed by the Exmouth varieties, which originated as seedlings at Exeter from the tree first raised in England by Sir John Colliton, and which flower much more freely than the parent plant. Other fine magnolias now to be met with in gardens are *M. cordata*, a North American deciduous tree 40 to 50 ft. high, with heart-shaped leaves, woolly beneath, and yellow flowers lined with purple; *M. hypoleuca*, a fine Japanese tree 60 ft. high or more, with leaves a foot or more long, 6 to 7 in. broad, the under surface covered with hairs; *M. macrophylla*, a handsome deciduous North American tree, with smooth whitish bark, and very large beautiful green leaves, 1 to 3 ft. long, 8 to 10 in. broad, oblong-obovate and heart-shaped at the base; the open sweet-scented bell-shaped flowers 8 to 10 in. across, are white with a purple blotch at the base of the petals; *M. stellata* or *Halleana*, a charming deciduous Japanese shrub remarkable for producing its pure white starry flowers as early as February and March on the leafless stems; and *M. Watsoni*, another fine deciduous Japanese bush or small tree with very fragrant pure white flowers 5 to 6 in. across.



Magnolia grandiflora, shoot with flower; rather less than ⅓ nat. size.
1. Flower after removal of the sepals and petals, showing the indefinite stamens, *s*, and carpels, *c*.
2. Fruit—the ripe carpels are splitting, exposing the seeds, some of which are suspended by the long funicle.
3. Floral diagram, *b*, bract.

The tulip tree, *Liriodendron tulipifera*, a native of North America, frequently cultivated in England, is also a member of the same family. It reaches a height of over 100 ft. in a native condition, and as much as 60 to 80 ft. in England. It resembles the plane tree somewhat in appearance, but is readily recognized by lobed leaves having the apical lobe truncated, and by its soft green and yellow tulip-like flowers—which however are rarely borne on trees under twenty years of age.

For a description of the principal species of magnolia under cultivation see J. Weathers, *Practical Guide to Garden Plants*, pp. 174 seq., and for a detailed account of the American species see C. S. Sargent, *Silva of North America*, vol. i.

MAGNUS, HEINRICH GUSTAV (1802–1870), German chemist and physicist, was born at Berlin on the 2nd of May 1802. His father was a wealthy merchant; and of his five brothers one, Eduard (1799–1872), became a celebrated painter. After studying at Berlin, he went to Stockholm to work under Berzelius, and later to Paris, where he studied for a while under Gay-Lussac and Thénard. In 1831 he returned to Berlin as lecturer on technology and physics at the university. As a teacher his success was rapid and extraordinary. His lucid style and the perfection of his experimental demonstrations drew to his lectures a crowd of enthusiastic scholars, on whom he impressed the importance of applied science by conducting them round the factories and workshops of the city; and he further found time to hold weekly "colloquies" on physical questions at his house with a small circle of young students. From 1827 to 1833 he was occupied mainly with chemical researches, which resulted in the discovery of the first of the platino-ammonium compounds ("Magnus's green salt" is $PtCl_2, 2NH_3$), of sulphovinic, ethionic and isethionic acids and their salts, and, in conjunction with C. F. Ammermüller, of periodic acid. Among other subjects at which he subsequently worked were the absorption of gases in blood (1837–1845), the expansion of gases by heat (1841–1844), the vapour pressures of water and various solutions (1844–1854), thermo-electricity (1851), electrolysis (1856), induction of currents (1858–1861), conduction of heat in gases (1860), and polarization of heat (1866–1868). From 1861 onwards he devoted much attention to the question of diathermancy in gases and vapours, especially to the behaviour in this respect of dry and moist air, and to the thermal effects produced by the condensation of moisture on solid surfaces.

In 1834 Magnus was elected extraordinary, and in 1845 ordinary professor at Berlin. He was three times elected dean of the faculty, in 1847, 1858 and 1863; and in 1861, rector magnificus. His great reputation led to his being entrusted by the government with several missions; in 1865 he represented Prussia in the conference called at Frankfort to introduce a uniform metric system of weights and measures into Germany. For forty-five years his labour was incessant; his first memoir was published in 1825 when he was yet a student; his last appeared shortly after his death on the 4th of April 1870. He married in 1840 Bertha Humblot, of a French Huguenot family settled in Berlin, by whom he left a son and two daughters.

See *Allgemeine deutsche Biog.* The Royal Society's *Catalogue* enumerates 84 papers by Magnus, most of which originally appeared in *Poggendorff's Annalen*.

MAGNY, CLAUDE DRIGON, Marquis de (1797–1879), French heraldic writer, was born in Paris. After being employed for some time in the postal service, he devoted himself to the study of heraldry and genealogy, his work in this direction being rewarded by Pope Gregory XVI. with a marquisate. He founded a French college of heraldry, and wrote several works on heraldry and genealogy, of which the most important were *Archives nobiliaires universelles* (1843) and *Livre d'or de la noblesse de France* (1844–1852). His two sons, Edouard Drigon and Achille Ludovice Drigon, respectively comte and vicomte de Magny, also wrote several works on heraldry.

MAGO, the name of several Carthaginians. (1) The reputed founder of the military power of Carthage, fl. 550–500 B.C. (Justin xviii. 7, xix. 1). (2) The youngest of the three sons of Hamilcar Barca. He accompanied Hannibal into Italy, and held important commands in the great victories of the first three years. After the battle of Cannae (216 B.C.) he sailed to Carthage to report the successes gained. He was about to return to Italy with strong reinforcements for Hannibal, when the government ordered him to go to the aid of his other brother, Hasdrubal, who was hard pressed in Spain. He carried on the war there with varying success in concert with the two Hasdrubals until, in 209, his brother marched into Italy to help Hannibal. Mago remained in Spain with Hasdrubal, the son of Gisco. In 207 he was defeated by M. Junius Silanus, and in 206 the combined forces of Mago and Hasdrubal were scattered by Scipio Africanus in the decisive battle of Silpia. Mago maintained himself for some time in Gades, but afterwards received orders to carry the war into Liguria. He wintered in the Balearic Isles, where the harbour Portus Magonis (Port Mahon) still bears his name. Early in 204 he landed in Liguria, where he maintained a desultory warfare till in 203 he was defeated in Cisalpine Gaul by the Roman forces. Shortly afterwards he was ordered to return to Carthage, but on the voyage home he died of wounds received in battle.

See Polybius iii.; Livy xxi.–xxiii.; xxviii., chs. 23–37; xxix., xxx.; Appian, *Hispanica*, 25–37; T. Friedrich, *Biographie des Barkiden Mago*; H. Lehmann, *Der Angriff der drei Barkiden auf Italien* (Leipzig, 1905); and further J. P. Mahaffy, in *Hermathena*, vii. 29–36 (1890).

(3) The name of Mago is also attached to a great work on agriculture which was brought to Rome and translated by order of the senate after the destruction of Carthage. The book was regarded as a standard authority, and is often referred to by later writers.

See Pliny, *Nat. Hist.* xviii. 5; Columella, i. 1; Cicero, *De oratore*, i. 58.

MAGPIE, or simply PIE (Fr. *pie*), the prefix being the abbreviated form of a human name (Margaret[1]), a bird once common throughout Great Britain, though now nearly everywhere scarce. Its pilfering habits have led to this result, yet the injuries it causes are exaggerated by common report; and in many countries of Europe it is still the tolerated or even the cherished neighbour of every farmer, as it formerly was in England if not in Scotland also. It did not exist in Ireland in 1617, when Fynes Morison wrote his *Itinerary*, but it had appeared there within a hundred years later, when Swift mentions its occurrences in his *Journal to Stella*, 9th July 1711. It is now common enough in that country, and there is a widespread but unfounded belief that it was introduced by the English out of spite. It is a species that when not molested is extending its range, as J. Wolley ascertained in Lapland, where within the last century it has been gradually pushing its way along the coast and into the interior from one fishing-station or settler's house to the next, as the country has been peopled.

Since the persecution to which the pie has been subjected in Great Britain, its habits have altered greatly. It is no longer the merry, saucy hanger-on of the homestead, but is become the suspicious thief, shunning the gaze of man, and knowing that danger may lurk in every bush. Hence opportunities of observing it fall to the lot of few, and most persons know it only as a curtailed captive in a wicker cage, where its vivacity and natural beauty are lessened or wholly lost. At large few European birds possess greater beauty, the pure white of its scapulars and inner web of the flight-feathers contrasting vividly with the deep glossy black on the rest of its body and wings, while its long tail is lustrous with green, bronze, and purple reflections. The pie's nest is a wonderfully ingenious structure, placed either in high trees or low bushes, and so massively built that it will stand for years. Its foundation consists of stout sticks, turf and clay, wrought into a deep, hollow cup, plastered with earth, and lined with fibres; but around this is erected a firmly interwoven, basket-like outwork of thorny sticks, forming a dome over the nest, and leaving but a single hole in the side for entrance and exit, so that the whole structure is rendered almost impregnable. Herein are laid from six to nine eggs, of a pale bluish-green freckled with brown and blotched with ash-colour. Superstition as to the appearance of the pie still survives even among many educated persons, and there are several versions of a rhyming adage as to the various turns of luck which its presenting itself, either alone or in company with others, is supposed to betoken, though all agree that the sight of a single pie presages sorrow.

The pie belongs to the same family of birds as the crow, and is the *Corvus pica* of Linnaeus, the *Pica caudata*, *P. melanoleuca*, or *P. rustica* of modern ornithologists, who have recognized it as forming a distinct genus, but the number of species thereto belonging has been a fruitful source of discussion. Examples from the south of Spain differ slightly from those inhabiting the rest of Europe, and in some points more resemble the *P. mauritanica* of north-western Africa; but that species has a patch of bare skin of a fine blue colour behind the eye, and much shorter wings. No fewer than five species have been discriminated from various parts of Asia, extending to Japan; but only one of them, the *P. leucoptera* of Turkestan and Tibet, has of late been admitted as valid. In the west of North America, and in some of its islands, a pie is found which extends to the upper valleys of the Missouri and the Yellowstone, and has long been thought entitled to specific distinction as *P. hudsonia*; but its claim thereto is now disallowed by some of the best ornithologists of the United States, and it can hardly be deemed even a geographical variety of the Old-World form. In California, however, there is a permanent race if not a good species, *P. nuttalli*, easily distinguishable by its yellow bill and the bare yellow skin round its eyes; on two occasions in the year 1867 a bird apparently similar was observed in Great Britain (*Zoologist*, ser. 2, pp. 706, 1016. (A. N.)

MAGWE, a district in the Minbu division of Upper Burma. Area, 2913 sq. m.; pop. (1901), 246,708, showing an increase of 12·38% in the decade. Magwe may be divided into two portions: the low, flat country in the Taungdwingyi subdivision, and the undulating high ground extending over the rest of the district. In Taungdwingyi the soil is rich, loamy, and extremely fertile. The plain is about 45 m. from north to south. At its southern extremity it is about 30 m. wide, and lessens in width to the north till it ends in a point at Natmauk. On the east are the Pegu Yomas, which at some points reach a height of 1500 ft. A number of streams run westwards to the Irrawaddy, of which the Yin and the Pin, which form the northern boundary, are the chief. The only perennial stream is the Yanpè. Rice is the staple product, and considerable quantities are exported. Sesamum of very high quality, maize, and millet are also cultivated, as well as cotton in patches here and there over the whole district.

In this district are included the well-known Yenangyaung petroleum wells. The state wells have been leased to the Burma Oil Company. The amount of oil-bearing lands is estimated at 80 sq. m. and the portion not leased to the company has been demarcated into blocks of 1 sq. m. and offered on lease. The remaining land belongs to hereditary Burmese owners called *twinsa*, who dig wells and extract their oil by the rope and pulley system as they have always done. Lacquered wood trays, bowls and platters, and cart-wheels, are the only manufactures of any note in the district.

The annual rainfall averages about 27 inches. The maximum temperature rises to a little over 100° in the hot season, and falls to an average minimum of 53° and 54° in the cold season.

The town of MAGWE is the headquarters of the district; pop. (1901), 6232. It is diagonally opposite Minbu, the headquarters of the division, on the right bank of the Irrawaddy.

MAGYARS, the name of the dominant race in Hungary, or Hungarians proper. Though they have become physically assimilated to the western peoples, they belong in origin and language to the Finno-Ugrian (*q.v.*) division of the Ural-Altaic race. They form barely half of the population of Hungary, but are by far the largest and most compact of all its racial groups.

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[1] "Magot" and "Madge," with the same origin, are names, frequently given in England to the pie; while in France it is commonly known as *Margot*, if not termed, as it is in some districts, *Jaquette*.

Magyar is the official language of Hungary, the official name of which (*Magyarország*, or "country of the Magyars") enshrines the Magyar claim to predominance. While all Magyars are properly Hungarians, all Hungarians are not necessarily Magyars. "Hungarian" may be used as a generic term covering all the various races of Hungary, while "Magyar" is strictly specific to a single group. The Magyars themselves, indeed, sometimes apply the name *Magyarország* to Hungary "proper," excluding Croatia-Slavonia, the whole kingdom being called *Magyarbirodalom*, the Magyar monarchy or realm. See HUNGARY.

MAHABALESHWAR, or MALCOLMPETH, a hill station in Satara district, and the principal sanatorium in the Bombay presidency, India. Pop. (1901), 5299. It is reached by carriage from Wathar railway station (39 m.) or by motor car from Poona (119 m.). Mahabaleshwar occupies the summit of a ridge of the Western Ghats, with a general elevation of 4500 ft. above sea-level. It was established in 1828 by Sir John Malcolm, governor of Bombay, who obtained the site from the raja of Satara in exchange for another patch of territory. The superior elevation of Mahabaleshwar renders it much cooler than Matheran (2460 ft.), a sanatorium about 50 m. E. of Bombay, but its heavy rainfall (292 in. annual average) makes it almost uninhabitable during the rainy season. The mean annual temperature is 67° F. In the hottest season (March-April) an extreme of a little over 90° is reached during the day. Mahabaleshwar forms the retreat usually during spring, and occasionally in autumn, of the governor of Bombay, and the chief officers of his establishment, and has the usual public buildings of a first-class sanatorium.

MAHAFFY, JOHN PENTLAND (1839–), Irish classical scholar, was born in Switzerland on the 12th of July 1839. He received his early education in Switzerland and Germany, and later at Trinity College, Dublin, where he held the professorship of ancient history. Mahaffy, a man of great versatility, published numerous works, some of which, especially those dealing with what may be called the Silver age of Greece, became standard authorities. The following deserve mention: *History of Classical Greek Literature* (4th ed., 1903 seq.); *Social Life in Greece from Homer to Menander* (4th ed., 1903); *The Silver Age of the Greek World* (1906); *The Empire of the Ptolemies* (1896); *Greek Life and Thought from Alexander to the Roman Conquest* (2nd ed., 1896); *The Greek World under Roman Sway from Polybius to Plutarch* (1890). His translation of Kuno Fischer's *Commentary on Kant* (1866) and his own exhaustive analysis, with elucidations, of Kant's critical philosophy are of great value. He also edited the Petrie papyri in the *Cunningham Memoirs* (3 vols. 1891–1905).

MAHALLAT, a province of central Persia, situated between Kashan and Irak. Pop. about 20,000; yearly revenue about £2500. Until 1890 it was one of the five "central provinces" (the other four being Irak, Ferahan, Kezzaz, and Savah), which were under a governor appointed by the shah; since then it has formed part of the Isfahan government. It is traversed by the Anarbar or Kum River, and comprises the city of Mahallat, divided into upper and lower, or Rivkan and Zanjirvan, and twenty-two flourishing villages. It was known in former times as Anar, the Anarus of Peutinger's tables. The city, capital of the province, is situated at an elevation of 5850 ft. in 33° 51′ N., 50° 30′ E.; pop. about 9000.

MAHAN, ALFRED THAYER (1840–), American naval officer and historian, was born on the 27th of September 1840 at West Point, New York. His father, Dennis Hart Mahan (1802–1871) was a professor in the military academy, and the author of textbooks on civil and military engineering. The son graduated at the naval academy in 1859, became lieutenant in 1861, served on the "Congress," and on the "Pocahontas," "Seminole," and "James Adger" during the Civil War, and was instructor at the naval academy for a year. In 1865 he was made lieut.-commander, commander in 1872, captain in 1885. Meanwhile he saw service in the Gulf of Mexico, the South Atlantic, the Pacific, and Asia, and did shore duty at Boston, New York and Annapolis. In 1886–89 he was president of the naval war college at Newport, Rhode Island. Between 1889 and 1892 he was engaged in special service for the bureau of navigation, and in 1893 was made commander of the "Chicago," of the European squadron. In 1896 he retired from active service, but was a member of the naval board of strategy during the war between the United States and Spain. He was a member of the peace congress at the Hague in 1899. This long and varied service gave him extensive opportunities for observation, which he supplemented by constant study of naval authorities and reflection on the interpretation of the problems of maritime history. His first book was a modest and compact story of the affairs in *The Gulf and Inland Waters* (1883), in a series of volumes by various writers, entitled *The Navy in the Civil War*; in 1890 he suddenly acquired fame by the appearance of his masterly work entitled *The Influence of Sea Power upon History, 1660–1783*. Having been impressed by the failure of historians to allow for the influence of sea power in struggles between nations, he was led to make prolonged investigations of this general theme (see SEA POWER). The reception accorded the volume was instant and hearty; in England, in particular, it was deemed almost an epoch-making work, and was studied by naval specialists, cabinet ministers and journalists, as well as by a large part of the general public. It was followed by *The Influence of Sea Power upon the French Revolution and Empire* (2 vols. 1892); *The Life of Nelson, the Embodiment of the Sea Power of Great Britain* (1897); and *Sea Power in its Relations to the War of 1812* (1905). The author's general aim in these works—some of which have been translated into French, German and Japanese—was to make the consideration of maritime matters paramount to that of military, political or economic movements, without, however, as he himself says "divorcing them from their surroundings of cause and effect in general history, but seeking to show how they modified the latter, and were modified by them." He selected the year 1660 as the beginning of his narrative, as being the date when the "sailing-ship era, with its distinctive features, had fairly begun." The series as a whole has been accepted as finally authoritative, supplanting its predecessors of similar aim, and almost—in the words of Theodore Roosevelt—founding a new school of naval historical writing.

Other works by Mahan are a *Life of Admiral Farragut* (1892); *The Interest of America in Sea Power* (1897); *Lessons of the War with Spain* (1899); *The Story of the War with South Africa* and *The Problem of Asia* (1900); *Types of Naval Officers drawn from the History of the British Navy* (1901); *Retrospect and Prospect*, studies of international relations (1902).

MAHANADI, or MAHANUDDY ("The Great River"), a river of India. It rises in 20° 10′ N., 82° E., 25 m. S. of Raipur town, in the wild mountains of Bastar in the Central Provinces. At first an insignificant stream, taking a northerly direction, it drains the eastern portion of the Chhattisgarh plain, then a little above Seorinarayan it receives the waters which its first great affluent, the Seonath, has collected from the western portion of the plain; thence flowing for some distance due E., its stream is augmented by the drainage of the hills of Uprora, Korba, and the ranges that separate Sambalpur from Chota Nagpur. At Padampur it turns towards the south, and struggling through masses of rock, flows past the town of Sambalpur to Sonpur. From Sonpur it pursues a tortuous course among ridges and rocky crags towards the range of the Eastern Ghats. This mountain line it pierces by a gorge about 40 m. in length, overlooked by forest-clad hills. Since the opening of the Bengal-Nagpur railway, the Mahanadi is little used for navigation. It pours down upon the Orissa delta at Naraj, about 7 m. west of Cuttack town; and after traversing Cuttack district from west to east, and throwing off numerous branches (the Katjori, Paika, Biropa, Chitartala, &c.) it falls into the Bay of Bengal at False Point by several channels.

The Mahanadi has an estimated drainage area of 43,800 sq. m., and its rapid flow renders its maximum discharge in time of flood second to that of no other river in India. During unusually high floods 1,500,000 cub. ft. of water pour every second through the Naraj gorge, one-half of which, uncontrolled by the elaborate embankments, and heavily laden with silt, pours over the delta, filling the swamps, inundating the rice-fields, and converting the plains into a sea. In the dry weather the discharge of the Mahanadi dwindles to 1125 cub. ft. per second. Efforts have been made to husband and utilize the vast water supply thrown upon the Orissa delta during seasons of flood. Each of the three branches into which the parent stream splits at the delta head is regulated by a weir. Of the four canals which form the Orissa irrigation system, two take off from the Biropa weir, and one, with its branch, from the Mahanadi weir. On the 31st of December 1868 the government took over the whole canal works from the East Indian Irrigation Company, at a cost of £941,368. The canals thus taken over and since completed, are the high-level canal, the Kendrapara canal, the Taldanda canal and the Machgaon canal, irrigating 275,000 acres.

MAHANOY CITY, a borough of Schuylkill county, Pennsylvania, U.S.A., 56 m. N.E. of Harrisburg. Pop. (1890), 11,286; (1900), 13,504, of whom 3877 were foreign-born, mostly Slavs; (1910 census) 15,936. It is served by branches of the Lehigh Valley and the Philadelphia & Reading railways. The borough is situated in the valley of Mahanoy Creek, and has an elevation of 1240 ft. above the sea; Broad Mountain (1795 ft.), a ridge extending through Schuylkill county, overlooks it on the S.E. The valley is a part of the anthracite coal region of Pennsylvania, fire clay abounds in the vicinity, and the borough's principal industries are the mining and shipping of coal, and the manufacture of shirts and foundry products. Mahanoy City, originally a part of Mahanoy township (pop. in 1910, 6256), was incorporated as a borough in 1863.

MAHAR, the name of a servile caste in the Deccan, India. Their special function, apart from that of scavenger, is to act as village watchman, as guardian of the village boundaries, and as public messenger. In some parts they are also weavers of coarse cotton cloth. In 1901 their total number in all India was just under three millions.

MAHARAJPUR, a village in Gwalior state, Central India. Pop. (1901), 366. It was the scene of a battle (Dec. 29, 1843) in which Sir Hugh Gough, accompanied by the governor-general, Lord Ellenborough, defeated the insurgent army of the Gwalior state.

MAHĀVAṂSA, the *Great Chronicle*, a history of Ceylon from the 5th century B.C. to the middle of the 5th century A.D., written in Pali verse by Mahānāma of the Dīghasanda Hermitage, shortly after the close of the period with which it deals. In point of historical value it compares well with early European chronicles. In India proper the decipherment of early Indian inscriptions was facilitated to a very great extent by the data found only in the Mahāvaṃsa. It was composed on the basis of earlier works written in Sinhalese, which are now lost, having been supplanted by the chronicles and commentaries in which their contents were restated in Pali in the course of the 5th century. The particular one on which our Mahāvaṃsa was mainly based was also called the Mahāvaṃsa, and was written in Sinhalese prose with Pali memorial verse interspersed. The extant Pali work gives legends of the Buddha and the genealogy of his family; a sketch of the history of India down to Asoka; an account of Buddhism in India down to the same date; a description of the sending out of missionaries after Asoka's council, and especially of the mission of Mahinda to Ceylon; a sketch of the previous history of Ceylon; a long account of the reign of Devānam-piya Tissa, the king of Ceylon who received Mahinda, and established Buddhism in the island; short accounts of the kings succeeding him down to Duṭṭha Gāmīni (Dadagamana or Dutegemunu); then a long account, amounting to an epic poem, of the adventures and reign of that prince, a popular hero, born in adversity, who roused the people, and drove the Tamil invaders out of the island. Finally we have short notices of the subsequent kings down to the author's time. The Mahāvaṃsa was the first Pali book made known to Europe. It was edited in 1837, with English translation and an elaborate introduction, by George Turnour, then colonial secretary in Ceylon. Its vocabulary was an important part of the material utilized in Childer's *Pali Dictionary*. Its relation to the sources from which it drew has been carefully discussed by various scholars and in especial detail by Geiger. It is agreed that it gives a reasonably fair and correct presentation of the tradition preserved in the lost Sinhalese Mahāvaṃsa; that, except in the earliest period, its list of kings, with the years of each reign, is complete and trustworthy; and that it gives throughout the view, as to events in Ceylon, of a resident in the Great Minster at Anurādhapura.

See *The Mahāvaṃsa*, ed. by Geo. Turnour (Colombo, 1837); ed. by W. Geiger (London, 1908); H. Oldenberg, in the introduction to his edition of the *Dīpavamsa* (London, 1879); O. Franke, in *Wiener Zeitschrift für die Kunde des Morgenlandes* (1907); W Geiger, *Dīpavamsa und Mahāvamsa* (Leipzig, 1905, trans. by Ethel M. Coomaraswamy, Colombo, 1908). (T. W. R. D.)

MAHAYANA ("Great Vehicle"), the name given to the later Buddhism, the popular religion which embraced all the people and had its pantheon of Buddhas and Bodhisatvas, with attendant deities and demons, spacious temples and images, pompous ceremonial and noisy festivals. It was thus contrasted with the Hinayana ("Little Vehicle") of the primitive Buddhism which had been only for the select few. (See BUDDHISM.)

MAHDĪ (Arab. "he who is guided aright"), a title assumed by the third Abbasid caliph (see CALIPHATE: *Abbasids*, § 3). According to Moslem traditionists Mahomet declared that one of his descendants, the imam of God, who would fill the earth with equity and justice, would bear the name of al-mahdi. The Sunnis hold that this mahdi has not yet appeared. The name of mahdi is also given by the Shi'ite Mahommedans to the last of the imams of the house of 'Ali. It was under the name of al-mahdi that Mokhtar proclaimed 'Ali's son Mahommed as the opponent of the caliph Abdalmalik, and, according to Shahrastani, the doctrine of the mahdi, the hidden deliverer who is one day to appear and fill the oppressed world with righteousness, first arose in connexion with a belief that this Mahommed had not died but lived concealed at Mount Radwā, near Mecca, guarded by a lion and a panther. The hidden imam of the common Shi'ites is, however, the twelfth imam, Mahommed Abu'l-Qasim, who disappeared mysteriously in 879. The belief in the appearance of the mahdi readily lent itself to imposture. Of the many pretenders to this dignity known in all periods of Moslem history the most famous was the first caliph of the Fatimite dynasty in North Africa, 'Obaidallah al-Mahdi, who reigned 909–933. After him was named the first capital of the dynasty, the once important city of Mahdia (*q.v.*). Another great historical movement, headed by a leader who proclaimed himself the mahdi (Mahommed ibn Abdallah ibn Tumart), was that of the Almohades (*q.v.*). In 1881 Mahommed Ahmed ibn Seyyid Abdullah (*q.v.*), a Dongolese, proclaimed himself al-mahdi and founded in the eastern Sudan the short-lived empire overthrown by an Anglo-Egyptian force at the battle of Omdurman in 1898. Concurrently with the claim of Mahommed Ahmed to be the mahdi the same title was claimed by, or for, the head of the Senussites, a confraternity powerful in many regions of North Africa.

MAHDIA (also spelt *Mehdia*, *Mehedia*, &c.), a town of Tunisia, on the coast between the gulfs of Hammamet and Gabes, 47 m. by rail S.S.E. of Susa. Pop. about 8000. Mahdia is built on a rocky peninsula which projects eastward about a mile beyond the normal coast line, and is not more than a quarter of a mile wide. The extremity of the peninsula is called Ras Mahdia or Cape Africa—Africa being the name by which Mahdia was designated by Froissart and other European historians during the middle ages and the Renaissance. In the centre of the peninsula and occupying its highest point is a citadel (16th century); another castle farther west is now used as a prison and is in the centre of the native town. The European quarter and the new port are on the south-west side of the peninsula. The port is available for small boats only; steamers anchor in the roadstead about a quarter of a mile from the shore. On the south-east, cut out of the rock, is the ancient harbour, or *cothon*, measuring about 480 ft by 240 ft., the entrance being 42 ft. wide. There are manufactories of olive oil, but the chief industry is sardine fishing, largely in the hands of Italians.

Mahdia occupies the site of a Phoenician settlement and by some authorities is identified with the town called Turris Hannibalis by the Romans. Hannibal is said to have embarked here on his exile from Carthage. After the Arab conquest of North Africa the town fell into decay. It was refounded in 912 by the first Fatimite caliph, 'Obaidallah-al-Mahdi, after whom it was named. It became the port of Kairawan and was for centuries a city of considerable importance, largely owing to its great natural strength, and its position on the Mediterranean. It carried on an active trade with Egypt, Syria and Spain. The town was occupied by the Normans of Sicily in the 12th century, but after holding it for about twelve years they were driven out in 1159 by the Almohades. In 1390 a joint English and French force vainly besieged Mahdia for sixty-one days. In the early part of the 16th century the corsair Dragut seized the town and made it his capital, but in 1550 the place was captured by the Spaniards, who held it until 1574. Before evacuating the town the Spaniards dismantled the fortifications. Under the rule of the Turks and, later, the beys of Tunis Mahdia became a place of little importance. It was occupied by the French in 1881 without opposition, and regained some of its former commercial importance.

During 1908 numbers of bronzes and other works of art were recovered from a vessel wrecked off Mahdia in the 5th century A.D. (see *Classical Review*, June 1909).

MAHÉ, a French settlement in the Malabar district of Madras, India, situated in 11° 43′ N. and 75° 33′ E., at the mouth of a river of the same name. Area, 26 sq. m.; pop. (1901), 10,298. It is the only French possession on the west coast of India, and is in charge of a *chef de service*, subordinate to the governor-general at Pondicherry. It is now a decaying place.

MAHESHWAR, a town in Indore state, Central India, on the N. bank of the Narbada (Nerbudda). Pop. (1901), 7042. Though of great antiquity and also of religious sanctity, it is chiefly noted as the residence of Ahalya Bai, the reigning queen of the Holkar dynasty during the last half of the 18th century, whose ability and munificence are famous throughout India. Close by her cenotaph stands the family temple of the Holkars.

MAHI, a river of western India, which rises in Central India and, after flowing through south Rajputana, enters Gujarat and falls into the sea by a wide estuary near Cambay; total length, 300 m.; estimated drainage area, 16,000 sq. m. It has given its name to the Mahi Kantha agency of Bombay, and also to the *mehwasis*, marauding highlanders often mentioned in Mahommedan chronicles.

MAHI KANTHA, a political agency or collection of native states in India, within the Gujarat division of Bombay. Over half the territory is covered by the native state of Idar. There are eleven other chiefships, and a large number of estates belonging to Rajput or Koli thakurs, formerly feudatories of Baroda. Several of the states are under British administration. Total area, 3125 sq. m.; pop. (1901), 361,545, showing a decrease of 38% in the decade, due to famine; estimated revenue, £76,000; tribute (mostly to the gaekwar of Baroda), £9000. Many of the inhabitants belong to the wild tribes of Bhils and Kolis. In 1897 a metre-gauge railway was opened from Ahmedabad through Parantij to Ahmednagar. At Sadra is the Scott College for the education of the sons of chiefs on the lines of an English public school. There are also Anglo-vernacular schools at Sadra, Idar and Mansa. The famine of 1899–1900 was severely felt in this tract.

MAHMUD I. (1696–1754), sultan of Turkey, was the son of Mustafa II., and succeeded his uncle Ahmed III. in 1730. After the suppression of a military revolt the war with Persia was continued with varying success, and terminated in 1736 by a treaty of peace restoring the *status quo ante bellum*. The next enemy whom Turkey was called upon to face was Russia, later joined by Austria. War went on for four years; the successes gained by Russia were outweighed by Austria's various reverses, terminating by the defeat of Wallis at Krotzka, and the peace concluded at Belgrade was a triumph for Turkish diplomacy. The sultan, throughout desirous for peace, is said to have been much under the influence of the chief eunuch, Haji Beshir Aga. In 1754 Mahmud died of heart-disease when returning from the Friday service at the mosque. He had a passion for building, to which are due numberless kiosques, where nocturnal orgies were carried on by him and his boon companions. In this reign the system of appointing Phanariote Greeks to the principalities of Moldavia and Wallachia was instituted. (See PHANARIOTES.)

MAHMUD II. (1785–1839), sultan of Turkey, was the son of Abu-ul-Hamid I., and succeeded his brother, Mustafa IV., in 1808. He had shared the captivity of his ill-fated cousin, the ex-sultan, Selim III., whose efforts at reform had ended in his deposition by the janissaries. Mahmud was thus early impressed with the necessity for dissembling his intention to institute reforms until he should be powerful enough to carry them through. The reforming efforts of the grand vizier Bairakdar, to whom he had owed his life and his accession, broke on the opposition of the janissaries; and Mahmud had to wait for more favourable times. Meanwhile the empire seemed in danger of breaking up. Not till 1812 was the war with Russia closed by the treaty of Bucharest, which restored Moldavia and the greater part of Wallachia to the Ottoman government. But though the war was ended, the terms of the treaty left a number of burning questions, both internal and external, unsettled. This was notably the case with the claim of Russia to Poti and the valley of the Rion (Phasis), which was still outstanding at the time of the congress of Vienna (1814–1815) and prevented the question of a European guarantee of the integrity of Turkey from being considered.

Meanwhile, within the empire, ambitious valis were one by one attempting to carve out dominions for themselves at the expense of the central power. The ambitions of Mehemet Ali of Egypt were not yet fully revealed; but Ali (*q.v.*) of Jannina, who had marched to the aid of the sultan against the rebellious pasha Pasvan Oglu of Widdin, soon began to show his hand, and it needed the concentration of all the forces of the Turkish empire to effect his overthrow and death (1822). The preoccupation of the sultan with Ali gave their opportunity to the Greeks whose disaffection had long been organized in the great secret society of the *Hetaeria Philike*, against which Metternich had in vain warned the Ottoman government. In 1821 occurred the abortive raid of Alexander Ypsilanti into the Danubian principalities, and in May of the same year the revolt of the Greeks of the Morea began the war of Greek Independence (see GREECE: *History*). The rising in the north was easily crushed; but in the south the Ottoman power was hampered by the defection of the sea-faring Greeks, by whom the Turkish navy had hitherto been manned. After three abortive campaigns Mahmud was compelled, infinitely against his will, to summon to his assistance the already too powerful pasha of Egypt, Mehemet Ali, whom he had already employed to suppress the rebellious Wahhabis in Arabia. The disciplined Egyptian army, supported by a well organized fleet, rapidly accomplished what the Turks had failed to do; and by 1826 the Greeks were practically subdued on land, and Ibrahim was preparing to turn his attention to the islands. But for the intervention of the powers and the battle of Navarino Mahmud's authority would have been restored in Greece. The news of Navarino betrayed Mahmud into one of those paroxysms of rage to which he was liable, and which on critical occasions were apt fatally to cloud his usual good sense. After in vain attempting to obtain an apology for "the unparalleled outrage against a friendly power" he issued on the 20th of December a solemn *hatti sheriff* summoning the faithful to a holy war. This, together with certain outstanding grievances and the pretext of enforcing the settlement of the Greek Question approved by the powers, gave Russia the excuse for declaring war against Turkey. After two hardly fought campaigns

(1828, 1829) Mahmud was at length, on the 14th of September 1829, compelled to sign the peace of Adrianople. From this moment until his death Mahmud was, to all intents and purposes, the "vassal of Russia," though not without occasional desperate efforts to break his chains. (For the political events of the period between the first revolt of Mehemet Ali (Sept. 1832) and the death of Mahmud see MEHEMET ALI.) The personal attitude of the sultan, which alone concerns us here, was determined throughout by his overmastering hatred of the upstart pasha, of whom he had stooped to ask aid, and who now defied his will; and the importance of this attitude lies in the fact that, as the result of the success of his centralizing policy, and notably of the destruction of the janissaries (*q.v.*), the supreme authority, hitherto limited by the practical power of the ministers of the Porte and by the turbulence of the privileged military caste, had become concentrated in his own person. It was no longer the Porte that decided, but the Seraglio, and the sultan's private secretary had more influence on the policy of the Ottoman empire than the grand vizier.

This omnipotence of the sultan in deciding the policy of the government was in striking contrast with his impotence in enforcing his views on his subjects and in his relations with foreign powers. Mahmud, in spite of—or rather because of—his well-meant efforts at reform, was hated by his Mussulman subjects and stigmatized as an "infidel" and a traitor to Islam. He was, in fact, a victim to those "half-measures" which Machiavelli condemns as fatal to success. Ibrahim, the conqueror of Syria, scoffed at the sultan's idea "that reform consisted in putting his soldiers into tight trousers and epaulettes." The criticism is not entirely unjust. Mahmud's policy was the converse of that recommended by Machiavelli, viz. in making a revolution to change the substance while preserving the semblance of the old order. Metternich's advice to Mahmud to "remain a Turk" was sound enough. His failure to do so—in externals—left him isolated in his empire: *rayahs* and true believers alike distrusted and hated him. Of this hatred he was fully conscious; he knew that his subjects, even many of his own ministers, regarded Mehemet Ali as the champion of Islam against the "infidel sultan;" he suspected the pasha, already master of the sacred cities, of an intention to proclaim himself caliph in his stead. This, together with the weakness due to military reforms but recently begun, drove him to rely on foreign aid; which, in the actual conditions of Europe, meant the aid of Russia. The long tradition of French friendship for Turkey had been broken, in 1830, by the conquest of Algiers. Austria was, for the time, but the faithful ally of the tsar. On the 9th of August 1832 Mahmud made, through Stratford Canning, a formal proposal for an alliance with Great Britain, which Palmerston refused to consider for fear of offending France. Mahmud bitterly contrasted the fair professions of England with the offers of effective help from Russia. His old ally having deserted him, he accepted the aid of his hereditary foe. The Russian expedition to the Bosporus, the convention of Kutaiah, and the treaty of Unkiar Skelessi (July 8, 1833) followed. Mahmud was under no illusion as to the position in which the latter placed him towards Russia; but his fear of Mehemet Ali and his desire to be revenged upon him outweighed all other considerations. He resented the action of France and England in forcing the settlement of Kutaiah upon him, and remained shut up in his palace, inaccessible to all save his favourites and the representative of Russia. With his single aim in view he busied himself with the creation of a national militia, with the aid of Moltke and other German officers. In 1834 the revolt of Syria against Ibrahim seemed to give him his opportunity. He pleaded the duty of a sultan to go to the aid of his subjects when oppressed by one of his servants; but the powers were obdurate, even Russia, much occupied in affairs nearer home, leaving him in the lurch. He was astute enough to take advantage of the offence given to the powers by Mehemet Ali's system of monopolies, and in 1838 signed with Great Britain, and afterwards with others, a commercial treaty which cut at the root of the pasha's system A few months later his passionate impatience overcame his policy and his fears. The hand of death was upon him, and he felt that he must strike now or never. In vain the powers, now united in their views, warned him of the probable consequences of any aggressive action on his part. He would rather die, he exclaimed, or become the slave of Russia, than not destroy his rebellious vassal. On his sole initiative, without consulting his ministers or the council of the empire, he sent instructions to Hafiz Pasha, commanding the Ottoman troops concentrated at Bir on the Euphrates, to advance into Syria. The fatal outcome of the campaign that followed he did not live to hear. When the news of Ibrahim's overwhelming victory at Nessib (June 24, 1839) reached Constantinople, Mahmud lay dying and unconscious. Early in the morning of the 1st of July his proud and passionate spirit passed away.

Mahmud II. cannot be reckoned among the great sultans, neither had he any of the calculating statecraft which characterized Abd-ul-Hamid II.; but his qualities of mind and heart, none the less, raised him far above the mass of his predecessors and successors. He was well versed in state affairs and loyal to those who advised and served him, personally brave, humane and kindly when not maddened by passion, active and energetic, and always a man of his word. Unhappily, however, the taint of the immemorial corruption of Byzantium had fallen upon him too, and the avenue to his favour and to political power lay too often through unspeakable paths. In view of the vast difficulty of the task before him at his succession it is less surprising that he failed to carry out his ideas than that he accomplished so much. When he came to the throne the empire was breaking up from within; one by one he freed the provinces from the tyrannical rulers who, like Ali of Jannina, were carving out independent, or quasi-independent, empires within the empire. If he failed in his wider schemes of reform, this was only one more illustration of a truth of which other "enlightened" sovereigns besides himself had experienced the force, namely, that it is impossible to impose any system, however admirable, from above on a people whose deepest convictions and prejudices it offends.

There is a great deal of valuable material for the history of Mahmud and his policy in the unpublished F.O. records (1832–1839), volumes of correspondence marked *Turkey.—From Sir Stratford Canning.—From Mr. Mandeville.—From Lord Ponsonby.* See further works mentioned under TURKEY: *History*; and MEHEMET ALI. (W. A. P.)

MAHMUD NEDIM PASHA (*c.* 1818–1883), Turkish statesman, was the son of Nejib Pasha, ex-governor-general of Bagdad. After occupying various subordinate posts at the Porte he became successively under-secretary of state for foreign affairs, governor-general of Syria and Smyrna, minister of commerce, and governor-general of Tripoli; minister successively of justice and of marine (1869); grand vizier from 1871 to 1872 and from 1875 to 1876. He was high in favour with Sultan Abd-ul-Aziz and fell much under the influence of General Ignatiev, the forceful Russian ambassador before the war of 1877–78, his subserviency to Russia earning for him the nickname of "Mahmudoff." His administration was most unsuccessful from every point of view, and he was largely responsible for the issue of the decree suspending the interest on the Turkish funds. He was minister of the interior from 1879 to 1883.

MAHMUD[1] **OF GHAZNI** (971–1030), son of Sabuktagin, Afghan conqueror, was born on the 2nd of October 971. His fame rests chiefly on his successful wars, in particular his numerous invasions of India. His military capacity, inherited from his father, Nasir-ud-din Sabuktagin, was strengthened by youthful experience in the field. Sabuktagin, a Turki slave of Alptagin, governor of Khorasan under Abdalmalik I. b. Nuḥ of the Samanid dynasty of Bokhara, early brought himself to notice (see SAMANIDS). He was raised to high office in the state by Alptagin's successor, Abū Ishāk, and in A.H. 366 (A.D. 977), by the choice of the nobles of Ghazni, he became their ruler. He soon began to make conquests in the neighbouring countries, and in these wars he was accompanied by his young son Mahmud. Before he had reached the age of fourteen he encountered in two expeditions under his father the Indian forces of Jaipal, raja of Lahore, whom Sabuktagīn defeated on the Punjab frontier

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[1] The name is strictly Maḥmūd.

In 994 Mahmud was made governor of Khorasan, with the title of Saif addaula (ud-daula) ("Sword of the State") by the Sāmānid Nūh II. Two years later, his father Sabuktagīn died in the neighbourhood of Balkh, having declared his second son, Ismail, who was then with him, to be his successor. As soon as Ismail had assumed the sovereignty at Balkh, Mahmud, who was at Nishapur, addressed him in friendly terms, proposing a division of the territories held by their father at his death. Ismail rejected the proposal, and was immediately attacked by Mahmud and defeated. Retreating to Ghazni, he there yielded, and was imprisoned, and Mahmud obtained undisputed power as sovereign of Khorasan and Ghazni (997)

The Ghaznevid dynasty is sometimes reckoned by native historians to commence with Sabuktagīn's conquest of Bost and Kosdār (978) But Sabuktagīn, throughout his reign at Ghazni, continued to acknowledge the Sāmānid suzerainty, as did Mahmud also, until the time, soon after succeeding to his father's dominions, when he received from Qādir, caliph of Bagdad (see CALIPHATE, C. § 25), a *khilat* (robe of honour), with a letter recognizing his sovereignty, and conferring on him the titles *Yamīn-addaula* ("Right hand of the State"), and *Amīn-ul-Millat* ("Guardian of the Faith"). From this time it is the name of the caliph that is inscribed on Mahmud's coins, together with his own new titles. Previously the name of the Sāmānid sovereign, Mansūr II. b. Nūh is given along with his own former title, Saif addaula Mahmūd. The earliest of those of the new form gives his name Mahmūd bin Sabuktagīn. Thereafter his father's name does not appear on his coins, but it is inscribed again on his tomb.

The new honours received from the caliph gave fresh impulse to Mahmud's zeal on behalf of Islam, and he resolved on an annual expedition against the idolaters of India. He could not quite carry out this intention, but a great part of his reign was occupied with his Indian campaigns. In 1000 he started on the first of these expeditions, but it does not appear that he went farther than the hill country near Peshawar. The hostile attitude of Khalaf ibn Ahmad, governor of Seistan, called Mahmud to that province for a short time. He was appeased by Khalaf's speedy submission, together with the gift of a large sum of money, and further, it is said, by his subdued opponent addressing him as *sultān*, a title new at that time, and by which Mahmud continued to be called, though he did not formally adopt it, or stamp it on his coins. Four years later Khalaf, incurring Mahmud's displeasure again, was imprisoned, and his property confiscated.

Mahmud's army first crossed the Indus in 1001, opposed by Jaipāl, raja of Lahore. Jaipāl was defeated, and Mahmud, after his return from this expedition, is said to have taken the distinctive appellation of *Ghāzi* ("Valiant for the Faith"), but he is rarely so-called. On the next occasion (1005) Mahmud advanced, as far as Bhera on the Jhelum, when his adversary Anang-pāl, son and successor of Jaipāl, fled to Kashmir. The following year saw Mahmud at Multan. When he was in the Punjab at this time, he heard of the invasion of Khorāsan by the Ilek Khan Nasr I. ruler of Transoxiana whose daughter Mahmud had married. After a rapid march back from India, Mahmud repelled the invaders. The Ilek Khan, having retreated across the Oxus, returned with reinforcements, and took up a position a few miles from Balkh, where he was signally defeated by Mahmud.

Mahmud again entered the Punjab in 1008, this time for the express purpose of chastising Sēwah Pāl, who, having become a Mussulman, and been left by Mahmud in charge of Multan, had relapsed to Hinduism. The Indian campaign of 1009 was notable. Near the Indus Mahmud was opposed again by Anang-pāl, supported by powerful rajas from other parts of India. After a severe fight, Anang-pāl's elephants were so terror-struck by the fire-missiles flung amongst them by the invaders that they turned and fled, the whole army retreating in confusion and leaving Mahmud master of the field. Mahmud, after this victory, pushed on through the Punjab to Nagar-kōt (Kangra), and carried off much spoil from the Hindu temples to enrich his treasury at Ghazni. In 1011 Mahmud, after a short campaign against the Afghans under Mahommed ibn Sūr in the hill country of Ghur, marched again into the Punjab. The next time (1014) he advanced to Thanēsar, another noted stronghold of Hinduism, between the Sutlej and the Jumna. Having now found his way across all the Punjab rivers, he was induced on two subsequent occasions to go still farther. But first he designed an invasion of Kashmir (1015), which was not carried out, as his progress was checked at Lōh-kōt, a strong hill fort in the north-west of the Punjab. Then before undertaking his longer inroad into Hindustan he had to march north into Khwārizm (Khiva) against his brother-in-law Mamūn, who had refused to acknowledge Mahmud's supremacy. The result was as usual, and Mahmud, having committed Khwārizm to a new ruler, one of Mamūn's chief officers, returned to his capital. Then in 1018, with a very large force, he proceeded to India again, extending his inroad this time to the great Hindu cities of Mathra on the Jumna and Kanauj on the Ganges. He reduced the one, received the submission of the other, and carried back great stores of plunder Three years later he went into India again, marching over nearly the same ground, to the support, this time, of the raja of Kanauj, who, having made friendship with the Mahommedan invader on his last visit, had been attacked by the raja of Kalinjar. But Mahmud found he had not yet sufficiently subdued the idolaters nearer his own border, between Kabul and the Indus, and the campaign of 1022 was directed against them, and reached no farther than Peshawar. Another march into India the following year was made direct to Gwalior.

The next expedition (1025) is the most famous of all. The point to which it was directed was the temple of Somnath on the coast of the Gujarāt peninsula. After an arduous journey by Multan, and through part of Rajputana, he reached Somnath, and met with a very vigorous but fruitless resistance on the part of the Hindus of Gujarāt. Moslem feet soon trod the courts of the great temple. The chief object of worship it contained was broken up, and the fragments kept to be carried off to Ghazni. The story is often told of the hollow figure, cleft by Mahmud's battle-axe, pouring out great store of costly jewels and gold. But the idol in this Sivite temple was only a tall block or pillar of hewn stone, of a familiar kind. The popular legend is a very natural one. Mahmud, it was well known, made Hindu temples yield up their most precious things. He was a determined idol-breaker. And the stone block in this temple was enriched with a crown of jewels, the gifts of wealthy worshippers. These data readily give the Somnath exploit its more dramatic form. For the more recent story of the Somnath gates see SOMNATH.

After the successes at Somnath, Mahmud remained some months in India before returning to Ghazni. Then in 1026 he crossed the Indus once more into the Punjab. His brilliant military career closed with an expedition to Persia, in the third year after this, his last, visit to India. The Indian campaigns of Mahmud and his father were almost, but not altogether, unvarying successes. The Moslem historians touch lightly on reverses. And, although the annals of Rajputana tell how Sabuktagīn was defeated by one raja of Ajmere and Mahmud by his successor, the course of events which followed shows how little these and other reverses affected the invader's progress. Mahmud's failure at Ajmere, when the brave raja Bisal-deo obliged him to raise the siege but was himself slain, was when the Moslem army was on its way to Somnath. Yet Mahmud's Indian conquests, striking and important in themselves, were, after all, in great measure barren, except to the Ghazni treasury. Mahmud retained no possessions in India under his own direct rule. But after the repeated defeats, by his father and himself, of two successive rajas of Lahore, the conqueror assumed the right of nominating the governors of the Punjab as a dependency of Ghazni, a right which continued to be exercised by seven of his successors. And for a time, in the reign of Masa'ud II.

(1098–1114), Lahore was the place of residence of the Ghaznevid sovereign.

Mahmud died at Ghazni in 1030, the year following his expedition to Persia. He is conspicuous for his military ardour, his ambition, strong will, perseverance, watchfulness and energy, combined with great courage and unbounded self-reliance. But his tastes were not exclusively military. His love of literature brought men of learning to Ghazni, and his acquaintance with Moslem theology was recognized by the learned doctors.

The principal histories of Mahmud's reign are—*Kitāb-i-Yamīnī* (Utbi); *Tarīkh-us-Subuktigīn* (Baihaki); *Tabakāt i Nasirī* (Minhāj el-Sirāj); *Rauzat-us-Safa* (Mir Khond); *Habīb-us-Siwar* (Khondamir). See Elliot, *History of India;* Elphinstone, *History of India;* and Roos-Keppel's translation of the *Tarīkh-i-Sultan Mahmūd-i-Ghasnavi* (1901).

MAHOBA, an ancient town in India, in Hamirpur district of the United Provinces. Pop. (1901), 10,074. As the capital of the Chandel dynasty, who ruled over Bundelkhand from the 9th to the 13th century, the neighbourhood is covered with architectural antiquities, prominent among which are artificial lakes, formed by banking up valleys with masonry dams. The largest of these is more than 4 m. in circuit.

MAHOGANY, a dark-coloured wood largely used for household furniture, the product of a large tree indigenous to Central America and the West Indies. It was originally received from Jamaica; 521,300 ft. were exported from that island in 1753. It is known botanically as *Swietenia Mahogoni*, and is a member of the order *Meliaceae*. It bears compound leaves, resembling those of the ash, and clusters of small flowers, with five sepals and petals and ten stamens which are united into a tube. The fruit is a pear-shaped woody capsule, and contains many winged seeds. The dark-coloured bark has been considered a febrifuge, and the seeds were used by the ancient Aztecs with oil for a cosmetic, but the most valuable product is the timber, first noticed by the carpenter on board Sir Walter Raleigh's ship in 1595 for its great beauty, hardness and durability. Dr Gibbons brought it into notice as well adapted for furniture in the early part of the 18th century, and its use as a cabinet wood was first practically established by a cabinet-maker named Wollaston, who was employed by Gibbons to work up some mahogany brought to England by his brother. It was introduced into India in 1795, and is now cultivated in Bengal and as far north as Saharunpur.

The timber of species of *Cedrela* and *Melia*, other members of the order *Meliaceae*, are used as Mahogany, and the product of the West African *Khaya senegalensis* is known as African mahogany. There is some confusion between the product of these various trees. Herbert Stone (*The Timbers of Commerce*, 1904) says: "The various species of mahogany and cedar are so confusing that it is difficult to make precise statements as to their structure or origin. I know of no convincing proof that any of the American kinds met with on the English market are the wood of *Swietenia Mahogani*, nor that those shipped from Africa are the wood of *Khaya senegalensis*. These two genera are very nearly allied to *Cedrela* and *Melia*, and it is difficult to separate any of the four from the rest by the characters of the wood. After giving the most careful attention to every detail, I lean to the view that most if not all of the mahoganies commonly met with are Cedrelas."

Kiggelaria Dregeana (natural order *Bixineae*), a native of South Africa, is known as Natal mahogany.

MAHOMET (strictly Muḥammad, commonly also Mohammed), founder of the religious system called in Europe after him Mahommedanism, and by himself Islam or Ḥanifism. He died, according to the ordinary synchronism, on the 7th of June 632 (12 Rabia, A.H. 11), and his birthday was exactly sixty-three or sixty-five years earlier, the latter number being evidently an interpretation in lunar years of a number thought to refer to solar years. The lunar system was introduced into Arabia by Mahomet himself quite at the close of his career; that which existed before was certainly solar, as it involved a process of intercalation—which, however, seems to have been arbitrarily manipulated by priests, whence certain synchronisms cannot be got for the events in the Prophet's career. The number 63 for the years of his life may rest on tradition, though it is unlikely that such matters were accurately noted; it can also be accounted for by a priori combination. A Meccan, it is said, became a full citizen at the age of 40; this then would be the age at which the mission might be started. The Medina period (of which count was kept) lasted ten to eleven years; for the Meccan period ten years would seem a likely length. Finally it was known that for some years—about three—the mission had been conducted secretly. The only event in contemporary history to which the Koran alludes in its earlier parts is the Persian conquest of Palestine in 616. Clearly Mahomet had begun to prophesy at that date.

His Country.

Before the rise of Islam, Mahomet's native place, Mecca, appears to figure nowhere in historical records, unless there be a reference to it in the "valley of Baca" (Psalm lxxxiv. 6). Its sacred, and therefore archaic, name is *Bakkah*; hence the identification of the name with that of the sanctuary Makoraba, known to the Greek geographers, is not philologically tenable; although so eminent a linguist as Dozy evolved a theory of the origin of the city from this name, which appears to be South Arabian for "sanctuary," and has no connexion with Hebrew (as Dozy supposed). In the 3rd century of Islam the mythology of Mecca was collected and published in book form, but we learn little more from it than names of tribes and places; it is clear that there was no record of the mode in which the community inhabiting the place had got there, and that little was remembered with accuracy of the events which preceded the rise of its prophet. The city had a sanctuary, called the *Cube* (*ka'ba*), of which the nucleus was the "Black Stone," probably to be identified with Allah, the god of the community; both still exist, or rather their legitimate substitutes, as the Ka'ba has been repeatedly reconstructed, and the original Black Stone was stolen by the Carmathians in the 4th century of Islam; they afterwards returned one, but it may or may not have been the same as that which they removed. At some time in the 6th century—said to have been the birth-year of the Prophet, but really much earlier—an Abyssinian invader raided Mecca with the view of abolishing this sanctuary; but for some reason had to desist. This expedition, known as the "Raid of the Elephant," one of these animals being employed in it, seems to be of great importance for explaining the rise of Islam; for a sanctuary which can repel an invader acquires tremendous reputation. Some verses in the Koran which are perhaps not genuine, record the miracle whereby Allah repelled the "People of the Elephant." The sanctuary was apparently in the possession of the tribe Koreish (Quraish), the origin of whose name is unknown, said to have come originally from Cutha in Mesopotamia. They were known (we are told) as the people of Allah, and, by wearing a badge, were sacrosanct throughout Arabia. If this be true, it was probably a privilege earned by the miraculous defence of the Ka'ba, and is sufficient to account for the rise of Meccan commerce of which we hear much in the biography of the Prophet, and to which some verses of the earliest part of the Koran allude; for merchants who were safe from attacks by bandits would have an enormous advantage. The records seem, however, to be inconsistent with this assertion; and the growth of the Meccan commerce is sufficiently accounted for by the fact that after the Abyssinian invasion pilgrimage to the Ka'ba became the practice of numerous Arab tribes, and for four months in the year (selected by Meccan priests) raiding was forbidden, in order to enable the pilgrimage to be safely made. In addition to this it would seem that all Mecca counted as sanctuary—*i.e.* no blood might under any circumstances be shed there. The community lived by purveying to pilgrims and the carrying trade; and both these operations led to the immigration of strangers.

Mahomet's Family.

There seems to be no doubt that Mahomet was himself a member of the tribe Koreish, and indeed too many of his relatives figure in history to permit of his parentage being questioned. His cousin 'Ali, fourth caliph, was the son of Abū Tālib, whose name attests the historical character of the kindred name 'Abd al-Mottalib, Mahomet's grandfather: for the fact that this name is in part enigmatical is certainly no argument against its genuineness. In the 3rd century of Islam a document was shown in which a man of San'a in Yemen acknowledged that he had borrowed from 'Abd al-Moṭṭalib 1000 silver dirhems of the Hudaida standard, and Allāh with the two "angels" (probably a euphemism for the goddesses Al-lāt and al-'Uzzā) served as witness; it is difficult to see why such a document should have been forged. The name Hāshim (for 'Abd al-Moṭṭalib's father) may or may not be historical; here, as in the ascending line throughout, we have subjects without predicates. The name of 'Abd al-Moṭṭalib's son, who was Mahomet's father, is given as 'Abdallāh; the correctness of this has been questioned, because "Servant of Allah" would seem to be too appropriate, and the name was often given by the Prophet to converts as a substitute for some pagan appellation. This, however, is hypercritical, as the name of the father could not easily be altered, when relatives abounded, and it would seem that at one time the Prophet made no theological use of the name Allah, for which he intended to substitute Raḥmān. The name of his mother is given as Āminah, and with this one of his own titles, Amīn, agrees; although the Arabs do not appear to bring the two into connexion. Her father's name is given as Wahb, and she is brought into relation with a Medinese tribe called the Banū 'Adī b. al-Najjār, to whom she is said to have brought her son in his early infancy. The circumstances may have been suggested by his later connexion with that place; yet in what seems a historical narrative her grave is mentioned as known to be at Abwa, midway between the two cities, whence this early bond between the Prophet and his future home may have really existed.

His own name is given in the Koran in the forms Aḥmad and the familiar Muḥammad; in contemporary poetry we also find the form Maḥmūd. Similar variation between derivatives from the same root is found in proper names which occur in early poetry; the meaning of all would be "the praised," if the root be given its Arabic signification—"the desired" if interpreted from the Hebrew.

The form Muḥammad (ordinarily transliterated Mohammed; Mahomet, Mehmet, &c., represent the Turkish pronunciation) is found in a pre-Islamic inscription, and appears to have been fairly common in Arabia. In Hag. ii. 7 a derivative of the Hebrew equivalent root occurs in the prophecy "and the desired of all nations shall come," and this passage has suggested the idea that the name may have been taken by the Prophet as the equivalent of "Messiah," while the Moslems themselves find its equivalent in the *Paraclete* of the Fourth Gospel, though this identification requires more ingenuity. His *kunyah* (*i.e.* the Arab title of respect, in which a man is called after his son) is Abu'l-Qāsim; other names by which he is called are titles of honour, *e.g.* Muṣṭafā "chosen." (See further the genealogical table, *ad fin.*)

Early Life.

In the Koran, Allah says that He found the Prophet an orphan, poor and astray; it is possible that all these expressions should be understood figuratively, like the "poor, naked, blind" of Christian hymns; the Arabs, however, take them literally, and Mahomet is said to have been a posthumous child, whose mother died a few months or years after his birth, and who was brought up first by his grandfather, and then by his uncle Abū Ṭālib, one of the poorer members of the family; in the controversy between the Alid and Abbasid pretenders of the 2nd century of Islam the Abbasid Manṣūr claims that his ancestor fed the ancestor of 'Ali, *i.e.* Abū Ṭālib, otherwise he would have had to beg. There was evidently an apparent inconsistency between Mahomet's being a poor orphan and the favourite grandchild of the eminent and wealthy 'Abd al-Moṭṭalib; and it was solved in this way. There was a tradition that in his early years he was sent into the desert to acquire the habits and the language of the Bedouins; and this seems to have been attested by the Prophet himself. In a tribal fight he is said to have acted as armour-bearer to one of his uncles, Zubair. There seems no doubt that he often accompanied Meccan caravans to the countries with which the Meccans had trade relations; such especially were Syria and south Arabia, and perhaps Egypt and Mesopotamia. It is conceivable that he may have visited Abyssinia by sea. For though accurate knowledge is nowhere to be found in the Koran, it exhibits a large amount of miscellaneous information, such as a trader might well pick up. His career as a caravan-conductor appears to have terminated with his marriage to Khadīja, daughter of Khuwailid, represented by the tradition as a wealthy widow, fifteen years his senior and forty years of age at the time of the union. As she became the mother of a numerous family, a special rule was discovered by Moslem physiologists extending the child-bearing period of Korashite women beyond that of others. Since it is claimed for Mahomet that he first gave Arab women the right to inherit property, the difficulty noticed is not the only one connected with this marriage; and Robertson Smith has called attention to some others, unconnected with his theory of "marriage and kinship in early Arabia." After his marriage Mahomet appears to have been partner in a shop in Mecca; where he apparently sold agricultural produce. His style is strongly marked by phrases and metaphors drawn from trade, though as a statesman he never displayed any financial ability.

Education.

Writing in the monumental script of South Arabia had been known for centuries in the peninsula; and shortly before the rise of Islam a cursive script—the parent of the ordinary Arabic character—had been started in the Christian state of Hira, with which the beginnings of modern Arabic literature are connected. A modification of this had been introduced into Mecca, and was probably used for contracts and similar documents. The word *ummī*, literally "popular" or "plebeian" (according to one etymology), applied to Mahomet in the Koran, is said to mean "one who can neither read nor write," and the most generally accepted view is that he could do neither, a supposition which enters into the doctrine of the miraculous nature of the Koran. According to another interpretation the word means "Meccan," *i.e.* native of "the Mother of the Villages" (*Umm al-Qura*); and the most probable theory is that he could do both, but unskilfully. Indeed on one historic occasion he erased certain words in a document; and where in the Koran he rebuts the charge of "taking notes," he does not employ the obvious retort that he could not write, but gives a far less convincing answer. For poetry, which seems to have been cultivated in Arabia long before his time, he possessed no ear; but we have little reason for supposing that either writing or versification had yet entered into Arabian education. The former would be acquired by those who needed it, the latter was regarded as a natural gift. There is reason for thinking the language of the Koran incorrect and ungrammatical in parts, but as it afterwards became the ultimate standard of classical Arabic, this point is not easy to prove. On the whole then his early life seems to have been such as was normal in the case of a man belonging to one of the more important families in a community which had not long been started on a career of prosperity.

Social System.

Of the organization of that community we unfortunately know very little, though we hear of a council-chamber, and, as has been seen, of an age-qualification for admission to it. It is, however, certain that the theory of decision by majority was absolutely unknown to Mahomet's second successor, whence we learn little from this tradition (even if it be authentic) of the mode whereby the tribes who together formed the Meccan population managed their common concerns, whether commercial or political. The form of government seems to have been a rudimentary oligarchy, directed by some masterful individual; before the Flight we read of various prominent personages, after the Flight and the battle of Badr (A.H. 2) one chieftain, Abū Sofiān (see CALIPHATE, *ad init.*), appears to take the lead whether in war or in policy. It would seem, however, that the right of independent action belonged to the individual tribes, even to the extent of refusing to take part in a campaign. For the settlement of ordinary disputes recourse was had (it appears) rather to soothsayers, near or distant, than to any regularly constituted authority or tribunal. On the other hand we are furnished with a list of officials who were concerned with different parts of the festal performances and the ordinary worship. Of these we may mention the Custodian of the Ka'ba, and the official whose duty was *siqāyah* ("watering"), said to mean furnishing the pilgrims with water, but more ingeniously interpreted in recent times as "rain-bringing," a function which even in the 2nd century of Islam the governor in some places was supposed to exercise.

Beginnings of the Mission.

Of Arabian paganism we possess no trustworthy or complete account; since we hear of no theological literature belonging to it, probably no such account could have been given. There were doubtless a variety of practices, many of which have been continued to this day in the ceremonies of the pilgrimage, and offerings of different sorts to various deities, interpreted variously by the worshippers in accordance with their spiritual, intellectual and moral levels; *e.g.* as actual stones, or as men (or more often women) residing in the stones or otherwise connected with them, or bearing a similar relation to trees, or stars, &c. In general every tribe had its patron of the kind, and where there were aggregations of tribes, connexions were established between these deities, and affiliation-theories excogitated; hence the theory attributed in the Koran to the Meccans that the goddesses al-'Uzzā, &c. were the daughters of Allah, may well represent the outcome of such speculation. These, however, were known to few, whereas the practices were familiar to all. Some of these were harmless, others barbarous; many offensive, but not very reprehensible, superstitions.

External influences.

Before Mahomet's time Arabian paganism had already been attacked both from the outside and from the inside. On the one hand the northern tribes had gradually been christianized, owing to the influence of the Byzantine empire; on the other hand south Arabia had fallen successively under Jewish, Abyssinian and Persian influence; and the last, though little is known of Persian rule, is unlikely to have favoured pagan cults. Christianity had also some important representation in Najran far south of Mecca, while Jewish settlements were prospering north of Mecca in the Prophet's future home Yathrib and its neighbourhood. Power, civilization and learning were thus associated with monotheism (Judaism), dualism (Mazdaism) and tritheism (as the Arabs interpreted Christianity); paganism was the religion of ignorance (*jāhiliyyah*, interpreted by Goldziher as "barbarism," but the difference is not very considerable). Mecca itself and the neighbouring and allied Ṭāif are said to have produced some monotheists or Christians, who identified the *Allah* of Mecca with the *Allāhā* or God of the Syrian Christians, called by the Abyssinian Christians "Lord of the Regions," and by the Jews "the Merciful" (*Raḥmānā*); one such is said to have been a cousin of Khadija, Mahomet's wife; his name is given as Waraqah, son of Naufal, and he is credited with copying or translating a Gospel. We even hear of flagellant monks and persons vowed to total abstinence among the precursors of Islam.

With these persons Mahomet had little in common, since they do not appear to have claimed to enforce their views upon others, or to have interfered with politics. He appears mainly to have been struck by the personality of the founders of the systems dominant in the civilized world, and to have aspired from the first to occupy the place of legislator or mouthpiece of the Deity; and that he was this was and is the main proposition of the Mahommedan creed. The "Prophet" or "Apostle" (at different times he employed both the Jewish and the Christian phrase), was the divinely appointed dictator of his community; if he were not obeyed, divine vengeance would overtake the disobedient. At this proposition Mahomet arrived by induction from the records of the Biblical prophets, as well as others who seem to have figured in Arabian mythology, *e.g.* the destruction of the tribe Thamūd (mentioned by Pliny, and therefore historical) for their disobedience to their prophet Ṣāliḥ, and of 'Ad (probably mythical) for their similar treatment of Hūd. The character of the message did not affect the necessity for obedience; at times it was condemnation of some moral offence, at others a trivial order. Divine vengeance overtook those who disobeyed either.

This is the theory of the prophetic office which pervades the Koran, wherein the doctrine is formulated that every nation had its divine guide and that Mecca before Mahomet's time had none. This place, then, Mahomet felt a divine call to fill. But we are never likely to ascertain what first put the idea into his mind. The fables which his biographers tell on this subject are not worth repeating; his own system, in which he is brought into direct communication with the Deity, though at a later period the angel Gabriel appears to have acted as intermediary, naturally leaves no room for such speculations; and since his dispensation was thought to be absolutely new, and to make a *tabula rasa* of the pagan past, his first followers, having broken with that past, left no intelligible account of the state of affairs which preceded their master's call. Some generations therefore elapsed before that past was studied with any sort of sympathy, and details could not then be recovered, any more than they can now be supplied by conjecture.

The Prophet's Call.

So far as Mahomet may be said from the first to have formulated a definite notion of his work, we should probably be right in thinking it to be the restoration of the religion of Abraham, or (as the Koran calls him) Ibrahim. Though we have no reason for supposing the name of Abraham or Ishmael to have been known in Mecca generally before Mahomet's time, the Biblical ethnology was not apparently questioned by those who were told of it, and there are stories, not necessarily apocryphal, of precursors of Mahomet going abroad in search of the "religion of Abraham." One feature of that system, associated in the Bible with the name of Ishmael as well, was circumcision, which was actually observed by the Meccan tribes, though it would appear with technical differences from the Jewish method; the association of monotheism with it would seem reasonable enough, in view of Jewish traditions, such as Mahomet may have heard on his travels; why the doctrine of the future life should be coupled with it is less obvious. That the Meccan temple and its rites had been founded by these two patriarchs appears to have been deduced by Mahomet himself, but perhaps at a later stage of his career. That these rites, so far as they were idolatrous, were in flagrant defiance of the religion of Abraham must have struck any one who accepted the accounts of it which were current among Jews and Christians. The precursors, however, appear to have felt no call to reform their fellow-citizens; whereas it is evident that Mahomet regarded himself as charged with a message, which he was bound to deliver, and which his God would in some way render effective.

As it was obvious that the claim to be God's mouthpiece was to claim autocracy, Mahomet employed the utmost caution in his mode of asserting this claim; on the question of his sincerity there have been different opinions held, and it is not necessary to take any view on this matter. For three years his followers were a secret society; and this period appears to have been preceded by one of private preparation, the first revelation being received when the Prophet was in religious retirement—a ceremony called *taḥannuth*, of which the meaning is uncertain, but which can have no connexion with the Hebrew *teḥinnōth* ("supplications")—on Mount Ḥirā, near Mecca.

The Koran.

If the traditional dates assigned to the *suras* (chapters) of the Koran (*q.v.*) are correct, the earliest revelations took the form of pages or rolls which the Prophet was to read by the "grace of God," as Joseph Smith, the founder of the Mormon community, said of the power given him to read the "Egyptian" characters on the gold plates which he had found. The command to read is accompanied by the statement that "his most generous Lord had taught man by the pen (*calamus*) that which he did not know." Waraqah, to whom the event is said to have been communicated by Khadija, called these communications "the Greater Law (*nomos*)." The Prophet was directed to communicate his mission at the first only to his nearest relatives. The utterances were from the first in a sort of rhyme, such as is said to have been employed for solemn matter in general, *e.g.* oracles or prayers. At an early period the production of a written communication was abandoned for oral communications, delivered by the Prophet in trance; their delivery was preceded by copious perspiration, for which the Prophet prepared (in accordance with instructions found in the Koran) by wrapping himself in a blanket. Trusty followers were instructed to take these utterances down, but the phenomena which accompanied their delivery at least in one case suggested imposture to the scribe, who apostatized in consequence. It is extraordinary that there is no reason to suppose that any official record was ever kept of these revelations; the Prophet treated them somewhat as the Sibyl did her leaves. This carelessness is equally astounding whether the Prophet was sincere or insincere.

If the matter afterwards collected in the Koran be genuine, the early revelations must have been miscellaneous in content, magical, historical and homiletic. To some strange oaths are prefixed. Apparently the purpose to be compassed was to convince the audience of their miraculous origin. The formulation of doctrines belongs to a later period and that of jurisprudence to the latest of all. In that last period also, when Mahomet was despot of Medina, the Koran served as an official chronicle, well compared by Sprenger to the leading articles on current events in a ministerial organ. Where the continuous paragraph is substituted for the ejaculation, the divine author apologizes for the style.

Certain doctrines and practices (*e.g.* washing of the person and the garments) must have been enjoined from the first, but our authorities scarcely give us any clear notion what they were. The doctrines to which the Prophet himself throughout assigned most value seem to have been the unity of God and the future life, or resurrection of the body. The former necessitated the abandonment of the idolatrous worship which formed part of the daily life of Mecca, and in which Mahomet and Khadija had been accustomed to take their part. Yet it seems to have been due to the initiative of the proselytes themselves rather than to the Prophet's orders that the Meccan worship was actually flouted by them; for the anecdote which represents the Prophet and his young cousin attempting to pull down the images in or about the Ka'ba appears to be apocryphal. The first Moslem ceremony would appear to have been the religious meeting for the purpose of hearing the delivery of revelations, of which after the Prophet's death the sermon (*khuṭbah*) took the place. After various provisional meeting-places, the house of one al-Arqam on Mt. Safa was adopted for this purpose; and here proselytes were initiated.

Growth of the Early Community

The names which the new community received from its founder are both philological puzzles; for the natural sense of Moslem (*Muslim*) appear to be "traitors," and to this a contemporary war-song of Mahomet's enemies alludes; while *Ḥanīf* (especially applied in the Koran to Abraham) seems to be the Hebrew word for "hypocrite." The former is explained in the Koran to mean "one who hands over his face or person to God," and is said to have been invented by Abraham; of the latter no explanation is given, but it seems to signify from the context "devotee." Since the divine name *Raḥmān* was at one time favoured by Mahomet, and this was connected with one Maslama of the tribe Ḥanīfa, who figures in politics at the end of Mahomet's career but must have been a religious leader far earlier, it has been suggested that the names originally belonged to Maslama's community. The honour of having been Mahomet's first convert is claimed for three persons: his wife Khadīja, his cousin Ali, who must have been a lad at the commencement of the mission, and Abū Bekr, son of Abū Quḥāfah, afterwards Mahomet's first successor. This last person became Mahomet's *alter ego*, and is usually known as the *Ṣiddīq* (Heb. word signifying "the saint," but to the Arabs meaning "faithful friend)". His loyalty from first to last was absolutely unswerving; he was selected to accompany Mahomet on the most critical occasion of his life, the Flight from Mecca; Mahomet is said to have declared that had he ever made a confidant of any one, that person would have been Abū Bekr; implying that there were things which were not confided even to him. The success of the Prophet's enterprise seems to have been very largely due to the part played by this adherent, who possessed a variety of attainments which he put at Mahomet's service; who when an intermediary was required was always ready to represent him, and who placed the commendation of the Prophet above every other consideration, private or public. The two appear to have regularly laid siege to those persons in Mecca whose adherence was desirable; and the ability which many of the earlier converts afterwards displayed, whether as statesmen or generals, is a remarkable testimony to their power of gauging men. It seems clear that the growth of wealth in Mecca had led to the accentuation of the difference between persons of different station, and that many were discontented with the oligarchy which governed the city. Converts could, therefore, be won without serious difficulty among the aliens and in general those who suffered under various disqualifications. Some members of the Jewish community seem also to have joined; and some relics of the Abyssinian expedition (*i.e.* descendants of the invaders). Among the most important converts of the Meccan period were Mahomet's uncle Ḥamza, afterwards for his valour called "the Lion of God"; 'Abd al-Raḥman (Abdarraḥman) son of 'Auf; Othman, son of 'Affān, who married two of the Prophet's daughters successively, and was Mahomet's third successor; and, more important than any save Abū Bekr, Omar, son of al-Khaṭṭāb, a man of extraordinary force of character, to whom siege seems to have been laid with extraordinary skill. At some time he received the honourable title *Fārūq* ("Deliverer"); he is represented as regularly favouring force, where Abū Bekr favoured gentle methods; unlike Abū Bekr, his loyalty was not always above suspicion. His adherence is ascribed to the period of publicity.

The secrecy which marked its early years was of the greatest value for the eventual success of the mission; for when Mahomet came forward publicly he was already the head of a band of united followers. His own family appear to have been either firm adherents, or violent enemies, or lukewarm and temporizing—this is the best which can be said for 'Abbās, eponymus of the Abbasid dynasty; or finally espousers of his cause, on family grounds, but not as believers.

First Period of Publicity.

Rejecting accounts of Mahomet's first appearance as a public preacher, which are evidently comments on a text of the Koran, we have reason for supposing that his hand was forced by ardent followers, who many times in his career compelled him to advance. The astute rulers of the community perceived that the claim made by Mahomet was to be dictator or autocrat; and while this was naturally ridiculed by them, some appear to have been devoted adherents of the gods or goddesses whom he attacked. The absence of dated documents for the period between this open proclamation (which in any case commenced before 616) and the Flight to Medina in 622 renders the course of events somewhat conjectural, though certain details appear to be well established. Apparently there was a war of words, followed by a resort to diplomacy and then to force; and then a period in which Mahomet's attention was directed to foreign conversions, resulting in his being offered and accepting the dictatorship of Yathrib.

Of the war of words we have an imperfect record in the Meccan suras of the Koran, which occasionally state the objections urged by the opponents. In the course of the debate the theological position of both parties seems to have shifted, and the knowledge of both was probably increased in various ways. The miracle of the Koran, which at first consisted in its mode of production, was transformed into a marvel connected with its contents; first by Mahomet's claiming to tell historical narratives which had previously been unknown to him; afterwards by the assertion that the united efforts of mankind and Jinn would be unable to match the smallest passage of the Koran in sublimity. Probably the first of these claims could not be long maintained, though A. J. Davis, "the Seer of Poughkeepsie," in our own time brought a similar one in regard to his *Principles of Nature*. Indeed both parties evidently resorted to external aid. To those who undertook to name the man who dictated stories of the ancients to Mahomet day and night, he replied that the individual whom they had in mind was a foreigner, whereas the Koran was in pure Arabic. This was obviously a quibble, for it was scarcely asserted that he delivered the matter dictated to him without alteration. The purity of the Arabic also appears to have been very questionable; for several expressions appear to be Ethiopic rather than Arabic, and the person whom the Meccans had in mind is likely to have been an Abyssinian Christian, since the Christian technicalities of the Koran are mainly derived from the Ethiopic Gospels and Acts. On one occasion when some questions suggested by learned foreigners had been propounded to the Prophet he required a fortnight's delay before the revelation which solved them came; the matter contained in his reply was certainly such as required research. His sources of information seem at all times to have been legendary rather than canonical; and the community which seemed to his opponents to agree best with his views was that of the Sabians or Mandaeans (*qq.v.*).

It has been suggested that Mahomet first threatened the Meccans with temporal punishment, and only when this threat failed to take effect resorted to the terrors of the Day of Judgment and the tortures of Hell; it seems however a mistake to distinguish between the two. These threats provided the Prophet with his most powerful sermons. The boasts of incomparable eloquence which the Koran contains are evidence that his oratorical power was effective with his audiences, since the more successful among the Arabic poets talk of their compositions somewhat in the same way. These discourses certainly led to occasional conversions, perhaps more frequently among women than men.

The Exiles in Axum.

The diplomatic war seems to have been due to the Prophet's increasing success, which led to serious persecution of Mahomet's less influential followers, though, as has been seen, no blood could be shed in Mecca. Abū Ṭālib, moreover, prevented him from being exiled, though he probably had to endure many personal insults. Something however had to be done for the persecuted Moslems, and (perhaps at the suggestion of his Abyssinian helper) Mahomet endeavoured to find a refuge for them in the realm of Axum. Abyssinia was doubtless connected in every Meccan mind with the "Expedition of the Elephant"; and such an alliance secured by Mahomet was a menace to the existence of the Meccan community. A deputation was therefore sent by the Meccan leaders to demand extradition of the exiles; and as chief of this expedition the future conqueror of Egypt, 'Amr b. al-'Āṣ (see 'AMR IBN EL-ASS), first figures in history. To frustrate his efforts Mahomet sent his cousin Ja'far armed with an exposition of the Prophet's beliefs and doctrines afterwards embodied in the Koran as the Sura of Mary (No. XIX.; though with the addition of some anti-Christian matter). The original document contained an account of the Nativity of Christ with various miracles not known to either the canonical or even the apocryphal gospels which have been preserved, but which would be found edifying rather than unorthodox by a church one of whose most popular books is *The Miracles of the Virgin Mary*. To this there were added certain notices of Old Testament prophets. The Abyssinian king and his ecclesiastical advisers took the side of Mahomet and his followers, whom they appear to have regarded as persecuted Christians; and an attempt made probably by the astute 'Amr to embroil them with the Abyssinians on the difficult question of the Natures of Christ failed completely. There seems reason for thinking that the Abyssinian king contemplated bringing back the exiles by force, but was diverted from this purpose by frontier wars; meanwhile they were safely harboured, though they seem to have suffered from extreme poverty. The want of an Abyssinian chronicle for this period is a serious disadvantage for the study of Islamic origins. The sequel shows that regular correspondence went on between the exiles and those who remained in Mecca, whence the former were retained within the fold of Islam, with occasional though rare apostasies to Christianity.

Mahomet's diplomatic victory roused the Meccan leaders to fury, and they decided on the most vigorous measures to which they could rise; Abū Ṭālib, Mahomet's protector, and the clan which acknowledged him as *sheikh*, including the Prophet and his family, were blockaded in the quarter which they occupied; as in other sanctuaries, though blood might not be shed, a culprit might be starved to death. That this did not occur, though the siege appears to have lasted some months at least, was due to the weak good nature of the Meccans, but doubtless also to the fact that there were enlisted on Mahomet's side many men of great physical strength and courage (as their subsequent careers proved), who could with impunity defy the Meccan embargo. After a time however the besieged found the situation intolerable, and any assistance which they might have expected from the king of Axum failed to come. The course adopted by Mahomet was retractation of those of his utterances which had most offended the Meccans, involving something like a return to paganism. A revelation came acknowledging the effectiveness of the Meccan goddesses as well as Allah, and the Meccans raised the siege. News of the reconciliation reached the Abyssinian exiles and they proceeded to return.

By the time they reached the Arabian coast the dispute had recommenced. The revelation was discovered to be a fabrication of the Devil, who, it appears, regularly interpolates in prophetic revelations; such at least is the apology preserved in the Koran, whence the fabricated verses have been expunged. Since our knowledge of this episode (regarded as the most disgraceful in the Prophet's career) is fragmentary, we can only guess that the Prophet's hand had once more been forced by the more earnest of his followers, for whom any compromise with paganism was impossible. The exiles went back to Abyssinia; and about this time both Abū Ṭālib and Khadīja died, leaving the Prophet unprotected.

He fled to the neighbouring oasis of Ṭāif, where wealthy Meccans had possessions, and where the goddess al-'Uzza was worshipped with special zeal—where she is said still to exist in the form of a block of stone. He had but little success there in proselytizing, and indeed had to cease preaching; but he opened negotiations with various Meccan magnates for a promise of protection in case of his return. This was at last obtained with difficulty from one Moṭ'im b. 'Adi. It would appear that his efforts were now confined to preaching to the strangers who assembled at or near Mecca for the ceremonies connected with the feasts. He received in consequence some invitations to come and expound his views away from Mecca, but had to wait some time before one came of a sort which he could wisely accept.

The Flight to Yathrib.

The situation which led to Mahomet's Flight (*hijra*, anglicized incorrectly *hejira*, *q.v.*) was singularly favourable to Mahomet's enterprise, and utilized by him with extraordinary caution and skill. At the palm plantation called Yathrib, afterwards known as *al-Medina*, Medina, "the City" (*i.e.* of the Prophet), there were various tribes, the two most important, called Aus and Khazraj, being pagan, and engaged in an internecine feud, while under their protection there were certain Jewish tribes, whose names have come down to us as Qainuqā', Naḍīr and Quraiẓa—implying that the Israelites, as might be expected, imitated the totem nomenclature of their neighbours. The memory of these Israelites is exclusively preserved by the Moslem records; the main stream of Jewish history flowed elsewhere. In the series of combats between the Aus and Khazraj the former had generally been worsted; the Jews, as usual, had avoided taking any active part in the fray. Finally, owing to an act of gross perfidy, they were compelled to fight in aid of the Aus; and in the so-called battle of Bu'āth the Aus aided by the Jews had won a victory, doubtless attributed to the God of the Jews. As has been seen, the divine name employed by Mahomet (*Raḥmān*) was one familiar to the Jews; and the Yathribites who visited Mecca at feast-time were naturally attracted by a professed representative of al-Raḥmān. The first Yathribite converts appear to have been Khazrajites, and one As'ad, son of Zurarah, is the most prominent figure. Their idea may have been in the first place to secure the aid of the Israelitish Deity in their next battle with the Aus, and indeed the primary object of their visit to Mecca is said to have been to request assistance for their war. For this the plan was substituted of inviting the Prophet to come to Mecca as dictator, to heal the feud and restore order, a procedure to which Greek antiquity offers parallels. The new converts were told to carry on secret propaganda in Yathrib with this end in view. At the next feast some of the rival faction embraced Islam. A trusty follower of Mahomet, Mus'ab b.'Umair, who resembled Mahomet in personal appearance, was sent to Yathrib to assist in the work. The correspondence between this person and the Prophet would, if we possessed it, be of the greatest value for the study of Islamic antiquity. We first hear at this time of *the conditions of Islam, i.e.* a series of undertakings into which the convert entered: namely, to abstain from adultery, theft, infanticide and lying, and to obey Mahomet *in licitis et honestis*. The wholesale conversion of Yathrib was determined by that of two chieftains, Usaid b. Ḥuraith and Sa'd b. Mu'adh, both Ausites. The example of these was quickly followed, and iconoclasm became rife in the place. At the next Meccan feast a deputation of seventy Yathribites brought Mahomet a formal invitation, which he accepted, after imposing certain conditions. The interviews between Mahomet and the Yathribites are known as the '*Aqabah* (probably with reference to a text of the Koran). The attitude of the Jews towards the project appears to have been favourable.

The Refugees.

Among the conditions imposed by Mahomet on his new adherents appears to have been the protection and harbouring of the older proselytes, whom Mahomet most wisely determined to send before him to Yathrib, where, in the event of the Yathribite loyalty wavering, they could be counted on with certainty. The welcome given these refugees (*muhājirūn*), as they were from this time known in contradistinction to the helpers (*anṣār*) or allies from Yathrib, is said to have been of the warmest; a Helper with two wives would hand one over to a wifeless Refugee. A yet more important condition which preceded the Flight was readiness to fight men of all colours in defence of the faith.

Although the transactions with the people of Yathrib had been carried on with profound secrecy, the nature of Mahomet's contract with his new adherents was somewhat divulged to the Meccan magnates, and the danger of allowing an implacable enemy to establish himself on the high-road of their north-bound caravans flashed upon them. The rule which forbade bloodshed in the sacred city had at last to be suspended; but elaborate precautions were to be taken whereby every tribe (except Mahomet's own clan) should have their share in the guilt, which would thus be spread over the whole community fairly. When the committee appointed to perpetrate the crime reached Mahomet's house, they found that it was too late; Mahomet had already departed, leaving Ali in his bed.

The actual Flight from Mecca to Yathrib has naturally been a favourite subject for romance, and indeed appears to have been executed with the greatest cunning. Accompanied by Abū Bekr only, Mahomet took refuge in a cave of Mt Thaur, in the opposite direction to that which he intended to take finally, and there remained for three days; provision had been made of every requisite, food, powerful camels, a trusty and competent guide. The date at which he reached Kuba, on the outskirts of Yathrib, where there was already some sort of Moslem oratory, is given as 8 Rabia I., of the year A.H. 1; the fact that he arrived there on the Jewish Day of Atonement gives us the date September 20, 622. The Meccans, who had employed professional trackers to hunt down the fugitives, proceeded to confiscate the houses and goods of Mahomet and of his followers who had fled.

Mahomet as Despot of Yathrib.

The safe arrival of Mahomet at his destination marks the turning-point in his career, which now became one of almost unbroken success; his intellectual superiority over both friends and enemies enabling him to profit by defeat little less than by victory. His policy appears to have been to bind his followers to himself and them to each other by every possible tie; he instituted brotherhoods between the Refugees and Helpers, which were to count as relationships for legal purposes, and having himself no sons, he contracted numerous marriages partly with the same end in view; *e.g.* with the infant daughter of Abū Bekr, Ayesha ('A'ishah), whose ability he appears to have discerned; and the unamiable Ḥafṣa, daughter of Omar. Of his own daughters three were given to faithful allies, the one by whom his line is supposed to have been continued to our time, Fātima, was reserved for his cousin Ali. Owing to his efforts the alliance between the Refugees and Helpers resisted numerous attempts on the part of enemies to break it up, and only towards the end of the Prophet's life, when he appeared to favour Meccans unduly, do we hear of any bitterness between the two communities.

The Medina Community.

The population of Yathrib, or, as it may now be called, Medina, soon divided into three groups: Mahomet's united followers; the Jews; and a party known as the "Hypocrites," *i.e.* professing Moslems, who were lukewarm, or disaffected, among whom the most prominent is 'Abdallah b. Ubayy, a Khazrajite chieftain, who is said to have himself aspired to be despot of Yathrib, and who till nearly the end of Mahomet's career figures somewhat as a leader of the opposition; of his importance there is no question, but the reason for it and the mode whereby he made it felt are often obscure. It would seem that the pagans remaining in Yathrib speedily adopted Islam after the Prophet's arrival, whence we hear little of serious opposition on their part. Coming in the capacity of prophet of the Israelitish God, Mahomet at first seems to have courted alliance with the Jews, and to have been ready to adopt their system with very slight modifications—similar to those which, according to his opinion, Jesus had come to introduce. The Jews met these advances by submitting him to examination in the intricacies of the *Torah*, and, finding him very poorly equipped, proceeded to denounce him as an imposter; one of his examiners is said to have even translated the *Torah* into Arabic with a view of convicting him of ignorance and imposture. They are further charged with exercising their magical arts on the Prophet and his followers, and to have succeeded thereby in producing barrenness among the Moslem women. Their conduct must not of course be judged by the statement of their enemies; it is however clear that Mahomet soon found that there was no possibility of compromising with them on religious questions, or of obtaining their loyal support; meanwhile he discovered that they were incapable of united and persistent action, and useless as warriors except against each other. He therefore resolved on their extermination. His ruthlessness in their case compared with his patience and forbearance in the case of the "Hypocrites" was consistent with his principle (always faithfully observed) that no inquiry was permissible into the motives of conversion, and with his division of mankind into the two antagonistic factions Believers and Unbelievers. The latter principle, as will be seen, was somewhat modified before the end of his life.

Development of Islam.

Mahomet's failure to effect a compromise with the Jews caused a reaction in his mind towards paganism, and after about a year's residence at Medina the direction of prayer, which had till then been towards Jerusalem, was turned southward to the pagan temple at Mecca. With this change we may perhaps couple the adoption of the name *Allah* for the Diety; in the Moslem formula "in the Name of Allah the Raḥmān the Merciful," the translation attached to the word *Raḥmān*, and the prefixing to it of the name *Allah* furnish clear evidence of theological transition, though the stages are not recorded; we know, however, that the Meccans approved of the name *Allah*, but objected to the name *Raḥmān*. Prayer (*ṣalāt*), said to have been prescribed on the occasion of the Prophet's ascent into heaven after a miraculous journey from Mecca to Jerusalem, began to assume a stereotyped form in the place of assembly built by Mahomet immediately after his arrival; the attitudes of prayer in use among many communities (*e.g.* the Jewish standing, the prostration of some Christian sects) were combined. In general it was Mahomet's principle, while taking over a practice from some other sect, to modify it so as to render the Moslem method absolutely distinct; thus when a summons to prayer became requisite, a new mode (by the voice of a crier called *muadhdhin* or *muezzin*) was preferred to the Christian hammer; a new sacred day was adopted, in lieu of the Jewish Saturday and the Christian Sunday, in the weekday on which he had safely reached Kuba, Friday; but the sanctity was reduced to the actual time occupied by public worship. On the subject of food he was satisfied with the regulations of the Council of

Jerusalem, recorded in Acts xv.; which were observed by few if any Christian sects. The prohibition of wine, which was enacted in A.H. 3, is said to have been occasioned by the riotous conduct of one of his followers when under the influence of liquor; Palgrave saw in it (perhaps with justice) a deliberate attempt to prevent harmony between Moslems and Christians, in whose most sacred rite wine is used. The Fast of Ramaḍān, in which food both liquid and solid is forbidden from sunrise to sunset, is said to be a pagan or semi-pagan institution; its importance for military training and discipline is not likely to have been overlooked by the Prophet. When the direction of prayer was altered, it is probable that Mahomet already intended to introduce into his system the whole of the pagan pilgrimage with its antique ceremonial (with, of course, a new interpretation); before this he is supposed to have aimed at the abolition of the Kaʻba and all that appertained to it.

The difference between religious and civil law has never been recognized by Islamic jurists, whose manuals deal equally with the law of contract and the amount of the body to be washed before prayer; the Prophet's ordinances on both subjects were suggested by the occasion in each case, and it would seem that the opinions of trusted advisers were regularly heard before a revelation was issued. Even when this had been done the ordinance might be cancelled by an abrogating revelation; it being "easy for Allah" to substitute for a text already revealed another that was better or at least as good.

As Islam began to spread outside the limits of Medina both conversion to Islam and persistence therein were reduced to simple tests; the pronunciation of the double formula of belief in Allah and Mahomet was sufficient to indicate conversion, whilst payment of an income-tax, called by the Jewish names for alms (*zakāt* and *ṣadaqah*), was evidence of loyalty. This income-tax, of which the definite assessment perhaps belongs to a later period, was for the support of necessitous converts—an element in the community whose presence accounts for the mode in which the development of the Islamic state proceeded.

First Campaigns of Mahomet.

The industries in which the Meccan Refugees had been engaged were not of a sort which they could exercise at Medina, where the palm took the place of the camel as the basis of society. Moreover the Prophet seems to have given some disastrous advice on the subject of palmiculture, and thereby to have accentuated the poverty of the place. He had, therefore, to find some fresh source of revenue in order to deal with this difficulty, and one of the Helpers is said to have suggested the plan which he adopted, viz. of attacking the Meccan caravans. With this view he organized a series of expeditions, taking the lead himself sometimes, while at others he gave it to one of his veteran followers; and at first only Refugees took part in them. The leaders of the caravans, however, were expert in evading attacks of this sort, which were doubtless regularly attempted by the desert tribes; and in the first year of his despotism Mahomet did not score a single success of the kind intended. The attempts were not wholly fruitless; for while on the one hand he accustomed his followers to campaigning, on the other he made a series of agreements with the chieftains of the tribes through whose territory the caravans ordinarily passed. Finding continued failure intolerable, he resolved to take advantage of his power to bind and to loose by sending an expedition of seven men under his cousin ʻAbdallah b. Jahsh to attack a caravan at the beginning of the sacred month Rajab, when, as raiding during such a season was unknown, success was practically certain. The commander on this, the Nakhlah raid, was given sealed orders, to be opened after two days' march; the men were then to be given the option of retiring, if they disapproved. Of this no one seems definitely to have availed himself, and the raid ended successfully, for considerable booty was captured, while of the four persons who escorted the caravan two were made prisoners, one escaped, and one, ʻAmr b. al-Ḥaḍrami, was killed; he was the first person slain fighting against an Islamic force. The violation of the sacred month seems to have caused considerable scandal in Arabia, but led to no serious consequence; on the other hand the shedding of blood created a feud between the people of Mecca and the Refugees, with whom the Meccans long declined to identify the people of Medina. The fact that the man who had been killed was a client, not a citizen, made no difference. The circumstance that booty had been actually acquired appears to have helped the Prophet's cause very considerably.

Attack on Meccan Caravan.

Both these consequences, the Meccan desire to avenge the blood that had been shed and the anxiety of the Medinese to take part in a successful raid, manifested themselves a few months later, when an expedition was organized by Mahomet to attack a caravan returning from Syria, which had escaped him the previous year. Many desired to take part in the raid, and finally some 300 persons were selected, including a large number of "Helpers." The leader of the caravan learned somehow that an attack was being organized by Mahomet on a large scale, and sent to Mecca for aid, while hurrying home by forced marches. This is the first historical appearance of Abū Sofiān (the leader of the caravan), who now for some years played the part of president in the Meccan opposition to Mahomet, and whose son was destined to found the second Mahommedan dynasty (see CALIPHATE, B). The day before the battle to be fought at Badr, near the point where the northern road leaves the coast to turn eastwards to Mecca, the Moslem army learned that the Meccan succour (some 1000 strong) was near, but that the caravan had escaped. The Meccans, it is asserted, would have returned home now that their object was secured, but the patrons of the man who had been killed in the former raid were compelled to strike for vengeance.

The battle (Ramaḍān 19, A.H. 2, usually made to synchronize with March 17, 624) ended in a complete victory for Mahomet, whose followers killed seventy of the enemy and took seventy prisoners—if we may trust what seem to be round numbers; it was attributed by him to divine co-operation, taking the form of an illusion wrought on the enemy, and the despatch of a regiment of angels to the assistance of the Believers, while on the other hand the treachery of the Devil did mischief to the Meccans. The popular tradition attributed it to the prowess of some of Mahomet's followers, especially his uncle Ḥamza and his cousin Ali. In the narratives which have come down and which seem to be authentic the result is amply accounted for by the excellence of the Moslem discipline and the complete absence of any on the Meccan side. Mahomet himself is said to have fainted at the first sight of blood, and to have remained during the battle in a hut built for him to which swift camels were tied, to be used in case of a defeat; yet these accounts make him responsible for the tactics, whilst assigning the credit for the strategy to one Ḥobab b. al-Mondhir. Several of Mahomet's old enemies and friends of Meccan days perished on this occasion; notably one Abu Jahl, his uncle, but represented as an implacable enemy; another hostile uncle, Abu Lahab, who is cursed in the Koran, was not present but died shortly after the battle.

The day is called in the Koran by a Syriac expression the "Day of Deliverance," and both for internal and external politics it was of incalculable advantage to Islam. The booty and the ransoms of the prisoners provided the means for dealing with distress; the story of supernatural aid soothed the feelings of the defeated Meccans and had a tendency to disarm resistance elsewhere; whilst Mahomet in the popularity acquired by his victory was able to strike forcibly at his enemies in Medina. One of the sequels to the victory was a series of assassinations whereby critics of his actions were removed.

The Taking of Mecca.

The defeat at Badr naturally led to efforts on the part of the Meccans to avenge their dead and besides to secure the commerce, by which they lived, from an enemy who was gradually getting all the seaboard that lay between Jeddah and Yanbo within his sphere of influence; and the year after Badr (A.H. 3) Abū Sofiān was able to lead a force said to be three times as great as that which had been defeated, and so numbering some 3000 men, against Medina itself; part of it was under Khālid b. al-Walid, one of the greatest of Arab captains, afterwards conqueror of Syria. It is said that Mahomet's plan was to remain in Medina itself, and leave it to the

Meccan commander to discover some way of taking the place; but that his hand was forced by his more ardent followers. Others, however, assign this advice to Abdallah b. Ubayy, and make the Prophet anxious to fight from the first. A battle was in consequence fought under Mt Uḥud (or Ohod), north-west of Medina, wherein Khālid succeeded in inflicting a severe defeat on Mahomet's forces; his uncle Ḥamza, hero of Badr, was killed on this occasion. Fortunately for the Moslems, the Meccans considered that they had finished their task when they discovered that they had killed a number of the former equal to those who had fallen at Badr on their own side; instead therefore of pursuing their victory they went home. The immediate effect on Arabia appears to have been to dissipate the illusion that the Prophet could count on supernatural assistance in his wars; and we hear of some blows being dealt him from outside. Meanwhile his relations towards the Medinese Jews had grown more and more hostile, and these are credited with doing their best to rouse the Meccans to a sense of the danger which threatened them in the continuance of the Prophet's power, and in general to stir up hostility against him in Arabia. Whether this part was played by them or not, in the fifth year of the Prophet's stay at Medina a fresh invasion of the territory took place by a vast confederate force of Meccans with their allies, the tribes Fazarah, Asad, Murrah, &c., to the number, it is said, of 10,000. This time the intention of the leaders was undoubtedly to stamp out Islam. For the first time in Arab warfare Mahomet resorted to the expedient of defending his city by a trench, called by a Persian name, and suggested by a Persian convert. But he also employed agents to sow dissension among the confederates, and succeeded with this no less than with the other expedient. After a brief stay, and scarcely striking a blow, the confederacy dispersed, leaving the Jews who still remained in Medina to the summary vengeance of the Prophet. The want of records written from the Meccan standpoint renders the abortiveness of this last attempt at storming the Prophet's stronghold scarcely intelligible.

From this time, however, the road towards the eventual taking of Mecca became easy, and we are told that such was the importance attached to that city throughout Arabia that its acquisition meant for the Prophet the acquisition of the whole peninsula. The next year (A.H. 6) he deemed it advisable to make a truce with the Meccans (the Truce of Ḥodaibiyah), whereby he secured for his followers the right of performing the pilgrimage in the following year; on this occasion he even consented to forgo his title "Prophet of Allah," when the Meccans refused to sign a deed in which it was employed, greatly to the scandal of his more earnest followers, including Omar; they were however too deeply committed to Islam to be able to defy the Prophet. When the pilgrimage was performed (A.H. 7), Mahomet not only won important converts in the persons of Khālid and the no less able 'Amr b. al-'Aṣ, but in general impressed the population with the idea that his was the winning side. An excuse was easily found for invading Mecca itself in the following year, when Abū Sofiān took the opportunity of embracing Islam before it was too late. Very little resistance was now made by the Meccans, whose chiefs were already in Mahomet's camp, and Mahomet used his victory with great moderation; his proscription list was finally reduced to two. The theory that all offences were cancelled by conversion was loyally observed. Moreover the Prophet incurred the displeasure of his Medinese friends by the anxiety which he displayed to soothe the feelings of his former enemies and antagonists. The Medinese, however, prevailed upon him to maintain their city as his political capital, while making Mecca the religious centre of his system; and this arrangement accounts perhaps more than anything else for the persistence of the system amid so many dynastic changes.

In the main he appears to have introduced little alteration into the government of Mecca, and it is said that he even declined to retaliate on those who had confiscated the possessions of the Refugees. Even the Ka'ba was left in the keeping of its former custodian, though of course its interior as well as its precincts were cleansed of all that could offend monotheists. In the following year the pilgrimage was for the first time conducted by a Moslem official, Abū Bekr. A proclamation was made on that occasion, forbidding idolaters in future to take part in the pilgrimage, and giving all Arabs who were not as yet converted four months' grace before force was to be brought to bear upon them. In the following year Mahomet conducted the Pilgrimage himself. This solemn occasion (the "Farewell Pilgrimage") was also employed for the delivery of an important proclamation, wherein the Prophet declared that God had completed their religion. The principle whereon he specially insisted was the brotherhood of Islam; but there is some difficulty in enucleating the original sermon from later additions.

Conquest of Arabia.

It would seem that Mahomet's enterprise originally comprised the conversion of Mecca only, and that he thought of himself as sent to his fellow-citizens only, as had been the case with earlier prophets, whose message was for their "brethren." His views took a somewhat different direction after his brief exile to Ṭāif, and the conquest of Arabia was in a way forced upon him in the course of his struggle with the Meccans. It is not indeed perfectly clear by what process he arrived at the resolution to exclude paganism from Arabia; at first he appears to have tolerated it at Medina, and in some of his earlier contracts with neighbouring tribes he is represented as allowing it, though some of our texts make him reserve to himself the right of enforcing Islam if he chose; only the Meccans were at first, according to the most authentic documents, excluded from all truce or treaty. At the battle of Badr he appears to have formulated the rule that no one might fight on his side who had not embraced Islam; and when once he had won fame as a successful campaigner, those who wished to share his adventures had to pass the Islamic test. After the battle of Uhud (Ohod) we hear of a tribe demanding missionaries to instruct them in Islamic principles; and though in the case recorded the demand was treacherous, the idea of sending missionaries appears not to have been unfamiliar even then, albeit the number sent (70), if rightly recorded, implies that the Prophet suspected the good faith of the applicants. After the taking of Mecca, whereby the chief sanctuary at any rate of north Arabia had been cleared of all idolatrous associations, and consecrated to monotheism, paganism in general was conscious of being attacked; and the city had scarcely been brought under the new régime before the Prophet had to face a confederation of tribes called Hawāzin and Thaqīf. The battle which ensued, known as the Day of Honain, was near ending disastrously for Islam; some of Mahomet's sturdiest followers fled; but the terrible danger of a defeat in the neighbourhood of recently conquered Mecca roused the Prophet and Ali to heroism, and they saved the day. Emissaries were now sent far and wide demanding the destruction of idols, and only Ṭāif appears to have made any considerable resistance; against this place for the first time the Prophet made use of siege artillery, such as was employed by the Byzantines; though compelled by the bravery of the inhabitants to raise the siege, he was afterwards able to take the city by capitulation. It has been observed that here only do we read of much attachment to the old deities; in most places they were discarded with few regrets when once their impotence had been found out. After the taking of Mecca and the victory of Honain there appears to have been a general desire, extending even to the extreme south of Arabia, to make the best terms with the conqueror so soon as possible; iconoclasm became general. Flatterers of various kinds, including poets, came to seek the favour of the sovereign; and a mock war of words appears to have been substituted by some tribes for more serious fighting, to terminate in surrender. For warfare of his sort Mahomet had a powerful helper in the poet Ḥassan b. Thābit, for whose effusions a pulpit was erected in the Medina mosque, and whose verses were said to be inspired by the Holy Spirit; though, as has been seen, Mahomet was not himself able to judge of their artistic merit. It was not, however, found easy to enforce the payment of the alms on these new converts; and this taxation caused an almost general revolt so soon as Mahomet's death had been ascertained.

Plan of World-conquest.

Although the central portions of the peninsula in Mahomet's time were practically independent, large portions of the north-west and south-east were provinces of the Byzantine and Persian empires respectively, whence any scheme for the conquest of Arabia would necessarily involve the conqueror in war with these great powers. The conquest of Persia is said to have been contemplated by the Prophet as early as A.H. 5, when the famous Trench was being dug; but it was not till the year A.H. 7, on the eve of the taking of Mecca, that the Prophet conceived the idea of sending missives to all known sovereigns and potentates, promising them safety if, but only if, they embraced Islam. The text of these letters, which only varied in the name of the person addressed, is preserved (doubtless faithfully) by the Moslem Oral Tradition; in the middle of the last century a French explorer professed to discover in Egypt the original of one of them—addressed to the mysterious personage called the Muqauqis (Muḳauḳis) of Egypt—and this, it appears, is still preserved amid other supposed relics of the Prophet in Constantinople, though there is little reason for believing it to be genuine. The anecdotes dealing with the reception of these letters by their addressees are all fabulous in character. Two appear to have sent favourable replies: the king of Axum, who now could send the exiles whom he had so long harboured to their successful master; and the Egyptian governor, who sent Mahomet a valuable present, including two Coptic women for his harem. The emperor Heraclius is claimed as a secret convert to Islam, on whom pressure had to be put by his advisers to conceal his convictions. The Persian king is said to have sent orders to have Mahomet arrested; his messengers arrived in Medina, but were unable to carry out the commands of their master, who died while they were there. Two of the letters are said to have had important results. One was addressed to the Himyarite chiefs (called by the south Arabian appellation *qail*) in Yemen, and effected their conversion; another to the governor of Bostra in Roman Arabia, who put the bearer of this insolent message to death; a force was despatched by Mahomet immediately afterwards (beginning of A.H. 8) to avenge this outrage; and though the Moslems were defeated in their first encounter with the Byzantine forces at Mutah, they appear to have given a good account of themselves; it was here that Ja'far, cousin of the Prophet, met his death. In A.H. 9 a successful expedition was led by the Prophet himself northward, in which, though no Byzantine force was encountered, a considerable region was withdrawn from the Byzantine sphere of influence, and made either Islamic or tributary to Islam. At the time of his death (of fever, after a short illness) he was organizing an expedition for the conquest of Syria.

Jewish and Christian Communities.

The Prophet claimed throughout that his revelation confirmed the Jewish and Christian Scriptures, and this claim is on the whole reasonable, though his acquaintance with both was in the highest degree vague and inaccurate. Still he reproduced the Old Testament as faithfully as he could, and though he patriotically endeavours to shed some lustre on his supposed ancestor Ishmael, he does not appear to have questioned the Biblical theory according to which the founder of the north Arabian nations was the son of a slave girl. On neither the truth of the Biblical history and miracles nor the validity of the Mosaic legislation does he appear to have cast any doubt. He even allows that Israel was the chosen people. The Gospel was known to him chiefly through apocryphal and heretical sources, which cannot certainly be identified; but he accepted the doctrine of the Virgin-birth, the miracles of healing the sick and raising the dead, and the ascension; the crucifixion and resurrection were clearly denied by the sect from whom he had received his information, and rejected by him, though certainly not because of any miracle which the latter involved. His quarrel with the Jews at Medina appears to have been by no means of his own seeking, but to have arisen unavoidably, owing to his particular view of his office being such as they could not accept; and his attempt to discredit, not the Mosaic Law, but the form in which they presented it, was an expedient to which he resorted in self-defence. An attempt was made shortly after his arrival at Medina to settle the relations between the two communities by a treaty, according to which, while their equality was guaranteed there should be little interference between the two; this, however, was found unworkable, and each victory of Mahomet over the Meccans was followed by violent measures against the Medinese Israelites. When experience had shown him their military incompetence he appears to have been unable to resist the temptation to appropriate their goods for the benefit of his followers; and his attack on the flourishing Jewish settlement of Khaibar, after the affair of Ḥodaibiyah, appears to have been practically unprovoked, and designed to satisfy his discontented adherents by an accession of plunder. Yet the consciousness that this process was economically wasteful suggested to him an idea which Islamic states are only now abandoning, viz. that of a tolerated caste, who should till the soil and provide sustenance for the Believers who were to be the fighting caste. Whereas then his former plan in dealing with Israelites had been to banish or massacre, he now left the former owners of Khaibar (who had survived the capture of the place) in possession of the soil, of whose produce they were to pay a fixed proportion to the Islamic state. The same principle was adopted in the case of later conquests of Jewish settlements.

Disputes with Christians occur somewhat later in the Prophet's career than those with Jews, for neither at Mecca nor Medina were the former to be found in any numbers; individuals are likely to have been found in both cities, and we hear of one Medinese "Abu'Amir the Monk," who after Mahomet's arrival at Medina branded him as an impostor, and, going himself into exile, made many an abortive attempt to discredit and injure Mahomet's cause. The notices of him are meagre and obscure. Mahomet's manifesto to the world, about the time of the taking of Khaibar, appears to represent his definite breach with Christianity; and when in the "year of the embassies" the Christians of Najran sent a deputation to him, they found that the breach between the two systems was not to be healed. Of the three alternatives open to them—conversion, internecine war, and tribute, they chose the last. The Christian tribes of north Arabia showed greater inclination towards the first. The Prophet's policy was to give Christians lighter terms than Jews, and though the Koran reflects the gradual adoption by the Prophet of an attitude of extreme hostility to both systems, its tone is on the whole far more friendly to the former than to the latter. Some other communities are mentioned in the Koran, but merely in casual allusions: thus we know that Mahomet's sympathy was with the Byzantines in their struggle with Persia, but in his most tolerant utterance the Magians or Mazdians as well as the Sabians (with whom his followers were identified by the Meccans) are mentioned with respect.

Mahomet's Administration.

The financial requirements of Mahomet's state were of the simplest kind, for there is no trace of any form of governmental department having been instituted by him, even when he was master of the peninsula; nor can we name any permanent officials in his employ except his *muaddhin* Bilal, and perhaps his court-poet Hassān. A staff of scribes was finally required both to take down his revelations and to conduct correspondence; but although he encouraged the acquisition of penmanship (indeed some of the prisoners at Badr are said to have been allowed to ransom themselves by teaching it to the Medinese), we know of no regular secretaries in his employ. As despot of Medina he combined the functions of legislator, administrator, general and judge; his duties in the last three capacities were occasionally delegated to others, as when he appointed a governor of Medina during his absence, or leaders for expeditions, with provision for successors in case of their falling, but we hear of no permanent or regular delegation of them. Till near the end of his career at Medina he maintained the principle that migration to that city was a condition of conversion; but when, owing to the extension of his power, this was no longer practicable, his plan was in the main to leave the newly converted communities to manage their internal affairs as before, only sending occasional envoys to discharge special duties, especially instruction in the Koran and the principles of Islam, and to collect the Alms; quite towards the end of his life he appears to have sent persons to the provinces to act as judges, with instructions to judge according to the Koran, and where that failed, *the practice* (*sunna*), *i.e.* the practice of the community, for which a later generation substituted the practice of the Prophet. There were, therefore, no regular payments to permanent officials; and the taxation called *Alms*, which developed into an income-tax, but was at first a demand for voluntary contributions, was wholly for the support of the poor Moslems; it might not be used for the maintenance of the state, *i.e.* Mahomet and his family. For them, and for public business, *e.g.* the purchase of war material and gratuities to visitors, provision was made out of the booty, of which Mahomet claimed one-fifth (the chieftain's share had previously, we are told, been one-fourth), while the remainder—or at least the bulk of it—was distributed among the fighting men; the Prophet appears to have prided himself on the justice of his distribution on these occasions, and doubtless won popularity thereby, though we hear occasionally of grumbling; for difficulties occurred when a defeated tribe embraced Islam, and so could claim equality with their conquerors, or when portions of the spoil were irregularly employed by Mahomet to allay resentment: the persons whose allegiance was thus purchased were euphemistically termed "those whose hearts were united." What afterwards proved the main source of revenue in Islamic states dates from the taking of Khaibar; for the rent paid to the state by tolerated communities for the right to work their land developed long after Mahomet's time into a poll-tax for Unbelievers (see CALIPHATE, *e.g.* B. § 8 and MAHOMMEDAN INSTITUTIONS), and a land-tax for all owners of land. Immediately after the taking of Khaibar certain communities, of which the most notable was Fadak, sent tribute before they had been attacked and reduced; their land was regarded by Mahomet as his private domain, but after his death it was withdrawn from his heirs by his successor Abū Bekr, in virtue of a maxim that Prophets left no inheritance, which in the opinion of Fāṭima was contrary to Koranic doctrine, and invented by Ayesha's father expressly for the purpose of excluding her and her husband from their rights; and this is likely to have been the case.

As a military organizer Mahomet, as has been seen, was anxious to adopt the most advanced of contemporary methods, and more than once is said to have scandalized the Arabs by foreign innovations, as at a later time the Moslem chiefs who first used gunpowder scandalized their co-religionists. The unit in his armies seems to have been, as of old, the tribe, under its natural leader; that he introduced no more scientific division, and nothing like a hierarchy of officers was perhaps due to the difficulty of reconciling such a system with the equality of all Moslems.

As has been seen, the Koran only assumed the character of a civil code as the need for one arose; and for some time after Mahomet's arrival at Medina old-fashioned methods of settling disputes continued in use, and doubtless in accordance with precedent where such was known. For difficult cases, even in Arab opinion, divine inspiration was required; and since Mahomet naturally claimed to be in sole enjoyment of this, his utterances soon became the unique source of law, though he did not at first think of organizing a code. Such a plan is said to have occurred to him, and he even wished to dictate a code upon his death-bed; but his friends supposed or professed to suppose him to be delirious. A table regulating the "Alms" was left by him, it is said, in the possession of Abū Bekr; but other traditions assign another origin to this document.

Just as there were no regular officials for the arrangement of business, so there were none for its execution; when punishment was to be administered, any follower of Mahomet might be called upon to administer it. In the case of the massacre of the Banū Quraiẓah care was taken to see that some of the heads were struck off by their former allies, in order that the latter might be unable at any time to bring a demand for vengeance. The Prophet hoped by the mere terror of his name to make complete security reign throughout Arabia, and there is no evidence that any system of policing either it or even Medina occurred to him.

Domestic Life.

Until the death of Khadija the Prophet's private life seems to have been normal and happy, for though the loss of his sons in infancy is said to have earned him a contemptuous epithet, he was fortunate in his adoption of Zaid b. Ḥarithah, apparently a prisoner ransomed by Khadija or one of her relatives, who appears as dutiful almost to excess and competent in affairs. The marriages of his daughters seem all to have been happy, with, curiously, the exception of that between Fāṭima and Ali. His domestic troubles, to which an unreasonable amount of space seems to be devoted, even in the Koran, began after the Migration, when, probably in the main for political reasons, he instituted a royal harem. One of these political motives was the principle which long survived, that the conquest of a state was consummated by possession of the former monarch's wife, or daughter; another, as has been seen, the desire to obtain the securest possible hold on his ministers. In his marriage with the daughter of his arch-enemy Abū Sofiān, before the latter's conversion, we can see a combination of the two. Few, therefore, of these marriages occasioned scandal; yet public morality seemed to be violated when the Prophet took to himself the wife of his adopted son Zaid, whose name has in consequence the honour of mention in the Koran in the revelation which was delivered in defence of this act. Its purpose was, according to this, to establish the difference between adoptive and real filiation. Serious trouble was occasioned by a charge of adultery brought against the youthful favourite Ayesha, and this had to be refuted by a special revelation; the charge, which was backed up apparently by Ali, seems to have been connected with some deeper scheme for causing dissension between the Prophet and his friends. Yet another revelation is concerned with a mutiny in the harem organized by Omar's daughter Hafsa, owing to undue favour shown to a Coptic concubine (Mary, mother of a son called Ibrahim, who died in infancy; his death was marked by an eclipse, January 27, 632); and various details of factions within the harem are told us by Mahomet's biographers.

Of the members of this harem the only prominent one is Ayesha, married to the Prophet shortly after the Flight, when she had scarcely passed the period of infancy, but who appears to have been gifted with astuteness and ambition that were quite beyond her years, and who maintained her ascendancy over the Prophet in spite of the fact that many carping criticisms of his revelations are attributed to her. Some of this may have been due to the obligations (including pecuniary obligations) under which her father had laid Mahomet; but her reputation seems to have been greatly enhanced by the sending down of a revelation to exonerate her (A.H. 6), for which she thanked God and not the Prophet. Each accession to the harem rendered the building of a house or room necessary for the newcomer's accommodation; a fact in which Robertson Smith perhaps rightly saw a relic of the older system whereby the tent was the property of women. The trouble noticed above seems to have arisen from the want of a similar arrangement in the case of slave girls, with whom Mahomet's system permits cohabitation. When Mahomet, whether in consequence of the fatigue incurred by the "Farewell Pilgrimage," or, as others thought, by the working of some poison put into his food some years before by a Jewess of Khaibar, was attacked by the illness which proved fatal, it was to the house of Ayesha that he was transferred (from that of another wife) to be nursed; and he apparently died in the arms of the favourite, on whose statements we have to rely for what we know of his last hours.

General Characteristics.

The traditional description of Mahomet is "of middle height, greyish, with hair that was neither straight nor curly; with a large head, large eyes, heavy eyelashes, reddish tint in the eyes, thick-bearded, broad-shouldered, with thick hands and feet"; he was in the habit of giving violent expression to the emotions of anger and mirth. The supposition that he at any time suffered from physical weakness seems absolutely refuted by his career as a leader of difficult, dangerous and wearisome expeditions, from his migration to Medina until his death; indeed, during his last years he exhibited a capacity for both physical and intellectual activity which implies a high degree of both health and strength; and without these the previous struggle at Mecca could scarcely have been carried on. The supposition that he was liable to fits (epileptic or cataleptic) was intended to account for certain of the phenomena supposed to accompany the delivery of revelations; some of these however rest on very questionable authority: and the greater number of the revelations give evidence of careful preparation rather than spontaneity.

The literary matter ascribed to the Prophet consists of (1) the Koran (*q.v.*); (2) certain contracts, letters and rescripts preserved by his biographers; (3) a number of sayings on a vast variety of topics, collected by traditionalists. The references in the Koran to a form of literature called "Wisdom" (*hikmah*) suggest that even in the Prophet's time some attempts had been made to collect or at least preserve some of the last; the general uncertainty of oral tradition and the length of time which elapsed before any critical treatment of it was attempted, and the variety of causes, creditable and discreditable, which led to the wilful fabrication of prophetic utterances, render the use to which No. 3 can be put very limited. Thus the lengthy description of the journey to heaven which Sprenger was inclined to accept as genuine is regarded by most critics as a later fabrication. It is very much to be regretted that the number of *pièces justificatives* (No. 2) quoted by the biographers is so small, and that for these oral tradition was preferred to a search for the actual documents, some of which may well have been in existence when the earliest biographies were written. Their style appears to have been plain and straightforward, though the allusions which they contain are not always intelligible.

In his personal relations with men Mahomet appears to have been able to charm and impress in an extraordinary degree, whence we find him able to control persons like Omar and Khalid, who appear to have been self-willed and masterful, and a single interview seems to have been sufficient to turn many an enemy into a devoted adherent. Cases (perhaps legendary) are quoted of his being able by a look or a word to disarm intending assassins.

Although the titles which he took were religious in character, and his office might not be described as sovereignty, his interests appear to have lain far more in the building up and maintenance of empire than in ecclesiastical matters. Thus only can we account for the violent and sudden changes which he introduced into his system, for his temporary lapse into paganism, and for his ultimate adoption of the cult of the Black Stone, which, it is said, gave offence to some of his sincere adherents (*e.g.* Omar), and seems hard to reconcile with his tirades against fetish-worship. The same is indicated by his remarkable doctrine that the utterance of the creed constituted a Moslem and not its cordial acceptance, and his practice of at times buying adhesion. Even an historian so favourable to the Prophet as Prince Caetani recognizes that ultimately what he regarded as most important was that his subjects should pay their taxes. And in general his system was not favourable to fanaticism (*al-ghulū fi'l-dīn*); he repeatedly gave permission for concealment of faith when the profession of it was dangerous; he took care to avoid institutions which, like the Jewish Sabbath, interfered seriously with military expeditions and the conduct of business, and permitted considerable irregularity in the matters of prayer and fasting when circumstances rendered it desirable. In his theory that Koranic texts could be abrogated he made wise provision against the danger of hasty legislation, though some of its usefulness was frustrated by his failure to provide for such abrogation after his death.

Mahomet's Reforms.

As has been seen, Mahomet claimed to introduce a wholly new dispensation, and a maxim of his law is that Islam cancels all that preceded it, except, indeed, pecuniary debts; it is not certain that even this exception always held good. Hence his system swept away a number of practices (chiefly connected with the camel) that were associated with pagan superstitions. The most celebrated of these is the arrow-game, a form of gambling for shares in slaughtered camels, to which poetic allusions are very frequent. More important than this was his attitude towards the blood-feud, or system of tribal responsibility for homicide (whether intentional or accidental), whereby one death regularly led to protracted wars, it being considered dishonourable to take blood-money (usually in the form of camels) or to be satisfied with one death in exchange. This system he endeavoured to break down, chiefly by sinking all earlier tribal distinctions in the new brotherhood of Islam; but also by limiting the vengeance to be demanded to such as was no more than the equivalent of the offence committed, and by urging the acceptance of money-compensation instead, or complete forgiveness of the offence. The remembrance of pre-Islamic quarrels was visited by him with condign punishment on those who had embraced Islam; and though it was long before the tribal system quite broke down, even in the great cities which rose in the new provinces, and the old state of things seems to have quickly been resumed in the desert, his legislation on this subject rendered orderly government among Arabs possible.

Next in importance to this is the abolition of infanticide, which is condemned even in early Suras of the Koran. The scanty notices which we have of the practice are not altogether consistent; at times we are told that it was confined to certain tribes, and consisted in the burying alive of infant daughters; at other times it is extended to a wider area, and said to have been carried out on males as well as females. After the taking of Mecca this prohibition was included among the conditions of Islam.

In the laws relating to women it seems likely that he regulated current practice rather than introduced much that was actually new, though, as has been seen, he is credited with giving them the right to inherit property; the most precise legislation in the Koran deals with this subject, of which the main principle is that the share of the male equals that of two females. Our ignorance of the precise nature of the marriage customs prevalent in Arabia at the rise of Islam renders it difficult to estimate the extent to which his laws on this subject were an improvement on what had been before. The pre-Islamic family, unless our records are wholly misleading, did not differ materially from the Islamic; in both polygamy and concubinage were recognized and normal; and it is uncertain that the text which is supposed to limit the number of wives to four was intended to have that meaning. The "condition of Islam" whereby adultery was forbidden is said to have been ridiculed at the time, on the ground that this practice had never been approved. Yet it would seem that certain forms of promiscuity had been tolerated, though the subject is obscure. Against these services we must set the abrogation of some valuable practices. His unfortunate essay in astronomy, whereby a calendar of twelve lunar months, bearing no relation to the seasons, was introduced, was in any case a retrograde step; but it appears to have been connected with the abrogation of the sanctity of the four months during which raiding had been forbidden in Arabia, which, as has been seen, he was the first to violate. He also, as has been noticed, permitted himself a slight amount of bloodshed in Mecca itself, and that city perhaps never quite recovered its sacrosanct character. Of more serious consequences for the development of the community was his encouragement of the shedding of kindred blood in the cause of Islam; the consequences of the abrogation of this taboo seem to have been felt for a great length of time. His assassinations of enemies were afterwards quoted as precedents in books of Tradition. No less unfortunate was the recognition of the principle whereby atonement could be made for oaths. On the question how far the seclusion of women was enjoined or countenanced by him different views have been held.

Sources.

Besides the contemporary documents enumerated above (Koranic texts, rescripts and authentic traditions) many of the events were celebrated by poets, whose verses were ostensibly incorporated in the standard biography of Ibn Isḥāq; in the abridgment of that biography which we possess many of these are obelized as spurious, and, indeed, what we know of the procedure of those who professed to collect early poetry gives us little confidence in the genuineness of such odes. A few, however, seem to stand criticism, and the *diwan* (or collection of poems) attributed to Ḥassan b. Thābit is ordinarily regarded as his. Though they rarely give detailed descriptions of events, their attestation is at times of value, *e. g.* for the story that the bodies of the slain at Badr were cast by the Prophet into a pit. Besides this, the narratives of eyewitnesses of important events, or of those who had actually taken part in them, were eagerly sought by the second generation, and some of these were committed to writing well before the end of the 1st century. The practice instituted by the second Caliph, of assigning pensions proportioned to the length of time in which the recipient had been a member of the Islamic community, led to the compilation of certain rolls, and to the accurate preservation of the main sequence of events from the commencement of the mission, and for the detailed sequence after the Flight, which presently became an era (beginning with the first month of the year in which the Flight took place). The procedure whereby the original dates of the events (so far as they were remembered) were translated into the Moslem calendar—for something of this sort must have been done—is unknown, and is unlikely to have been scientific.

Mahomet's conduct being made the standard of right and wrong, there was little temptation to "whitewash" him, although the original biography by Ibn Isḥāq appears to have contained details which the author of the abridgment omitted as scandalous. The preservation of so much that was historical left little room for the introduction of miraculous narrations; these therefore either belong to the obscure period of his life or can be easily eliminated; thus the narratives of the Meccan council at which the assassination of Mahomet was decided, of the battles of Badr, Uḥud and Ḥonain, and the death of Sa'd b. Mu 'adh, would lose nothing by the omission of the angels and the devil, though a certain part is assigned the one or the other on all these occasions. We should have expected biographies which were published when the 'Abbasids were reigning to have falsified history for the purpose of glorifying 'Abbās, their progenitor; the very small extent to which this expectation is justified is a remarkable testimony to their general trustworthiness.

RELATIVES OF THE PROPHET[1]

1. *Family of 'Abd al-Moṭṭalib*, Mahomet's maternal grandfather:—*'Abbās (d. A.H. 32 or 34), *Ḥamza (d. A.H. 3), 'Abdallāh, father of the

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[1] * is prefixed to names which figure on occasions which seem to be historical. Female names are in italics.

Prophet, *Abū Ṭālib (said to be named 'Abd Manāf), ? *Zubair, Ḥārith, Ḥajal, Moqawwam, Ḍirār, *Abū Lahab (said to be named 'Abd al-'Uzzā, d. A.H. 2), **Ṣafiyyah* (d. A.H. 20), *Umm Ḥakīm, al-Baiḍā, 'Ātikah, Umaimah, Arwā, Barrah.*

2. *Family of Abū Ṭālib:*—*'Aqīl (d. after A.H. 40), *Ja'far (d. A.H. 8), Ṭālib, Ṭulaiq, 'Alī, the caliph, *Umm Hāni', Jumānah, Raiṭah.*

3. *Family of Mahomet. Wives:*—**Khadīja* (Children:—Qāsim; ? 'Abd Manāf (Ṭāhir, Tayyib); **Zainab* m. Abu'l-'Āṣ b. Rabī', d. A.H. 7; **Ruqayyah*, m. 'Othmān b. 'Affān, d. A.H. 2; **Umm Kulthūm* m. 'Othmān b. 'Affān, d. A.H. 9; **Fāṭimah*, m. 'Alī, d. A.H. 11): **Saudah bint Zam'ah*,? d. A.H. 54, **'A'ishah (Ayesha) bint Abī Bekr* (d. A.H. 56), **Hafṣa bint 'Omar* (d. A.H. 45 or 47), **Zainab bint Khuzaimah*, d. before A.H. 11, **Zainab bint Jaḥsh*, d. A.H. 20, **Umm Salimah*, d. A.H. 59, **Maimūnah*, d. A.H. 38, **Juwairiyah*, d. A.H. 56, **Umm Ḥabībah Ramlah bint Abī Sofiān*, d. A.H. 44.

Concubines:—**Ṣafiyyah bint Ḥuyyay*, d. A.H. 36, **Raiḥānah bint Zaid*, **Māriyah the Copt*, d. A.H. 15 or 16, mother of Ibrāhim. (Other names given by Ibn Sa'd, vol. viii.)

Chronological Table of Chief Events in the Life of Mahomet.[1]

? 570 Birth.
? 595 Marriage with Khadīja.
? 610 Commencement of call.
? 613 Public appearance.
616 Persian conquest of the nearer East.
? 617 Flight of his followers to Abyssinia.
? 618–619 Siege in Mecca. Retractation and subsequent repudiation. Death of Abū Talib and Khadija.
? 620 Flight to Ṭāif.
622 July 16. Beginning of the Moslem era.
Sept. 20. Arrival at Kuba after the Flight.
632 Jan. 27. Death of his son Ibrāhīm.
632 June 7. Death of Mahomet.

The following dates are given by the Arabic historians according to their own calendar. For the reasons which have been seen it is impossible to obtain certain synchronisms.

A.H. 2. Rajab 1. Raid of 'Abdallah b. Jaḥsh to Nakhlah.
Ramaḍān 19. Battle of Badr.
Shawwāl 15. Attack on the Banū Qainuqā.
3. Rabīa I. 14. Assassination of Ka'b b. al-Ashraf.
Shawwāl 7. Battle of Uḥud.
4. Ṣaphar. Massacre of Mahomet's 70 missionaries at Bi'r Ma'ūnah.
Rabīa I. Attack on the Banu Naḍīr.
Dhu'l-Qa'da. Abortive raid called "the lesser Badr."
5. Shaabān 2. Attack on the Banu'l-Muṣṭaliq (according to Wāqidī).
Dhu'l-Qa'da. Battle of the Trench.
Massacre of the Banū Quraiẓah.
6. Jomādā i. Capture of a caravan by Zaid b. Ḥārithah.
Futile attempt to assassinate Abū Sofiān.
Dhu'l-Qa'da. Affair of Hodaibiyah.
7. Jomādā i. Taking of Khaibar. Mission extended to the world.
Dhu'l-Qa'da. Pilgrimage to Mecca (called *'umrat al-qadiyyah*)
8 Jomādā i. Expedition to Mūtah.
Ramaḍān 20. Taking of Mecca.
Shawwāl. Battle of Ḥonain.
Attack on Ṭā'if.
9. Muḥarram. Tax-gatherers sent over Arabia.
Rajab. Expedition to Tabūk.
Rival Mosque built at Kubā, destroyed on Mahomet's return to Medina.
Dhu'l-Ḥijja. Pilgrimage conducted by Abu Bekr.
Abolition of idolatry in Arabia.
10. Ramaḍān. Expedition of 'Alī to Yemen.
Dhu'l-Qa'da. "Farewell Pilgrimage."
11. Ṣaphar. Expedition ordered against the Byzantines.

Companions of the Prophet.

The *ṣaḥābah*, as they are called, are the subject of a vast literature, and the biographical dictionaries devoted to them, of which the best known are the *Usd ul-ghāba* of the historian Ibn Athīr and the *Iṣābah* of Ibn Ḥajar al-'Asqalāni, enumerate many thousands. The following two lists are of special groups.

(*a*) *Naqībs, i.e.* leaders selected by Mahomet from the Medinese tribes: i. *Khazrajites*:—As'ad b. Zurārah, Sa'd b. al-Rabī', 'Abdallah b. Rawāḥah, al-Barā' b. Ma'rūr, 'Abdallah b. 'Amr b. Ḥarām, 'Ubādah b. al-Ṣāmit, Sa'd b. 'Ubādah, al-Mondhir b. 'Amr; ii. *Ausites*: Usaid b. Ḥuḍair, Sa'd b. Khaithamah, Rifā'ah b. 'Abd al-Mondhir.

(*b*) *Commanders of Expeditions*: names occurring in (*a*) are not repeated: 'Abdallāh b. Jaḥsh, 'Abd ar-Raḥmān b. 'Auf, Abū Bekr, Abū Qatādah, Abū 'Ubaidah b. al-Jarrāḥ, 'Ali, 'Alqamah b. Mujazziz, 'Āmr b. al-'Āṣ (ibn el-Ass), Bashīr b. Sa'd, Ḍaḥḥāk b. Sofiān, Ghālib b. 'Abdallāh, Ibn Abi'l-Aujā, Ka'b b. 'Umair, Khālid b. al-Walīd, Kurz b. Jābir, Marthad b. Abī Marthad, Muḥammad b. Maslamah, Quṭbah b. 'Āmir, Sa'd b Abī Waqqāṣ, Sa'd d. Zaid, Salama b. 'Abd al-Asad, Shujā' b. Wahb, 'Ubaidah b. al-Ḥārith, 'Ukkāshah b. Miḥṣan, 'Umar b. al-Khaṭṭāb, Usamah b. Zaid, 'Uyainah b. Ḥiṣn, Zaid b. Ḥārithah.

AUTHORITIES.—The biography of Ibn Isḥāq was before the world long before the two chief causes for the falsification of tradition had begun to have serious effects; these were the need for legal precedents, and the concept of saintliness, combining those of asceticism and thaumaturgy. These gave rise to the classical works on the *Evidences of Mohammed's Mission* by Abū Nu'aim (d. A.D. 1012–1013) and Baihaqī (d. A.D. 1066).

Lives of the Prophet († indicates that the work is lost); †'Urwah b. Zubair (d. 712–713); †Musa b. 'Ukbah (d. 758–759); †Mohammed b. Isḥāq (d. 768); Mohammed b. Hishām (d. 828–829), ed. Wüstenfeld (Göttingen, 1860); reprinted in Egypt by Zubair Pasha, a series of excerpts from the last; Mohammed b. Omar al-Wāqidī (d. 823), portion published by Kremer (Calcutta, 1855), abridged trans. of a fuller copy by Wellhausen, *Muhammad in Medina* (Berlin, 1882); Mohammed b. Sa'd (d. 844–845), an encyclopaedic work on the history of Mahomet and his followers, called *Ṭabaqat*, ed. Sachau and others (Berlin, foll.); Mohammed b. Jarīr al-Ṭabarī (see TABARI). Many more writers on this subject are enumerated in the *Fihrist*, cf. Sprenger's *Leben Muhammads*, iii. 54–76.

Among the most popular compilers of later times are: Ibn al-Athīr (*q.v.*) al Jazarī, the historian (d. 1233); Aḥmad b. Ali al Kasṭalānī (d. A.D. 1517), whose *al-Mawāhib al-Laduniyyah* was published with commentary (Cairo, 1278); Ḥosain b. Mohammed al Diyarbakrī (d. 1574) whose work *Ta'rikh al-Khamīs* was published in Cairo, A.H. 1382; 'Ali b. Burhān al-dīn al-Ḥalabī (d. A.D. 1634), whose biography called *Insān al-'uyūn* was published in Cairo, A.H. 1292. To these must be added all the collections of Tradition.

Modern Authorities.—The critical study of the Life of Mahomet begins in Europe with the publication by Th. Gagnier in 1723 of the Life by Abulfeda (*q.v.*). Presently there appeared an apologetic biography by Henri Cmte. de Boulainvilliers (2nd ed., Amsterdam, 1731), to which Gagnier replied in 1732 (*La Vie de Mahomet, traduite*, &c. ibid.). The next considerable advance in the treatment of the subject is marked by the biography of G. Weil (*Muhammed der Prophet*, Stuttgart, 1843), which is wholly without religious bias; the popular life by Washington Irving (London, 1849) is based on this. That by J. L. Merrick (the *Life and Religion of Mohammed*, Boston, U.S.A., 1850) rests on Shi'ite sources. The search for MSS. in India conducted by A. Sprenger led to the discovery of fresh material, which was utilized by Sprenger himself in his unfinished *Life of Mohammad* (Pt. 1, Allahabad, 1851), and his more elaborate *Das Leben und die Lehre des Mohammad* (Berlin, 1861–1865), and by Sir William Muir in his *Life of Mahomet*, London, 1858–1861) 4 vols.: afterwards abridged in one volume and reprinted. These are still the standard treatises on the subject; the pro-Christian bias of Muir is very marked, while Sprenger has hazarded numerous conjectures on subjects with which he had little familiarity. The biography by S. W. Koelle, *Mohammed and Mohammedanism* (London, 1889), is pro-Christian, the popular work of Syed Ameer Ali *The Spirit of Islam*, (London, 1896) an apology for Mahommedanism. Later treatises, resting on original authorities, are those by H. Grimme *Mohamed*, (Münster, 1892, and Munich, 1904), F. Buhl, *Mohameds Liv* (Copenhagen, 1903—Danish: since translated into German), D. S. Margoliouth *Mohammed and the Rise of Islam* (N.Y., 1905, &c.), and Prince Caetani *Annali del Islam*, i. ii. (Milan, 1905–1907). For the direction of public opinion in Mahomet's favour the Lecture on *The Hero as Prophet* in Carlyle's *Heroes and Hero-worship* (London, 1846) was singularly effective; his views were enforced by R. Bosworth Smith *Mohammed and Mohammedanism*, (London, 1873, &c.). A somewhat similar line was taken in France by J. Barthélémy Saint-Hilaire, *Mahomet et le Coran*, (Paris, 1865), while the *Vie de Mahomet d'après la Tradition* of E. Lamairesse and G. Dujarric (Paris, 1897) is written entirely from the Moslem standpoint.

See further CALIPHATE, *ad init.*; MAHOMMEDAN INSTITUTIONS; MAHOMMEDAN LAW; MAHOMMEDAN RELIGION. (D. S. M.*)

MAHOMMED AHMED IBN SEYYID ABDULLAH (1848–1885), Sudanese tyrant, known as "the Mahdi," was born in Dongola. His family, known as excellent boat-builders, claimed to be *Ashraf* (or *Sherifs*), *i.e.* descendants of Mahomet. His father was a *fiki* or religious teacher, and Mahommed Ahmed devoted himself early to religious studies. When about twenty years old he went to live on Abba Island on the White Nile about 150 m. above Khartum. He first acquired fame by a quarrel with the head of the brotherhood which he had joined, Mahommed asserting that his master condoned transgression of the divine law. After this incident many dervishes (religious mendicants) gathered round the young sheikh, whose reputation for sanctity speedily grew. He travelled secretly through Kordofan, where (with ample justification) he denounced to the villagers the extortion of the tax-gatherer and told of the coming of the mahdi who should deliver them from the oppressor. He also wrote a pamphlet summoning true believers to purify their religion from the defilements of the "Turks" *i.e.* the Egyptian officials and all non-native inhabitants of the Sudan. The influence he gained at length aroused the anxiety of the authorities, and in May 1881 a certain Abu Saud, a notorious scoundrel, was sent to Abba Island to bring the sheikh to Khartum. Abu Saud's mission failed, and Mahommed Ahmed no longer hesitated to call himself al-Mahdi al Montasir, "The Expected Guide." In August he defeated another force sent to Abba Island to arrest him, but thereafter deemed it prudent to retire to Jebel Gedir, in the Nuba country south of Kordofan, where he was soon at the head of a powerful force; and 6000 Egyptian troops under Yusef Pasha, advancing from Fashoda, were nearly annihilated in June 1882. By the end of 1882 the whole of the Sudan south of Khartum was in rebellion, with the exception of the Bahr-el-Ghazal and the Equatorial Provinces. In January 1883 El Obeid, the capital of Kordofan, was captured. In the November following Hicks Pasha's force of 10,000 men was destroyed at Kashgil, and in the same year the mahdi's lieutenant, Osman Digna, raised the tribes in the eastern Sudan, and besieged Sinkat and Tokar, near Suakin, routing General Valentine Baker's force of 2500 men at El Teb in February 1884. The operations undertaken by Great Britain in face of this state of affairs are narrated under EGYPT: *Military Operations.* It need only be added that General Gordon (*q.v.*) was besieged at Khartum by the mahdi and was killed there when the town was captured by the mahdists on the 25th–26th of January 1885. The mahdi himself died at Omdurman a few months later (June 22, 1885), and was succeeded in power by his khalifa Abdullah.

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[1] Dates are given A.D.

When he announced his divine mission Mahommed Ahmed adopted the Shi'ite traditions concerning the mahdi, and thus put himself in opposition to the sultan of Turkey as the only true commander of the faithful. To emphasize his position the mahdi struck coins in his own name and set himself to suppress all customs introduced by the "Turks." His social and religious reforms are contained in various proclamations, one of which is drawn up in the form of ten commandments. They concern, chiefly, such matters as ritual, prayers, soberness in food and raiment, the cost of marriage and the behaviour of women. How far the mahdi was the controller of the movement which he started cannot be known, but from the outset of his public career his right-hand man was a Baggara tribesman named Abdullah (the khalifa), who became his successor, and after his flight to Jebel Gedir the mahdi was largely dependent for his support on Baggara sheikhs, who gratified one of his leading tastes by giving him numbers of their young women. In the few months between the fall of Khartum and his death the mahdi, relieved from the incessant strain of toil, copied in his private life all the vices of Oriental despots while maintaining in public the austerity he demanded of his followers. His death is variously attributed to disease and to poisoning by a woman of his harem. On the occupation of Omdurman by the British (Sept. 1898) the mahdi's tomb was destroyed, his body burnt and the ashes thrown into the Nile (see SUDAN: *Anglo-Egyptian*).

See *Mahdiism and the Egyptian Sudan* by F. R. Wingate (1891); *Ten Years' Captivity in the Mahdi's Camp* (1882–1892) from the MS. of Father Joseph Ohrwalder by F. R. Wingate (1892) and *Fire and Sword in the Sudan* (1879–1895) by Slatin Pasha (trans. F. R. Wingate, 1896). Both Ohrwalder and Slatin were personally acquainted with the mahdi, and their narratives contain much first-hand information. Wingate prints many translations of the proclamations and correspondence of the mahdi.

MAHOMMEDAN INSTITUTIONS. Of all the institutions of Islam the caliphate is the oldest, the most fundamental, and in essence the most enduring. For its history see CALIPHATE; the present subject is its origin and nature. Mahomet enjoyed absolute rule over his people as a divinely inspired and guided prophet. He led the public prayers; he acted as judge; he ruled. If he consulted with others or paid attention to public feeling or local usage, it was as a matter of policy; the ultimate decision lay with himself. He was the state. On his death a leader was put in his place of similar authority, though without the divine prophetic guidance. He was called the "successor" (*khalīfa,* caliph) of the Prophet, later also the *amīr-al-mu'minīn,* commander of the faithful, and was elected by the Moslems, just as the Arab tribes had always elected their chiefs. He was thus an absolute ruler, but was democratically elected; and such is the essence of the caliphate among Sunnite Moslems to this day. For them it has been a matter of agreement (see MAHOMMEDAN LAW) from the earliest times that the Moslem community must appoint such a leader (see IMĀM). The Shi'ites, on the other hand, hold that the appointment lies with God, and that God always has appointed, though his appointment may not always have been known and accepted. Their position may be called a legitimist one. Some few heretical sects have held that the necessity of a leader was based on reason, not on the agreement of the community. But, for all, the rule of the leader thus appointed is absolute, and all authority is delegated from him and, in theory, can be resumed by him at any time. Just as God can require unreasoning obedience from his creatures (his "slaves" in Arabic), so can the caliph, his representative on earth.

The Caliphate.

But Abu Bekr, the first caliph, nominated his successor, Omar, and that nomination was accepted and confirmed by the people. So a second precedent was fixed, which was again carried a step farther, when Moawiya I., the first Omayyad caliph, nominated his son, Yazīd I., as his successor, and caused an oath of allegiance to be taken to him. The hereditary principle was thus introduced, though some relics of the form of election persisted and still persist. The true election possible in the early days of the small community at Medina became first a formal acceptance by the populace of the capital; then an assertion, by the palace guard, of their power; and now, in the investiture of the sultans of the Ottoman Turks, who claim the caliphate, a formal ceremony by the 'ulemā (*q.v.*) of Constantinople. The Ottoman claim is based on an asserted nomination by the last Abbasid, who died in exile in Egypt in 1538, of the Ottoman sultan, Suleiman the Great, as his successor. Such a nomination in itself was a perfectly legal act, but in this case had a fatal flaw. It is an absolute condition, laid down in tradition, that the caliph must be of the tribe of Koreish (Quraish), that of the Prophet.

The duties of this democratically elected autocrat are, in theory, generally stated as follows. He shall enforce legal decisions and maintain the divinely revealed restrictive ordinances; guard the frontiers and equip armies; receive the alms; put down robberies, thieving, highwaymen; maintain the Friday services and the festivals; decide disputes and receive evidence bearing on legal claims; marry minors, male and female, who have no guardians; divide booty. He must be a free, male, adult Moslem; must have administrative ability; must be an effective governor and do justice to the wronged. So long as he fulfils these conditions he is to be absolutely obeyed; private immorality or even tyranny are not grounds for deposing him. This is a position reached by Islam practically. But a caliph who openly denied the faith would be as impossible as an unbelieving pope. The caliph, therefore, is the highest executive officer of a system assumed to be definite and fixed. He, in a word, administers Islam; and the content of Islam is determined by the agreement of the Moslem people, expressed immediately through the 'ulemā, and ultimately, if indirectly and half-consciously, by the people. To depose him a *fatwā* (see MUFTI) would be required—in Turkey from the Sheikh-ul-Islām—that he had violated some essential of the Moslem faith, and no longer fulfilled the conditions of a caliph.

The Dīwāns.

But it was impossible for the caliph personally to administer the affairs of the empire, and by degrees the supreme office was gradually put into commission, until the caliph himself became a mere figurehead, and vanished into the sacred seclusion of his palace. The history of the creation of government bureaus (*dīwāns;* see DIVAN) must therefore now be sketched. The first need which appeared was that of a means of regulating and administering the system of taxation and the revenues of the state. Immense sums flowed into Medina from the Arab conquests; the surplus, after the requirements of the state were met, was distributed among the believers, All Moslems had a right to a certain share of this, which was regarded as booty. Omar, the second caliph, regulated this distribution and also the system of taxation, and the result was the first divan and the constitution of Omar, looked back to now by all Sunnite Moslems as an ideal. The sources of revenue were (i) the poor-rate (*zakāt*), a tithe paid by every Moslem; (ii) the fifth of all booty; (iii) the poll-tax (*jizya*) on non-Moslems; and (iv) the land-tax (*kharāj*) also on non-Moslems. Thus the constitution determined the position of all non-Moslems in a Moslem state. The ideal was that the Moslems should be kept apart as a superior, fighting caste, and that the non-Moslems should support them (cf. CALIPHATE, B. § 8, on the reign of Omar II.). The Moslems, therefore, were forbidden to acquire land in conquered countries. The non-Moslems must retain their lands, cultivate them and pay the land-tax (the Arabic word is also used of revenue from the work of a slave) and the poll-tax (the Arabic word means also "ransom"), and give contributions in kind to support the local Moslem garrisons which were massed in great camp-cities at strategic points. If a non-Moslem embraced Islam he entered the ruling caste; his land was distributed among his non-Moslem fellows, and he no longer paid the land-tax but rather received support from the public funds. The amount of these pensions varied with the standing of the pensioner from 10,000 dirhems (a dirhem equalled about a franc) to the widows and relations of the Prophet down to 300. This bureau had, therefore, not only to keep the books of the state, but also to maintain a list of all Moslems, classified genealogically and socially. Its registers were kept by Greeks, Copts and Persians; the Arabs, it may be said in general, adopted the method of administration which they found in the captured countries and drew upon the trained services of their inhabitants.

Such a system led naturally to wholesale conversions to Islam; and the consequent decline in revenue, combined with large donations of lands by Othman, the third caliph, to his own family, gradually broke it down. The first patriarchal period of conquest, unearned wealth and the simple life—called by Moslems the period of the "four rightly guided caliphs," and very happily by Sachau, *ein mönchisches Imperium*—passed rapidly into the genuinely Arab empire of the Omayyads, with whom came an immediate development of organization in the state. The constructive genius in this was Moawiya, the first Omayyad caliph. Under him the old simplicity vanished. A splendid and ceremonious court was maintained at Damascus. A chamberlain kept the door; a bodyguard surrounded the caliph, and even in the mosque the caliph, warned by the murder of Othman and of Ali, prayed in a railed-off enclosure. The beginning of the seclusion of the caliph had come, and he no longer walked familiarly among his fellow Moslems. This seclusion increased still further when the administration of the state passed by delegation into other hands, and the caliph himself became a sacrosanct figure-head, as in the case of the later Abbasids; when theories of semi-divine nature and of theocratic rule appeared, as in the case of the Fatimites; and finally when all the elaborate court ritual of Byzantium was inherited by the Ottoman sultans.

But Moawiya I. was still a very direct and personal ruler. He developed a post-system for the carrying of government despatches by relays, and thus received secret information from and kept control of the most distant provinces. He established a sealing-bureau by which state papers were secured against change. He dealt arbitrarily with the revenues of the state and the pensions of the Moslems. Governors of provinces were given a much freer hand, and were required to turn over to the central treasury their surplus revenue only. As they were either conquerors or direct successors of conquerors they had an essentially military government, and were really semi-independent rulers, unhampered except by direct action of the caliph, acting on information sent by the postmaster, who was his local spy. Being thus the heads of armies of occupation, they were not necessarily charged with the control of religious ritual and of justice. These, like every other function, inhered in the office of the caliph and he generally appointed in each province independent cadis over the courts and imāms to be in charge of religious services. Yet the governor was sometimes permitted to hold these two other offices (see CADI; IMĀM).

The Vizierate.

Further administrative developments came with the Abbasids. They created a new city, Bagdad, between the Tigris and the Euphrates, where the three races, Syrian, Arab and Persian, met and sought with Bagdad as a capital to consolidate the empire. The Arab empire, it is true, had passed away with the Omayyads; yet there might be a chance to create a world-empire of all the Moslem peoples. But not even the genius and administrative skill of the early Abbasids could hold together that unwieldy mass. The semi-independent provinces soon became fully independent, or at most acknowledged the caliph as a spiritual head and paid a nominal tribute. His name might stand on the coinage and prayers be offered for him in the Friday service, the two signs of sovereignty to this day in Islam. With this crumbling of the empire went a more elaborate organization; bureaus took the place of principles and of the energy of individual rulers. As the system of Moslem law was built on that of the Roman codes, so was the machinery of administration on that of Persia. And with the Abbasids the chance of the Persians had come. Abū 'l-Abbās, the first Abbasid caliph, was the first to appoint a vizier (*wazīr*, "helper," so Aaron is the *wazīr* to Moses in the Koran), a confidential minister to advise him and come between him and the people. Advisers the caliphs had had before; but not a definite adviser with this name. He must, we are told, have a strain of the ruler in him and a strain of the people to be able to work with both. He must know how to be acceptable; fidelity and truthfulness are his capital; sagacity, firmness, generosity, clemency, dignity, effectiveness of speech are essential. It is plain that the vizier became as important as the caliph. But Abū 'l-Abbās was fortunate in early securing as his vizier the grandfather of the house of the Barmecides (*q.v.*). On this Persian family the fortunes of the Abbasids hung, and it secured for them and for Islam a short golden age, like that of the Antonines, until the jealous madness of Hārūn al-Rashīd cast them down. Thereafter the vizierate had many vicissitudes. Technically a vizier could be either limited or unlimited. The limited vizier had no initiative; he carried out the commands of the caliph. The unlimited vizier, often afterwards called the grand vizier, exercised full authority and was the *alter ego* of the caliph, to whom he was required only to report. Naturally the formal distinction is a later theorizing of history; for a weak ruler his vizier became absolute, for a strong ruler his vizier remained subordinate. Here, as with regard to all Moslem institutions, a marked distinction must be made between the historic facts and the speculative edifices raised by constitutional theorizers. Compare especially MAHOMMEDAN LAW. Until the time of Rāḍī (934–940) the vizierate thus fluctuated in importance. In that caliphate the vizier lost all authority, and in his place came the *amīr al-omarā*—equivalent to the *major domus* of the Franks—the head of the Turkish bodyguard, in terror of whom the caliph now stood. When in 945 the Būyids captured Bagdad and the caliph became a purely spiritual sovereign, they took the title "vizier" for their own chief minister, and the caliphs retained only a secretary (see CALIPHATE, C. § 22). Under the Seljuks, however, they regained their viziers and some real authority. Elsewhere, also the vizierate had its vicissitudes. Under the Mamelukes the vizier fell to be merely the court purveyor. Under the Omayyads of Spain the title was given to several responsible officers of the state, but their chief was called *ḥājib*, chamberlain. Under the Almohades the chamberlain was called vizier. In the modern Turkish empire the grand vizier (called generally *ṣadr A'ẓam*) is the sultan's representative in secular matters, and nominally stands between the sovereign and all the other officials. He is the president of the council of ministers, but Abd-ul Hamid II. deprived the office of almost all its importance.

Other Ministers.

Under the early Abbasids the four most important ministers were the chief cadi, the chief of police or head of the life guards, the minister of finance and the postmaster, who was the head of the system of information and espionage which covered the empire. But at different times the different bureaus varied greatly. Under Motawakkil we find the bureau of taxes and finance; bureau of the crown estates; bureau of state book-keeping; bureau of war, *i.e.* of hired troops; bureau which kept reckoning and control of the pensions of the clients and slaves of the ruling family; bureau of the post system; bureau of expenditures. But in spite of this elaborate system, no Moslem government has, except sporadically, been highly centralized. Provided the taxes are paid, a large measure of local autonomy has always been enjoyed by the country districts. Under the Abbasids almost the only exception was the necessarily centralized control of the irrigation system of the Tigris and Euphrates. And similarly elsewhere.

In the case of all these offices, we have delegation by the caliph, under necessity, of his too heavy burdens. But one duty of an Oriental ruler he could not so easily lay aside. It had always to be possible for the oppressed to come into his presence and claim justice; he must sit in the gate and judge. Therefore, when the caliph found it necessary to delegate the ordinary administration of justice, he found it also necessary to set up a special court of oppressions, which developed, to a certain extent, into a court of appeals. The first to establish such a separate court was Abdal-malik the Omayyad

(685–705), and his example was followed by the more vigorous of the caliphs up to the time of Mohtadī the Abbasid (869–870). If any other than the caliph presided over this court it had to be a man whose dignity, independence and authority commanded respect. He was not bound by strict rules of evidence, method and literal application of law as was the cadi. Rather, he applied a system of equity suited to the absolute source of authority which he represented.

As the chief of police, mentioned above, was rather the head of the caliph's bodyguard, there was also a police system after our ideas, but more thoroughgoing. The *muhtasib* had charge in the broadest sense of public order and morals in the streets, and had oversight as to weights, measures and adulterations; but had no right to interfere privately or enter houses save in the clearest and most necessary cases. He had a summary jurisdiction in all minor cases where no trial was necessary; but where witnesses and oaths entered the case must go to the cadi. Slaves and beasts of burden were under his guardianship; he prevented public scandals, such as the sale of wine; he regulated the public conduct of Jews and Christians. In the interest of public morals he had to find suitable husbands for widows and see that they did not marry before the legal time; questions of paternity also he had to investigate. The outdoor costume of the people he could regulate. It should, of course, be remembered that the canon law of Islam covers minutely all sides of life (see Mahommedan Law).

It is impossible in Islam to separate logically from the mass of institutions those which we should call religious, as Islam on all sides is for the Moslem equally religious. But perhaps the following may practically be separated under that rubric. Islam, runs a tradition, is built on five things: testimony that there is no god save Allah, and that Mahomet is the apostle of Allah; prayer; the poor-rate; pilgrimage; fasting. For these see Mahommedan Religion.

The law and usage of religious foundations in perpetuity (*waqf*, mortmain) became as important in Islam as monastic endowments in medieval Europe, and such foundations tended similarly to absorb the greater part of the national wealth. It was the only safe way of providing for posterity. A pious foundation could be erected in such a way that either so much from its funds would be paid yearly in perpetuity to the descendants of the erector, or those descendants would be employed as officials of the foundation.

The Imâm.

When it became impossible for the caliph to lead the people personally in prayer in the mosque, he delegated that part of his duties to another, hence called imām (*q.v.*). Naturally, then, the appointment of the imām would lie with the supreme ruler. This holds of the daily prayers in the principal mosque (*al-masjid al-jāmi'*) supported by the ruler where the Friday service is held, but in the separate smaller mosques built by each community the community chooses its own imām. With regard to the Friday service, the schools of law disagree as to the necessity of the presence of an imām appointed by the chief ruler. But the imām should certainly make mention of the ruler in his sermon and pray for him. At the occasional prayers, such as those for rain, &c., the presence of an imām appointed by the ruler is not necessary. The imām appoints the *muaddhin*, the announcer of the hour of prayer from the minaret, and both have a claim on the state treasury.

Another office exercised when possible by the caliph, but very frequently delegated to some high dignitary, such as the heir to the caliphate or a prince, was the leadership of the pilgrimage caravan to Mecca and back. Sometimes this official, called *amir-al-ḥajj*, was appointed imām as well. He then led all the pilgrimage ceremonies at Mecca. When outside of towns where there was a cadi he exercised also over the caravan the rights of a judge.

The Cadi.

Mahommedan law (*q.v.*) is treated separately. Here, again, as judging is a duty of the caliph, a cadi is the delegate, or, when appointed by a vizier or governor, a delegate of his delegate. He examines into disputes brought before him and enforces his judgments, he names administrators of the estates of minors, the insane, &c.; he supervises the *waqf* property of mosques and schools in his district and inspects highways and public buildings; he watches over the execution of wills; he inflicts the due legal penalties for apostasy, neglect of religious duties, refusal to pay taxes, theft, adultery, outrages, murder; he can inflict the penalties of imprisonment, fine, corporal punishment, death; if there is no imām, he can perform his duty, as in fact can anyone who has the requisite knowledge. But it should be noticed that all this holds only of the un-europeanized Moslem state.

The Army.

For the existence of an army in Islam, there are two grounds, the holy war (*jihād*, *q.v.*) against unbelievers without the state and the suppression of rebellion within. Under the ordinance of Omar the entire community was preserved and used as a weapon for the subduing of the world to Islam, and every able-bodied male Moslem was theoretically a fighting man, part of the national militia. This army was divided into corps situated in the conquered lands, as armies of occupation, where they eventually came to form military colonies in great camp-cities. The occupied countries had to support them, and they were bound to render military service at any time. But as the ideal of Omar broke down before facts the use of mercenary and slave troops finally increased, although there has always continued in Moslem armies acting against unbelievers a proportion of volunteers not paid a fixed wage but subsidized by the state from the poor-rate and alms funds. The generals were appointed by the caliph, and had either unlimited authority to act as his representatives, concluding peace, acting as cadi and imām, distributing booty; or were restricted within limits, *e.g.* to simple leading of the troops and carrying on military operations. They, in turn, appointed their subordinates; this principle of giving a head full powers and full responsibility was very generally applied in Islam. It was controlled of course by the espionage of the postal system. As war by a Moslem power is essentially sacred war, the regulations of *jihad* must be considered here. Unbelievers must first be invited to embrace Islam and, if they follow a sacred book and are not idol-worshippers, are given a choice between (*a*) becoming Moslems; or (*b*) submitting to the Moslems and entering on a treaty with them of protection and tribute; or (*c*) fighting. If they accept Islam, their lives, families and property are secure, and they form henceforth part of the Moslem community. The ability of Islam to create a common feeling between highly different races is one of its most striking features. If they submit and enter on treaty relations, they pay a poll-tax, for which their personal safety is assured, and assume a definitely inferior status, having no technical citizenship in the state, only the condition of protected clients (*dhimmis*). If they elect to fight, the door of repentance is open, even when the armies are face to face. But after defeat their lives are forfeit, their families are liable to slavery, and all their goods to seizure. It is open to the sovereign either to put them to death; or to enslave them; or to give them their liberty; or to exchange them for ransom or against Moslem prisoners. The sovereign will choose that which is best for Islam. As for their families and wealth, the sovereign can release them only with consent of the army that has captured them. Apostates must be put to death. Four-fifths of the booty after a battle goes to the conquering army.

The technical art of war seems to have been little studied among Moslems; they have treatises on archery but very little upon tactics. Their writers recognize, however, the essential difference between the European and Persian methods of charging in solid lines and holding the ground stubbornly, and the Arab and Berber method of flying attacks and retreats by clouds of cavalry. Therefore, one explained, the custom grew of using a mass of European mercenaries as a fixed nucleus and rallying-point. The early Moslem armies, too, had used the solid, unyielding charge, which may have been the secret of their success. For one of the greatest puzzles of history is the cause which changed the erratic, untrustworthy swarms of Arab horsemen with their childish strategy into the ever-victorious legions of the first caliphs. They certainly learned rapidly. Byzantium and Persia taught them the use of military engines and the entrenched camp. Before that they had been, at the best, single knights with mail-shirt, helmet, sword and lance. Bowmen, too, they used, but the principal use of the bow seems to have come with the Turks.

Education.

The glory of Moslem education was its university system, which fed the higher learning and did not serve every-day needs. Its primary system was very poor, almost non-existent; and technical education has never been recognized in Islam. Primary teachers were despised as ignorant and foolish. Apparently, if we may trust the many stories of how ignorant men set up for themselves, there was no control of them by the state. Their pupils were young only; they taught the rudiments of reading, Koran, catechism, prayer, writing and arithmetic, but very little of the latter. Technical education was given by the gilds through their apprentice system, teaching mechanical arts and crafts. This was genuine instruction, but was not so regarded; it was looked upon rather as are the mysteries and secrets of operative masonry. It produced artisans of independent character, but not artists. Thus there was no distinction between architect and builder; there was no sculpture; and painting, so far as it went, was like carving, a craft. All Moslem university education, like all Moslem science, revolved round theology. There were, apparently, only two outstanding exceptions to this rule, the academy of Mamun (813–833) at Bagdad, and the hall of wisdom of the Fatimites at Cairo (1004–1171); both of these are explained by their environment. From the earliest times, independent scholars instructed classes in mosques—the common places of meeting for the community—and gave their pupils personal certificates. Their subjects were the reading and interpretation of the Koran; the body of traditions from the Prophet; the thence deduced system of theology; the canon law. But the interpretation of the Koran involved grammatical and lexicographical studies of early Arabic, and hence of the early Arabic literature. Theology came to involve metaphysical and logical studies. Canon law required arithmetic and mensuration, practical astronomy, &c. But these last were strictly ancillary; the object of the instruction was primarily to give knowledge of value for the life of the next world, and, secondarily, to turn out theologians and lawyers. Medicine was in Jewish and Christian hands; engineering, architecture, &c., with their mathematical bases, were crafts. Then this instruction was gradually subsidized and organized by the state, or endowed by individuals. How early this took place is uncertain. But the individual teacher, with his certificate, remained the object of the student; there was nothing corresponding to our general degrees. Thirdly, educational institutions came to be equipped with scholarships of money or in kind for the students. The first instance of this is generally ascribed to Nishapur (Naisābūr) in 1066; but it soon became general in the system and afforded a means of control and centralization. A final, and most important, characteristic was the wide journeying of the students "in search of knowledge." Aided by Arabic as the universal language of learning, students journeyed from teacher to teacher, and from Samarkand to the Atlantic, gathering on their way hundreds of personal certificates. Scholars were thus kept in touch all over the Moslem world, and intellectual unity was maintained.

The Sayyids.

To the democratic equality of Islam, in which the slave of to-day may be the prime minister of to-morrow, there is one outstanding exception. The descendants of the Prophet and of his relatives (the family of Hāshim) formed and form a special class, held in social reverence, and guarded from contamination and injury. These are the *sayyids* (lords), and genealogical registers of them are carefully preserved. They are of all degrees of wealth and poverty, but are guarded legally from *mésalliances* with persons of ignoble origin or equivocal occupation. Their influence is very great, and in some parts of the Moslem world they have the standing and reverence of saints.

See Von Kremer, *Culturgeschichte des Orients*, based largely on Māwardī's *Aḥkām*, trans. in part by Ostrorog; McG. de Slane's trans. of Ibn Khaldūn, *Prolégomènes*; Lane, *Manners and Customs of the Modern Egyptians*; R. F. Burton, *Pilgrimage to Mekka*; Snouck Hurgronje, *Mekka*; Hughes, *Dictionary of Islam*; Juynboll, *De Mohammedaansche Wet*; Macdonald, *Development of Muslim Theology*, &c. For women in Islam, see HAREM. (D. B. MA.)

MAHOMMEDAN LAW. The legal situation in the Moslem world is of the highest complexity, and can be made intelligible only by tracing its historical development. First came the system (*fiqh*, *sharī'a*) which takes the place in Islam of canon law in Roman Christendom. It begins with Mahomet sitting as judge over the primitive Moslem community at Medina. He was the Prophet of God, and judged, as he ruled, absolutely; any decision of his was valid. But he found it, in general, advisable and fitting to follow the local law or usage of Medina when the new faith did not require a change. It thus came about that his decisions followed, at one time, the usage of the Arab tribes of Medina; at another, the law respected by the Jewish tribes there—a rabbinic development of the law of Moses, deeply affected by Roman law; at another, the more developed commercial law of Mecca, known to his followers who had fled thence with him; or, finally, his own personal judgment, stated it might be as his own sense of right or as the decision of Allah and even incorporated in the Koran. In his use of these he was an eclectic opportunist, and evidently, except as regards such frequently recurring subjects as inheritance, marriage, &c., had no thought of building up a system or code. At his death he left behind only a few specific prescriptions in the Koran and a mass of recorded decisions of cases that had come before him. He had used himself, in our terms, common law, equity, legislation; to guide his followers he left his legislative enactments and the record of his use of common law. Since his death there has been no new legislation in orthodox Islam.

With the death of Mahomet began the development and codification of Moslem law. It was at first entirely practical. Cases had to be decided, and to decide them there was, first, the Koran; secondly, if nothing *ad rem* was found in the Koran, there were the decisions of the Prophet; thirdly, if these failed, there was the common law of Medina; and, fourthly, if it, in turn, failed, the common sense of the judge, or equity A knowledge of the decisions of Mahomet came thus to be of great importance, and records of such decisions were eagerly sought and preserved. But this was simply a part of a much wider movement and tendency. As among primitive peoples in general, custom and usage have always been potent among the Arabs. The ways of the fathers, the old paths, they love to tread. Very early there arose a special reverence for the path and usage (*sunna*) of Mahomet. Whatever he did or said, or left unsaid or undone, and how he did it, has become of the first importance to the pious Moslem, who would act in every way as did the Prophet. There is evidence that for this purpose the immediate companions of Mahomet took notes, either in memory or in writing, of his table talk and wise sayings, just as they took down or learned by heart for their private use the separate fragments of the Koran. His sayings and doings, manners and customs, his answers to questions on religious life and faith, above all his decisions in legal disputes, came to be recorded on odd sheets in private notebooks. This was the beginning of the enormous literature of traditions (*ḥadīth*) in Islam. The collecting and preserving of these, which was at first private, for personal guidance and edification, finally became one of the most powerful weapons of political and theological propaganda, and coloured the whole method and fabric of Moslem thought. All knowledge tended to be expressed in that form, and each element of it to be traced back to, and given in the words of, some master or other through a chain of transmitters. Above all there grew up an enormous mass of evidently forged sayings put into the mouth of Mahomet. At every important political or theological crisis each party would invent and put into circulation a tradition from him, supporting its view. By a study of these flatly opposed "sayings" it is possible to reconstruct the different controversies of Islam in the past, and to discover what each party regarded as the essence of its position.

The first collecting of traditions was for private purposes, and the first publication dealing with them was legal. This was the *Muwaṭṭa'* of Malik ibn Anas (d. 795), a *corpus juris* based partly on traditions, and a protest in its methods against the too speculative character of the books of canon law which preceded it. Thereafter came collections of two different types. The earlier kind was arranged according to the companions of Mahomet, on whose authority the traditions were transmitted; after each companion came the traditions going back to him. The best known example of this kind is the *Musnad* of Ahmad ibn Hanbal. The other kind, called *Muṣannaf* (classified), contains traditions arranged in chapters according to their subject matter. That of Bukhārī is the most famous, and is arranged to give a traditional basis for a complete system of canon law; its rubrics are those of such a system. Another is that of Muslim ibn al-Hajjāj, who paid less attention to legal aspects and more to minute accuracy. There are many others of more or less acceptance and canonicity. Bukhārī's book enjoys a reverence only second to that of the Koran. But in all these publications the primary object was to purify the mass of traditions of forged accretions and to give to the believer a sound basis for his knowledge of the usages of the Prophet, whether for his personal or for public use. These two kinds were a natural development. In the Moslem community there were from the first students of tradition proper whose interest lay in collecting, testing and transmitting, not in combining, systematizing and elucidating; whose preference was to take a single statement from the Prophet and apply it to a case, without reasonings or questionings. And there were students of canon law who were interested rather in the system and results, and who, while they used traditions, used them only to an end and insisted on the free application of speculative principles. The conflict of the future was to be between these traditionalists, on the one hand, and rationalists, on the other; and the result was to be a compromise.

With the wide sweep of Moslem conquest another element came into the development. This was Roman law, which the Moslem jurist found at work in the conquered Roman provinces and in the law courts of which they went to school. It is to be remembered that the Arab armies were not devastating hordes; they recognized the need of law and order wherever they went, and it was the policy of their leaders to take over the administrative systems of the countries which they seized. Even the Arabic legal nomenclature shows evident signs of literal translation from Latin, and many Moslem principles can be traced to the Roman codes. One important development was plainly influenced by the liberty involved in the *Responsa prudentium* of Roman lawyers, and by the broad conception of the law of nature in the Edict of the Praetor. In its earliest stages Moslem law recognized in the judge a liberty of opinion (*ra'y*) which went beyond even that of the *Responsa* and became plain equity, in the English sense, and one school (the Hanifite) established as a basis the right of preference (*istiḥsān*) even when the analogy of the code dictated otherwise; while another (the Malikite) used the term *istiṣlāḥ*, "a seeking of (general) benefit" to the community, in a similar situation. But these developments were bitterly contested, and the liberty of opinion was in the end narrowed down to a principle of analogy (*qiyās*), the nearest approach to which in Western law is legal fiction.

It is necessary now to return to the first successors of Mahomet. "For thirty years after my death," he is said to have declared, "my people will tread in my path (*sunna*); thereafter will come kings and princes." This tradition crystallizes the later feeling of Islam. The first thirty years were a golden age; the centre of the state was the Prophet's own city of Medina; the conditions of the state continued in close conformity to those of his own time. The study of tradition, *i.e.* of his usage, went hand in hand with the study of law. They were vital functions of the state, and it encouraged both.

Then came the great *débâcle*. The *ancien régime*, a semi-monkish, theocratic empire, went down, and the Omayyad dynasty, kings and princes of the old Arab type, took its place (see CALIPHATE, B). The public life of the state was no longer deeply religious; the pious said that it was godless. Under these conditions law was indeed still needed; but it had to be opportunist. Its development went on, but became speculative. The study of tradition was now private, and its students were more and more the personally pious. There were, thus, two results. On the one hand, the framers of systems of canon law—as it now was—no longer lived in contact with reality; hypothetical and ideal structures were reared which could never stand the touch of the practical law-court. And on another, traditions and law, even this hypothetical law, came to take separate roads. The interest of the students of tradition became the gathering of traditions for their own sake, going no farther than a striving to regulate each detail of life by some specific, concrete, prophetic dictum. They had no use for systems that went beyond the mere registering of these dicta. The feeling also became widespread that any system of government which did not simply reproduce the patriarchal form of Medina was of the world and the devil—a thing with which no religious man could have aught to do. At every turn he would have to peril his soul.

Here we must place the transition of this law with which we have hitherto dealt from being the law of the land to being in essence a variety of canon law. It was always broader than any western secular law. It regulated all the aspects of life—duty to God, to one's neighbour, to one's self. It was really a system of duties, ethical, legal, religious. It did not limit itself to defining the forbidden (*ḥarām*); but designated actions also as required (*farḍ*, *wājib*), recommended (*mandūb*, *mustahabb*), indifferent (*jā'iz*, *mubāḥ*), disliked (*makrūh*). It played the part of, or rendered necessary, a religious director quite as much as a lawyer. And for a time at Medina it was really the law of the land. But from the Omayyad period on it has held the position of the canon law of the Roman Church in countries that will not recognize it and yet dare not utterly reject it. It governs, in one or other of its four schools, the private lives of all pious Moslems, it regulates some semi-public relationships—*e.g.* marriage, divorce, inheritance; it compels respect, if not acceptance, from the state; and by its ideal standard the world, filled with righteousness by the Mahdi, will be ruled in the Moslem millennium.

The rise of the Abbasids brought a change, but not a great one. They had promised a return to the old religious attitudes, and the promise was formally kept. But in substance they were as much as the Omayyads, and though the state was outwardly on a pious footing, and the religious sentiment of the people was respected, the old, absolute canon law was not restored. It was made possible for more theologians and lawyers to work with the state, but an irreconcilable party still remained, and the situation was fixed as it is to this day. It is true that the struggle to adapt such a single and detailed system to all the varying conditions, climates and times of the great empire was impossible; but the failure marked the great rent in the supposed unity of Islam between the church and the world, religion and law.

Yet the Abbasids did, in their way, encourage legal studies, and under them processes and results, long pursued in private, became public. Almost within the first century of their dynasty the four legal schools, or rites, were formed and the principles established which survive to this day.

The first school to take definite form was the Hanifite, founded by Abū Ḥanīfa (d. 767), who left behind him a definite system and many enthusiastic pupils. He was a man of means, in touch with commercial, but not with practical legal life, a speculative or philosophical jurist. Being of non-Arab origin, the usage of Medina had small interest for him. He therefore used few traditions, and preferred to go back to the Koran, and extract from it by reasoning the rulings which fitted his ideas. This he called the use of analogy (*qiyās*); but, in his hands, it became practically legal fiction, the application of a law in some sense undreamed by its first imposer. But he had another, and still freer instrument. The effect of differences in local conditions had been early observed and admitted in general terms. Abū Ḥanīfa reduced it to a subjective formula. Under such conditions he claimed the right of preference (*istiḥsān*) of a ruling suited to the local needs, even when the strict analogy indicated otherwise. This met and meets with vehement protest when formally stated, but the usage of Islam has practically accepted it. His system, finally, was not developed through the exigencies of actual cases, but was worked out as a system of casuistry, though in a good sense. He tried, that is, to construct a system of rules to answer any conceivable question. After his death his pupils elaborated it still further, and accepted public office. The 'Abbāsids adopted his school, and threw their influence on its side; its philosophic breadth and casuistic possibilities evidently commended it to them. Later, the Ottoman Turks also adopted it, and it may be said to hold now a leadership among the four legal rites. Its influence has undoubtedly tended to broaden and humanize Moslem law.

Twenty-eight years after Abū Ḥanīfa, Malik ibn Anas, the founder of the Malikite school, died at Medina. In many points his situation was precisely opposite to that of Abū Ḥanīfa, and yet his results were very similar. He was a working jurist, in practical touch with actual life; he was in the centre of the tradition of the usage of the Prophet, in the line, one might say, of the apostolic succession. He, therefore, used traditions much more generally than did Abū Ḥanīfa, and when he, under pressure, took refuge in opinion, he certainly felt that he, under his conditions, had a better right to do so than any outsider. But two of his principles marked a distinct advance and showed that he was no mere traditionalist. For one, he laid down the conception of public advantage (*istiṣlāḥ*); when a rule founded on even a valid analogy would work a general injury it was to be set aside; justice must not be overcome by logic. And, for the other, he laid stress on the conception of the agreement (*ijmā'*), an idea which was to have indefinite importance in the future. When the surviving companions of the Prophet, after his death, agreed upon any point as belonging to their store of tradition and experience, their agreement was accepted as final. In the first instance they agreed that such had been the statement of the Prophet. That easily passed over into an agreement that such was the true Moslem view, and finally into an acceptance of the principle that the Moslem Church, when unanimous, could formulate truth—practically as in the canon of Vincent of Lérins, *Quod semper, quod ubique, quod ab omnibus*. But such a broadly catholic position was still in the future, and for Malik, juristic agreement meant the agreement of Medina, though there are signs that he permitted the same latitude to other places also. It was a way of allowing for local conditions rather than of reaching the voice of the Church. His law book, the *Muwaṭṭa'*, the earliest in our possession written by the founder of a school, has already been mentioned. It is a collection of about seventeen hundred traditions of juristic importance, arranged according to subject, with appended remarks on the usage of Medina and on his own view of each matter.

So far opinion and local usage had fully held their own, and the philosophical jurist had been free to work out his system. The difference between the *istihsān* of Abū Ḥanīfa and the *istiṣlāḥ* of

Malik was not great; students attended the lectures of both and combined their systems. But a reaction now began, and the traditionalist party finally made itself felt. We have the inevitable rivalry between the historical-empirical and the speculative-philosophical schools of jurisprudence, rendered all the more bitter in that the historical lawyers believed, in this case, that they were defending a divine institution. There resulted, first, one of the most important schools, the Shāfi'ite; secondly, an extremely literal school for which ash-Shāfi'ī did not go far enough, and which has now vanished; and thirdly, the Ḥanbalite school, still surviving in small numbers, more moderately traditional than the last.

The school founded by ash-Shāfi'ī (d. 820), a pupil of Malik, came first in order of time. The others were really revolts against the mildness of his compromise. His characteristics were a broad-minded, steady grasp of means and ends, a perception of what could and what could not be done, a willingness to admit all the tried principles in due balance, and, at one point especially, the insight of genius as to the possibilities of these principles. He laid great stress on tradition; a clear, authentic tradition he regarded as no less valid than the Koran itself. If the tradition was chronologically later than a Koranic passage and corrected that passage, he followed the tradition. But in this he was only regulating a fixed tendency. The Koran may be regarded theoretically as the first of all the sources of law and theology; practically its clear statements have been over-ridden in many cases. Most important of all, the principle of agreement (*ijmā'*) came finally with him to its full rights. The agreement of the Moslem peoples was to be the voice of God. "My people," said a tradition from Mahomet, "will never agree in an error." And so, over traditions and over the Koran itself, the agreement tacitly or explicitly ruled and rules. It stamps as authoritative that which the other principles lay down. At the head of each section of a Shāfi'ite law book we read, "The basis of this, before the agreement, is such and such." But with the aid of a principle of this breadth it was easy to reject the opinion which was so objectionable to the traditionalist party. In its place he took analogy (*qiyās*), which, discreetly used, could serve almost the same purpose. The Koranic passage or the tradition with which an analogy was suggested should, he taught, be examined to see if there was a reason clearly stated for the command. If so, that reason would give a basis for the analogy. Analogy based on the mechanical or external could not hold.

The four bases thus laid down by ash-Shāfi'ī—Koran; prophetic usage as expressed in traditions; analogy; agreement—have come to be accepted by all existing schools. This applies to all spheres of life, ethical, social, theological, legal, and it should never be forgotten that the Koran is only one of the sources for Moslem faith and conduct.

Few words are needed for the other, reactionary schools. One, now long extinct, was founded by a certain Dā'ūd uẓ-Ẓāhiri, "David the Literalist," born three or four years before the death of ash-Shāfi'ī, and so called because he insisted upon an absolutely literal interpretation of his texts—Koran or tradition—without account of context or metaphor. In consequence he had to reject analogy, and limited agreement to that of the companions of Mahomet; the Church of Islam was to have no constructive authority. In one point he showed great sanity of judgment, namely in his rejection of the principle *jurare in verba magistri*, otherwise regnant in Islam. His school had long and interesting consequences, mostly theological, but is now extinct, and never took rank with the others. The Moslem world found his positions too impossible, and now no one swears to his words. The other, the Ḥanbalite school, was founded by the scholars of Ahmad ibn Ḥanbal after his death in 885. He himself would never have revolted against his master, ash-Shāfi'ī, but it was soon felt that his system, so far as he had any, was in essential opposition. He had been no lawyer, but a theologian and a collector and student of traditions. All his life had been a protest against speculation in divine things. Where the Koran and traditions were silent, he, too, had been silent. For this agnostic principle he had witnessed and suffered, and his standing with the people was that of a saint. Naturally, then, the last still existent school of traditionalist protest was launched in his name. It minimizes agreement and analogy, is literal in its interpretations, and is now by far the smallest of the four surviving schools. Its external history is that of a testifying and violent minority.

Other men, such as Ṭabarī, the historian and commentator, have had dreams that they, too, might join the Four Imāms (see IMĀM) as founders of legal rites, but none has succeeded. The Four remain the ultimate exponents of this canon law, and under the banner of one or other of them every Moslem must range himself. As there is a principle of unity in Islam, expressed in the alleged prophetic saying, "My people will never agree in an error," so there is a principle of variety, also expressed in an alleged prophetic saying, "The disagreement of my people is a mercy from God." The four rites may differ upon many points, yet the adherents of one never dream of regarding the adherents of the others as outside the Church of Islam; they are not "dissenters" in the English sense. God is merciful to his creatures, and gives them so much liberty of choice. Yet in practice this liberty is not great. The principle of swearing to the words of the master is a dead hand laid upon Islam. A man's legal rite is generally settled by the place and other conditions of his birth, and after he has once accepted a rite, he must, if good and pious, follow it in all its details. Only the avowed sceptic or the recognized eccentric can be an eclectic.

The geographical distribution of the rites is roughly as follows: Moslems in Central Asia and northern India and the Turks everywhere are Hanifites; in Lower Egypt, Syria, southern India and the Malay Archipelago they are Shāfi'ites; in Upper Egypt and in north Africa, west of Egypt, they are Malikites; only the Wahhābis (*q.v.*) in central Arabia are Ḥanbalites. But the will of the sovereign has also had a powerful influence and has frequently dictated the legal, as well as the theological, affiliations of his subjects. The Turks, for example, have thrown their weight almost everywhere on the Hanifite side. Their policy is to appoint only Hanifite judges (see CADI), although for private and personal questions they appoint and pay Muftis (*q.v.*) of the other rites. In other cases, with a population of mixed legal adherence, the government has been known to appoint judges of different rites.

The Shī'ite canon law is dealt with separately, but some mention of two outstanding sects is here in place. The Ibādites (see MAHOMMEDAN RELIGION: *Sects*) have a system of canon law which in essentials is of older codification than that of any of the orthodox schools, going back to Abdallah ibn Ibād himself, of the first century of the Hijra (Hejira). Its basis is above all the Koran, then a sparing use of traditions, natural to their early origin, and finally the agreement of their own learned men, again natural to an extreme dissenting sect, and it still rules the Ibādite communities at Oman, Zanzibar and the Mzab in southern Algeria. At all these places they, the last descendants of the Khārijites, hold severely apart, while the other Moslems shrink from them as heretics of the worst. Not nearly so far from ordinary Islam, but still of an extreme self-conscious Puritanism are the Wahhābis. They are really Ḥanbalites, but apply the rules of that school with uncompromising, reforming energy. The doctrine of the agreement of the Church of Islam they reject; only that of the immediate companions of Mahomet is valid. The people of Mahomet can err and has erred; each man must, on his own responsibility, draw his doctrine from the Koran and the traditions. Here they follow the Ẓāhirites.

All these schools of law administer a scheme of duties, which, as has already been remarked, comes nearest to the canon law of the Roman Church, and which for centuries has had only a partial connexion with the real legal systems of the Moslem peoples. Among the Wahhābis and Ibādites alone is it the whole of law. Elsewhere, since the Omayyad period, its courts have been in great part pushed aside by others, and its scheme has come to be regarded as an expression of impossible theory, to be realized at best with the coming of the millennium. The causes and methods of this change call now for detailed notice.

As Islam spread beyond the desert and the conditions in which the life of Mahomet and his companions had been cast, it came to regions, climates, customs, where the Arabian usages no longer held. Not only were the prescripts of Medina ill adapted to the new conditions; the new people had legal usages of their own to which they clung and which nothing could make them abandon. It was rather the Moslem leaders who were compelled to abandon their ideas and for the sake of the spread of Islam to accept and incorporate much that was diametrically opposed to the original legislation either of the Koran or of Mahomet's recorded decisons. As in religion the faiths of the conquered peoples were thinly veneered with Moslem phrases, so in law there grew up a customary code (*'ādāt*) for each country, differing from every other, which often completely obscured and annulled the prescriptions of the canon law. The one was an ideal system, studied and praised by the pious learned; the other was the actual working of law in the courts.

But besides the obstinate adherence of various peoples to their old paths, the will of individual rulers was a determining factor. When these ceased to be saints and students of divine things, and came to be worldly statesmen and opportunists, followers of their own objects and pleasures, no system could hold which set a limit to their authority. The Oriental ruler must rule and judge on his own initiative, and the schools of canon law tended to reduce everything to an academic fixedness. There thus arose a new and specific statute law, emanating from the sovereign. At first he judged in the gate as seemed good in his eyes and as was his right and duty (cf. "court of oppressions"; see MAHOMMEDAN INSTITUTIONS); later, his will was codified as in the Turkish statute law (*qawānīn*) derived from various European codes. Thus there has grown up in almost every Moslem country at least two systems of courts, the one administering this canon law, and taking cognisance of private and family affairs, such as marriage, divorce, inheritance, its officials also giving rulings on purely personal religious questions, such as details of the ritual law, the law of oaths and vows, &c.; the other, the true law courts of the land, administering codes based on local custom and the decrees of the local rulers.

A rift almost as important entered the legal life of the Moslem lands on another side. Non-Moslem communities, settled in Moslem territory, have been uniformly permitted to administer and judge themselves according to their own customs and laws. Save when they come into direct contact and conflict with Moslems, they are left to themselves with a contemptuous tolerance. The origin of this attitude in Islam appears to be threefold. (i) The Islam of theory cannot conceive of a mixed state; it takes account, only, of a state containing none but Moslems, and its ideal is that the whole world will, in the end, form such a state. In practice, then, Moslems try to shut their eyes to the existence of non-Moslems in their midst and make no provision for them until compelled. That a non-Moslem should have the same civil position as a Moslem is unthinkable. (ii) This, of course, produces an attitude of extreme contempt. The only citizens are Moslems and all others are to be looked down upon and left to themselves. What they do or think among themselves does not matter; they are outside the ring-fence of Islam. (iii) A different, but equally important, cause is the Moslem indolence. When the Arabs conquered, they knew that they must administer the conquered lands, and they, very wisely, sought help from the machinery which they found in operation. But besides the ordinary organization of the state, they found also various ecclesiastical organizations, Christian and Jewish, and to these they gave over the administration of the non-Moslem sections of the community, making their rabbis and bishops their responsible heads and the links of contact with the Moslem rulers. They, unquestionably, found the same method in use by the Byzantine government; but in Moslem hands it went so far as to make a number of little states (*millet*, *milal*) within the state and effectually to preclude the possibility of ever welding all the inhabitants of the land into one corporate life.

But this indolence, when applied to resident aliens, had consequences still more serious, because external as well as internal. Following the same method of leaving the unbeliever to settle his affairs for himself, the European merchant, living and trading in the East, was put first by usage and finally by treaty under the jurisdiction and control of his own consul. Thus there grew up the extra-territorial law of the capitulations and conventions, by which the sanctity of the person and household of an ambassador is extended to every European. And this in turn, has reacted on the status of the non-Moslem subject races, and has come to be the indirect but chief support on which they lean. Through it, an element has developed which makes it practically impossible for a Moslem state to introduce legal changes even remotely affecting its non-Moslem population, alien or subject, without the consent of the European embassies. Any change may be upset by their refusal to accept it as incompatible with the capitulations and conventions. The embassies have thus, as interpreters of a part, at least, of the constitution, come to hold a position remarkably, if absurdly, like that of the Supreme Court of the United States (see Young, *Corps de droit Ottoman*, *passim*).

There may be said, then, in short, to be three elements in the legal life of a Moslem state: the sacred and fixed canon law of Islam; the civil law, based on the usages of the different peoples, Moslem and non-Moslem, and on statutes going back to the will of rulers; the international law of the capitulations, with a contractual sanction of its own. The hope for the future in Islam, there can be little doubt, lies in the principle of the agreement of the Moslem people, with its conception of catholic unity, and its ability, through that unity, to make and abrogate laws. As the Moslem peoples advance, their law can, thus, advance with them, and the grasp of the dead hand of the canon law be gradually and legally released.

See I. Goldziher, *Muhammedanische Studien*, I. and II. (Halle a.S., 1889–1890); *Zahiriten* (Leipzig, 1884); E. Sachau, *Zur ältesten Geschichte des muhammedanischen Rechts* (Vienna Akad., 1870) and *Muhammedanisches Recht* (Stuttgart and Berlin, 1897); Snouck Hurgronje, review of preceding in *Z.D.M.G.* liii. 125 seq. and "Le droit musulman" (*Rev. de l'hist. des religions*, xxxvii. 1 seq. and 174 seq.); Juynboll, *Handleiding tot de Kennis von de mohammedaansche Wet* (Leiden, 1903); Von Kremer, *Culturgeschichte des Orients—unter den Chalifen*, i. 470 seq. (Vienna, 1875–1877); Hughes, *Dictionary of Islam*, pp. 285 seq. (London, 1896); D. B. Macdonald, *Development of Muslim Theology*, &c., pp. 65 seq. (New York, 1903); Bukhari, *Les Traditions islamiques traduites . . . par O. Houdas et W. Marcel* (Paris, 1906); N. B. E. Bailie, *Digest of Moohummadan Law* (2 vols., London, 1875–1887). A good bibliography appeared in the *Bulletin of the New York Public Library* for January 1907. (D. B. Ma.)

MAHOMMEDAN RELIGION. The Mahommedan religion is generally known as *Islam*—the name given to it by Mahomet himself—and meaning the resigning or submitting oneself to God. The participle of the same Arabic verb, *Muslim* (in English usually spelt Moslem), is used for one who professes this religion. The expression "Mahommedan religion" has arisen in the West probably from analogy with "Christian religion," but is not recognized as a proper one by Moslem writers. Islam claims to be a divinely revealed religion given to the world by Mahomet, who was the last of a succession of inspired prophets. Its *doctrine* and *practices* are to be found in (1) the Book of God—the Koran—which was sent down from the highest heaven to Gabriel in the lowest, who in turn revealed it in sections to Mahomet; (2) the collections of tradition (*ḥadith*) containing the sayings and manner of life (*sunna*) of the Prophet; (3) the use of analogy (*qiyās*) as applied to (1) and (2); and (4) the universal consent (*ijmā'*) of the believers. The *worship* of Islam consists in (1) the recital of the creed; (2) the recital of the ordained prayers; (3) the fast during the month of Ramadhān; (4) almsgiving; (5) the *ḥajj*, the pilgrimage to Mecca. The *theology* of Islam finds its first public expression among the orthodox in the teaching of al-Ash'arī (d. after 932), but had its real beginning among the sects that arose soon after the death of Mahomet.

Islam is the latest of the so-called world-religions, and as several of the others were practised in Arabia at the time of Mahomet, and the Prophet undoubtedly borrowed some of his doctrines and some of his practices from these, it is necessary to enumerate them and to indicate the extent to which they prevailed in the Arabian world.

Relations with Other Religions.—The religions practised in Arabia at the time of Mahomet were heathenism, Judaism, Christianity, and Zoroastrianism.

1. *Heathenism* was the religion of the majority of the Arabs. In the cities of south Arabia it was a survival from the forms represented in the Sabaean, Minaean and Himyaritic inscriptions of south Arabia (see Arabia: *Antiquities*). The more popular form current among the nomads is known very imperfectly from the remains of pre-Islamic poetry and such works as the *Kitāb ul-Aṣnām* contained in Yaqūt's geography, from Shahrastānī's work on the sects, and from the few references in classical writers. From these we have mostly names of local deities (cf. J. Wellhausen, *Reste arabischen Heidentums*, 2nd ed., Berlin, 1897) and ancient religious customs, which remained in part after the introduction of Islam (cf. W. Robertson Smith, *The Religion of the Semites*, Edinburgh, 1889, and *Kinship and Marriage in Early Arabia*, Cambridge, 1885). From these sources we learn that Arabian religion was a nature-worship associated with fetishism. Sun, moon and stars were worshipped, some tribes being devoted to the worship of special constellations. Certain stones, wells and trees were regarded as sacred and as containing a deity. Many (perhaps most) tribes had their own idols. Hobal was the chief god of the Ka'ba in Mecca with its sacred stone, but round him were grouped a number of other tribal idols. It was against this association (*shirk*) of gods that Mahomet inveighed in his attempt to unify the religion and polity of the Arabs. But there were features in this heathenism favourable to unity, and these Mahomet either simply took over into Islam or adapted for his purpose. The popularity of the Ka'ba in Mecca as a place of resort for worshippers from all parts of Arabia led Mahomet not only to institute the *ḥajj* as a duty, but also to take over the customs connected with the heathen worship of these visits, and later to make Mecca the *qibla*, *i.e.* the place to which his followers turned when they prayed. The name of Allah, who seems to have been the god of the Koreish (cf. D. S. Margoliouth, *Mohammed*, p. 19, London, 1905), was accepted by Mahomet as the name of the one God, though he abandoned the corresponding female deity Al-lāt.

2. *Judaism* had long been known in Arabia at the time of the Prophet. Whether Hebrews settled in Arabia as early as the time of David (cf. R. Dozy, *Die Israeliten zu Mecca*, Leipzig, 1864), or not, is of little importance here as Judaism cannot be said to have existed until the end of the 5th century B.C. The Seleucid persecutions and the political troubles that ended with the fall of Jerusalem (A.D. 70) probably sent many Jews to Arabia. In the 5th and 6th centuries the history of south Arabia and of Nejrān is largely that of the strife between Jews and Christians. In the north-west the Jews possessed Temā, Khaibar, Yathrib (Medina), Fadak, and other smaller settlements. In these they lived as self-contained communities, not seeking to proselytize but working at their trades, especially concerned with money and jewelry. Mahomet seems to have expected their help in his proclamation of monotheism, and his first *qibla* was Jerusalem. It was only when they refused to accept him as prophet that he turned in anger against them. They had, however, supplied him with much material from the Old Testament, and the stories of creation, the patriarchs and early kings and prophets occur continually in the Koran, told evidently as they were recited by the common people and with many mistakes caused by his own misunderstanding.

3. *Christianity*, though later than Judaism, had a sure footing in Arabia. It had suffered persecution in Nejrān and had been supported in the south by the Abyssinian invasions. The kingdom of Hira was largely Christian; the same is true of the north Arabian tribes of Bakr and Taghlib, and east of the Jordan and on the Syrian boundary as well as in Yemāma Christianity had made progress. Pre-Islamic literature contains many allusions to the teaching and practices of Christianity. Of the time of its introduction little is known; little also of the form in which it was taught, save that it came from the Eastern Church and probably to a large extent through Monophysite and Nestorian sects. Tradition says that Mahomet heard Christian preaching at the fair of Ukaz, and he probably heard more when he conducted the caravans of Khadija. Gospel stories derived apparently from uncanonical works, such as the Gospel of the Nativity, occur in the Koran. The asceticism of the monks attracted his admiration. A mistaken notion of the Trinity was sharply attacked by him. It is curious that his followers in the earliest times were called by the heathen Arabs, Sabians (*q.v.*), this being the name of a semi-Christian sect. In the time of the Omayyads Christianity led to some of the earliest theological sects of Islam (see below).

4. *Zoroastrianism* was known to the Arab tribes in the north-east, but does not seem to have exercised any influence in Mecca or Medina except indirectly through Judaism in its angelology. As soon, however, as the armies of Islam conquered Mesopotamia it began to penetrate the thought and practices of Islam (see below).

Sources of Authority.—Islam, as we have said, is founded on: (1) the Koran; (2) the tradition or rather the *sunna* (manner of life of Mahomet) contained in the tradition (*Ḥadīth*); (3) *ijmā'*; the universal agreement; (4) *qiyās* (analogy).

1. The *Koran*[1] (properly *Qur'ān* from *qara'a* to collect, or to read, recite) is the copy of an uncreated original preserved by God (see below), sent down from the seventh heaven to Gabriel in the first heaven, and revealed to Mahomet in sections as occasion required. These revelations were recited by the Prophet and in many cases written down at once, though from ii. 100 it would seem that this was not always the case. God is the speaker throughout the revelations. It seems probable that the whole Koran was written in Mahomet's lifetime, but not brought together as a whole or arranged in order.

As it exists now the Koran consists of 114 chapters called *suras* (from *sura*, a row of bricks in a wall, a degree or step). The first is the *Fātiḥa* (opening), which occupies the place of the Lord's Prayer in Christianity. The others are arranged generally in order of length, the longest coming first, the shortest (often the earliest in date) coming at the end. Certain groups, however, indicated by initial unvowelled letters, seem to have been kept together from the time of the Prophet. At the head of each *sura* is a title, the place of its origin (Mecca or Medina) and the number of its verses (*āyāt*) together with the formula, "In the name of God the Merciful, the Compassionate" (except in *sura* 9). For liturgical purposes the whole book is divided into 60 sections (*aḥzāb*) or into 30 divisions (*ajzā*), each subdivided into a number of prostrations (*ruk'a* or *sajda*). The origin of the collected and written Koran is due to Omar, who in the caliphate of Abū Bekr pointed out that many possessors of *suras* were being slain in the battles of Islam and their property lost, that there was a danger in this way that much of the revelation might disappear, and that men were uncertain what was to be accepted as genuine revelation. Accordingly Zaid ibn Thābit who had been secretary to Mahomet, was commissioned to collect all he could find of the revelation. His work seems to have been simply that of a collector. He seems to have done his work thoroughly and made a copy of the whole for Abū Bekr. The collection was thus chiefly a private matter, and this copy passed after Abū Bekr's death into the hands of Omar, and after his death to Ḥafṣa, daughter of Omar, a widow of Mahomet. In the caliphate of Othman it was discovered that there were serious differences between the readings of the Koran possessed by the Syrian troops and those of the Eastern soldiers, and Othman was urged to have a copy prepared which should be authoritative for the Moslem world. He appointed Zaid ibn Thābit and three members of the tribe of Koreish (Quraish) to do the work. Each of these made a copy of Abū Bekr's collection, carefully preserving Koreishite forms of words. How far the text was amended by the help of other copies is doubtful; in any case the mode of procedure was undoubtedly very conservative. The four similar manuscripts were sent, one each to Medina, Cufa (Kufa), Basra and Damascus, and an order was issued that all differing copies should be destroyed. In spite of the personal unpopularity of Othman this recension was adopted by the Moslem world and remains the only standard text. A few variant readings and differences of order of the *suras* in the collections of Ubay ibn Ka'b and of Ibn Mas'ūd were, however, known to later commentators. The only variants after the time of Othman were owing to different possible ways of pronouncing the consonantal text. These are usually of little importance for the meaning. As the text is now always vowelled, variations are found in the vowels of different copies, and the opinions of seven leading "readers" are regarded as worthy of respect by commentators (see Th. Nöldeke, *Geschichte des Qorāns*, pp. 279 seq., Göttingen, 1860). Various characteristics enable one to establish with more or less certainty the relative chronological order of the *suras* in the Koran, at any rate so far as to place them in the first or second Meccan period or that of Medina. The form of the sentences is a guide, for the earliest parts are usually written in the *saj'* form (see ARABIA: *Literature*). The expressions used also help; thus the "O ye people" of the Meccan period is replaced in the Medina *suras* by "O ye who believe." The oaths in the first Meccan period are longer, in the second shorter, and are absent in the Medinan. In the earliest period the style is more elevated and passionate. Occasionally the time of origin is determined by reference to historical events. In accordance with such principles of criticism two leading scholars, Nöldeke (*loc. cit.*) and H. Grimme (in his *Mohammed Zweiter Teil. Einleitung in den Koran. System der koranischen Theologie*, Münster, 1895), have arranged the *suras* as follows:—

Order of Suras in Koran.

NÖLDEKE.	
Mecca.	
1st to 5th yr. (*a*).	96. 74. 111. 106. 108. 104. 107. 102. 105. 92. 90. 94. 93. 97. 86. 91. 80. 68. 87. 95. 103. 85. 73. 101. 99. 82. 81. 53. 84. 100. 79. 77. 78. 88. 89. 75. 83. 69. 51. 52. 56. 70. 55. 112. 109. 113. 114. 1.
5th and 6th yr. (*b*).	54. 37. 71. 76. 44. 50. 20. 26. 15. 19. 38. 36. 43. 72. 67. 23. 21. 25. 17. 27. 18.
7th yr. to Flight (*c*).	32. 41. 45. 16. 30. 11. 14. 12. 40. 28. 39. 29. 31. 42. 10. 34. 35. 7. 46. 6. 13.
Medina.	2. 98. 64. 62. 8. 47. 3. 61. 57. 4. 65. 59. 33. 63. 24. 58. 22. 48. 66. 60. 110. 49. 9. 5.
GRIMME.	
Mecca. (1).	[1] In old *saj'* form: 111. 107. 106. 105. 104. $\underline{103}$. 102. 101. 100. 99. 108. 96. 95. 94. 93. 92. 91. 90. 89. 88. $\underline{87}$. 86. $\underline{85}$. $\underline{84}$. 83. 82. $\underline{81}$. 80. 79. $\underline{78}$. 77. $\underline{76}$. 75. $\underline{74}$. $\underline{73}$. 70. 69. 68. 114. 113. 56. 55. 54. $\underline{53}$. 52. 51. 50. 15. $\underline{22}$. $\underline{14}$.
(2).	In loosened *saj'* form: 46. 72. 45. 44. 41. 97. 40. 39. 38. 37. 36. 35. 34. 32. 31. 67. 30. $\underline{29}$. 28. 27. 26. 71. 25. 20. 23. 43. 21. 19. 1. 42. 18. 17. $\underline{16}$. 13. 12. 11. 10. $\underline{7}$. 6. 98. (112. 109).
Medina.	
From the Flight to Badr.	$\underline{2}$. 62. $5_{16-88 \cdot 100-120}$. 47 and some interpolations in Meccan *suras*.
From Badr to Ohod	8. 24. 59.
From Ohod to capture of Mecca.	3. 29_{1-12}. 4. 57. 64. 61. 60. 58. 65. 33. 63. 49. 110. 48. 5_{1-14}. 66. 9_{1-24}.
After capture of Mecca.	9_{25-130}.

Theology.

On the supposition that the arrangements given above are at any rate approximately correct, it is possible to trace a certain development in the teaching of the Koran on some of the chief dogmas. It must, however, be borne in mind that orthodox Islam recognizes the Koran as the work not of Mahomet but of God. Yet Moslem theologians recognize that some revelations are inconsistent with others, and so have developed the doctrine of *nāsikh* and *mansūkh* ("abrogating" and "abrogated"), whereby it is taught that in certain definite cases a later revelation supersedes an earlier. A critical study of the Koran shows in the earlier revelations the marks of a reflective mind trained under the influence of Arabian education and stirred by an acquaintance (somewhat imperfect) with Judaism and Christianity. The later revelations seem to be influenced by the now dominant position of the Prophet and a desire after the capture of Mecca to incorporate such heathen religious ceremonies as are national. God is one and universal from the beginning. His unity is emphasized as against the mistaken conception of the Christian Trinity. At first his might is taught by the name *Rabb* (Lord) which is generally used with an attribute as "the highest Lord," "Lord of the worlds," "Lord of men," "Lord of heaven and earth," "Lord of the East and West," or "our Lord." Then he is identified with the god Allah (see above) and the first part of the later Moslem creed is announced—*la ilaha illa-llaha*, "there is no god but Allah." But every act of creation is a proof not only of God's power but also of his beneficence (xiv. 37), and so he becomes known as *ar-Raḥmān*, "the Compassionate." The attributes of God may all be arranged in the three classes of his power, unity and goodness. They are expressed by the ninety-nine "beautiful names" applied to him in the Koran (see E. H. Palmer, *The Quran* in "Sacred Books of the East," vol. vi., Introd. pp. 67–68, Oxford, 1880). In the Medina period of Mahomet's life the nature of God is not so clear, and the description of it varies according to the moods of the Prophet.

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[1] See also KORAN.

[1] Underlined = with interpolations.

Beside God are two other uncreated beings: (1) the original of the Koran, the "mother of the Book" (xliii. 3) on a "preserved tablet" (*lauḥ maḥfūẓ*) (lxxxv. 22), in accordance with which God acts, and (2) the throne (*kursī*) (ii. 256). **Spirits.** When the heavens are created, God sits on his throne in the seventh heaven; around him are angels, pure, sexless beings, some of whom bear the throne, while some are engaged in praising him continually. They are also his messengers and are sent to fight with the believers against the heathen. Some are the guardian angels of men, others are the watchmen of hell. Mediate beings between God and man are the "word" (*amr*) and from it the "spirit" (*rūḥ*) or "holy spirit" (*rūḥ ul-qudus*). Another manifestation of God to the believers only is the "glory" (*sakina*).

God created the world in six days according to the plan of the Book. Each new life was created by God's breathing into it a soul. **Cosmology.** The duality of soul and body is maintained. In each man is a good and a bad impulse. The bad impulse which was latent in Adam was roused to action by Satan (*Iblīs*). Adam by his fall lost the grace of God, which was restored to him solely by the gracious choice of God. Between men and angels in their nature are the genii (*jinn*) male and female, inhabitants of desert places, created from smokeless fire. They had been accustomed to spy round heaven, but in Mahomet's time could learn no more of its secrets. Some of them were converted by the Prophet's teaching. Lowest of creation in his estate is Satan (*Shaiṭān*), who was an angel but was expelled from heaven because he refused to worship Adam at his Lord's command. God has revealed himself to man by (1) writing (*kitāb*), and (2) prophets. As he had given to the Jews the Law (*Taurāt*) and to the Christians the Gospel (*Injīl*) so he revealed to Mahomet the Koran (Qur'ān, known also by other names, *e.g. al-Furqān*, *al-Tafṣīl*, &c.), each single revelation being called an *aya*. With his revelation God has also sent an apostle or prophet to each people. Several of these are mentioned in the Koran, Moses the prophet of the Jews, Jesus (*Īsā*) that of the Christians. Mahomet is not only the apostle of the Moslems but the "seal of the prophets," *i.e.* the final member of the class. His mission at first was to warn men of imminent judgment. Later he became more of a teacher. At first he seems to have relied for the salvation of men on his natural faculties, but later announced the doctrine of God's election. **Ethics.** The ethics of the Koran are based on belief (*imān*) and good works, the latter alone occurring in the early Meccan *suras*. Fear of the judgment of God was a motive of action; this is followed by repentance and turning to God. A complete surrender to God's will (*islām*) is the necessary condition of religious life and is expressed in the phrase so common in everyday speech among the Moslems—*inshallah*, "if God will." God has full power to overlook evil deeds if he will. Unbelievers can acquire no merit, however moral their actions. A short account of the chief ethical requirements of the Koran is given in xvii. 23–40:—

> "Put not God with other gods, or thou wilt sit despised and forsaken. Thy Lord has decreed that ye shall not serve other than Him; and kindness to one's parents, whether one or both of them reach old age with thee, and say not to them, 'Fie,' and do not grumble at them, but speak to them a generous speech. And lower to them the wing of humility out of compassion, and say, 'O Lord! have compassion on them as they brought me up when I was little!' Your Lord knows best what is in your souls if ye be righteous, and, verily, He is forgiving unto those who come back penitent.
>
> "And give thy kinsman his due and the poor and the son of the road; and waste not wastefully, for the wasteful were ever the devil's brothers, and the devil is ever ungrateful to his Lord.
>
> "But if thou dost turn away from them to seek after mercy from thy Lord, which thou hopest for, then speak to them an easy speech.
>
> "Make not thy hand fettered to thy neck, nor yet spread it out quite open, lest thou shouldest have to sit down blamed and straightened in means. Verily, thy Lord spreads out provision to whomsoever He will or He doles it out. Verily, He is ever, well aware of and sees His servants.
>
> "And slay not your children for fear of poverty; we will provide for them; beware! for to slay them is ever a great sin.
>
> "And draw not near to fornication; verily, it is ever an abomination, and evil is the way thereof.
>
> "And slay not the soul that God has forbidden you, except for just cause; for he who is slain unjustly we have given his next of kin authority; yet let him not exceed in slaying; verily, he is ever helped.
>
> "And draw not near to the wealth of the orphan, save to improve it, until he reaches the age of puberty, and fulfil your compacts; verily, a compact is ever enquired of.
>
> "And give full measure when ye measure out, and weigh with a right balance; that is better and a fairer determination.
>
> "And do not pursue that of which thou hast no knowledge; verily, the hearing, the sight and the heart, all of these shall be enquired of.
>
> "And walk not on the earth proudly; verily, thou canst not cleave the earth, and thou shalt not reach the mountains in height.
>
> "All this is ever evil in the sight of your Lord and abhorred."
>
> (E. H. Palmer's translation.)

The eschatology of the Koran is especially prominent in its earlier parts. The resurrection, last judgment, paradise and hell are all described. **Eschatology.** At death the body again becomes earth, while the soul sinks into a state of sleep or unconsciousness. At a time decreed, known as "the hour" (*as-Sa'a*), "the day of resurrection" (*yaum ul-qiyyāma*), "day of judgment" (*yaum-ud-dīn*), &c., an angel will call or will sound a trumpet, the earth will be broken up, and the soul will rejoin the body. God will appear on his throne with angels. The great book will be opened, and a list of his deeds will be given to every man, to the good in his right hand, to the evil in his left (*sura* 69). A balance will be used to weigh the deeds. The *jinn* will testify against the idolaters. The righteous will then obtain eternal peace and joy in the garden (*al-janna*) and the wicked will be cast into the fiery ditch (*Jahannam*), where pains of body and of soul are united.

2. The *Tradition.*—The revelation of God is twofold—in a writing and by a prophet. The former was contained in the Koran, the latter was known from the actions of Mahomet in the different circumstances of life. The manner of life of the Prophet (*sunna*) was contained in the tradition (*al-ḥadīth*). The information required was at first naturally obtained by word of mouth from the companions and helpers of Mahomet. These in turn bequeathed their information to their younger companions, who quoted traditions and gave decisions in their names.

For long these traditions circulated orally, the authority of each depending on the person who first gave it and the reliability of the chain (*isnād*) of men who had passed it on from him. At first this tradition was regarded as explanatory of, or at the most supplementary to, the teaching of the Koran. Early Moslem teachers pointed to the Jews as having two law-books—the *Taurāt* and the *Mishna*—while Islam had only one—the Koran. But opinion changed, the value of tradition as an independent revelation came to be more highly esteemed until at last it was seriously discussed whether a tradition might not abrogate a passage of the Koran with which it was at variance. The writing of traditions was at first strongly discouraged, and for more than a century the stories of the Prophet's conduct passed from mouth to mouth. Had all the narrators been pious men, this might have been tolerable, but this was not the case. The Omayyad dynasty was not a pious one. Men who were not religious but wished to appear so invented traditions to justify their manner of life. The sectarians did not hesitate to adopt the same means of spreading their own teaching. Many Moslem writers testify to the fact that forged traditions were circulated, and that religious opinion was confused thereby. The need for some sort of authoritative collection seems to have been felt by the one pious Omayyad caliph, Omar II. (717–720), who is said to have ordered Ibn Shihāb uz-Zuhrī to make such a collection. Of this work, if it was carried out, we know nothing further. It was, however, by a man born during this reign that the first systematic collection of traditions was made—the *Muwatta'* of Mālik ibn Anas (*q.v.*). Yet this work is not a book of tradition in the religious sense. It is really a *corpus juris* and not a complete one. The object of Mālik was simply to record every tradition that had been used to give effect to a legal decision. The work of sifting the vast mass of traditions and arranging them according to their relation to the different parts of religious life and practice was first undertaken in the 3rd century of Islam (A.D. 815–912). In this century all the six collections afterwards regarded as canonical by the Sunnites (orthodox) were made. By this time an immense number of traditions was in circulation. Bukhārī in the course of sixteen years' journeying through Moslem lands collected 600,000, and of these included 7275 (or, allowing for repetitions, 4000) in his work. The six collections of tradition received by the Sunnites as authoritative are: (i) The *Kitāb ul-jāmi' uṣ-Ṣaḥīḥ* of Bukhārī (*q.v.*) (810–870). This is the most respected throughout the Moslem world and most carefully compiled (ed. L. Krehl and T. W. Juynboll, Leiden, 1862—and frequently in the East; also with many commentaries. French translation by O. Houdas and W. Marcais, Paris, 1903 sqq.). (ii) The *Ṣaḥīḥ* of Muslim (817–875) with an introduction on the science of tradition (ed. Calcutta, 1849, &c.). (iii) The *Kitāb uṣ-Sunan* of Abū Dā'ūd (817–888) (ed. Cairo, 1863, Lucknow, 1888, Delhi, 1890). (iv) The *Jāmi' uṣ-Ṣaḥīḥ* of Tirmidhī (*q.v.*). (v) The *Kitāb uṣ-Sunan* of Nasā' ī (830–915) (ed. Cairo, 1894). (vi) The *Kitāb uṣ-Sunan* of Ibn Māja (824–866) (ed. Delhi, 1865 and 1889). The last four are not held in the same repute as the first two.

3. *Ijmā'* is the universal consent which is held to justify practices or beliefs, although they are not warranted by the Koran or tradition, and may be inconsistent with the apparent teaching of one or both of these. These beliefs and practices, which had often come from the pre-Islamic customs of those who had become believers, seem to have escaped notice until the Abbasid period. They were too deeply rooted in the lives of men to be abolished. It became necessary either to find a tradition to abrogate the earlier forbidding one, or to acknowledge that *ijmā'* is higher than the tradition. The former expedient was resorted to by some later theologians (*e.g.* Nawāwī) by a fiction that such a tradition existed though it was not found now in writing. But in earlier times some (as Ibn Qutaiba) had adopted the latter alternative, saying that the truth can be derived much earlier from the *ijmā'* than from the tradition, because it is not open to the same chances of corruption in its transmission as the latter. Tradition itself was found to confirm this view, for the Prophet is related to have said, "My people does not agree to an error."

But *ijmā'* itself has been used in different senses: (i) The *ijmā'* of Medina was used to indicate the authority coming from the practices of the people of Medina (see below). (ii) The *ijmā'* of the whole community of Moslems is that most commonly recognized. It was used to support fealty to the Abbasid dynasty. By it the six books of tradition mentioned above are recognized as authoritative, and it is the justification of the conception of Mahomet as superhuman. (iii) Some of the more thoughtful theologians recognize only the *ijmā'* of the doctors or the teachers of Islam (the *mujtahidūn*), these being restricted by the orthodox to the first few generations after Mahomet, while the Shi'ites allow the existence of such up to the present time.

4. The fourth basis of Islam is *qiyās*, *i.e.* analogy. It is that process by which a belief or practice is justified on the ground of something similar but not identical in the Koran, the tradition or *ijmā'*. Originally it seems to have been instituted as a check upon the use of private opinion (*ra'y*) in the teaching of doctrine. The extent to which it may be used is a subject of much discussion among theologians. Some would apply it only to a "material similarity," others to similarity of motive or cause as well.

Worship and Ritual.—The acts of worship required by Islam are five in number: (i) the recital of the creed; (ii.) observance of the five daily prayers; (iii) the fast in the month of Ramadhān; (iv) giving of the legal alms; (v) the pilgrimage to Mecca.

Creed.

i. The creed is belief—"la ilaha illa-llahu, Muḥammad rasūl allahi," "there is no god but God (Allah), Mahomet is the apostle of God." It is required that this shall be recited at least once in a lifetime aloud, correctly, with full understanding of its meaning and with heartfelt belief in its truth. It is to be professed without hesitation at any time until death.

Prayer.

ii. Every man who professes Islam is required in ordinary life to pray five times in each day. In the Koran these prayers are commanded, though four only are mentioned. "Wherefore glorify God, when the evening overtaketh you, and when ye rise in the morning, and unto Him be praise in Heaven and earth; and in the evening and when ye rest at noon" (xxx. 16–17), but commentators say the "evening" includes the sunset and after sunset. The five times therefore are: (1) Dawn or just before sunrise, (2) just after noon, (3) before sunset, (4) just after sunset, and (5) just after the day has closed. Tradition decides within what limits the recitals may be delayed without impairing their validity. Prayer is preceded by the lesser ablution (*waḍū*) consisting in the washing of face, hands (to the elbows) and feet in prescribed manner. Complete washing of the body (*ghusl*) is required only after legal pollution. In prayer the worshipper faces the *qibla* (direction of prayer), which was at first Jerusalem, but was changed by the Prophet to Mecca. In a mosque the *qibla* is indicated by a niche (*miḥrab*) in one of the walls. The prayers consist of prescribed ejaculations, petitions, and the recital of parts of the Koran, always including the first *sura*, accompanied by prostrations of the body. Detailed physical positions are prescribed for each part of the worship; these vary slightly in the four orthodox schools (see below). On a journey, in time of war or in other special circumstances, the set form of prayers may be modified in accordance with appointed rules. Besides these private prayers, there is the prayer of the assembly, which is observed on a Friday (*yaum ul-jam'a*, "the day of assembly") in a mosque, and is usually accompanied by an address or declamation (*khutba*) delivered from a step of the pulpit (*minbar*). Special prayers are also prescribed for certain occasions, as on the eclipse of the sun or the moon, &c. Among the Sūfis special attention is given to informal prayer, consisting chiefly in the continual repetition of the name of God (*dhikr*) (see SUFI'ISM). This is still a characteristic of some of the dervish (*q.v.*) communities.

Fasting.

iii. The command to fast begins with the words, "O ye who believe! There is prescribed for you the fast, as it was prescribed for those before you." The expression "those before you" has been taken to refer to the Jews, who fasted on the day of atonement, but more probably refers to the long fast of thirty-six days observed by the Eastern Christians. In the passage of the Koran referred to (ii. 179–181) Moslems are required to fast during the month of Ramadhān, "wherein the Koran was revealed," but if one is on a journey or sick he may fast "another number of days," and if he is able to fast and does not, "he may redeem it by feeding a poor man," but "if ye fast, it is better for you." This fast was probably instituted in the second year at Medina. At that time the corrected lunar year was in use and Ramadhān, the ninth month, was always in the winter. A few years later Mahomet decreed the use of the uncorrected lunar year, which remains the standard of time for the Moslem world, so that the month of fasting now occurs at all seasons of the year in turn. The fast is severe, and means entire abstinence from food and drink from sunrise to sunset each day of the month. The fast is associated with the statement that in this month God sent down the Koran from the seventh heaven to Gabriel in the lowest that it might be revealed to the Prophet.

Alms.

iv. Alms are of two kinds: (1) the legal and determined (*zakāt*), and (2) voluntary (*ṣadaqāt*). The former were given in cattle, grain, fruit, merchandise and money once a year after a year's possession. For cattle a somewhat elaborate scale is adopted. Of grain and fruit a tenth is given if watered by rain, a twentieth if the result of irrigation. Of the value of merchandise and of money a fortieth is prescribed. In the early days of Islam the alms were collected by officials and used for the building of mosques and similar religious purposes. At the present time the carrying of these prescriptions is left to the conscience of the believers, who pay the alms to any needy fellow-Moslem. A good example of a *ṣadaqā* is found in a gift to an unbeliever (see C. M. Doughty, *Arabia deserta*, i. 446, ii. 278, Cambridge, 1888).

Pilgrimage.

v. The fifth religious duty of the Moslem is the pilgrimage (*ḥajj*) to Mecca, which should be performed once by every Moslem "if he is able," that is if he can provide or obtain the means to support himself on pilgrimage and his family during his absence, and if he is physically capable. The pilgrimage is made at one time of the (Moslem) year, namely, from the 7th to the 10th of the month Dhu'l-Hijja. For the arrangements for the journey from various countries to Mecca see CARAVAN. When the pilgrim arrives within five or six miles of the holy city he puts off his ordinary dress after ablution and prayer, and puts on the two seamless wrappers which form the dress of the pilgrim (the *iḥrām*), who goes without head-covering or boots or shoes. He must not shave at all, or trim the nails or anoint the head during the ceremonial period. The chief parts of the ceremonial are the visit to the sacred mosque *masjid ul-ḥarām*), the kissing of the black stone, the compassing of the Ka'ba (the *Ṭawāf*) seven times, three times running, four times slowly, the visit to the Maqām Ibrahim, the ascent of Mount Ṣafā and running from it to Mount Marwa seven times, the run to Mount Arafāt, hearing a sermon, and going to Muzdalifa, where he stays the night, the throwing of stones at the three pillars in Minā on the great feast day, and the offering of sacrifice there (for the localities see MECCA). After the accomplishment of these ceremonies the ordinary dress is resumed, the pilgrimage is finished, but the pilgrim usually remains another three days in Mecca, then visits Medina to pay his respects to the tomb of Mahomet. Beside the *hajj* (great pilgrimage) Islam also recognizes the merit of the *'umra* (or lesser pilgrimage), *i.e.* a religious visit to Mecca at any time accompanied by most of the ceremonies of the *hajj*.

The ceremonies of the *hajj* have been described by several European travellers who have witnessed them, such as J. L. Burckhardt in 1814, Sir Richard Burton in 1853 (see bibliography to MECCA). A concise account of them is given in T. P. Hughes, *Notes on Muhammadanism* (3rd ed., London, 1894). Details in vol. i. of Bukhāri's traditions (Houdas and Marcais's French translation, i. 493–567).

The Development of Islam.—The battle of Siffīn (657) between 'Ali and Moawiya was the occasion of the first breach in the unity of Islam, and the results remain to this day. The occasion was in the first case political, but politics were at that time too intimately connected with religion to be considered apart from it. After the battle (see CALIPHATE) 'Alī was practically compelled to submit his claims to arbitration, whereupon a number of his supporters broke away from him, saying that there should have been no appeal save to the Book of God. These men were for the most part country Arabs, and, inspired by the free spirit of the desert, were democratic, claiming that the caliph should be elected by the whole community from any family (and not from the Koreish alone), and that the caliph might be deposed for sin. A few extremists were republicans and would do without a caliph altogether. The whole party was known as the Kharijites (Khārijiyya or Khawārij). The Moslems who disagreed with them were regarded by them as renegades and were to be put to death. They were soon divided into extremists and moderates. The former put to death the children of unbelievers and refused to hold intercourse in daily life with unbelievers. The moderates, who came to be known as Ibadites (from their leader 'Abdallah ibn 'Ibād), would allow the children of unbelievers to grow up, and would then deal with them according to their choice. In ordinary life they would mix with all men, but marriage with other Moslems outside their own ranks was forbidden. These still remain in Oman, parts of Algeria and East Africa.

Another party, consisting mainly of city Arabs infected with Persian ideas as to the divinity of the ruler, clung to 'Alī with inconvenient affection. They regarded 'Alī and his descendants as the only legitimate caliphs, and came to be known as Shi'ites (*q.v.*). They remain to-day the largest part of Islam outside orthodoxy. During the Omayyad caliphate (661–750) there were three centres of religious thought and influence; students and teachers often passed from one to the other, thus making universal the teachings which in their origin were due to local circumstances. These centres were Damascus (the seat of the caliphate), Medina and the East (Irak, &c.). In Damascus the court was worldly and indifferent to the interests of Islam. The early Omayyads were distinguished for their striving after dominion (*mulk*). Instead of attempting to propagate Islam, they tolerated other religions and favoured Christians who were distinguished as poets (*e.g.* Akhtal) or officials (John of Damascus), or men likely to be of use to them in any way. The doctrines of Christianity began to influence even serious Moslems and to affect their way of stating Moslem belief. John of Damascus (d. before 767), the Greek theologian, and his pupil, Theodorus Abucara (d. 826), have written controversial works on Islam, from which it seems probable that disputations on subjects pertaining to religion were held between Christians and Moslems. Two schools of heretical Moslem sects arose under these influences—that of the Murjiites and that of the Qadarites. The Murjiites ("postponers") were so called because they postponed the judgment of human actions until the Day of Judgment. In politics they accepted the Omayyads as *de facto* rulers, since they were Moslems, and left the judgment of their actions to God. As theologians they taught that religion consists in belief (*imān*) in the unity of God and in his apostle, and in that alone; consequently no one who held this faith would perish eternally, though he had been a sinner. This was opposed to the Khārijite doctrine that the unrepentant sinner would perish eternally, even though he had professed Islam.

The Qadarites were concerned with the doctrine of predestination and free-will. So long as Moslems were fighting the battles of Islam they naturally paid most attention to those revelations which laid stress on the absolute determination of a man's destiny by God. They fought with great bravery because they believed that God had foreordained their death or life and they could not escape His will. In the quieter realm of town and court life and in their disputations with Christians they were called upon to reconcile this belief with the appeals made in the Koran to man's own self-determination to good, to courage, &c. Mahomet was not a systematic theologian and had done nothing to help them. The Qadarites declared that man had power over his own actions. But the teaching of predestination had gained too great a hold on Moslems to be thus displaced. The teaching of the Qadarites was held to be heresy, and one of its first professors, Ma'bad ul-Juhanī, was put to death in 699.[1] During this period Medina was the home of tradition. Those who had been in closest relation with the Prophet dwelt there. The very people of the city derived a certain splendour and authority from the fact that Mahomet had lived and was buried there. Free thought in religion had little chance of arising, less of expressing itself, in the holy city. But the Koran was diligently studied, traditions were collected (and invented) though not yet written in books, and innovation (*bid'a*) was resolutely avoided. At the same time it really did contribute a new element to religious practice, for the custom (*ijmā'*, see above) of Medina gained a certain authority even in Syria and the East.

In the East, on the other hand, there was more mental activity, and the religious teachers who came from Medina had to be prepared to meet with many questions. The wits of the Moslems were sharpened by daily contact with Christians, Buddhists, Manichaeans and Zoroastrians. Ḥasan ul-Baṣrī (*q.v.*), who has been claimed as one of the first mystics, also as one of the first systematic theologians of Islam, was remarkable alike for his personal piety and his orthodoxy. Yet it was among his pupils that the great rationalist movement originated. Its founder was Wāṣil ibn 'Atā, who separated himself (whence his followers were called Motazilites, strictly Mu'tazilites, "Separatists") from his teacher and founded a school which became numerous and influential. The Mu'tazilites objected to the attributes of God being considered in any way as entities beside God; they explained away the anthropomorphisms used in speaking of the deity; they regarded the Koran as created and as a product of Mahomet writing under the divine influence. Briefly, they asserted the supremacy of reason (*'aql*) as distinct from faith received by tradition (*naql*). They also called themselves "the people of justice and unity" (*Ahl ul-'adl wat-tauḥīd*). Such a faith as this naturally found favour rather with the thinking classes than with the uneducated multitude, and so went through many vicissitudes. At the time of its appearance and until the reign of Ma'mūn its adherents were persecuted as heretics. After discussions among the theologians Ma'mūn took the decided step of proclaiming that the Koran was created, and that a belief in this dogma was necessary. Other Mu'tazilite doctrines were proclaimed later. Mu'tazilites were appointed to official posts, and an inquisition (*miḥna*) was appointed to enforce belief in their doctrines. This movement was strongly opposed by the orthodox and especially by Aḥmad ibn Hanbal (*q.v.*). By him the founding of theology on reason was rejected, and he suffered persecution for his faith (see W. N. Patton, *Aḥmed ibn Hanbal and the Miḥna*, Leiden, 1897). Mu'tazilism retained its sway until 849, when the caliph Motawakkil again declared the Koran uncreate and restored orthodoxy. It was during the early years of the Abbasid rule that the four legal schools of Abū Ḥanīfa (d. 767), Mālik ibn Anas (d. 795), ash-Shāfi'ī (d. 819) and Ibn Ḥanbal (d. 855) came into existence (see Mahommedan Law). As the bases of religion and law were the same, so the methods applied in the treatment of the one affected the other. Abū Ḥanīfa depended little on tradition, but referred back to the Koran, making use of individual opinion (*ra'y*) as controlled by analogy (*qiyās*) with a written ordinance. Mālik Ibn Anas supplemented the Koran and Sunna by customary law founded largely on the custom (*ijmā'*) of Medina, and by what he conceived to be for the public good (*istiṣlāḥ*). Shafi'ī recognized tradition as equal to the Koran, and even as being able to supersede its ordinances, while he also recognized the universal custom (*ijmā'*) of the Moslem world as divine and binding. His four bases of religion—Koran, sunna, qiyās and ijmā'—have been generally accepted in Islam (see above). Ibn Hanbal's position has been already mentioned. All these four schools are reckoned orthodox, and all orthodox Moslems belong to one or another of them. Another teacher of this time, who founded a school which did not succeed in being recognized as orthodox, was Dā'ūd uz-Ẓāhirī. Trained as a Shafi'ite, he became too strict for this school, rejected analogy, restricted *ijmā'* to the agreement or custom of the companions of Mahomet, and accepted the whole of the Koran and tradition in the most literal and external sense. His followers were called Ẓāhirites (*i.e.* externalists). After Ash'arī's time these principles were applied to theology by Ibn Ḥazm (*q.v.*) see I. Goldziher, *Die Zahiriten, ihr Lehrsystem und ihre Geschichte* (Leipzig, 1884).

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[1] For the doctrines of these two sects see Shahrastānī's *Book of Sects*, and for the Qadarites, A. de Vlieger's *Kitāb ul-Qadr, matériaux pour servir à l'étude de la doctrine de la prédestination dans la théologie musulmane* (Leiden, 1903).

Before turning to the reform of Ash'arī and the introduction into orthodox theology of scholastic philosophy it is necessary to notice another phase of religious life which became the common property of orthodox and heretics. This was the introduction of asceticism in religious practice and of mysticism in religious thought. Sufi'ism (*q.v.*), which combined these two, is rightly not counted among the sects of Islam. Asceticism seems to have won a certain amount of approval from Mahomet himself, who much respected the Christian monks. The attention paid in early Islam to the joys and punishments of the future life led to self-denial and simple living in this world. An Arabian writer, speaking of the simplicity of manners of the first four caliphs, says that their affairs were conducted with more consideration of the future life than of this world. Many Moslems went even farther than these caliphs, and gave up all concern as far as possible with the affairs of this world and lived in poverty, in wanderings or in retirement (see Dervish). For the historical development of this movement, with its accompanying mysticism, see Sufi'ism. Ash'arī (d. before 942) was for forty years a Mu'tazilite, then became orthodox (see Ash'arī), and at once applied rational methods for the support and interpretation of the orthodox faith. Before him, reason had not been allowed any scope in orthodox theology. He was not the first to use it; some teachers (as al-Junaid) had employed it in teaching, but only in secret and for the few. The methods of scholastic philosophy were now introduced into Moslem theology. The chief characteristic of his religious teaching was the adoption of the *via media* between materialistic grossness and the ideas of pure speculative philosophy. Thus he taught, as to the attributes of God, that they exist, but are not to be compared with human attributes; as to His visibility, that He can be seen but without the limitations of human sight. As to the great question of free will, he denied man's power but asserted his responsibility. So he passed in review the doctrines of God, faith, the Koran, sin, intercession, &c., and for the first time in the history of Islam produced a systematic theology. The teaching of Ash'arī was taken up and propagated by the Buyids soon after his death, and was developed and perfected by Abū Bekr ul-Bāqilānī, the Cadi (d. 1012), but up to the middle of the 5th century of Islam (*c.* A.D. 1058) was suspected elsewhere and confounded with Mu'tazilism. The Ash'arite al-Juwainī (known as Imām ul-Haramain) was persecuted under Toghrul Beg (*c.* 1053) and exiled, but was restored under Alp Arslan by the vizier Niẓām ul-Mulk, who founded an Ash'arite college (the Niẓāmiyya). In the West, Ibn Ḥazm (*q.v.*) fiercely opposed the system, but Ghazālī established its orthodoxy in the East, and it spread from Persia to Syria and Egypt under the Ayyūbites and Mamelukes and thence to the Almohades in Africa under Ibn Tumart (1130). It remains the predominating influence to the present day, its only serious rival being the theological system of al-Matāridī, a Hanifite (d. 945), whose creed as represented in that of an-Nasafī is still used largely by the Turks. Since the 12th century no great theological movement has been made in Islam. The quiet of religious life has twice been broken, once by Wahhābism (*q.v.*) in Arabia, once by Bābism (*q.v.*) in Persia.

The Sects

According to an early tradition Mahomet said that Islam would be divided into seventy-three parties (sects),[1] of which seventy-two would perish and one would be saved. The orthodox Arabian writers on heretical sects of Islam feel compelled by this tradition to make up their number to seventy-two, and, as different writers adopt different divisions or are familiar with different parties, the names of sects amount to some hundreds. Each writer, however, adopts certain main classes under which he attempts to group the others. Abū Muṭī' Makḥūl at the beginning of the 10th century in his "Refutation" (MS. in Bodleian Library) has six such chief classes: Ḥarūrites (*i.e.* Khārijites), Rāfiḍites (*i.e.* Shi'ites), Qadarites, Jabarites, Jahmites and Murjiites. Ibn Hazm (*q.v.*) adopts four classes: Mu'tazilites (Motazilites), Murjiites, Shi'ites and Khārijites. Shahrastānī (*q.v.*) complains of the want of system in earlier writers, and suggests as bases of classification the position of parties with regard to the doctrines as to (1) the divine attributes, (2) predestination and free-will (3) promises and threats, faith and error, (4) revelation, reason, the imāmate. In one part of his preface he gives as the chief parties the Qadarites, Ṣifātites, Khārijites and Shi'ites, proposing to divide these classes according to leaders who agreed with the main doctrines of their class but differed in some points. In another place he mentions four opposite pairs of sects: (1) the Qadarites with their doctrine of free-will, and the Jabarites, who are necessitarians; (2) the Ṣifātites, who maintain the eternal nature of the attributes of God, and the Mu'tazilites, who deny it; (3) the Murjiites, who postpone judgment of actions until the Last Day, and the Wā'idites, who condemn in this life; (4) the Khārijites, who consider the caliphate a human institution, and the Shi'ites, who deify their ruler. In his detailed treatment of the sects Shahrastānī arranged them under the headings: Mu'tazilites, Jabarites, Ṣifātites, Khārijites, Murjiites and Shi'ites. About the same time as Shahrastānī two other Arabian writers wrote on the sects—Ṭāhir ul-Isfarainī (d. 1078), whose MS. is in the Berlin library, and Abd ul-Qādir ul-Jīlānī (1078–1166) in his *Kitāb ul-Ghaniyya li-Tālibi Tariq il-Haqqi* (Cairo, 1871). Both adopt as main classes Rāfiḍites (or Shi'ites), Qadarites (or Mu'tazilites), Khārijites, Murjiites, Najjārites, Dirārites, Jahmites, Mushabbiha, to which Ṭāhir adds Bakrites, Karrāmites, and a class including those sects which are not reckoned as Moslem though they have sprung from Islam. Jīlānī adds to the eight the Kilābites.

The following list is not a complete list of names of sects but is founded on that of Shahrastānī.[2]

Afṭaḥites.—Shī'ites of the Imāmite class, who ascribe the imāmate to 'Abdallah ul-Afṭaḥi, the son of Ṣādiq.

Ajārida.—Khārijites, followers of Ibn 'Ajarrad, who agreed for the most part with the Najadāt (below), considered grave sins as equivalent to unbelief, but remained friendly with those who professed Islam but did not fight for it. They rejected *sura* 7 as a fable. Shahrastāni enumerates seven divisions of this sect.

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[1] For the origin and significance of this number see M. Steinschneider, "Die kanonische Zahl der muhammedanischen Secten und die Symbolik der Zahl, 70–73," in *Zeitschr. d. deutschen morgenl. Gesellschaft*, iv., 145–170 (1850); and I. Goldziher, "Le Denombrement des sectes mohamétanes" in *Revue de l'hist. des religions*, xxvi. 129–137 (1892).

[2] The names are given throughout in the anglicized form on the analogy of Shi'ites, which is recognized in common usage. The strict termination according to the scheme of transliteration adopted in this work is *iyya*, or *iya*, *e.g.* Hishāmiyya for Hishāmites. For information regarding the important sects see separate articles and the preceding portion of this article.

Akhnasites.—A section of the Tha'āliba not so strict in treatment of those who fear to fight for Islam.

Ash'arites.—Followers of Ash'arī (*q.v.*) who are counted by Shahrastānī among the Ṣifātites.

Aṭrāfites.—A division of the 'Ajārida who agree with the Hamzites except that they excuse the lower classes for inaction when they are ignorant of the law.

Azraqites.—Khārijites who followed al-Azraq in the days of Ibn Zubair. They held 'Ali to be an unbeliever; those who did not fight were unbelievers; the children of unbelievers were to be put to death and went to hell. Sin is unbelief.

Bahshamites.—Mu'tazilites akin to the Jubbā'ites.

Baihasites.—Khārijites, followers of Abu Baihas ul-Haitham, who was put to death by the caliph Walīd. They asserted the necessity of knowledge for religion.

Bāqirites.—Shi'ites who followed Abū Ja'far ul-Bāqir, the fifth imām, and looked for his return.

Bāṭinites.—Isma'ilites, so called because they believe that every external has an internal (*bātin*), and every passage in the Koran has an allegoric meaning.

Bishrites.—Mu'tazilites, followers of Bishr ibn Mu'tamir, one of the most learned men of his party. His teaching was philosophical and was distinguished by his doctrine of "origination" (*tawallud*).

Bunānites.—Kaisānites, followers of Bunān ibn Sim'ān un-Nahdī, who claimed that the imāmate passed from Abū Hāshim to himself and that he had also acquired the divine element of 'Alī.

Butrites.—Zaidites, followers of Kathīr un-Nawā ul-Abtar, who agreed with the Suleimanites (Sulaimānites) except that he suspended judgment as to whether Othmān was a believer or not.

Dirārites.—Jabarites who empty God of his attributes, and assert that man has a sixth sense by which he will see God on the day of resurrection. The actions of man are "created" and acquired by him. A caliph need not be chosen from the Koreish.

Ghāliites (Ghulā) are the extreme Shi'ites (*q.v.*) in ascribing deity to the imāms. Their heresies are said to be four in number: (1) Making God resemble man, (2) ascribing change of mind to God, (3) looking for the return of the imām, (4) metempsychosis. They are divided by Shahrastānī into ten classes.

Ghassānites.—Murjiites, followers of Ghassān ibn ul-Kufī, who say that faith consists of knowledge of God, his apostle, and the Koran *in general* not in detail, and that faith increases but is not diminished.

Ḥabitites = Ḥāyitites (below).

Ḥadathites (Ḥudabites) are Mu'tazilites, followers of Faḍl ibn ul-Ḥadathī, who agreed with the Ḥāyitites (below).

Ḥafṣites.—Ibāḍites, followers of Ḥafṣ ibn abī-l-Miqdām, who distinguished between idolatry (*shirk*) and unbelief (*kufr*).

Ḥamzites.—'Ajārida, followers of Hamza ibn Adrak in Sijistān. They agree with the Maimūnites, but condemn the children of unbelievers to hell.

Ḥārithites.—Ibāḍites who differ from others in holding the Mu'tazilite doctrine of free-will.

Ḥarūrites.—A name given to the first Khārijites, who rebelled against 'Āli, and met in Ḥarūra near Kufa.

Hāshimites.—Shi'ites who supported Abū Hāshim, son of Mahommed ibn ul-Ḥanafiyya, although they held that his father had gone astray.

Hashwiites.—A party who asserted the eternity even of the letters of the Koran. They are not mentioned as a separate sect by Shahrastānī; cf. van Vloten, "*Les Hachwia et Nabila*," in the *Acts of the 11th Oriental Congress* (Paris, 1899), pt. iii., pp. 99 sqq.

Ḥāyiṭites.—Mu'tazilites who agreed with the Naẓẓāmites, but added three heresies of their own: (1) the divinity of the Messiah, (2) metempsychosis, (3) the interpretation of all references to the vision of God as referring to the "first Reason" or "creative Reason."

Hishāmites.—A name given to two sects: (1) Mu'tazilites, strong in their assertion of man's free-will, even opposing the statement of the Koran. (2) Shi'ites of the extreme kind, who attributed to God a body with quantities (measurements) and qualities.

Ḥudabites.—See Ḥadathites.

Hudhailites (Hodhailites).—Mu'tazilites, followers of Abū-l Hudhail Ḥamdān, who was a leading teacher of his party and developed the philosophical side of its teaching. Ten of his main doctrines are given by Shahrastānī.

Ibāḍites.—Khārijites of moderate tendencies (see above).

Ilbāites.—Ghāliites who put 'Alī above Mahomet and blamed the latter because he called men to himself instead of to 'Alī.

Imāmites.—One of the chief divisions of the Shi'ites (*q.v.*).

Isḥāqites.—Ghāliites agreeing with the Nuṣairites except that they incline to speak of the imams' participation in the prophetic office rather than of their divinity.

Isma'īlites.—This name is applied to all who consider Isma'īl ibn Ja'far the last imām, some believing that he did not die but will return, others, that at his death his son Mahommed became imām (see ASSASSINS); it is also used as equivalent to the Bāṭinites.

Ithna'asharites.—Imāmites who accept the twelve imāms (see SHI'ITES).

Jabarites.—Those who deny all actions and power to act to man and ascribe all to God (see above).

Ja'farites.—Imāmites who carry the imāmate no farther than Ja'far uṣ-Ṣadīq.

Jāhiẓites.—Mu'tazilites, followers of the celebrated writer Jāhiẓ (*q.v.*), who indulged in philosophical speculations, believed in the eternity of matter, and was regarded as a naturalist (*ṭaba'ī*) rather than a theist (*allahī*).

Jahmites.—Jabarites, followers of Jahm ibn Ṣafwān, who was put to death at Merv toward the close of the Omayyad period. He was extreme in his denial of the attributes of God.

Jārūdites.—Zaidites who held that Mahomet designated 'Alī as imām, not by name but by his attributes, and that the Moslem sinned by not taking sufficient trouble to recognize these attributes.

Jubbā'ites.—Mu'tazilites who followed the philosophical teaching of Abu 'Alī Mahommed ul-Jubbā'i of Basra.

Kaisānites.—A main class of the Shi'ites (*q.v.*).

Kāmilites.—Ghāliites, followers of Abū Kāmil, who condemned the companions (*Anṣār*) because they did not do allegiance to 'Alī, and 'Alī because he surrendered his claims.

Karrāmites.—Ṣifātites, followers of Ibn Karrām, who went so far as to ascribe a body to God, and assimilated his nature to human nature.

Kayyālites.—Ghāliites, followers of Ahmad ibn Kayyāl, who, after supporting a propaganda for an Aliite, claimed to be the imām himself on the ground of his power over the spheres.

Khalafites.—'Ajārida of Kermān and Multān, who believed that God wills good and evil, but condemned the children of unbelievers to hell.

Khārijites.—One of the earliest sects of Islam (see above).

Khārimites.—'Ajārida, agreeing mostly with the Shu'aibites and teaching that the relation of God to a man depends on what he professes at the end of his life.

Khaṭṭābites.—Ghāliites, followers of Abū-l Khaṭṭāb, who was put to death by Ibn Mūsā at Kufa. He was a violent supporter of Ja'far uṣ-Ṣādiq, who however disowned him.

Khayyātites.—Mu'tazilites, followers of Abū-l Ḥosain ul-Khayyāt, a teacher in Bagdad, part of whose philosophical teaching was that the non-existent is a thing.

Ma'badites.—Tha'labites who differed from the Akhnasites on the question of the marriage of believing women and from Tha'lab on the question of taking alms from slaves.

Maimūnites.—'Ajārida, followers of Maimūn ibn Khālid, who believed that God wills good only and that man determines his actions.

Majhūlites.—Tha'labites, agreeing generally with the Khārimites, but teaching that he who knows some names and attributes of God and is ignorant of some knows God.

Ma'lūmites.—Tha'labites agreeing generally with the Khārimites but alleging that a believer must know all the names and attributes of God.

Manṣūrites.—Ghāliites, followers of Abū Manṣūr ul-'Ijlī, who at first supported al-Bāqir, but, rejected by him, claimed the imāmate for himself. He was crucified by the caliph Hishām ibn 'Abd ul-Mālik (Abdalmalik).

Mu'ammarites.[1]—Mu'tazilites who strongly denied the predestination of God, and affirmed that God created bodies only, and that the accidents spring naturally from them.

Mufaḍḍalites.[1]—The same as the Mūsāites (*q.v.*).

Mughīrites.[1]—Ghāliites, followers of Mughīra ibn Sa'īd ul-'Ijlī, who claimed the imāmate and prophetic office and held extremely gross views of God.

Muhakkima[1] (the first).—Another name for the Ḥarūrites (above).

Mukarramites.[1]—Tha'labites who taught that sin consists in ignorance of God.

Mukhtārites.[1]—Kaisānites, followers of al-Mukhtār ibn 'Ubaid, who held to Mahommed ibn ul-Ḥanafīyya but was disowned by him. He allowed the possibility of change of mind on the part of God.

Murjiites.—Those who postponed judgment of actions until the Day of Judgment. See above.

Mūṣāites.—Imāmites who held to the imāmate of Mūsā ibn Ja'far, who was imprisoned by Harun al-Rashid and poisoned.

Mushabbiha.[1]—Ṣifātites who compared God's actions with human actions. They said that the Koran was eternal with all its letters, accents and written signs.

Mu'tazilites.[1]—The rationalists of Islam. See above, cf. also H. Steiner, *Die Mu'taziliten oder die Freidenker im Islām* (Leipzig, 1865).

Muzdārites.[1]—Mu'tazilites, followers of al-Muzdār, a pupil of Bishr (cf. Bishrites) whose teaching he developed further. He taught that God has power to do evil, but, if he acted thus, would be an evil God; also that man can produce the equal of the Koran.

Najadat (also known as *'Adhirites*).—Kharijites, who followed Najda ibn 'Āmir of Yemāma as he went to join the Azraqites but withdrew from these, being more orthodox than they. He held that fear of fighting was not sin.

Nāwisites take their name from a person or a place. They are Ja'farites who believe in Ṣādiq as the mahdi.

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[1] All these names are alternatively spelt *Mo-* instead of *Mu-*.

Nazzāmites.—Mu'tazilites, followers of Ibrahīm ibn Sayyār un-Nazzām, who was an extremist in his teaching of man's free-will and other philosophical doctrines.

Nu'mānites.[1]—Ghāliites agreeing in some points with Hishūmites, but holding that God is a light in the form of a man, yet not a body.

Nuṣairites.[1]—Ghāliites who agree with the Isḥāqites except that they lay more stress on the incorporation of the deity.

Qadarites.—The upholders of free-will (see above).

Qata'ites.—Mūsāites who regard the rank of the imāms as closed with the death of Mūsā.

Rāfiḍites.—A term used by some writers to denote the Shi'ites as a whole; by others given to a class of the Shi'ites who forsook Zaid ibn 'Alī because he forbade them to abuse the Companions.

Rashīdites.—Tha'labites, followers of Rashid ut-Tūsi, sometimes called 'Ushrites ("tithers") because they differed from others on the question of tithing the produce of land watered by rivers and canals.

Rizāmites.—Kaisānites of Khorasān at the time of Abū Muslim, to whom they ascribed the imāmate and the Spirit of God. They also believed in metempsychosis.

Saba'ites.—Ghāliites, who followed 'Abdallah ibn Sabā (see SHI'ITES).

Ṣāliḥites.—(*a*) Zaidites, followers of al-Hasan ibn Ṣāliḥ, who agreed with the teachings of the Butrites (above); (*b*) Murjiites, followers of Ṣāliḥ ibn Amr, who united with the doctrines of their own party those of the Qadarites.

Ṣaltites.—'Ajārida who had nothing to do with the children of believers until they had grown up and professed Islam.

Shaibānites.—Tha'labites, followers of Shaibān ibn Salama, who was killed in the time of Abū Muslim (Moslem). They arose chiefly in Jorjān and Armenia and agreed in doctrine with the Jahmites.

Shamiṭites.—Ja'farites, followers of Yaḥyā ibn Abū Shamiṭ.

Shi'ites.—See separate article.

Shu'aibites.—'Ajārida who said that God creates the actions of men, and men appropriate them.

Ṣifātites are those who ascribe eternity to all the attributes of God, whether they denote essence or action, or are of the class called descriptive attributes.

Ṣifrites, the same as Ziyādites (below).

Sulaimānites (Suleimanites).—Zaidites, followers of Suleimān ibn Jarīr, who held that the appointment to the imāmate was a matter of consultation and that the imāmates of Abū Bekr and Omar were legal although 'Alī had a better claim.

Tha'labites.—A party of the Khārijites, followers of Tha'lab ibn Amir, who agreed with the 'Ajārida except that he was friendly with children until they actually denied the faith. He also took alms from slaves when they were rich, and gave alms to poor slaves.

Thaubānites.—Murjiites who said that faith consists in the knowledge and confession of God and His apostle, and what the intellect is not capable of doing. What the intellect can do (or leave) is not of faith.

Thumāmites.—Mu'tazilites, followers of Thumāma ibn Ashras in the days of Mamūn, who taught that all non-Moslems would become dust on the day of resurrection.

Tūmanites.—Murjiites who taught that faith depends on obedience rather to the principles than to the commands of Islam.

'Ubaidites.—Murjiites who believed that anything but idolatry might be forgiven, and that if a man died professing the unity of God his sins would not hurt him.

Wa'īdites.—Those who, opposed to the Murjiites, pronounced judgment in this life; they are not counted as a separate sect by Shahrastānī (see above).

Wāṣilites.—A name given to those who followed Wāṣil ibn 'Atā, the founder of Mu'tazilitism, who denied the attributes of God, asserted the power of man over his own actions, taught the existence of a middle place between heaven and hell, and despised the parties of Othman and 'Alī alike.

Yazīdites.—Ibāḍites who said that they followed the religion of the Sabians in the Koran, and believed that God would send an apostle from the Persians.

Yūnusites.—Murjiites who taught that faith consists in knowledge of God, subjection to Him, abandonment of pride before Him, and love in the heart. Obedience apart from knowledge is not of faith.

Zaidites.—The moderate Shi'ites (see SHI'ITES).

Ziyādites.—Khārijites, followers of Ziyād ibn ul-Aṣfar, who did not regard those who abstained from fighting for Islam as unbelievers, and did not kill the children of idolaters or condemn them to hell.

AUTHORITIES.—For the philosophy and theology of Ash'arī see M. A. F. Mehren, *Exposé de la réforme de l'Islamisme par Abou-'l Hasan Ali el-Ash'arī* (Leiden, 1878); W. Spitta, *Zur Geschichte Abu-l Hasan al-Ash'arīs* (Leipzig, 1876); M. Schreiner, *Zur Geschichte des Ash'aritenthums* (Leiden, 1891); D. B. Macdonald, *Development of Muslim Theology, Jurisprudence and Constitutional Theory* (London, 1903). The last work contains translations of the creeds of Ash'arī and Nasafī (Matāridite). A further bibliography of works on the faith and outlook of Islam will be found in D. B. Macdonald's *Muslim Theology*.

The text of the Koran has been edited by G. Flügel, Leipzig, various dates; and by G. M. Redslob, Paris, 1868 and 1880. There are also hundreds of Eastern editions. Concordances have been published by G. Flügel, Leipzig, 1842 (several times reprinted), also in Egypt, Palestine and India. A dictionary and glossary were published by J. Penrice, London, 1873. English translations have been made by G. Sale, London, 1734 (the fullest edition is that with notes by E. M. Wherry, 4 vols., London, 1882–1886); by J. M. Rodwell with notes, London, 1861 and 1876; and by E. H. Palmer in vols. vi. and ix. of the "Sacred Books of the East," Oxford, 1880–1882. Among the best or best-known Arabic commentaries are those of Ṭabarī (*q.v.*), Zamakhsharī (*q.v.*), Baidhawī (*q.v.*), the Jalalain (see SUYUTI), and such later ones as the Mafātiḥ ul-Ghaib of ar-Rāzi (d. 1210). The composition and theology of the Koran are treated in the works of Nöldeke and Grimme referred to above.

On the eschatology of Islam see M. Wolff, *Muhammedanische Eschatologie* (Leipzig, 1872); and on the doctrine of revelation, Otto Pautz, *Muhammeds Lehre von der Offenbarung* (Leipzig, 1898). (G. W. T.)

MAHONY, FRANCIS SYLVESTER (1804–1866), known as "Father Prout," Irish priest and author, son of a woollen manufacturer, was born in Cork in 1804. His classical education was chiefly obtained at a Jesuit college at Amiens, and after studying in Paris he entered the Jesuit college at Rome and was admitted into the Society of Jesus. He served in Switzerland and at Clongoweswood, Ireland, where he was prefect of studies and subsequently master of rhetoric. Here he was involved in scandals that led to his resignation. On going to Italy he was told at Florence that he was expelled from the Society. He succeeded, however, in obtaining priest's orders at Rome in 1832, and returned to Ireland, but subsequently went to London, officiating for some time in the chapel of the Bavarian Legation. While there he fell in with William Maginn, and about 1834 began to contribute his celebrated "Prout Papers" to *Fraser's Magazine*. These consist of episodes in the life of the parish priest "Father Prout," and dialogues after the model of "Christopher North," varied by translations of well-known English songs into Latin, Greek, French and Italian verse, which he humorously represents as being the true originals from which the English authors had merely plagiarized them. Mahony's translations have been universally admired for the extraordinary command which they display of the various languages into which his renderings are made, and for their spirit and freedom both of thought and expression. His original verse tends chiefly to show that with all his sarcastic and cynical wit his genius had also its tender, serious and sentimental side. His "Bells of Shandon" has always been greatly admired. In 1846 Mahony became correspondent at Rome to the *Daily News*, and his letters from that capital gave very vivid pictures of the first years of the reign of Pius IX. The last twelve or fifteen years of his life were spent in Paris, whence he supplied the *Globe* with a series of piquant letters on the incidents of the day. He died in Paris on the 18th of May 1866.

The *Reliques of Father Prout* were collected from *Fraser's Magazine* and published in two volumes in 1836; *The Final Reliques of Father Prout*, chiefly extracted from the *Daily News* and the *Globe*, were edited by Blanchard Jerrold in 1876, and an edition of his works, edited by Charles Kent, was published in 1881.

MAHOUT (Hind. *makāwat*), an elephant-driver. The mahout sits on the elephant's neck and directs him by voice and by the use of a goad called *ankus*.

MAHRATTAS, a people of India, inhabiting the district known by the ancient name of Maharashtra (Sans. "great kingdom or region"). This large tract, extending from the Arabian Sea on the west to the Sātpura mountains in the north, comprises a good part of western and central India, including the modern provinces of the Konkan, Khandesh, Berar, the British Deccan, part of Nagpur, and about half the nizam's Deccan.

The etymology of the word Mahratta (*Marāthā*) is uncertain. The name does not indicate a social caste, or a religious sect; it is not even tribal. Strictly, it is confined to the upper class from whom Sivaji's generals were mostly drawn, and who sometimes claim a Rajput origin. In a wider sense it may be extended to include all who inhabit Maharashtra and speak Mahratti as their mother-tongue. In 1901 the total number of speakers of Mahratti in all India exceeded 18 millions.

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[1] These names are alternatively spelt *No-* instead of *Nu-*.

The Mahrattas have always been a separate nation or people, and still regard themselves as such, though nowadays they are almost all under British or Mahommedan jurisdiction; that is, they belong either to British India or to the nizam's dominions. There are indeed still three large native states nominally Mahratta: that of Sindhia near the borders of Hindustan in the north, that of Holkar in Malwa in the heart of the Indian continent, and that of the gaekwar in Gujarat on the western coast. But in these states the prince, his relatives and some of his ministers or officials only are Mahrattas; the mass of the people belong to other sections of the Hindu race. These states then are not to be included in the Mahratta nation, though they have a share in Mahratta history.

In general terms the Mahrattas, in the wider sense, may be described under two main heads: first the Brahmans, and secondly the low-caste men. The Mahratta Brahmans possess, in an intense degree, the qualities of that famous caste, physical, intellectual and moral. They have generally the lofty brow, the regular features, the spare upright figure, and the calm aspect which might be expected in a race maintained in great purity yet upon a broad basis. In modern times they have proved themselves the most able and ambitious of all the Brahmans in the Indian Empire. They are notably divided into two sections: the Konkanast, coming from the Konkan or littoral tract on the west coast below the Western Ghāt mountains; and the Deshast, coming from the uplands or Deccan, on the east of the mountains. Though there have been many distinguished Deshasts, yet the most remarkable of all have been Konkanasts. For instance, the pēshwas, or heads of the Mahratta confederation which at one time dominated nearly all India, were Konkanast Brahmans. The birthplaces of these persons are still known, and to this day there are sequestered villages, nestling near the western base of the Ghāts, which are pointed to as being the ancestral homes of men who two centuries ago had political control over half India.

Apart from the Brahmans, the Mahrattas may be generally designated as Sūdras, the humblest of the four great castes into which the Hindu race is theoretically divided. But the upper classes claim to be Kshattriyas or Rajputs. They probably are aborigines fundamentally, with a mixture of what are now called the Scythian tribes, which at a very early time overran India. The ordinary Mahrattas, who form the backbone of the nation, have plain features, an uncouth manner, short stature, a small but wiry frame. Though not powerful physically as compared with the northern races of the Punjab and Oudh, they have much activity and an unsurpassed endurance. Born and bred in or near the Western Ghāt mountains and the numerous tributary ranges, they have all the qualities of mountaineers. In recent times they enter military service less and less, betaking themselves mainly to cultivation and to the carrying business connected with agriculture. As husbandmen they are not remarkable; but as graziers, as cartmen, as labourers, they are excellent. As artisans they have seldom signalized themselves, save as armourers and clothweavers.

In the Konkan there are some superior proprietors termed Khots. With this and perhaps some other exceptions, there are not in the Mahratta country many large landlords, nor many of the superior tenure-holders whose position relatively to that of the peasantry has caused much discussion in other parts of India. There are indeed many Mahratta chiefs still resident in the country, members of the aristocracy which formerly enjoyed much wealth and power. They are sometimes in the position of landlords, but often they are the assignees of the land revenue, which they are entitled under special grants to collect for themselves instead of for government, paying merely a small sum to Government by way of quit-rent. Under them the cultivators are by British arrangements placed in the position of peasant proprietors. The village community has always existed as the social unit in the Mahratta territories, though with less cohesion among its members than in the village communities of Hindustan and the Punjab. The ancient offices pertaining to the village, as those of the headmen (*patel*), the village accountant, &c., are in working order throughout the Mahratta country.

The Mahratta peasantry possess manly fortitude under suffering and misfortune. Though patient and good-tempered in the main, they have a latent warmth of temper, and if oppressed beyond a certain limit they would fiercely turn upon their tormentors. As a rule they are orderly and law-abiding, but traditions of plunder have been handed down to them from early times, and many of them retain the predatory instincts of their forefathers. The neighbourhood of dense forests, steep hill-sides, and fastnesses hard of access offers extraordinary facilities to plunderers for screening themselves and their booty. Thus gang robbery is apt to break out, gains head with rapidity, and is suppressed with difficulty. In times of peace it is kept under, but during war, or whenever the bands of civil order are loosened, it becomes a cause of anxiety and a source of danger. The women have frankness and strength of character; they work hard in the fields, and as a rule evince domestic virtue.

The peasantry preserve a grave and quiet demeanour, but they have their humble ideas of gaiety, and hold their gatherings on occasions of births or marriages. They frequently beguile their toil with carols. They like the gossiping and bartering at the rural markets and in the larger fairs, which are sometimes held in strikingly picturesque localities. They are superstitious, and worship with hearty veneration any being or thing whose destructive agency they fear. They even speak of the tiger with honorific titles. They are Hindus, but their Hinduism is held to be of a non-Aryan type. They are sincerely devout in religion, and feel an awe regarding "the holy Brahmans," holding the life and the person of a Brahman sacred, even though he be a criminal of the deepest dye. They of course regard the cow as equally sacred. There are two principal sects among modern Hindus—those who follow Vishnu, and those who follow Siva. The Mahrattas generally follow Siva and his wife, a dread goddess known under many names. The Mahratta war-cry, "Har, Har, Mahadeo," referred to Siva. All classes high and low are fond of the religious festivals, the principal of which, the Dasahra, occurs in October, when the first harvest of the year has been secured and the second crops sown. This has always been held with the utmost pomp and magnificence at every centre of Mahratta wealth and power. The people frequently assemble in bowers and arbours constructed of leafy boughs to hear *kathas* recited. These recitations are partly religious, partly also romantic and quasi-historical. After them national resolves of just resistance or of aggressive ambition have often been formed.

Apart from the Mahratta Brahmans, as already mentioned, the Mahratta nobles and princes are not generally fine-looking men. There is general truth in what was once said by a high authority to the effect that, while there will be something dignified in the humblest Rājpūt, there will be something mean in the highest Mahratta. Bluff good-nature, a certain jocoseness, a humour pungent and ready, though somewhat coarse, a hot or even violent disposition, are characteristics of Mahratta chieftains. They usually show little aptitude for business or for sedentary pursuits; but, on the other hand, they are born equestrians and sportsmen. Mahratta ladies and princesses have often taken a prominent part, for good or evil, in public affairs and dynastic intrigues.

Though they have produced some poetry, the Mahrattas have never done much for literature. Nor have they been distinguished in industrial art. Their architecture in wood, however, was excellent; and the teak forests of their country afforded the finest timber for building and for carving. They had also much skill in the construction of works for the supply of drinking water on a large scale and for irrigation.

The range of the Western Ghāts enabled the Mahrattas to rise against their Mahommedan conquerors, to reassert their Hindu nationality against the whole power of the Mogul Empire, and to establish in its place an empire of their own. It is often stated that in India British conquest or annexation succeeded Mahommedan rule; and to a considerable extent this was the case. But, on the other hand, the principal power, the widest sovereignty, which the British overthrew in India was that of the Mahrattas.

During the earlier Moslem invasions in 1100 and in subsequent years, the Mahrattas do not seem to have made much resistance. They submitted to several Mahommedan kings under the changing circumstances of those times. It was against the Mahommedan king of Bijapur in the Deccan that Sivaji, the hero of Mahratta history, first rebelled in 1657. Sivaji and his fighting officers were Mahrattas of humble caste, but his ministers were Brahmans. When the Mogul Empire absorbed the Bijapur kingdom he defied the emperor. He imparted a self-reliant enthusiasm to his countrymen, formed them into an army, and organized them as a political community; his mountaineer infantry, though limited in numbers, proved desperately courageous; his cavalry was daring and ubiquitous. The Moslems, having once overcome the Hindus in almost all parts of India, had not for centuries met with any noteworthy uprising. Sivaji, however, planned their expulsion, and before the end of his restless life made much progress in the execution of that design. The new state which he founded was maintained under various vicissitudes after his death. Mahratta resistance, once aroused by him, was never extinguished, and the imperial resources were worn out by ceaseless though vain efforts to quell it. The great Mogul emperor's impoverished and enfeebled successor was fain to recognize the Mahratta state by a formal instrument. The Mahratta king, a descendant of Sivaji, had become a *roi fainéant*, and the arrangement was negotiated by his Brahman minister, whose official designation was the pēshwa. The office **of pēshwa then became hereditary in the minister's family,** and grew in importance as the Mahratta kingdom rose, while the king sunk into the condition of a puppet. Thus the Mahratta power was consolidated throughout nearly the whole of Maharashtra under the Brahman pēshwa as virtual sovereign, with his capital at Poona, while the titular Mahratta raja or king had his court at the neighbouring city of Satara. Despite his political importance, however, the raja was still venerated as the descendant of Sivaji.

Then several chiefs carved out principalities of their own from among the ruins of the Mogul Empire. Thus Raghoji Bhonsla established himself in the tracts lying underneath the southern base of the Satpura range (namely, Nagpur and Berar), overran Orissa and entered Bengal. Damaji Gaekwar descended from the Western Ghāts upon the alluvial plains of Gujarat around Baroda; Tukoji Holkar subdued the uplands of Malwa beyond the Vindhya range on the north bank of the Nerbudda; and Mahadji Sindhia obtained possession of large tracts immediately south of Agra and Delhi, marched into Hindustan and became virtually the master of the Mogul emperor himself (see GWALIOR). Sivaji's own father had founded a dominion at Tanjore in the extreme south, which, however, never had relations with the central power at Poona. The same may be said of the state of Kolhapur, allotted to a younger branch of Sivaji's family.

But these principalities, though independent respecting internal administration, and making war or peace with their neighbours according to opportunity, owned allegiance to the pēshwa at Poona as the head of the Mahratta race. On state occasions heads of principalities would visit Poona by way of acknowledging the superior position of the pēshwa. On the other hand, the pēshwa was careful to obtain the sanction of his nominal sovereign at Satara to every important act of state. Thus a confederation was formed of which the Brahman pēshwa or head was at Poona, governing the adjacent territories, while the members, belonging to the lower castes, were scattered throughout the continent of India. Such was the Mahratta Empire which supplanted the Mogul Empire. The Mahratta power grew and prospered till it embraced all western and most of central India. Its culminating point was reached about 1750, or about a century after Sivaji first rebelled against his Mahommedan sovereign.

Its armies drew soldiers from all parts of India. The infantry was not of good quality; but its cavalry was really an enormous force, numbering fully a hundred thousand in all. The horsemen were splendidly audacious in riding for long distances into the heart of a hostile country, without support, striking some terrific blows, and then returning rapidly beyond reach of pursuit. They could truly boast of having watered their horses in every Indian river from the Cauvery to the Indus. If attacked, however, in a competent manner, they would not stand; and afterwards, in conflict with the British, whole masses of them behaved in a dastardly manner. As their ambition grew the chiefs began to organize their troops after the system learnt from the English and French. In this way several Frenchmen—Benoit de Boigne, Perron and others—rose in the Mahratta service to a position dangerous to the British. But the new system was unsuited to the Mahratta genius; it hampered the meteoric movements of the cavalry, which was obliged to manœuvre in combination with the new artillery and the disciplined battalions. Mahratta elders hence uttered predictions of military disaster which were in the end more than fulfilled.

The rapid and amazing success of the Mahratta confederation rendered it the largest Hindu power that ever existed in India. But it lacked the elements of true greatness. It was founded by plundering expeditions, and its subsequent existence was tainted by the baseness of this predatory origin. With the exception of the pēshwas, its chiefs were little more than freebooting warriors, for the most part rude, violent and unlettered. Their custom was to offer their neighbours or victims the alternative of paying *chouth*, that is, one-fourth of the revenue, or being plundered and ravaged. Thus the Mahratta *chouth* came to have an ominous significance in Indian history. Desultory efforts were made to establish a civil government, but in the main there was no administration formed on statesmanlike principles. The pēshwas, on the other hand, as Brahmans, were men of the highest education then possible in India. But they were absorbed by the direction of military and political combinations, and by intrigues for the preservation of their own power; and, even allowing for all this, they failed to evince the civil capacity which might have been anticipated. While several displayed commanding abilities, and some possessed many virtues, one alone attempted to conduct an administration in an enlightened manner, and he died prematurely.

There were at the same time powers existing in India to keep the Mahrattas in check, and some parts of India were excepted from their depredations. The English power was rising at Calcutta, Madras and Bombay. The nascent Sikh power prevented Mahratta incursions from being permanently successful in the Punjab. As the Mogul Empire broke up, some separate Mahommedan powers rose upon its ruins. The nizam of the Deccan established himself at Hyderabad, comparatively near the headquarters of the pēshwa. Hyder Ali was proclaimed sultan of Mysore in the south. Ahmed Shah Abdali burst upon India from Afghanistan. The Mahrattas bravely encountered him at Panipat near Delhi in 1761, and were decisively defeated. The defeat, however, did not essentially shake the Mahratta confederation. It was collision with the English that broke that wonderful fabric to pieces.

The first collision with the English occurred in 1775, arising from a disputed succession to the pēshwaship. The English government at Bombay supported one of the claimants, and the affair became critical for the English as well as for the Mahrattas. It was at this conjuncture that Warren Hastings displayed his political genius and rendered signal service to his country, by succouring from Bengal the defeated Bombay army and negotiating a peace (in 1782) that restored the *status quo*.

The next collision happened in 1803. The pēshwa had fallen into grave difficulties with some of the principal members of the Mahratta confederation. He therefore placed himself under British protection, and this led to the great Mahratta War, in which the Marquis Wellesley displayed those talents for military and political combination which rendered him illustrious. It was during the campaigns which ensued that General Arthur Wellesley defeated Sindhia and the Bhonsla raja at Assaye, and General Lake won the victories of Farrukhabad, Dig and Laswari over Sindhia and Holkar. The three confederates, Sindhia, Holkar and the Bhonsla, concluded peace with the British government, after making large sacrifices of territory in favour of the victor, and submitting to British control politically. It was during these events that the British won the province of Orissa, the old Hindustan afterwards part of the North-Western Provinces, and a part of the western coast in Gujarat.

The third collision came to pass between 1816 and 1818, through the conduct, not only of the confederates, but also of the pēshwa (Baji Bao) himself. During the previous war the pēshwa had been the protégé and ally of the British; and since the war he had fallen more completely than before under British protection—British political officers and British troops being stationed at his capital. He apparently felt encouraged by circumstances to rebel. Holkar and the Bhonsla committed hostile acts. The predatory Pindaris offered a formidable resistance to the British troops. So the pēshwa ventured to take part in the combination against the British power, which even yet the Mahrattas did not despair of overthrowing. After long-protracted menaces, he attacked the British at Kirkee, but failed utterly, and fled a ruined man. Ultimately he surrendered to Sir John Malcolm, and was sent as a state pensioner to Bithūr, near Cawnpore. The British, however, released the raja of Satara from the captivity in which he had been kept during the pēshwa's time, and reinstated him on the throne, with a limited territory. Owing to these events the British government became possessed of the Konkan and of the greater part of the Deccan.

It remains to mention briefly the fortunes of each remaining member of the once imperial confederation. The principality of Satara was held to have lapsed in 1848 by the death of the raja without lineal heirs, and was annexed by the British government. The Bhonsla raja of Nagpur died without lineal heirs in 1853, and his territory was likewise annexed. The house of Holkar remained faithful to its engagements with the British government, and its position as a feudatory of the empire was maintained. In Sindhia's territory, by reason of internal feuds, the British had to undertake measures which were successfully terminated after the battles of Maharajpur and Panniar in 1843. But on the whole the house of Sindhia remained faithful. Sindhia himself was actively loyal during the Mutiny. The gaekwar gradually fell under British control towards the close of the 18th century, and his house never engaged in hostilities with the British government. The ex-pēshwa lived to old age at Bithur, and died in 1857. His adopted son grew up to be the Nana Sahib, of infamous memory, who took a leading part in the Mutiny.

See J. Grant Duff, *History of the Mahrattas* (3 vols., 1826); T. D. Broughton, *Letters written in a Mahratta Camp* (1813); M. G. Ranade, *Rise of the Maratha Power* (Bombay, 1900).
(R. T.; J. S. Co.)

MAHSEER, or MAHASEER (*Barbus mosal*), a kind of barbel, abundant in the rivers of India, especially in pools of the upper and more rapid streams where they issue from the mountainous part of the country. It is one of the largest species of the Cyprinid family, attaining to a length of 3 to 5 ft., and sometimes exceeding a weight of 70 lb. Its body is well-proportioned, rather elongate, and somewhat like that of the European barbel, but covered with very large scales, of which there are only twenty-five or twenty-seven placed along the lateral line; the dorsal fin is armed with a long and strong spine, and the mouth provided with four slender and short barbels. The lips are sometimes produced into fleshy lobes. To the fisherman in India the mahseer affords the same kind of sport as the salmon in the British Isles, and it rivals that fish as regards size, strength and activity. Its flesh is likewise much esteemed.

MAI, ANGELO (1782–1854), Italian cardinal and philologist, was born of humble parents at Schilpario in the province of Bergamo, Lombardy, on the 7th of March 1782. In 1799 he entered the Society of Jesus, and in 1804 he became a teacher of classics in the college of Naples. After completing his studies at the Collegium Romanum, he lived for some time at Orvieto, where he was engaged in teaching and palaeographical studies. The political events of 1808 necessitated his withdrawal from Rome (to which he had meanwhile returned) to Milan, where in 1813 he was made custodian of the Ambrosian library. He now threw himself with characteristic energy and zeal into the task of examining the numerous MSS. committed to his charge, and in the course of the next six years was able to restore to the world a considerable number of long-lost works. Having withdrawn from the Society of Jesus, he was invited to Rome in 1819 as chief keeper of the Vatican library. In 1833 he was transferred to the office of secretary of the congregation of the Propaganda; on the 12th of February 1838 he was raised to the dignity of cardinal. He died at Castelgandolfo, near Albano, on the 8th of September 1854.

It is on his skill as a reader of palimpsests that Mai's fame chiefly rests. To the period of his residence at Milan belong: Fragments of Cicero's *Pro Scauro*, *Pro Tullio*, *Pro Flacco*, *In Clodium et Curionem*, *De aere alieno Milonis*, *De rege* (*Alexandrino* (1814); *M. Corn. Frontonis opera inedita, cum epistolis item ineditis, Antonini Pii, Marci Aurelii, Lucii Veri et Appiani* (1815; new ed., 1823, with more than 100 additional letters found in the Vatican library); portions of eight speeches of Quintus Aurelius Symmachus; fragments of Plautus; the oration of Isaeus *De hereditate Cleonymi*; the last nine books of the *Antiquities* of Dionysius of Halicarnassus, and a number of other works. *M. Tullii Ciceronis de republica quae supersunt* appeared at Rome in 1822; *Scriptorum veterum nova collectio, e vaticanis codicibus edita* in 1825–1838; *Classici scriptores e vaticanis codicibus editi* in 1828–1838; *Spicilegium romanum* in 1839–1844; and *Patrum nova bibliotheca* in 1845–1853. His edition of the celebrated *Codex vaticanus*, completed in 1838, but not published (ostensibly on the ground of inaccuracies) till four years after his death (1858), is the least satisfactory of his labours and was superseded by the edition of Vercellone and Cozza (1868), which itself leaves much to be desired. Although Mai was not as successful in textual criticism as in the decipherment of manuscripts, he will always be remembered as a laborious and persevering pioneer, by whose efforts many ancient writings have been rescued from oblivion.

See B. Prina, *Biografia del cardinale Angelo Mai* (Bergamo, 1882), a scientific work, which gives a full and, at the same time, a just appreciation of his work; Cozza-Luzi, *Epistolario del card. Angelo Mai* (Bergamo, 1883); life by G. Poletto (Siena, 1887).

MAIA, in Greek mythology, the eldest of the Pleiades, the seven daughters of Atlas and the Oceanid Pleïone. She and her sisters, born on Mt Cyllene in Arcadia, are sometimes called mountain goddesses. In a cave of Cyllene Maia became by Zeus the mother of the god Hermes. The story is told in the *Hymn to Hermes* attributed to Homer. She was identified by the Romans with Maia Majesta, an old Italian goddess of spring, to whom a sacrifice was offered on the 1st of May by the priest of Vulcan.

MAIDA, a town of Calabria, Italy, in the province of Catanzaro, from which it is 30 m. W.S.W. direct, and 12 m. N.N.E. of Pizzo by rail (the station is 8 m. W. of the town). Pop. (1901), 5190. The town gives its name to the plain of Maida, where in 1806 British troops under Sir John Stuart defeated the French under Regnier. The names Maida Hill and Maida Vale in London are derived from this battle.

MAIDAN, an Indian term for any open plain. The Maidan is the name of the park in Calcutta, surrounding Fort William, where society people drive in the afternoon. The name is also applied to one of the valleys in the Afridi country of Tirah, and to the plateau portion of the state of Mysore.

MAIDEN, or MAID, a young unmarried girl. "Maid" is a shortened form of "maiden," O. Eng. *maegden*, which represents a diminutive of a Teutonic word meaning "young person," of either sex. An old English word "may," meaning a kinsman or kinswoman, and also a virgin or girl, represents the original. In early usage "maiden" as meaning "virgin" is frequently applied to the male sex, thus, in Malory's *Morte d'Arthur*, Sir Percyvale is called a "parfyte clene megden." Apart from the direct applications of the word to the unmarried state, such as "maiden name," "maiden lady," &c., the word is used adjectivally, implying the preservation of the first state of an object, or indicating a first effort of any kind. Probably a "maiden" fortress is one which has never fallen, though the *New English Dictionary* suggests that the various "maiden castles" in England, usually ancient earthworks, may have been so called from being so strong that they could be defended by maidens, and points out that Edinburgh Castle, called "maiden-castle" by William Drummond of Hawthornden (*Speech for Edinburgh to the King*), is styled *Castrum puellarum*, the "castle of the maidens," in Geoffrey of Monmouth. A "maiden" assize, circuit or session is one at which there are no prisoners for trial; a "maiden over" or "maiden" in cricket is an over from which no runs are scored. A "maiden speech" is the first speech made by a member of parliament in the house. In the *Annual Register* for 1794 (quoted in *N.E.D.*) the expression, with reference to Canning's first speech, is said to be "according to the technical language of the house." "Maiden" is applied to several objects, to a movable framework or horse for drying and airing of linen, to a washerwoman's "dolly" or wooden beater, to the "kirnbaby" formed of the last sheaf of corn reaped which formerly figured in the Scottish harvest homes, and to the beheading instrument, known as the "Scottish maiden" (see below). "Maid," apart from its primary sense of an unmarried woman, is chiefly used for a domestic female servant, usually with a qualifying word prefixed, such as "housemaid," "parlourmaid," &c.

The title of "MAID OF HONOUR" is given to an unmarried lady attached to the personal suite of a queen. The custom of sending young girls of noble or good birth to the court of a prince or feudal superior, for the purpose, primarily, of education, goes back to early feudal times, and is parallel with the sending of boys to act as pages and squires to the feudal castles. The regular establishment of maids of honour (*filles d'honneur*) appears first in the royal court of France. This has usually been attributed to Anne of Brittany, wife of Charles VIII.; she had a group of unmarried girls of high rank at her court as part of her household, in whom she took a lively and parental interest, educating them and bestowing a dowry upon them on their marriage. A slightly earlier instance, however, has been found. When the young Margaret of Austria came to France on her espousal to Charles VIII., broken by his marriage to Anne of Brittany, there were in her train several *filles d'honneur*, whose names appear in the *Comptes d'argenterie de la reine Marguerite d'Autriche*, from 1484–1485 and 1488–1489 (*Archives de l'empire K.K. 80 and 81* quoted by A. Jal, *Dictionnaire critique de biographie et d'histoire*). It is from the days of Francis I. that the *chroniques scandaleuses* begin which circle round the maids of honour of the French court. The maids of Catherine de Medici, celebrated as the "flying squadron," *l'escadron volant*, are familiar from the pages of Pierre de l'Estoile (1574–1611) and Brantôme. Among those whose beauty Catherine used in her political intrigues, the most famous were Isabelle de Limeuil, Mlle de Montmorency-Fosseux, known as *la belle Fosseuse*, and Charlotte de Baune. The *filles d'honneur*, as an institution, were suppressed in the reign of Louis XIV., at the instigation of Mme de Montespan—who had been one of them—and their place was taken by the *dames de palais*. In the English court, this custom of attaching "maids of honour" to the queen's person was no doubt adopted from France. At the present day a queen regnant has eight maids of honour, a queen consort four. They take precedence next after the daughters of barons, and where they have not by right or courtesy a title of their own, they are styled "Honourable."

THE SCOTTISH MAIDEN was an instrument of capital punishment formerly in use in Scotland. It is said to have been invented by the earl of Morton, who is also said to have been its first victim. This, however, could not have been the case, as the maiden was first used at the execution of the inferior agents in the assassination of Rizzio (1561) and Morton was not beheaded till 1581. The maiden was practically an early form of guillotine. A loaded blade or axe moving in grooves was fixed in a frame about ten feet high. The axe was raised to the full height of the frame and then released, severing the victim's head from his body. At least 120 suffered death by the maiden, including the regent Morton, Sir John Gordon of Haddo, President Spottiswood, the marquis and earl of Argyll. In 1710 it ceased to be used; it is now preserved in the museum of the Society of Antiquaries of Scotland, in Edinburgh.

MAIDENHAIR, in botany, the common name for a fern, *Adiantum Capillus-Veneris*, characterized by the spreading hair-like branches of the frond, the ultimate pinnules of which are ¼ to 1 in. long with a rounded crenate outer edge and repeatedly forked veins; the sori (or masses of spore-capsules) are in the crenatures of the pinnules, and are protected by a kidney-shaped involucre. The plant is widely distributed in temperate and tropical regions, and is occasionally found in the western counties of England, the Isle of Man, and west Ireland, growing on damp rocks or walls especially near the sea. The genus *Adiantum* is a large one containing many handsome species both tropical and temperate, well known in greenhouse and hothouse cultivation.

MAIDENHAIR-TREE is a popular name for *Ginkgo biloba*, a remarkable and handsome gymnospermous tree, the fan-shaped leaves of which with their forked veins recall those of the maidenhair (see GYMNOSPERMS).

MAIDENHEAD, a market town and municipal borough in the Wokingham parliamentary division of Berkshire, England; 24½ m. W. of London by the Great Western railway. Pop. (1901), 12,980. Area, 2125 acres. It is pleasantly situated on and above the west (right) bank of the Thames, and is much in favour as a residential town and a resort of boating parties. Though of high antiquity it is wholly modern in appearance, and a large number of handsome houses have been built in its vicinity. A beautiful timbered house of the 15th century, however, survives in Ockwells, a short distance south of the town. The stone bridge carrying the London road over the Thames dates from 1772; but the crossing is of ancient importance. Maidenhead has trade in malt and grain. The borough is under a mayor, 4 aldermen and 12 councillors.

The history of Maidenhead (Maydenhutt, Maydenhith) is bound up with that of the ancient bridge. It is not mentioned in Domesday. Edward I. (1297) gave a grant of pontage in aid of the bridge, which was almost broken down; similar grants to the "bailiffs and good men of Maydenhithe" were made by succeeding sovereigns. In 1451 Henry VI. incorporated the gild of the Brethren and Sisters of Maydenhith to provide certain necessaries for the celebration of Mass and to keep the bridge in order: the gild, dissolved at the Reformation, was revived by Elizabeth, who, however, later (1581) substituted for it a corporation consisting of a warden, bridgemaster, burgesses and commonalty: the governing charter until the 19th century was that of James I. (1685) incorporating the town under the title of the mayor, bridgemaster and burgesses. In 1400 Thomas Holand, earl of Kent, held the bridge in the interests of the deposed Richard II., but was eventually forced to retire. In 1643 a meeting took place in the town between Charles I. and three of his children. In the 18th century a considerable trade was done in carrying malt, meal and timber in barges to London: at that time three fairs were held which have now practically disappeared. The Wednesday market is held under a charter of Elizabeth (1582).

MAID MARIAN, a personage incorporated in the English legend of Robin Hood. There is no evidence that she had originally any connexion with the Robin Hood cycle. She seems to have been an essential feature of the morris dance, and in the may-game was paired sometimes with Robin-Hood, but oftener with Friar Tuck. The well-known pastoral play of Adam de la Hale, *Jeu de Robin et Marion*, and the many French songs on the subject, account for the association of the names. In the ballads on Robin Hood her name is twice casually mentioned, but there is a late ballad, by a certain S. G. (F. J. Child, *English and Scottish Ballads*, i. 219), which tells how Maid Marian sought Robin in the forest disguised as a page, and fought with him for an hour before she recognized him by his voice. S. G. was perhaps acquainted with the two plays, written in 1598, of *The Downfall* and *The Death of Robert Earl of Huntingdon*, by Anthony Munday and Harry Chettle. In *The Downfall* Matilda Fitz Walter escapes from the persecution of King John by following her lover to Sherwood Forest, where they took the names of Robin Hood and Maid Marian, and lived apart until they could be legally united. Perhaps this tale has some connexion with the romance of the outlaw Fulk Fitz Warin. Matilda or Mahaud, widow of Theobald Walter, escaped from John's solicitations by marrying the outlawed Fulk and following him to the forest. There were in semi-historical legends three Matildas pursued by King John, of whom particulars are given by H. L. D. Ward in his *Catalogue of Romances* (i. 502). Their several histories were fused by the Elizabethan dramatists, and associated with the Maid Marian of the morris dance, who up to that time had probably only a vague connexion with Robin Hood.

MAIDSTONE, a market town and municipal and parliamentary borough, and the county town of Kent, England, 41 m. E.S.E. of London by the South Eastern & Chatham railway. Pop. (1901), 33,516; area, 4008 acres. It lies principally on the eastern bank of the river Medway, the modern part spreading over the western slopes of a picturesque valley, which is intersected and environed by orchards and hop gardens, this being the richest agricultural district of Kent. The hop grounds form the so-called middle growth of Kent, and the town has the principal grain market in the county. Archbishop Boniface in 1260 established a hospital here (Newark hospital) for poor pilgrims, the chapel of which, with modern additions, is now St Peter's Church. The parish church of St Mary, which had existed from Norman times, was demolished in 1395 by Archbishop Courtenay, who erected on the site the present church of All

Saints. This fine Perpendicular building contains, besides many excellent monuments, the richly carved sedilia and the twenty-eight oak seats used by the collegiate priests. Courtenay also founded a college of secular canons, the ruins of which are an interesting specimen of 14th-century architecture. From the reign of John until the Reformation the archbishops had a residence here, at which Stafford and Courtenay died. This Perpendicular building, with its Elizabethan east front, was acquired by the corporation as a memorial of Queen Victoria's Jubilee in 1887, and houses the school of science and art. The rectory, with the manor, passed into lay hands at the Reformation; and, having been a perpetual curacy for three hundred and twenty years, the living became a vicarage in 1866. The grammar school was founded in 1549, and endowed with the estates of the local Corpus Christi fraternity, then dissolved; the hall in which the gild assembled remains, but the school is established in modern buildings on a new site. There are oil-mills, rope, sacking and twine factories, and cement, lime, and brick works. There is a considerable carrying trade on the Medway. A museum, with public library, was opened in 1858, in an interesting building of the early part of the 16th century. This is the headquarters of the Kent Archaeological Society, founded by the Rev. L. B. Larking in 1858. In 1890 an art gallery was added. The West Kent and General hospital, the county ophthalmic hospital, county gaol and barracks may be mentioned among other institutions. From Saxon times down to 1830 condemned malefactors were executed, and all the great county meetings were held, on Penenden Heath, a common situated about a mile north-east of the town, and enclosed by the corporation as a public recreation ground. The parliamentary borough of Maidstone returns one member. The town is governed by a mayor, 6 aldermen and 18 councillors.

There is evidence of a Roman settlement at Maidstone. The name Maidstone (Medwegestun, Meddestane, Maydestan), probably meaning Medway Town, is presumably of Saxon origin. At the time of the Domesday Survey it belonged to the archbishop of Canterbury, and from the reign of John the archbishops had a residence there. Its position in the centre of Kent gave it an early importance; the shire-moot was held on Penenden Heath in the 11th century, and Maidstone was an assize town in the reign of Edward I. In 1537 Cranmer exchanged the manor of Maidstone with the king, and it was granted by Edward VI. to Sir Thomas Wyatt. Edward also incorporated the town by the title of the mayor, jurats and commonalty; it had formerly been governed by a portreve and 12 "brethren." This charter was forfeited through Wyatt's rebellion; a second charter was granted by Elizabeth in 1559 and confirmed by subsequent sovereigns. A new charter constituting a governing body of a mayor, 12 jurats and 40 common councilmen was given at the petition of the inhabitants by George II. in 1747, and remained the governing charter until 1835. Four fairs were granted by the charter of 1559; these are now held on the 13th of February, the 12th of May, the 20th of June and the 17th of October. A Thursday market was granted by Henry III. to Archbishop Boniface, and a market every second Tuesday in the month by charter of George II. A corn market on Tuesday and a cattle market on Thursday are still held. The manufacture of linen and woollen goods was introduced by Walloons, who settled here in 1567. This was succeeded by paper-making, now the chief industry of the town. The cultivation of hops has been carried on since the 17th century.

Maidstone has been associated with various incidents of general history. Wat Tyler broke into the prison, liberated John Ball the rebel preacher, and committed various depredations. Several of the leading inhabitants joined Jack Cade's rising. The rising of the Kentish Royalists in 1648 collapsed at Maidstone, where on the 1st of June Fairfax, after five hours' obstinate fighting, captured the town at midnight.

See *Victoria County History, Kent*; J. M. Russell, *History of Maidstone* (1881).

MAIHAR, a native state of Central India, in the Baghelkhand agency. Area, 407 sq. m.; pop. (1901), 63,702; estimated revenue, £4700. The state, which is watered by the Tons river, consists mainly of alluvial soil covering sandstone, and is fertile except in the hilly district of the south. A large area is under forest, the produce of which provides a small export trade. The chief, whose title is raja, claims descent from the Kachwaha Rajput clan. The state suffered severely from famine in 1896–1897. The town of Maihar (pop. 6802) is on the East Indian railway, 97 m. N. of Jubbulpore. Extensive ruins of shrines and other buildings in its neighbourhood indicate a former much greater extent of the place.

MAIL. (1) (Through Fr. *maille*, from Lat. *macula*, a spot or hole, the mesh of a net), properly a metal ring or link which, joined closely with other links, formed the fabric of body and other armour in the middle ages, till it was superseded by plate-armour. The word "mail," properly applied to this form of chain-armour, is also used of armour generally, whether plate or chain, and is also transferred to the horny defensive coverings of animals, such as the tortoise, crab, &c. (see Arms and Armour). (2) (O. Eng. *mál*, speech; probably the same as O. Saxon *mahal*, assembly; in meaning connected with O.Norse *mále*, stipulation), a Scots law term meaning rent, tax. "Mails and duties" are the rents, whether in kind or money, of an estate. In English the word only survives in "blackmail" (*q.v.*). (3) (Through O. Fr. *male*, mod. *malle*, a Teutonic word surviving in Dutch *maal*), properly a bag, especially one used in travelling; this word, which appears in Chaucer, is now applied chiefly to the despatch and delivery of postal matter. In this sense "mail" is properly the bag in which such matter is conveyed, and hence is applied to the contents of the mail, postal matter collectively, and to the train, carts, or other means used in the despatch and delivery of the same. In general usage "mail" is confined to the "foreign" as opposed to the "inland" despatch of letters, &c., and to which the word "post" is chiefly applied; in official language, the word refers to the inland despatch. The word appears also in "mail-coach," a coach used for conveying the mails, and in "mail-cart," a cart similarly employed. This word is also applied to a light low vehicle propelled or drawn by hand, suitable for young children. The "mail phaeton" is a type of phaeton with high seat for two persons and drawn by a pair of horses.

MAILLY, LOUISE JULIE, Comtesse de (1710–1751), mistress of Louis XV. of France, was the daughter of Louis, marquis de Nesle. She was the eldest of three sisters who succeeded one another as favourites of the king. In 1726 she married her cousin, Louis Alexandre de Mailly. Although Louis XV. had paid her attentions from 1732, she did not become titular mistress until 1738. She did not use her position either to enrich herself or to interfere in politics. She was supplanted by her sister, the duchess of Châteauroux, and obliged to leave court in 1742.

See E. and J. de Goncourt, *La Duchesse de Châteauroux et ses sœurs* (1879); Toussaint, *Anecdotes curieuses de . . . Louis XV.* (2 vols., 1905); J. B. H. R. Capefigue, *Mesdemoiselles de Nesle et la jeunesse de Louis XV.* (1864).

MAIMANA, a town and khanate of Afghan Turkestan. The town is situated 100 m. S.W. of Balkh, and only some 25 m. from the frontier of Russian Turkestan. It is about two-thirds the size of Herat, square built and surrounded by a ruined wall and moat. The khanate was for long in dispute between Bokhara and Kabul, but in 1868 Abdur Rahman laid siege to the town, and it was compelled to come to terms. Its political status as an Afghan province was definitely fixed by the Russo-Afghan boundary commission of 1885. The inhabitants are chiefly Uzbegs.

MAIMAND, a town in the province of Fars, Persia, a few miles east of Firuzabad and about 70 m. from Shiraz. It has a population of about 5000, almost wholly occupied with the manufacture and sale of rose-water, which is largely exported to many parts of Persia as well as to Arabia, India and Java. The district also produces great quantities of almonds. The rose gardens cover several square miles. In 1349 a great part of Maimand and of three little villages belonging to it became *wakf* (pious endowment) of the shrine at Shiraz of Mīr Ahmed, surnamed Shah Chiragh, a son of Musa Kazim, the seventh imām of the Shiahs, and the remainder of the Maimand grounds was given to the shrine by Mīr Habbib Ullah Sharifi and by Shah Ismail in 1504; the administration of the Maimand property as well as the guardianship of the shrine is still with the descendants of Mīr Habbib Ullah.

MAIMBOURG, LOUIS (1610–1686), French Jesuit and historian, was born at Nancy. He entered the Society of Jesus at the age of sixteen, and after studying at Rome became a classical master in the Jesuit college at Rouen. He afterwards devoted himself to preaching, but with only moderate success. After having taken some part in minor controversies he threw himself with energy into the dispute which had arisen as to the Gallican liberties; for his *Traité historique sur les prérogatives de l'Église de Rome* (1682) he was by command of Innocent XI. expelled from the Society, but rewarded by Louis XIV. with a residence at the abbey of St Victor, Paris, and a pension. He died on the 13th of August 1686. His numerous works include histories of Arianism, the iconoclastic controversy, the Greek schism, Lutheranism, Calvinism, and of the pontificates of Leo I. and Gregory I.; they are mere compilations, written indeed in a very lively and attractive style, but inaccurate and untrustworthy.

The History of Arianism was published in English (1728–1729) by William Webster, with an appendix on the English writers in the Socinian and Arian controversies.

MAIMING, mutilation, a physical injury. which involves the loss of, or incapacity to use, a bodily member. The verb "to maim," in M. E. *maynhe*, *mahayme*, *mayme*, &c. was adopted from O. Fr. *mahaignier*: cf. It. *magagnars*, Med. Lat. *mahemiare*, *mahennare*, &c. (see Du Cange, *Gloss.*, *s.v.* "Mahamium"). Maiming or mutilation is and has been practised by many races with various ethnical and religious significances, and was a customary form of punishment on the principle of an "eye for an eye" (see MUTILATION). In law "maiming" is a criminal offence; the old law term for a special case of maiming of persons was "mayhem" (*q.v.*), an Anglo-French variant form of the word. Maiming of animals by others than their owners is a particular form of the offences generally grouped as "malicious damage." For the purpose of the law as to this offence animals are divided into cattle, which includes horses, pigs and asses, and other animals which are either subjects of larceny at common law or are usually kept in confinement or for domestic purposes. The punishment for maiming of cattle is three to fourteen years' penal servitude. Malicious injury to other animals is a misdemeanour punishable on summary conviction. For a second offence the penalty is imprisonment with hard labour for over twelve months. (Malicious Damage Act 1861.) Maiming of animals by their owner falls under the Cruelty to Animals Acts.

MAIMON, SALOMON (1754–1800), German philosopher, was born of Jewish parentage in Polish Lithuania, and died at Nieder-Siegersdorf on the 22nd of November 1800. He married at the age of twelve, and studied medicine in Berlin. In 1770 he severed his connexion with his orthodox co-religionists by his critical commentary on the *Moreh Nebuhim* of Maimonides, and devoted himself to the study of philosophy on the lines of Wolff and Moses Mendelssohn. After many vicissitudes he found a peaceful residence in the house of Count Kalkreuth at Nieder-Siegersdorf in 1790. During the ensuing ten years he published the works which have made his reputation as a critical philosopher. Hitherto his life had been a long struggle against difficulties of all kinds. From his autobiography, it is clear that his keen critical faculty was developed in great measure by the slender means of culture at his disposal. It was not till 1788 that he made the acquaintance of the Kantian philosophy, which was to form the basis of his lifework, and as early as 1790 he published the *Versuch über die Transcendentalphilosophie*, in which he formulates his objections to the system. He seizes upon the fundamental incompatibility of a consciousness which can apprehend, and yet is separated from, the "thing-in-itself." That which is object of thought cannot be outside consciousness; just as in mathematics $\sqrt{-1}$ is an unreal quantity, so "things-in-themselves" are *ex hypothesi* outside consciousness, *i.e.* are unthinkable. The Kantian paradox he explains as the result of an attempt to explain the origin of the "given" in consciousness. The *form* of things is admittedly subjective; the mind endeavours to explain the *material* of the given in the same terms, an attempt which is not only impossible but involves a denial of the elementary laws of thought. Knowledge of the given is, therefore, essentially incomplete. Complete or perfect knowledge is confined to the domain of pure thought, to logic and mathematics. Thus the problem of the "thing-in-itself" is dismissed from the inquiry, and philosophy is limited to the sphere of pure thought. The Kantian categories are, indeed, demonstrable and true, but their application to the given is meaningless and unthinkable. By this critical scepticism Maimon takes up a position intermediate between Kant and Hume.. Hume's attitude to the empirical is entirely supported by Maimon. The casual concept, as given by experience, expresses not a necessary objective order of things, but an ordered scheme of perception; it is subjective and cannot be postulated as a concrete law apart from consciousness. The main argument of the *Transcendentalphilosophie* not only drew from Kant, who saw it in MS., the remark that Maimon alone of his all critics had mastered the true meaning of his philosophy, but also directed the path of most subsequent criticism.

Maimon's chief works, in addition to the above quoted, are *Philos. Wörterbuch* (1791); *Streifereien im Gebiete der Philos.* (1793); *Über die Progresse der Philos.* (1793); *Die Kategorien des Aristoteles mit Anmerkungen erläutert* (1794); *Versuch einer neuen Logik* (1794 and 1798); *Kritische Untersuchungen über den menschl. Geist* (1797). See *S. Maimons Lebensgeschichte von ihm selbst beschrieben* (1792, ed. K. P. Moritz; Eng. trans. by J. C. Murray, 1888); Wolff, *Maimoniana* (1813); Witte, *S. Maimon* (1876).

MAIMONIDES, the common name of RABBI MOSES BEN MAIMON (1135–1204), also known from the initials of these last words as RAMBAM, Jewish philosopher. His life falls into three epochs, which may be typified by the towns in which they were passed, viz. Cordova, Fez and Cairo. He was born in Cordova on the 20th of March 1135, the eve of Passover; he had a brother, David, and one sister. His early years were spent in his native town, which had then just passed the zenith of its glory. The Arab rulers had fostered the development of science, art, medicine, philosophy, literature and learning. All these influences played their part in the education of Maimonides, whose father, besides training him in all branches of Hebrew and Jewish scholarship, implanted in the youth a sound knowledge of these secular studies as well. In 1148 Cordova was taken from the last Fatimite caliph by the victorious Almohades, who had spread over Spain from N. Africa. These militant revivalists strove to re-establish Islam in what they considered its primitive simplicity. They laid great stress on the unity of God, and tolerated neither schism within the faith nor dissent without. The position of the orthodox Spanish Jews became intolerable, and Maimon, after ten years of hardships, wanderings and escapes, decided to take his family out of the country. He settled in Fez. The years which Maimonides spent there (1160–1165) were memorable for his friendship with Abdul Arab Ibn Muisha—a Moslem poet and theologian—and for the commencement of his literary activity. His energies were diverted towards stimulating the religious feelings of his brethren and combating assimilation. In consequence he became alarmed for his own safety, and in 1165 left for Egypt, where he settled after a passing visit to the Holy Land. Cordova taught him the humanities; Fez humanity. Cairo, besides giving him prominence at court and in the Jewish community, was the centre of the almost world-wide influence which he exercised over Jewry by his monumental writings and dominant personality. By 1177 Maimonides was the recognized chief of the Cairene congregation and consulted on important matters by communities far and wide. Here he was joined by his most famous disciple, Joseph Aknin. But his early life in Egypt was fraught with deep sorrow. His father died soon after their arrival, and Maimonides himself suffered severely from prostration and sickness. His brother David, jointly with whom he carried on a trade in gems, was shipwrecked in the Indian Ocean. With him perished the entire fortune of the family. Forced to earn a livelihood, Maimonides turned to medicine. The fame of his skill eventually brought him the appointment of body physician to Saladin, to whom, it is said, he was so attached that when Richard I. wrote from Ascalon, offering him a similar post at the English court, Maimonides refused. He married the sister of Ibn al Mâli, one of the royal secretaries. In 1186, his son Abraham was born. His remaining years were spent in ceaseless activity and in controversy, which he sought to avoid. He died amidst universal sorrow and veneration.

The works of Maimonidos fall into three periods: (*a*) To the Spanish period belong his commentary on the whole Talmud (not fully carried out), a treatise on the calendar (*Maamar ha-ibbur*), a treatise on logic (*Milloth Higgayon*), and his commentary on the *Mishnah* (this was called *Siraj* or *Maor*, *i.e.* "Light": begun 1158, completed 1168 in Egypt). (*b*) While he was in Fez, he wrote an essay on the Sanctification of the Name of God (*Maamar Kiddush Hashem*, *Iggereth Hashemad*). (*c*) The works written in Egypt were: Letter to the Yemenites (*Iggereth Teman* or *Pethaḥ Tiqvah*); *Responsa* on questions of law; Biblical and Rabbinical Code (*Misnheh Torah* or *Yad Hahazaka*, completed 1180); *Sepher hamitswoth*, an abbreviated handbook of the preceding; and his great philosophical work *Moreh Nebuḥim* or "the guide of the perplexed" (1190). To these must be added certain portions of the *Mishnah* commentary, such as the "Eight Chapters," the discussion on reward and punishment and immortality, the Jewish Creed, which have acquired fame as independent works.

The influence of Moses ben Maimon is incalculable. "From Moses unto Moses there arose not one like Moses," is the verdict of posterity. Maimonides was the great exponent of reason in faith and toleration in theology. One of the main services to European thought of the "Guide" was its independent criticism of some of Aristotle's principles. His codification of the Talmud was equally appreciated in the study of the scholar and in practical life. Christian Europe owed much to Maimonides. Not only did his "Guide" influence scholasticism in general, but it was from his Code that the Church derived its medieval knowledge of the Synagogue.

A complete bibliography will be found in *Maimonides*, by David Yellin and Israel Abrahams (London, 1903); the final chapter of that work gives a summary of the influence of Maimonides on Christian philosophers such as Aquinas, and Jewish such as Spinoza. The "Guide" has been translated into English by M. Friedlander (1881–1885; new ed., 1905). See also *Jewish Encyclopedia*, articles *s.v.*, and the volumes edited by Guttmann, *Moses ben Maimon* (Leipzig, 1908, &c.). (H. Le.)

MAIN (Lat. *Moenus*), a river of Germany, and the most important right-bank tributary of the Rhine. It has two sources, the Weisse Main (White Main), which rises in the Fichtelgebirge on the east side of the Ochsenkopf, and the Rote Main (Red Main), which, rising on the eastern slope of the Frankish Jura, flows past Bayreuth. They unite 3 m. below Kulmbach, 920 ft. above the sea. Hence the river, already of considerable size, pursues a north-westerly direction, skirting the spurs of the Frankish Jura in a pleasant valley. At Lichtenfels the river takes a south-westerly course, which it retains until entering the fertile basin of Bamberg. Here it receives from the south-east the waters of its chief tributary, the Regnitz, and enters upon its middle course. Its direction is now again north-west, and meandering through pleasant vales and pastures it passes Hassfurt and reaches Schweinfurt. Its course is now almost due south to Ochsenfurt, when it again proceeds north-west. Continuing in this direction amid vine-clad hills, it washes the walls of the university city of Würzburg, and thence, dividing the forest-clad ranges of the Spessart and the Odenwald, reaches Gemünden. Here it is joined from the right by the Frankish Saale and, turning abruptly south, receives at Wertheim the beautiful Tauber. Feudal castles and medieval towns now crown its banks, notably, Freudenberg and Miltenberg. From the latter it proceeds due north to Aschaffenburg, whence passing Frankfort it pours its yellow waters into the green waters of the Rhine just above Mainz. The Main has a total length of 310 m. and drains a basin of approximately 11,000 sq. m. It is navigable from the confluence of the Regnitz, 240 m. from its mouth, for barges and other small craft, and through the Ludwig Canal is connected with the Danube.

See Ulrici, *Das Maingebiet in seiner natürlichen Beschaffenheit* (Kassel, 1885); E. Faber, *Zur Hydrographie des Maingebiets* (Munich, 1895), and Lill, *Mainthal, Main und Mainschiffahrt* (Berlin, 1904).

MAIN (from the Aryan root which appears in "may" and "might," and Lat. *magnus*, great), a word meaning properly power or strength, especially physical. This use chiefly survives in the expression "with might and main." The word is more common as a substantival elliptical use of the adjective, which usually has the sense of principal or chief in size, strength, importance, &c. Thus "the main," the high open sea, is for "main sea," cf. "mainland," the principal part of a territory excluding islands and sometimes far-projecting peninsulas. The expression "the Spanish main" properly meant that part of the main land of the N.E. coast of South America stretching from the Orinoco to the Isthmus of Panama, and the former Spanish possessions in Central America bordering on the Caribbean Sea, but it is often loosely used, especially in connexion with the buccaneers, of the Caribbean Sea itself. The term "main" is also thus used of a principal pipe or cable for conducting gas, water, electricity, &c. The elliptical use does not appear, however, in such expressions as main road, line, stream. Another use of the word "main" has a somewhat obscure history. It appears as a term in the game of hazard, and also in cock-fighting. In the last it is used for a match, and for the cocks engaged in a match. In hazard it is the number called by the "caster" before the dice are thrown; this may be any number from five to nine inclusive. The usual derivation is from the French *main*, a hand, but according to the *New English Dictionary* there is no evidence for this, and the more probable explanation is that it is an adaptation of "main" meaning principal or chief. From this use of the word in hazard the expression "main chance" is derived. "Main," a shortened form of domain or demesne, only now survives in Scotland, usually in the plural "mains" for a home farm.

MAINA (or MANI) and **MAINOTES**, a district and people of the Peloponnesus, the modern Morea. Maina is the country occupied by the mountain range of Taygetus from Sparta to Cape Matapan, the ancient Taenarum. It is now divided between the modern districts Oetylos and Gythion. Before the organization of the present kingdom of Greece, Maina was subdivided into Ἔξω Μάνη, Outer Maina, from the frontier of Kalamata, on the Gulf of Messenia, to Vitylo (Oetylos) and inland to the summit of Taygetus; Κάτω Μάνη, Lower Maina, from Vitylo to Cape Matapan; and Μέσα Μάνη, or Inner Maina, on the east, and on the Gulf of Laconia as far as the plain of Elos. It contained over a hundred villages. The country is mountainous and inaccessible, a formation to which it owes its historical importance. The Mainotes claim to descend from the Spartans, and probably represent the Eleuthero, or free, Laconians who were delivered by Rome from the power of Sparta, as is suggested by the traces of ancient Greek in their dialect and by their physical type. Their country being a natural fortress, they were able to defend themselves against the Byzantine emperors, the barbarians who broke into the empire, the Latin princes of Achaea of the house of Villehardouin, and the Turks. As their country is also poor and maritime, they were early tempted to take to piratical adventure. Gibbon says that "in the time of Constantine Porphyrogenitus they had acquired the name of Mainotes, under which they dishonour the claim of liberty by the inhuman pillage of all that is shipwrecked on their rocky shore." Their neighbours gave their country the name of "Kakaboulia"—the land of wicked counsels. The passes of their mountains were elaborately fortified and their villages were full of fortified towers (*pyrgoi*) from which they formed their own favourite epithet, Maina Polypyrgos—many-towered Maina. On the western side it also contains the remains of feudal keeps, erected by William II. de Villehardouin (1245–1278) and other Latin princes of Achaea. The Mainotes did not become Christians till the 9th century. From the 15th till the 17th century they recognized a family which claimed to belong to the Comneni of Trebizond as head chiefs. But the real power was in the hands of the chiefs of the different families and villages, who formed a turbulent and martial aristocracy. Enduring and ferocious feuds were common among them. In the course of the 18th century the family of Mavromicheli (Black Michael), which belonged to lower Maina, established a general headship over the Mainotes after much strife and many murders. When Russia endeavoured to promote a rising against the Turks in the Morea in 1770 the Mainotes acted with her, and the strength of their country enabled them to escape the vengeance of the Turks when the Christians were cynically deserted by the Russians. In 1777 their practical independence was recognized by the sultan's officers. During the Greek war of independence the Mainotes were chiefly led by Petros (Petro Bey) Mavromicheli, known to his countrymen as the king of Maina, who undoubtedly cherished the hope of establishing a principality for himself. The freedom of Greece, for which he had fought in his own way, proved the ruin of his ambition. He found the new order less compatible with his schemes than the Turkish dominion. Petro Bey was imprisoned by the Greek president Capodistrias (see CAPO D'ISTRIA, COUNT), who was in revenge murdered by the Mavromichelis. The family were finally content to become courtiers and officials in the reign of King Otto I. In the 19th century Maina was but little affected by civilization, except in so far as the efficiency of modern navies debarred the Mainotes from their old resource of piracy.

See W. Martin Leake, *Travels in the Morea* (1830); M. E. Yemeniz, "La Maina," in *Revue des deux mondes* (March 1, 1865); and Philipson, "Zur Ethnographie des Peloponnes," in *Petermanns Mittheilungen*, vol. 36 (Gotha).

MAINE, ANNE LOUISE BÉNÉDICTE DE BOURBON, DUCHESSE DU (1676–1753), daughter of Henri Jules de Bourbon, prince de Condé and Anne of Bavaria, was born on the 8th of November 1676. On the 19th of March 1692 she married Louis Auguste de Bourbon, duc du Maine, son of Louis XIV. and Mme de Montespan. The duchesse du Maine held a little court at Sceaux, where she gave brilliant entertainments and immersed herself in political intrigues. Displeased with the action of the regent Orleans in degrading the illegitimate children of Louis XIV. from their precedence above the peers of France, she induced her husband to join in the Cellamare conspiracy for the transference of the regency to the king of Spain. The plot, however, was discovered, and she was imprisoned in 1719. The following year she returned to Sceaux, where she resumed her salon and gathered round her a brilliant company of wits and poets. She died in Paris on the 23rd of January 1753.

See Général de Piépape, *La Duchesse du Maine* (1910).

MAINE, SIR HENRY JAMES SUMNER (1822–1888), English comparative jurist and historian, son of Dr James Maine, of Kelso, Roxburghshire, was born on the 15th of August 1822. He was at school at Christ's Hospital, and thence went up to Pembroke College, Cambridge, in 1840. At Cambridge he was one of the most brilliant classical scholars of his time. He won a Craven scholarship and graduated as senior classic in 1844, being also senior chancellor's medallist in classics. Shortly afterwards he accepted a tutorship at Trinity Hall. In 1847 he was appointed regius professor of civil law, and he was called to the bar three years later; he held this chair till 1854. Even the rudiments of Roman law were not then included in the ordinary training of English lawyers; it was assumed at the universities that any good Latin scholar could qualify himself at short notice for keeping up such tradition of civilian studies as survived. Maine cannot have known much Roman law in 1847, but in 1856 he contributed to the *Cambridge Essays* the essay on Roman law and legal education, republished in the later editions of *Village Communities*, which was the first characteristic evidence of his genius. Meanwhile he had become one of the readers appointed by the Inns of Court, in the first of their many half-hearted attempts at legal education, in 1852. Lectures delivered by Maine in this capacity were the groundwork of *Ancient Law* (1861), the book by which his reputation was made at one stroke. Its object, as modestly stated in the preface, was "to indicate some of the earliest ideas of mankind, as they are reflected in ancient law, and to point out the relation of those ideas to modern thought." Within a year of its publication the post of legal member of council in India was offered to Maine, then a junior member of the bar with little practice, few advantages of connexion, and no political or official claims. He declined once, on grounds of health; the very next year the office was again vacant. This time Maine was persuaded to accept, not that his health had improved, but that he thought India might not make it much worse. It turned out that India suited him much better than Cambridge or London. His work, like most of the work done by Englishmen in India in time of peace, was not of a showy kind—its value is shown by the fact that he was asked to prolong his services beyond the regular term of five years, and returned to England only in 1869. The subjects on which it was his duty to advise the government of India were as much political as legal. They ranged from such problems as the land settlement of the Punjab, or the introduction of civil marriage to provide for the needs of unorthodox Hindus, to the question how far the study of Persian should be required or encouraged among European civil servants. On the civil marriage question in particular, and some years earlier on the still more troublesome one of allowing the remarriage of native converts to Christianity, his guidance, being not only learned but statesmanlike, was of the greatest value. Plans of codification, moreover, were prepared, and largely shaped, under Maine's direction, which were carried into effect by his successors, Sir J. Fitzjames Stephen and Dr Whitley Stokes. The results are open to criticism in details, but form on the whole a remarkable achievement in the conversion of unwritten and highly technical law into a body of written law sufficiently clear to be administered by officers to many of whom its ideas and language are foreign. All this was in addition to the routine of legislative and consulting work and the establishment of the legislative department of the government of India on substantially its present footing.

Maine's power of swiftly assimilating new ideas and appreciating modes of thought and conduct remote from modern Western life came into contact with the facts of Indian society at exactly the right time, and his colleagues and other competent observers expressed the highest opinion of his work. In return Maine brought back from his Indian office a store of knowledge which enriched all his later writings, though he took India by name for his theme only once. This essay on India was his contribution to the composite work entitled *The Reign of Queen Victoria* (ed. T. H. Ward, 1887). Not having been separately published, it is perhaps the least known of Maine's writings; but its combination of just perception and large grasp with command of detail is not easily matched outside W. Stubbs's prefaces to some of the chronicles in the Rolls series, and (more lately) F. W. Maitland's monographs. As vice-chancellor of the university of Calcutta, Maine commented, with his usual pregnant ingenuity, on the results produced by the contact of Eastern and Western thought. Three of these addresses were published, wholly or in part, in the later editions of *Village Communities*; the substance of others is understood to be embodied in the Cambridge Rede lecture of 1875, which is to be found in the same volume. The practical side of Maine's experience was not long lost to India; he became a member of the secretary of state's council in 1871, and remained so for the rest of his life. In the same year he was gazetted a K.C.S.I. In 1869 Maine was appointed to the chair of historical and comparative jurisprudence newly founded in the university of Oxford by Corpus Christi College. Residence at Oxford was not required, and the election amounted to an invitation to the new professor to resume and continue in his own way the work he had begun in *Ancient Law*. During the succeeding years he published the principal matters of his lectures in a carefully revised literary form: *Village Communities in the East and the West* (1871); *Early History of Institutions* (1875); *Early Law and Custom* (1883). In all these works the phenomena of societies in an archaic stage, whether still capable of observation or surviving in a fragmentary manner among more modern surroundings or preserved in contemporary records, are brought into line, often with singular felicity, to establish and illustrate the normal process of development in legal and political ideas.

In 1877 the mastership of Trinity Hall, Cambridge, where Maine had formerly been tutor, became vacant. There were two strong candidates whose claims were so nearly equal that it was difficult to elect either; the difficulty was solved by a unanimous invitation to Maine to accept the post. His acceptance entailed the resignation of the Oxford chair, though not continuous residence at Cambridge. Ten years later considerations of a somewhat similar kind led to his election to succeed Sir William Harcourt as Whewell professor of international law at Cambridge. His all too short performance in this office is represented by a posthumous volume which had not received his own final revision, *International Law* (1888)

Meanwhile Maine had published in 1885 his one work of speculative politics, a volume of essays on *Popular Government*, designed to show that democracy is not in itself more stable than any other form of government, and that there is no necessary connexion between democracy and progress. The book was deliberately unpopular in tone; it excited much controversial comment and some serious and useful discussion.

In 1886 there appeared in the *Quarterly Review* (clxii. 181) an article on the posthumous work of J. F. M'Lennan, edited and completed by his brother, entitled "The Patriarchal Theory." The article, though necessarily unsigned (in accordance with the rule of the *Quarterly* as it then stood), was Maine's reply to the M'Lennan brothers' attack on the historical reconstruction of the Indo-European family system put forward in *Ancient Law* and supplemented in *Early Law and Custom*. Maine was generally averse from controversy, but showed on this occasion that it was not for want of controversial power. He carried the war back into the invader's country, and charged J. F. M'Lennan's theory of primitive society with owing its plausible appearance of universal validity to general neglect of the Indo-European evidence and misapprehension of such portions of it as M'Lennan did attempt to handle.

Maine's health, which had never been strong, gave way towards the end of 1887. He went to the Riviera under medical advice, and died at Cannes on the 3rd of February 1888. He left a wife and two sons, of whom the elder died soon afterwards.

An excellent summary of Maine's principal writings may be seen in Sir Mountstuart Grant Duff's memoir. The prompt and full recognition of Maine's genius by continental publicists must not pass unmentioned even in the briefest notice. France, Germany, Italy, Russia have all contributed to do him honour; this is the more remarkable as one or two English publicists of an older school signally failed to appreciate him. Maine warned his countrymen against the insularity which results from ignorance of all law and institutions save one's own; his example has shown the benefit of the contrary habit. His prominent use of Roman law and the wide range of his observation have made his works as intelligible abroad as at home, and thereby much valuable information—for example, concerning the nature of British supremacy in India, and the position of native institutions there—has been made the property of the world of letters instead of the peculiar and obscure possession of a limited class of British public servants. Foreign readers of Maine have perhaps understood even better than English ones that he is not the propounder of a system but the pioneer of a method, and that detailed criticism, profitable as it may be and necessary as in time it must be, will not leave the method itself less valid or diminish the worth of the master's lessons in its use. The rather small bulk of Maine's published and avowed work may be explained partly by a fine literary sense which would let nothing go out under his name unfinished, partly by the drawbacks incident to precarious health. Maine's temperament was averse from the labour of minute criticism, and his avoidance of it was no less a matter of prudence. But it has to be remembered that Maine also wrote much which was never publicly acknowledged. Before he went to India he was one of the original contributors to the *Saturday Review*, founded in 1855, and the inventor of its name. Like his intimate friend Fitzjames Stephen, he was an accomplished journalist, enjoyed occasional article-writing as a diversion from official duties, and never quite abandoned it. The practice of such writing probably counted for something in the freedom and clearness of Maine's style and the effectiveness of his dialectic. His books are a model of scientific exposition which never ceases to be literature.

See Sir A. Lyall and others, in *Law Quart. Rev.* iv. 129 seq. (1888); Sir F Pollock, "Sir Henry Maine and his Work," in *Oxford Lectures, &c.* (1890); "Sir H Maine as a Jurist," *Edin. Rev.* (July 1893); Introduction and Notes to new ed. of *Ancient Law* (1906); Sir M. E. Grant Duff, *Sir Henry Maine: a brief Memoir of his Life, &c.* (1892); *Notes from a Diary, passim*, L. Stephen, "Maine" in *Dict. Nat Biog.* (1893), Paul Vinogradoff, *The Teaching of Sir Henry Maine* (1904). (F. Po.)

MAINE, an old French province, bounded N. by Normandy, E. by Orléanais, S. by Touraine and Anjou, and W. by Brittany. Before the Roman Conquest the region occupied by this province was inhabited by the Aulerci Cenomanni and the Aulerci Diablintes; under the Roman empire it consisted of two *civitates* comprised in the Provincia Lugdunensis Tertia—the Civitas Cenomannorum and the Civitas Diablintum, whose chief towns were Le Mans and Jublains. These two *civitates* were united during the barbarian period and formed a single bishopric, that of Le Mans, suffragan to the metropolitan see of Tours. Under the Merovingians and Carolingians the diocese of Le Mans corresponded to the Pagus Cenomanensis, and in the feudal period to the county of Maine. In the 16th century the county of Maine, with the addition of Perche, formed a military government—the province of Maine. Since 1790 this province has been represented approximately by the departments of Sarthe and Mayenne, the respective capitals of which are Le Mans and Laval. In 1855 the bishopric of Laval was separated from that of Le Mans. Maine was evangelized in the 3rd century by St Julian. After forming part of the kingdom of Syagrius, it was conquered by Clovis at the end of the 5th century. Owing to the scarcity of documents the history of Maine until the end of the 9th century is merged in the history of the bishops of Le Mans, which has come down to us in the *Actus pontificum Cenomannis in urbe degentium* (ed. Busson-Ledru, Le Mans, 1901), composed under the direction of Bishop Aldric (832–857). Roger (*c.* 892–*c.* 898) was perhaps the first hereditary count of Maine; the counts whose existence is certain are Hugh I. (*c.* 939–before 992), Hugh II. (before 992–1015), Herbert I. (1015–1032 to 1036), Hugh III. (1032 to 1036–1051), Herbert II. (1051–1062), William the Bastard (1063–1087), Robert Curthose (1087–1091), Hugh IV. (1091–1092) and Helias (1092–1110). Maine, which was in the vassalage of Anjou as early as the 9th century, was united to Anjou in 1110 by the marriage of Count Helias's daughter to Fulk V., count of Anjou, and passed to the English crown in 1154, when Henry Plantagenet (who was born at Le Mans) became king of England. In 1204, after the confiscation of the estates of John of England, Maine was united to France; in 1246 it was separated from France by Louis IX., who handed it over to his brother Charles, count of Provence. Again united to France in 1328, it was given in 1356 as an apanage to Louis, second son of King John II., and did not definitely return to the French crown until 1481, after the death of Charles II., count of Maine. During the Hundred Years' War Maine was taken in 1425 by the English, who lost it in 1448.

See *Histoire de l'église du Mans*, by Dom Piolin (Paris, 1851–1858), which is useful but out of date; *Revue historique et archéologique du Maine* (1876); *La Province du Maine* (1893); B. Hauréau, *Histoire littéraire du Maine* (1870–1877).

MAINE, a North Atlantic state of the United States of America, the most north-easterly state in the Union, and the largest of the New England group. It lies between 43° 4′ and 47° 27′ 33″ N., and between 66° 56′ 48″ and 71° 6′ 41″ W It is bounded N W. by the Canadian province of Quebec; N. and E. by the Canadian province of New Brunswick, from which it is separated in part by the natural barriers of the Saint John River, the Grand (or Schoodic) Lakes, the Saint Croix River, and Passamaquoddy Bay, S.S.E. by the Atlantic Ocean, and W by New Hampshire, the Piscataqua and Salmon Falls rivers being the natural boundary lines at the S.W. The area of the state is 33,040 sq. m., 3145 sq. m. being water surface.

Maine attracts more summer visitors than any other state in the Union. This is due to the cool and refreshing summer climate, the picturesque coast and its many islands, which are favourite grounds for camps and summer cottages, the mountains, and the beautiful lakes and rivers, many of which afford opportunities for good fishing and canoeing. Among the more widely known resorts are Mount Desert Island, on which is Bar Harbor, a fashionable summer place of great beauty; Long Island, Orr's and other islands in Casco Bay, Old Orchard, with a gently sloping white sand sea-beach 9 m. long, Rangeley and Moosehead Lakes, favourite resorts of fishermen and hunters; Mt Katahdin, in the heart of the moose country, and Poland Springs (38 m. by rail from Portland) in Androscoggin county, near lake Anasigunticook. About 1870, camps, summer cottages, summer hotels and boarding houses began to multiply throughout the state. The needs of this summer population gave a new impulse and a new turn to agriculture; and the demand for souvenirs revived among the Indians basket-weaving, moccasin-making, and such crafts.

Physical Features.—The surface is a gently rolling upland, forming a part of the "New England uplands," above which rise isolated mountain peaks and clusters of peaks, and below which are cut numerous river valleys.[1] The highest peak is Mt Katahdin (5200 ft.), a little N.E. of the centre of the state in Piscataquis county, which rises from a comparatively level upland. South-west of Katahdin, in Franklin county, are most of the other high peaks of the state: Saddleback Mountain (4000 ft.), Mt Abraham (3388 ft.), Mt Bigelow (3600 ft.), and Mt Blue (3200 ft.). A little N. of this line of mountain peaks is the water-parting which divides the state into a north slope and a south slope. The north slope descends gently both to the N. and to the E.; although quite hilly in the middle and western portions it is so poorly drained that swamps abound in all sections. The south slope which contains nearly all the mountains and is generally more hilly, has a mean descent toward the sea of about 7 ft. to the mile, the fall being greater in the W., where the mountains are high at the N. and the shore low at the S., and less to the E., where the water-parting is lower and the shore high and rocky.

After the uplift which caused the rivers to cut below the general "uplands," and develop well marked valleys for themselves, came the period of the great continental glaciation. The glacier or ice sheet overran all Maine, irregularly scouring out the bed rock to produce rock basins, damming up many river valleys with glacial deposits and completely disarranging the drainage lines. When the ice melted, the rock basins and the dammed-up valleys filled with water to produce lakes. This is the origin of the numerous lakes of Maine, which give it some of its most beautiful scenery, and help to make it a holiday resort in summer. These lakes are about 1600 in number, are scattered in all parts of the state, are especially numerous at high elevations, and have an aggregate area of more than 2000 sq. m. Few other regions have so many large lakes so variously situated, and with such beauty of aspect and surroundings. They contribute largely to a constant supply of water power for which the course of the rivers of S.W. Maine are exceptionally well adapted; many of them abound in trout, salmon, togue, black bass and pickerel; and near them there is still much game. Moosehead Lake (about 120 sq. m.; 35 m. long and from 2 m. to 10 m. wide), on the boundary between Piscataquis and Somerset counties, is the largest in Maine and the largest inland body of water wholly in New England; the Kennebec River is its principal outlet and Mt Kineo rises abruptly to about 1760 ft. above the sea (about 700 ft above the lake) on its eastern shore. Other lakes, such as the Rangeley Lakes,[2] Chesuncook and Twin Lakes on the Penobscot, and the Grand or Schoodic Lakes, in the western boundary at the head waters of the Saint Croix River, equal or surpass Moosehead in picturesqueness. The glacier or ice sheet, above referred to, deposited till or boulder clay, which was compacted under the enormous pressure of the ice sheet to form the "hard-pan" referred to later. The glaciation is also responsible for the poor soil of most of the state, for, although the rocks are the same crystallines which give good soils further south in unglaciated regions, all the decayed portions of the Maine rocks have been removed by glacial erosion, revealing fresh, barren rock over great areas, or depositing the rather sterile hard-pan as a thin coating in other places.

After the uplift came a period of subsidence, during which this region sank one or more thousand feet, allowing the sea to encroach on the land and run far inland into the previously made river valleys. This depression probably occurred during the glacial period, perhaps toward its close, and is responsible for the second most important feature of Maine physiography, the embayed coast. To this subsidence are due the picturesque coastal scenery, the numerous islands and bays, the good harbours and the peculiar coast-line.

The shortest distance between the N.E. and the S.W. extremities of the coast is only 225 m.; but, on account of projections and indentations, the coast-line measures not less than 2500 m. The headlands, the deep indentations and the numerous islands in the bays and beyond produce a beautiful mingling of land and sea and give to the whole ocean front the appearance of a fringed and tasselled border; west of the mouth of the Kennebec River are a marshy shore and many low grassy islands; but east of this river the shore becomes more and more bold, rising in the precipitous cliffs and rounded summits of Mt Desert and Quoddy Head, 1527 and 1000 ft. high respectively All along the coast-line there are capacious and well-protected harbours, Casco, Penobscot, Frenchman's, Machias and Passamaquoddy bays being especially noteworthy.

After the subsidence came another period of uplift, possibly still in progress. This uplift has brought up submarine deposits of sand, &c., to form little coastal plains at some points along the coast, providing good land for settlement and clay for brick and pottery Further evidence of this uplift is found in old beach lines now well above sea-level.

The principal river systems of Maine are the Saint John on the north slope, and the Penobscot, the Kennebec, the Androscoggin, and the Saco on the south slope. The mean height of the basin of the St John is exceeded only by that of the Androscoggin, but the fall of the St John River through the greater part of its course in Maine is only sufficient to give a sluggish or a gentle current. The Penobscot, Kennebec, Androscoggin and Saco have numerous falls and rapids.

Fauna.—The animal life of Maine shows a mixture of northern and southern forms, and very little that is peculiar as compared with surrounding regions. The state has moose, caribou and deer, especially in the northern part. The black bear, wolf, catamount, wolverine, wild cat, fox, beaver, racoon, marten, sable, woodchuck, skunk, otter, mink, rabbit and squirrel are also found. Geese, ducks and other water fowl frequent the lakes and bays in the migratory season, and eagles, gulls, hawks, kingfishers, owls, plover, woodcock, "partridge" (ruffed grouse), robins, orioles, bobolinks, blue birds, swallows, sparrows, and many other insectivorous birds are common. In the inland waters salmon, trout, togue (*Salvelinus namaycush*), pickerel and bass abound; along the shore there are lobsters, clams and scallops (*Pecten irradians*); and off the shore are herring, alewives, mackerel, cod, halibut, haddock, smelts, hake, menhaden, porgies and porpoises. The game in the North Woods attracts large numbers of sportsmen during the autumn season.

Flora.—Maine was formerly covered with forests, principally of white pine and spruce, but mixed with these were some hemlock, tamarack, cedar, and, on the south slope, birch, poplar, oak, maple and beech. Chestnut and walnut are rare and are found only near

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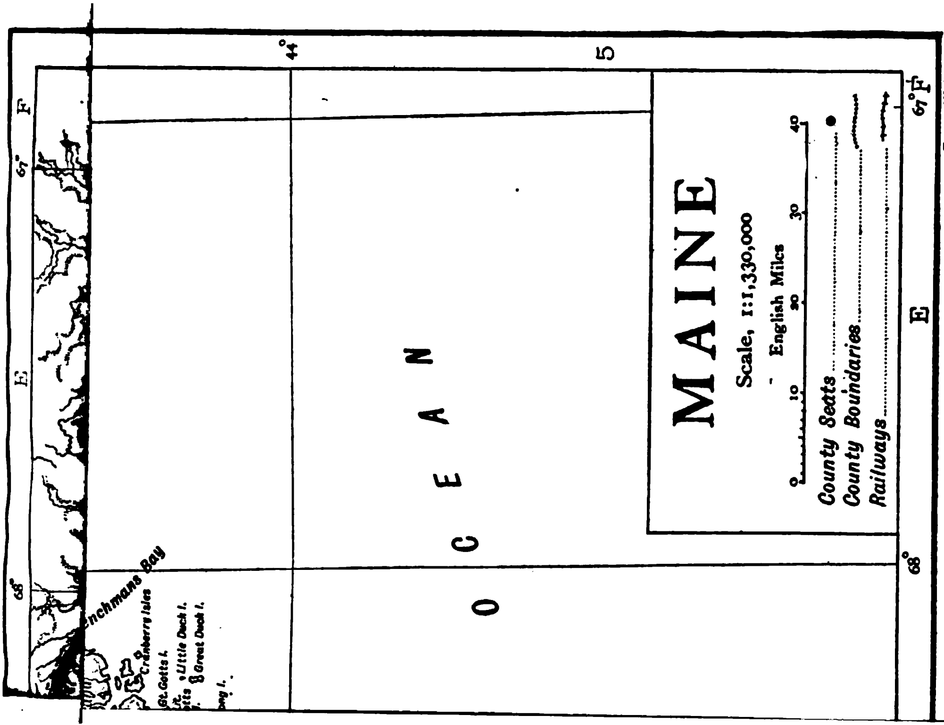
[1] This condition results from the fact that Maine and the adjacent region were worn down nearly to sea-level by stream erosion, except certain peaks and ridges inland; then the region was elevated and numerous river valleys were cut down below the general erosion surface formed before. Thus we have a general "upland surface," above which the mountain remnants tower, and below which the rivers have been entrenched.

[2] This name is applied to a chain of lakes (the Rangeley, or Oquossoc, the Cupsuptic, the Mooselookmeguntic, the Molechunkamunk or Upper Richardson, the Welokenebacook or Lower Richardson, and the Umbagog) in Franklin and Oxford counties, in the western part of the state; the Umbagog extends into New Hampshire and its outlet helps to form the Androscoggin River. These lakes are connected by straits, have a total area of between 80 and 90 sq. m., and are from 1200 to 1500 ft. above the sea. They are sometimes called the Androscoggin Lakes.



Emery Walker sc.

the south-west border. In 1900 about 21% of the state's area was cleared, and much besides had once been cleared, but not being suited to agriculture had become reforested. Of fruit trees the chief is the apple. The plum, cherry and pear also thrive. The peach grows well only in the south-west near the border. Species of grape, gooseberry and currant are native, and others are cultivated with advantage. The blackberry, raspberry, blueberry and strawberry grow wild in profusion throughout the state.

Climate.—The climate of the state is moist and, for its latitude, cold. Extremes of temperature are not so great as farther inland in the same latitude; for the summer heats are tempered by the sea and the cool north winds, and the winter cold is so constant as to be less severely felt than the changing temperature of more southern districts. The summers are short, there being only about 4½ months between frosts even in the southern sections, and the mean summer temperature is about 62° F. The mean winter temperature is approximately 20° F., and the mean annual temperature for the entire state is 42° F., that for the north slope being about 5° F. less than that for the south slope. Although the temperature remains pretty steadily below the freezing point for at least three months of the year, many of the harbours remain unobstructed; for the tides and the prevailing off-shore winds break up and drive off the ice. The precipitation is about 42 in. annually, and is distributed very evenly throughout the year, 10–11 in. of rain or its equivalent in snow falling each season. During 4½ months about 44% of the precipitation is in the form of snow; but the snow-fall varies from about 60 in. on the coast to more than 100 in. on the north slope. The winds are variable; at no season of the year is it usual for them to blow from the same direction for many days in succession. But, with the exception of those from the west, they are maritime and consequently moisture-bearing. In summer, especially in the latter part of it, the cool and moist N. or N.E. winds often cause a considerable part of the state to be enveloped in fog for several days in succession.

Agriculture.—The soil is for the most part glacial drift, containing a large mixture of clay with sand or gravel, and the sub-soil is mostly "hard-pan," *i.e.* mingled clay and boulders which have been so much compressed by glacial action as to make the mixture hard and ledge-like. Except in the valley of the Aroostook and along the Kennebec, the Penobscot, and some other rivers, the soil is generally unfit for cultivation, there being too little alluvium mixed with it to make it fertile. In the Arroostook valley, however, is the largest undivided area of good arable land in all New England, the soil being a deep, porous, yellow loam well adapted to the growth of cereals and to market gardening. The most sterile regions are on the mountains and along the coast. Because of the cold climate, the large areas in which there is little or no good arable land, the growing demand for timber land, and the large and constant supply of water-power afforded by the principal rivers, agriculture in Maine, as in all the other New England states except Vermont, is a smaller industry than manufacturing; in 1900 there were 87,932 people engaged in manufacturing and only 76,932 engaged in agriculture. Only 32·9% of the state's land area was in that year included in farms, only 37·9% of this farm land was improved, and only 16·3% of the improved land was in crops other than hay and forage. Nevertheless, as indicated by the unusually large proportion of farmers who either own their farms or pay cash rent for them, farming usually is profitable. The number of farms in 1900 was 59,299; of these 18,644 contained between 50 and 100 acres and 17,191 contained between 100 and 175 acres, the average size being 106·2 acres; 54,263 (or 91·5%) were operated by their owners, 775 were operated by part owners, 2030 by cash tenants, and only 745 by share tenants. Beginning with the middle of the 19th century, the increasing competition of the more productive soils of the West, the growth of urban population in the state, and the number of summer visitors effected the reforesting of much poor land and the more intensive cultivation of the better arable land. The cultivation of cereals, for example, has given way to a marked extent in nearly all the farming districts except in Aroostook county to market gardening, dairying, and egg and poultry production. The number of dairy cows increased from 157,240 in 1890 to 183,000 in 1908, and the annual production of milk increased from 57,969,791 gallons in 1890 to 99,586,188 gallons in 1900. The number of other neat cattle (180,878 in 1900; 151,000 in 1908) decreased during every decade from 1860 to 1900; the number of sheep in 1900 was 427,209 (31·9% less than in 1890), and in 1908 it was 267,000; but the number of horses in 1890 and 1900 was about the same (140,310 in 1900, but only 116,000 in 1908). Hay is still by far the largest crop, the acreage of it and of forage in 1899 being 1,270,254 acres, or 76·5% of that of all crops, and the yield was 1,133,932 tons; in 1907 the acreage was 1,400,000 acres, and the crop was 2,100,000 tons. The acreage of cereals decreased from 187,013 in 1880, when agriculture in Aroostook county was little developed, to 166,896 in 1899, when the cereal acreage in Aroostook county alone was 82,069. Maine potatoes are of a superior quality, and the acreage of this crop increased from 49,617 in 1889 to 118,000 in 1907. Sweet Indian corn, cabbages, turnips, cucumbers and tomatoes are grown in large quantities. The fruit crop consists very largely of apples and strawberries (1,421,773 bushels of apples and 1,066,860 quarts of strawberries in 1899). The output of eggs increased from 9,369,534 dozen in 1889 to 13,304,150 dozen in 1899. The most productive dairy section of the state is a belt extending from the south-west corner N.E. entirely across the state and embracing the whole or parts of the counties of York, Oxford, Cumberland, Androscoggin, Kennebec, Penobscot and Aroostook.

Lumber Industry.—Except in the remote parts, the valuable white pine, for which Maine was long noted, has been cut; but the woodland of the state was estimated in 1900 at 23,700 sq. m. or 79% of its area. The tendency is for this area to increase, for the establishment between 1890 and 1900 of large paper and pulp mills on some of the principal rivers of the south slope greatly increased the value of forests, especially those of spruce and poplar. The state makes large appropriations for preventing and extinguishing forest fires, and in 1903 established a department of forestry in the university of Maine. Good spruce, which is by far the most valuable timber in the state and is used most largely for the manufacture of paper and pulp, stands in large quantities in the St John, Penobscot, Androscoggin and Kennebec basins. Poplar, also used for the manufacture of paper, abounds in several sections of the south slope, but is most abundant in the basin of the Kennebec. White birch, used largely for the manufacture of spools, is found throughout a wide belt extending across the middle of the state. There is much cedar on the north slope. Oak, maple and beech are rather scarce. A new growth of white pine and other timber is gradually becoming valuable. The value of the timber product increased from $11,849,654 in 1890 to $13,489,401 in 1900, and to $17,937,683 in 1905.

Fisheries.—Fishing has always been an important industry in Maine. From 1901 to 1904 inclusive, the average annual catch amounted to 195,335,646 lb, and its average value was $5,557,083. In 1908, according to state reports, the catch was 185,476,343 lb, valued at $3,849,900. Herrings are caught in largest quantities (in 1908, according to state reports, 68,210,800 lb, valued at $450,665), and Maine is noted for the canning of the smaller herrings under the name of "sardines." In 1908, according to state reports, the take of lobsters was 17,635,980 lb, valued at $1,558,252. Maine markets more clams than any other state in the Union, and the catches of cod, hake, haddock, smelt, mackerel, swordfish, shad, pollock, cusk, salmon, alewives, eels and halibut are of importance. The scallop fishery is becoming more and more valuable. For the protection and promotion of the lobster fishery the United States government has established a lobster hatchery at Boothbay Harbor; and the state legislature enacted a law in 1895 prohibiting the taking of lobsters less than 10½ in. in length (one effect of this law being to drive the lobster-canning industry from the state) and another law in 1903 for the protection of lobsters with eggs attached. This latter law directs the state fish commissioner to purchase such lobsters whenever caught and either to liberate them or to sell them to the United States for keeping in a fish hatchery.

Minerals.—The principal mineral products are granite, limestone, slate, clay products and mineral waters. In 1905 Maine held first rank among the states of the Union as a producer of granite, the value of the output being $2,713,795. In 1907 Maine's granite was valued at $2,146,420, that of Massachusetts at $2,328,777, and that of Vermont at $2,693,889. The stone is of superior quality, and the largest part of it is used for building purposes; much of it is used as paving blocks and some for monuments. It abounds all along the coast east of the Kennebec and on the adjacent islands, and is found farther inland, especially about the Rangeley lakes in Franklin and Oxford counties, and, near Mt Katahdin, in Penobscot and Piscataquis counties. The principal quarries, however, are situated in positions most convenient for shipment by water, in the vicinity of Penobscot bay and in Kennebec county, and these have supplied the bulk of the material used in the construction of many prominent buildings and monuments in the United States. The Fox Island granite comes from the quarries on Vinalhaven Island and the surrounding islands, and on Vinalhaven were quarried monolithic columns 51·5 to 54 ft. long and 6 ft. in diameter for the Cathedral of St John the Divine in New York City. Black granite was quarried in 1907 at 12 quarries, in York, Lincoln, Waldo, Penobscot and Washington counties. Limestone abounds, especially in the south-east part of the state, but it is quarried chiefly in Knox county. As its colour—blue and blue-black streaked with white—renders it undesirable for building purposes, nearly all of it is burned into lime, which has become a very important article of manufacture in the city of Rockland; the industry dates back to 1733 in Knox county. In 1907 the quantity of lime burned in Maine was 159,494 tons and its value was $747,947. Slate is quarried chiefly in Piscataquis county, most of it being used for roofing, but some for blackboards; in 1907 the amount quarried in Maine was valued at $236,106. About 1896 some remarkably white and pure feldspar began to be quarried in Androscoggin, Oxford and Sagadahoc counties, but afterwards the spar mined in Maine was of less excellent quality; in 1907 the production in Maine was valued at $157,334, the total for the entire country being $499,069. Clay is obtained in various places, and in 1905 the total value of the clay products was $619,294. In Oxford county tourmaline, spodumene (or kunzite) and beryl occur, the tourmaline crystals being notably large and beautiful. Mineral water occurs in many localities, particularly in Androscoggin, York, Cumberland and Oxford counties; the most famous springs are the Poland Springs in Androscoggin county. Most of the mineral waters bottled in the state are chalybeate and slightly alkaline—saline; their average temperature is about 43°. In 1908 27 springs were reported, their aggregate sales amounting to 1,182,322 gallons. Copper, gold alloyed with platinum, iron ore, barytes, graphite and lead occur in small quantities in the state. In 1908 the total mineral product of the state was valued at $7,044,678.

Manufactures.—Although Maine has no coal and only a very small amount of iron ore within her borders for the encouragement of manufacturing, yet the abundance of fine timber and the numerous coves, bays and navigable streams along or near the coast promoted ship-building from the first, and this was the leading industry of the state until about the middle of the 19th century, when wooden ships began to be supplanted by those of iron and steel. Until about the same time, when the Maine liquor law was passed, the manufacture of rum from molasses, received in exchange for lumber and fish in the West Indies, was also an important industry. It was not until early in the 19th century that the large and constant supply of water power afforded by the rivers began to be used to any considerable extent. The first cotton mill was built at Brunswick on the Androscoggin about 1809, and from 1830 the development of cotton manufacturing was rapid; woollen mills followed, and late in the 19th century were erected some of the largest paper and pulp mills in the country, which are run by water power from the rivers, and use the spruce and poplar timber in the river basins. The total value of the manufactures of the state increased from $95,689,500 in 1890 to $127,361,485 in 1900; and in 1905 the value of factory-made products alone was $144,020,197, or 27·5 % greater than their value in 1900.[1] Measured by the value of the output, paper and wood pulp rose from fifth among the state's manufactures in 1890 to third in 1900 and to first in 1905; from $3,281,051 in 1890 to $13,223,275 in 1900, an increase of 303% within the decade, and to $22,951,124 in 1905, a further increase of 73·6% in this period. Lumber and timber products ranked second (1905)—$11,849,654 in 1890, $13,489,401 in 1900, and $17,937,683 in 1905. Cotton goods ranked third (1905) in value—$15,316,909 in 1890, $14,631,086 in 1900, and $15,404,823 in 1905. Woollen goods ranked fourth (1905)—$8,737,653 in 1890, $13,744,126 in 1900, an increase of 57·3% within the decade; and the value of the factory-made product alone in 1905 was $13,969,600, or 20·1% greater than in 1900. Boots and shoes ranked fifth (1905)—$12,295,847 in 1900, and $12,351,293 in 1905. Fish, canned and preserved, followed next, $1,660,881 in 1890 and $4,779,773 in 1900, an increase within the decade of 187·8%, most of which was in one branch—the canning of small herring under the name "sardines"; from 1900 to 1905 the increase was slight, only $275,358, or 5·8%. In the value of its manufactures as compared with those of the other states of the Union, in wooden ships and boats, Maine in 1900 and in 1905 was outranked by New York only; in canned and preserved fish by Washington only (the value of fish canned and preserved in Maine in 1900 was 21·7% of the total for the United States, and in 1905 19·2%); in the output of woollen mills by Massachusetts and Pennsylvania only; in the output of paper mills by New York and Massachusetts only. It ranked ninth in 1900 and tenth in 1905 in the value of its cotton goods. Portland, Lewiston, Biddeford, and Auburn are the leading manufacturing cities, and in 1905 the total value of their manufactures was 21·5% of those of the entire state. But from 1900 to 1905 the value of manufactures grew most rapidly in Rockland (especially noted for lime), the increase being from $1,243,881 to $1,822,591 (46·5%), and in Waterville, where the increase was from $2,283,536 to $3,069,309 (34·4%). Among the largest paper mills are those at Millinocket, in Penobscot county, at Madison on the Kennebec river, and at Rumford Falls on the Androscoggin river. Lewiston leads in the manufacture of cotton goods; Auburn, Bangor and Augusta, in the manufacture of boots and shoes; Bath, in ship and boat building; Eastport and Lubec, in canning "sardines."

Transportation and Commerce.—The south-western part of the state, including the manufacturing, the quarrying, and much of the older agricultural district, early had fairly satisfactory means of transportation either by water or by rail; for the coast has many excellent harbours, the Kennebec river is navigable for coast vessels to Augusta, the Penobscot to Bangor, and railway service was soon supplied for the villages of the south-west, but it was not until the last decade of the 19th century that the forests, the farming lands, and the summer resorts of Aroostook county were reached by a railway, the Bangor & Aroostook. The first railway in the state, from Bangor to Old Town, was completed in 1836, and the state's railway mileage increased from 12 m. in that year to 245 m. in 1850, to 1377·47 m. in 1890, and to 2210·79 in January 1909. The principal railway systems are the Maine Central, which enters every county but one, the Boston & Maine, the Bangor & Aroostook, the Grand Trunk and the Canadian Pacific. Lines of steamboats ply regularly between the largest cities of the state and Boston, between Portland and New York, and between Portland and several Canadian ports.

The foreign trade, especially that with the West Indies and with Great Britain, decreased after 1875, and yet much trade from the West that goes to Montreal during the warmer months passes through Portland during the winter season. The chief exports to foreign countries are textile fabrics, Indian corn, meat, dairy products, apples, paraffin, boards and shooks; the chief imports from foreign countries are sugar, molasses and wool. Fish, canned goods, potatoes, granite, lime, paper, and boots and shoes are also exported to foreign countries to some extent, but they are shipped in larger quantities to other states of the Union, from which Maine receives in return cotton, coal, iron, oil, &c. The ports of entry in Maine are Bangor, Bath, Belfast, Castine, Eastport, Ellsworth, Houlton, Kennebunk, Machias, Portland, Wiscasset and York.

Population.—The population in 1880 was 648,936; in 1890, 661,086; in 1900, 694,466; and in 1910, 742,371.[2] From 1880 to 1900 there was an increase of only 7%, a percentage which was exceeded in every other state in the Union except Nevada and Vermont. Of the total population of 1900, 599,291, or 86·3%, were native whites, 93,330 were foreign-born, 1,319 were negroes, 798 were Indians, 119 were Chinese, and 4 were Japanese. Of the inhabitants born in the United States, 588,211, or 97·8%, were natives of New England and 560,506 were natives of Maine, and of the foreign-born 67,077, or 71·8%, were natives of Canada (36,169 English and 30,908 French), and 10,159, or 10·8%, were natives of Ireland. Of the total population, 199,734 were of foreign parentage—*i.e.* either one or both parents were foreign-born—and 89,857 were of Canadian parentage, both on the father's and on the mother's side (41,355 English and 48,502 French). The French-speaking inhabitants probably number considerably more than 50,000. They are of two quite distinct classes. One, numbering about 15,000, includes those who became citizens by the establishment of the northern boundary in 1842 and their descendants. They are largely of Acadian stock. The state has established among them a well-appointed training school for teachers, conducted in the English language, the graduates of which render excellent service in the common schools. The other class is of French-Canadian immigrants, who find profitable employment in the manufacturing centres. The colony of Swedes established by the state near its north-eastern border in 1870 has proved in every way successful. The Indians are remnants of the Penobscot and Passamaquoddy tribes, the Passamaquoddies being a little the more numerous. The Penobscots' chief gathering places are on the islands of the Penobscot river north of Old Town; the Passamaquoddies', on the shores of Passamaquoddy Bay and the banks of the Saint Croix river.

Roman Catholics are more numerous than all the Protestant sects taken together, having in 1906 a membership of 113,419 out of a total of 212,988 in all denominations. In the last decade of the 19th century the urban population (*i.e.* population of places having 4,000 inhabitants or more) increased from 226,268 to 251,685, or 11·2%; the semi-urban population (*i.e.* population of incorporated places, or the approximate equivalent, having less than 4,000 inhabitants) increased from 14,221 to 26,674, or 87·5%; while the rural population (*i.e.* population outside of incorporated places) decreased from 420,597 to 416,134, or 1%. The principal cities of the state are: Portland, pop. (1910), 58,571; Lewiston, 26,247; Bangor, 24,803; Biddeford, 17,079; Auburn, 15,064; Augusta (the capital), 13,211; Waterville, 11,458; Bath, 9,396; Westbrook, 8,281; and Rockland, 8,174.

Administration.—Maine has had but one state constitution; this was ratified in December 1819, about three months before the admission of the state into the Union. It admits of amendment by a two-thirds vote of both houses of the legislature followed by a majority vote of the electorate at the next

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[1] The census of 1905 was taken under the direction of the United States census bureau, but the statistics for hand trades were omitted.

[2] According to previous censuses the population was as follows: (1790) 96,540; (1800) 151,719; (1810) 228,705; (1820) 298,335; (1830) 399,455; (1840) 501,793; (1850) 583,169; (1860) 628,279; (1870) 626,915.

September election; or, as provided by an amendment adopted in 1875, the legislature may by a two-thirds vote of each house summon a constitutional convention. From 1819 to 1875 twelve amendments were adopted; in 1875, after nine more were added, the twenty-one were incorporated in the text; and between 1875 and 1899 nine more were adopted. Suffrage is conferred by the constitution on all male citizens of the United States who are at least twenty-one years of age and have, for some other reason than because of being in the military, naval or marine service of the United States, or of being students at college, lived in the state for three months next preceding any election; the following classes, however, are excepted: paupers, persons under guardianship, Indians not taxed, and, as provided by an amendment adopted in 1892, persons intellectually incapable of reading the state constitution in the English language or of writing their names. State elections were annual until 1897 when they were made biennial; they are held on the second Monday in September in even numbered years, Maine being one of the few states in the Union in which they are not held in November.

The governor is the only executive officer of the state elected by popular vote. There is no lieutenant-governor, the president of the Senate succeeding to the office of governor in case of a vacancy, but there is a council of seven members elected by the legislature (not more than one from any one senatorial district), whose sole function is to advise the governor. The governor's term of office is two years (before 1879 it was one year); and the constitution further directs that he shall be at least thirty years of age at the beginning of his term, that he shall be a native-born citizen of the United States, that when elected he shall have been a resident of the state for five years, and that he shall reside in the state while in office. His power of appointment is unusually extensive and the advice and consent of the council (instead of that of the Senate as in other states) are required for his appointments. He appoints all judges, coroners and notaries public, besides all other civil and military officers for whose appointment neither the constitution nor the laws provide otherwise. The governor is commander-in-chief of the state militia. Any bill of which he disapproves he can within five days after its passage prevent from becoming a law unless it is passed over his veto by a two-thirds vote of each house of the legislature. He and the council examine and pass upon election returns; he may summon extra sessions of the legislature, and he may grant pardons, reprieves, and commutations in all cases except impeachment, but the manner of hearing applications for pardon is in a measure prescribed by statute, and he must present to the legislature an account of each case in which he grants a pardon. His salary is $2,000 a year. The seven members of the council, the secretary of state, the treasurer, the attorney general and the commissioner of agriculture are elected biennially by a joint ballot of the two houses of the legislature, which also elects, one every two years, the three state assessors, whose term is six years.

The legislature meets biennially at Augusta, the capital, and is composed of a Senate of thirty-one members and a House of Representatives of one hundred and fifty-one members. Members of each house are elected for a term of two years: one senator from each senatorial district and one to seven representatives (one for a population of 1,500, and seven for a population of 26,250) from each township, or, where the township or plantation has less than 1,500 inhabitants, from each representative district, according to its population. There is a new reapportionment every ten years, counting from 1821. Every senator and every representative must at the beginning of his term have been for five years a citizen of the United States, for one year a resident of the state, and for three months next preceding his election, as well as during his term of office, a resident of the township or district which he represents; and every senator must be at least twenty-five years of age. All revenue bills must originate in the House of Representatives, but to such bills the Senate may propose amendments provided they relate solely to raising revenue. Other bills may originate in either house. In September 1908 a constitutional amendment was adopted providing for referendum and initiative by the people. Any bill proposed in the legislature or passed by it must be referred to popular vote before becoming law, if there is a referendum petition therefor signed by 10,000 voters; and a petition signed by 12,000 voters initiates new legislation.

At the head of the department of justice is the supreme judicial court, which consists of a chief justice and seven associate justices appointed by the governor and council for a term of seven years. When it sits as a law court, at least five of its justices must be present, and it holds three such sessions annually: one at Augusta, one at Bangor, and one at Portland. But only one of its justices is required for a trial court, and trial courts are held two or three times a year in each county for the trial of both civil and criminal cases which come before it in the first instance or upon appeal. In Cumberland and Kennebec counties there is a superior court presided over by one justice and having extensive civil and criminal jurisdiction; and in each of the counties there are a probate court for the settlement of the estates of deceased persons and courts of the trial justice and the justice of the peace for the trial of petty offences and of civil cases in which the debt or damage involved does not exceed $20.

The principal forms of local government are the town (or township), the plantation, the county and the city. As in other parts of New England, the town is the most important of these. At the regular town meeting held in March the electorate of the town assembles, decides what shall be done for the town during the ensuing year, elects officers to execute its decisions with limited discretion, and votes money to meet the expenses. The principal officers are the selectmen (usually three), town clerk, assessors, collector, treasurer, school committee and road commissioner. A populous section of a town, in order to promote certain financial ends, is commonly incorporated as a village without however becoming a governing organization distinct from the town. Maine is the only state in the Union that retains what is known as the organized plantation. This is a governmental unit organized from an unincorporated township having at least 200 inhabitants,[1] and its principal officers are the moderator, clerk, three assessors, treasurer, collector, constable and school committee. The county is a sort of intermediate organization between the state and the towns to assist chiefly in the administration of justice, especially in the custody of offenders, and in the making and care of roads. Its officers are three commissioners, a treasurer, a register of deeds, a judge and a register of probate, and a sheriff. They are all elected: the commissioners for a term of six years, one retiring every two years, the register of deeds and the judge and the register of probate for a term of four years, and the others for two years. Among other duties the commissioners care for county property, manage county business and take charge of county roads. Maine has no general law under which cities are chartered, and does not even set a minimum population. A town may, therefore, be incorporated as a city whenever it can obtain from the legislature a city charter which a majority of its electorate prefers to a continuance under its town government; consequently there is much variety in the government of the various cities of the state.

By the laws of Maine the property rights of a wife are approximately equal to those of a husband. A woman does not lose nor a man acquire right to property by marriage, and a wife may manage, sell, or will her property without the assent of her husband. She may even receive as her own the wages of her personal labour which was not performed for her own family. In the absence of a will, bar or release, there is no legal distinction between the rights of a widower in the estate of his deceased wife and those of a widow in the estate of her deceased husband. The grounds for divorce in the state are adultery, impotence, extreme cruelty, desertion for three consecutive years next preceding the application, gross and confirmed habits of intoxication, cruel and abusive treatment, or a husband's gross or wanton refusal or neglect to provide a suitable maintenance for his wife.

Under the laws of Maine a householder owning and occupying a house and lot may hold the same, or such part of it as does not exceed $500 in value, as a homestead exempt from attachment, except for the satisfaction of liens for labour or material, by filing in the registry of deeds a certificate stating his desire for such an exemption, provided he is not the owner of an exempted lot purchased from the state; and the exemption may be continued during the widowhood of his widow or the minority of his children. A considerable amount of personal property, including apparel, household furniture not exceeding $100 in value, a library not exceeding $150 in value, interest in a pew in a meeting-house, and a specified amount of fuel, provisions, tools or farming implements, and domestic animals, and one fishing boat, is also exempt from attachment.

Maine was the first state in the Union to enact a law for prohibiting the sale of intoxicating liquors. An act for restricting the sale of such liquors was passed in 1846; the first prohibitory act was passed, largely through the influence of Neal Dow, in 1851; this was frequently amended; and in 1884 an amendment to the constitution was adopted which declares the manufacture of intoxicating liquors and their sale, except "for medicinal and mechanical purposes and the arts," forever prohibited. By the law enacted for enforcing this prohibition the governor and council appoint a state liquor commissioner from whom alone the selectmen of a town, the mayor or aldermen of a city, are authorized to receive the liquors which may be sold within the exceptions named in the amendment, and the selectmen, mayor or aldermen appoint an agent who alone is authorized to sell any of these liquors within their jurisdiction and who is forbidden to sell any whatever to minors, Indians, soldiers and drunkards. But the law labours under the disadvantage of all laws not vigorously sustained by general public sentiment, and is grossly violated. For the most part it is executed to the degree demanded by local sentiment in the several municipalities, thus operating in practice much the same as a "local option" law. The law looks to checking the demand by preventing the supply; and since habitual reliance on the stringency of law tends to the neglect of other influences for the removal of evils from the community, the citizens seem to absolve themselves from personal responsibility, both for the execution of the law and for the existence of the evil itself. There has been a strong movement for the repeal of the law, and the question of prohibition has long been an important one in state politics.

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[1] An unincorporated township containing less than 200 inhabitants may, on the application of three resident voters, be organized as a plantation, but does not pay state or county taxes unless by special legislative order. Other unincorporated districts, especially islands along the coast, are called "grants," "surpluses," "gores" or "tracts."

The death penalty was abolished in Maine in 1876, restored in 1883, and again abolished in 1887.

Penal and Charitable Institutions.—The state penal and reformatory institutions consist of the state prison at Thomaston, the state (reform) school for boys at South Portland, and a state industrial school for girls at Hallowell, established in 1875 and taken over by the state in 1899. The two schools are not places of punishment, but reformatory schools for delinquent boys (from 8 to 16 years of age) and girls (from 6 to 16 years), who have been committed by the courts for violations of law, and, in the case of girls, who, by force of circumstances or associations, are "in manifest danger of becoming outcasts of society." The prison is in charge of a board of three inspectors and a warden, and each of the other two institutions is in charge of a board of trustees; the inspectors, warden, and trustees are all appointed by the governor and council. Convicts in the prison are usually employed in the manufacture of articles that are not extensively made elsewhere in the state, such as carriages, harness, furniture and brooms. The inmates of the state school for boys receive instruction in farming, carpentry, tailoring, laundry work, and various other trades and occupations; and the girls in the state industrial school are trained in housework, laundering, dressmaking, &c. Paupers are cared for chiefly by the towns and cities, those wholly dependent being placed in almshouses and those only partially dependent receiving aid at their homes. The charitable institutions maintained by the state are: the military and naval orphan asylum at Bath, the Maine institution for the blind at Portland, the Maine school for the deaf (established in 1876, and taken over by the state in 1897) at Portland, the Maine insane hospital at Augusta, the Eastern Maine insane hospital at Bangor, and a school for the feeble-minded (established in 1907) at West Pownal, each of which is governed by trustees appointed by the governor and council, with the exception of a part of those of the orphan asylum, who are appointed by the corporation. Besides the strictly state institutions, there are a number of private charitable institutions which are assisted by state funds; among these are the eye and ear infirmary at Portland, the Maine state sanatorium at Hebron for the treatment of tuberculosis, and various hospitals, orphanages, &c. The national government has a branch of the national home for disabled volunteer soldiers at Togus, and a marine hospital at Portland.

Education.—The school-district system was established in 1800 while Maine was still a part of Massachusetts and was maintained by the first school law passed, in 1821, by the state legislature; but, beginning in the next year, one town after another received the privilege of abolishing its districts, and in 1893 the system was abolished by act of the legislature. A state board of education, composed of one member from each county, was established in 1846, but for this was substituted, in 1852, a commissioner of schools for each county, appointed by the governor, and two years later a state superintendent of schools was substituted for the county commissioners. County supervision by county supervisors was tried in 1869–1872. Since these several changes the common school system has been administered by towns and cities subject to an increasing amount of control through enactments of the state legislature and the general supervision of the state superintendent. The town officers are a superintending school committee of three members and a superintendent. The members of the committee are elected for a term of three years, one retiring every year, and women as well as men are eligible for the office. The superintendent may be elected by the town or appointed by the committee, or towns having not less than twenty or more than fifty schools may unite in employing a superintendent. In cities the committee is usually larger than in towns and is commonly elected by wards. Since 1889 each town and city has been required to furnish textbooks, apparatus and supplies, without cost to the pupils. The minimum length of the school year is fixed by a statute of 1893 at twenty weeks; the average length is about twenty-eight weeks. A compulsory education law, enacted in 1901, requires the attendance at some public or approved private school of each child between the ages of seven and fifteen during all the time that school is in session, except that necessary absences may be excused. For the maintenance of the common schools each town is required (since 1905) to raise annually at least fifty-five cents *per capita*, exclusive of what may be received from other sources, and to this is added the proceeds of a state tax of one and a half mills on a dollar, one-half the proceeds of the tax on savings banks, a 6% income from the permanent school fund (derived mainly from the sale of school lands), and state appropriations for the payment in part of the superintendence in towns that have united for that purpose. Any section of a town may establish and maintain a high school provided there be not more than two such schools in one town, and the state makes appropriations for the support of such schools equal to one-half the cost of instruction, but the maximum grant to any one such school is $250.

The state maintains five normal schools: that at Farmington (established 1864), that at Castine (1866), that at Gorham (1879); that at Presque Isle (the Aroostook state normal school, 1903), and the Madawaska training school at Fort Kent, each of which is under the direction of a board of trustees consisting of the governor, the state superintendent of schools, and five other members appointed by the governor and council for not more than three years. At the head of the public school system is the university of Maine, near the village of Orono in Orono township (pop. in 1900, 3257), Penobscot county. This institution was founded in 1865 as the state college of agriculture and the mechanic arts; in 1897 the present name was adopted. It embraces a college of arts and sciences, a college of agriculture, a college of technology (including a department of forestry), a college of law (at Bangor), and a college of pharmacy. The most conspicuous of its twenty-five buildings is the library, built with funds contributed by Andrew Carnegie. In 1908–1909 the university had 104 instructors and 884 students, of whom 113 were in the college of law at Bangor and 420 in the college of technology. The university is maintained with the proceeds of an endowment fund derived chiefly from public lands given by the national government in accordance with the land grant, or Morrill, Act of 1862 (see MORRILL, JUSTIN S.) and from the bequest ($100,000) of Abner Coburn (1803–1885); by appropriations of Congress under the second Morrill Act (1890), and under the Nelson Amendment of 1907, by appropriations of the state legislature, and by fees paid by the students. Connected with the university is an agricultural experiment station, established and maintained under the Hatch Act (1887) and the Adams Act (1906) of the national Congress. The government of the university is entrusted, subject to inspection of the governor and council, to a board of eight trustees. Among the important institutions of learning which have no official connexion with the state are Bowdoin College (opened in 1802), at Brunswick; Colby College (Baptist, opened in 1818), at Waterville; and Bates College (originally Free Baptist but now unsectarian; opened in 1863), at Lewiston. In 1900 5·1% of the state's inhabitants ten years of age and over were illiterate (*i.e.* could neither read nor write, or could read but not write); of the native whites within this age limit 2·4% were illiterate, of the foreign whites, 19·4%. Of the foreign-born whites 15·7% were unable to speak English.

Finance.—The chief sources of the state's revenue are a general property tax and taxes on the franchises of corporations, especially those of railway and insurance companies and savings banks; among the smaller sources are licences or fees, a poll tax, and a collateral inheritance tax. The general property tax for state and local purposes is assessed by local assessors, but their work is reviewed for the purpose of equalization among the several towns and counties by a board of state assessors, which also assesses the corporations. This board of three members (not more than two of whom may be of the same political party) is elected by a joint ballot of the two houses of the legislature for a term of six years, one member retiring every two years. The state is prohibited by the constitution from creating a debt exceeding $300,000 except for the suppression of a rebellion, for repelling an invasion, or for war purposes; and every city and town is forbidden by an amendment adopted in 1877 from creating one exceeding 5% of the assessed value of its property. But the state was authorized by an amendment adopted in 1868 to issue bonds for the reimbursement of the expenses incurred by its cities, towns, and plantations on account of the Civil War, and these bonds, with those issued by the state itself during the Civil War, constituted the largest part of the state's bonded indebtedness. The bonded debt, however, is rapidly being paid; in January 1901 it was $2,103,000, and in January 1909 only $698,000.

History.—During the 16th century and the early part of the 17th, the coast of Maine attracted various explorers, among them Giovanni da Verrazano (1524), Estéban Gomez (1525), Bartholomew Gosnold (1602), Martin Pring (1603), Pierre du Guast, Sieur De Monts (1604), George Weymouth (1605), and John Smith (1614), who explored and mapped the coast and gave to the country the name New England; but no permanent English settlement was established within what are now the borders of the state until some time between 1623 and 1629. In 1603 De Monts received from Henry IV. of France a charter for all the region between 40° and 46° N. under the name of Acadie, or Acadia, and in 1604 he built a fort on Neutral Island at the mouth of the Saint Croix river. This he abandoned in 1605, but some of his followers were in the vicinity a few years later. In the same year George Weymouth explored the south-west coast, kidnapped five Indians, and carried them to England, where three of them lived for a time in the family of Sir Ferdinando Gorges, who soon became the leader in founding Maine. In 1607 the Plymouth Company, of which he was an influential member and which had received a grant of this region from James I. of England in the preceding year, sent out a colony numbering 120 under George Popham (*c*. 1550–1608), brother of Sir John Popham, and Raleigh Gilbert, son of Sir Humphrey Gilbert. The colony established itself at the mouth of the Kennebec river in August, but, finding its supplies insufficient, about three-fifths of its number returned to England in December; a severe winter followed and Popham died; then Gilbert, who succeeded to the presidency of the council for the colony, became especially interested in his claim to the territory under his father's charter,[1] and in 1608 the colony was abandoned. In 1609 the French Jesuits Biard and Masse established a fortified mission station on the island of Mount Desert, and although this as well as the remnant of De Monts' settlement at the mouth of the Saint Croix was taken in 1613 by Sir Samuel Argall (d. 1626), acting under the instructions of the English at Jamestown, Virginia, some of these colonists returned later. In 1620 the Council for New England, the successor of the Plymouth Company, obtained a grant of the country between latitude 40° and 48° N. extending from sea to sea, and two years later Gorges and John Mason (1586–1635) received from the Council a grant of the territory between the Merrimac and the Kennebec rivers for 60 m. inland under the name of the Province of Maine. In 1629 they divided their possession, Gorges taking the portion between the Piscataqua and the Kennebec. Numerous grants of land in this vicinity followed within a few years; and in the meantime permanent settlements at York, Saco, Biddeford, Port Elizabeth, Falmouth (now Portland) and Scarborough were established in rapid succession. The Council for New England surrendered its charter in 1635. In the division of its territory Gorges retained the portion previously granted to him, and the region between the Kennebec and the Saint Croix north to the Saint Lawrence, though still claimed by the French as part of Acadia, was conveyed to Sir William Alexander (1567?–1640); later, in 1664, this was conveyed to the duke of York, afterwards James II. of England.

Gorges named his tract the County of New Somersetshire, and immediately began the administration of government, setting up in 1635 or 1636 a court at Saco under the direction of his kinsman William Gorges. In 1639 he procured for his province a royal charter modelled after that of Maryland, which invested him with the feudal tenure of a county palatine and vice-regal powers of government. He called into existence a formidably large number of officers to govern it, but his charter was in conflict with the other (mutually conflicting) grants of the Council for New England, east of the Piscataqua; and Gorges and his agents met with a determined opposition under the leadership of George Cleeve, the deputy-president of the Lygonia, or "Plough" Patent, which extended along the coast from Cape Porpoise to Casco, and in issuing which the Council for New England had granted governmental as well as territorial rights. Moreover, Puritan Massachusetts, which was naturally hostile to the Anglicanism of Gorges and his followers, interpreted her charter so as to make her northern boundary run east and west from a point 3 m. north of the source of the Merrimac river, and on this basis laid claim to practically the whole of Maine then settled. The factional quarrels there, together with the Commonwealth government in England, made it easy for Massachusetts to enforce this claim at the time, and between 1652 and 1658 Maine was gradually annexed to Massachusetts. In 1672 Massachusetts extended her boundary eastward as far as Penobscot Bay. Ferdinando Gorges, a grandson of the original proprietor, brought before parliament his claim to Maine and in 1664 a committee of that body decided in his favour; but Massachusetts successfully resisted until 1677, when the king in council decided against her. She then quietly purchased the Gorges claim for £1,250 and held the province as a proprietor until 1691, when by the new Massachusetts charter Maine was extended to the Saint Croix river, and was made an integral part of Massachusetts.

The French still claimed all territory east of the Penobscot, and not only was Maine an exposed frontier and battleground during the long struggle of the English against the Indians and the French, but its citizens bore a conspicuous part in the expeditions beyond its borders. Port Royal was taken in May 1690 by Sir William Phipps and Louisburg in June 1745 by Sir William Pepperell, both these commanders being from Maine. These expeditions were such a drain on Maine's population that Massachusetts was called upon to send men to garrison the little forts that protected the homes left defenceless by men who had gone to the front. During the War of Independence, the town of Falmouth (now Portland), which had ardently resisted the claims of the British, was bombarded and burned, in 1775; in the same year Benedict Arnold followed the course of the Kennebec and Dead rivers on his expedition to Quebec; and from 1779 to 1783 a British force was established at Castine. The embargo and non-intercourse laws from 1807 to 1812 were a severe blow to Maine's shipping, and in the War of 1812 Eastport, Castine, Hampden, Bangor and Machias fell into the hands of the British.

Maine was in general well governed as a part of Massachusetts, but a geographical separation, a desire to be rid of the burden of a large state debt, and a difference of economic interests as well as of politics (Maine was largely Democratic and Massachusetts was largely Federalist) created a desire for an independent commonwealth. This was felt before the close of the War of Independence and in 1785–1787 conventions were held at Falmouth (Portland) to consider the matter, but the opposition prevailed. The want of protection during the War of 1812 revived the question, and in 1816 the General Court in response to a great number of petitions submitted to a vote in the towns and plantations of the District the question: "Shall the legislature be requested to give its consent to the separation of the District of Maine from Massachusetts, and the erection of said District into a separate state?" The returns showed 10,393 yeas to 6501 nays, but they also showed that less than one-half the full vote had been cast. Acting upon these returns the legislature passed a bill prescribing the terms of separation, and directed another vote of the towns and plantations upon the question of separation and the election of delegates to a convention at Brunswick which should proceed to frame a constitution in case the second popular vote gave a majority of five to four for separation; but as that vote was only 11,969 yeas to 10,347 nays the advocates of separation were unsuccessful. But a large source of opposition to separation was removed in 1819 when Congress, dividing the east coast of the United States into two great districts, did away with the regulation which, making each state a district for entering and clearing vessels, would have required coasting vessels from the ports of Maine as a separate state to enter and clear on every trip to or from Boston; as a consequence, the separation measures were carried by large majorities this year, a constitution was framed by a convention which met at Portland in October, this was ratified by town meetings in December, and Maine applied for admission into the Union. Owing to the peculiar situation at the time in Congress, arising from the contest over the admission of Missouri, the question of the admission of Maine became an important one in national politics. By an Act of the 3rd of March 1820, however, Maine was finally admitted into the Union as a separate state, her admission being a part of the Missouri compromise (*q.v.*).

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[1] By this charter, issued in 1578, Sir Humphrey Gilbert was entitled to all territory lying within two hundred leagues of any colony that he might plant within six years; although it had long since lapsed, Raleigh Gilbert seems not to have been aware of it.

The boundary on the north had not yet been ascertained, and it had long been a subject of dispute between the United States and Great Britain. The treaty of 1783 (Article II.) had defined the north-east boundary of the United States as extending along the middle of the river St Croix "from its mouth in the bay of Fundy to its source" and "due north from the source of St Croix river to the highlands; along the said highlands which divide those rivers that empty themselves into the river St Lawrence from those which fall into the Atlantic Ocean, to the north-westernmost head of Connecticut river; thence down along the middle of that river to the forty-fifth degree of north latitude." Great Britain claimed that the due north line was 40 m. long and ran to Mars Hill in Aroostook county, and that the highlands ran thence westerly 115 m. to the source of the Chaudière; the United States, on the other hand, claimed that the northerly line was 140 m. long, running to highlands dividing the Ristigouche and the tributaries of the Metis; and there was a further disagreement with regard to the side of the highlands on which the boundary should be, and as to what stream was the "north-westernmost head of Connecticut river." The fifth article of the Jay treaty of 1794 provided for a commission to decide what the St Croix river actually was, and this commission in 1798 defined the St Croix, saying that its mouth was in Passamaquoddy bay and that the boundary ran up this river and the Cheputnatecook to a marked monument. The treaty of Ghent in 1814 (Article IV.) referred the question of the ownership of the islands in Passamaquoddy bay to a commission which gave Moose, Dudley and Frederick islands to the United States; and the same treaty by Article V. provided for the survey (which was made in 1817–1818) of a part of the disputed territory, and for a general commission. The general commissioners met at St Andrews, N.B., in 1816, and in New York City in 1822, only to disagree; and when the king of the Netherlands, chosen as arbitrator in 1829 (under the Convention of 1827) rendered in 1831 a decision against which the state of Maine protested, the Federal Senate withheld its assent to his decision. In 1838–1839 the territory in dispute between New Brunswick and Maine became the scene of a border "war," known as the "Aroostook disturbance"; Maine erected forts along the line she claimed, Congress authorized the president to resist any attempt of Great Britain to enforce exclusive jurisdiction over the disputed territory, and an armed conflict seemed imminent. General Winfield Scott was sent to take command on the Maine frontier, and on the 21st of March 1839 he arranged a truce and a joint occupancy of the territory in dispute until a satisfactory settlement should be reached by the United States and Great Britain. The Webster-Ashburton treaty of 1842 was a compromise, which allowed Maine about 5500 sq. m. less than she had claimed and allowed Great Britain about as much less than her claim; all grants of land previously made by either party within the limits of the territory which by this treaty fell within the dominions of the other party were to be "held valid, ratified and confirmed to the persons in possession under such grants, to the same extent as if such territory had . . . fallen within the dominions of the party by whom such grants were made"; and the government of the United States agreed to pay to Maine and Massachusetts[1] "in equal moieties" the sum of $300,000 as compensation for the lands which they had claimed and which under the treaty they were called upon to surrender. The long controversy, which is known in American history as "The North-East boundary dispute," was not finally settled however until 1910.

It was the Democratic majority in the district of Maine that effected the separation from Massachusetts, and from the date of that separation until 1853 Maine was classed as a Democratic state, although it elected a Whig governor in 1838 and in 1840, and cast its electoral vote for John Quincy Adams in 1824 and 1828 and for W. H. Harrison in 1840. As a result of the slavery question, there was a party disintegration between 1850 and 1855, followed by the supremacy of the Republican party from 1856 to 1878. In 1878, of the 126,169 votes cast in the election for governor, Selden Connor (b. 1839), re-nominated by the Republicans, received 56,554; Joseph L. Smith ("National" or "Greenback"), 41,371; Alonzo Garcelon (1813–1906) (Democratic), 28,218; as no candidate received a majority of the votes, the election was left to the legislature.[2] The vote of the House eliminated Connor, and Garcelon was chosen in the Senate by a Democratic-National fusion. Again there was no election by popular vote in 1879, and Garcelon and his council, to secure the election of a fusion government, counted-in a fusion majority in the legislature by evident falsification of the returns. On the 3rd of January 1880 the Supreme Court declared the governor and council in error in counting in a fusion majority, but on the 7th the governor swore in a legislature with 78 fusion and only two Republican members, and, the governor's term having expired, the president of the Senate, James D. Lamson, became governor, ex-officio. On the 12th the legislative chambers were seized by the Republicans, whose organized legislature was declared legal by the Supreme Court, and who chose as governor Daniel Franklin Davis (1843–1897); whereupon, on the 17th, Joshua L. Chamberlain, to whom the peaceful solution of the difficulty had largely been due, retired from the task assigned him by Garcelon on the 5th of January "to protect the public property and institutions of the state" until Garcelon's successor should be duly qualified. In 1880 the Democrats and Greenbacks united and elected their candidate, but after 1883 Maine was strongly Republican until 1910.

The governors of the state have been as follows:—

William King	Democrat	1820
William Durkee Williamson (acting)	„	1821
Benjamin Ames (acting)	„	1821
Albion Keith Parris	„	1822
Enoch Lincoln . . . . : . . .	„	1827
Nathan Cutler (acting)	„	1829
Jonathan G. Hunton	„	1830
Samuel Emerson Smith	„	1831
Robert Pinckney Dunlap	„	1834
Edward Kent	Whig	1838
John Fairfield	Democrat	1839
Edward Kent	Whig	1841
John Fairfield	Democrat	1842
Edward Kavanagh (acting)	„	1843
Hugh J. Anderson	„	1844
John Winchester Dana	„	1847
John Hubbard	„	1850
William George Crosby	Whig and Free Soil	1853
Anson Peaslee Morrill	Republican	1855
Samuel Wells	Democrat	1856
Hannibal Hamlin	Republican	1857
Joseph H. Williams (acting) . . .	„	1857
Lot Myrick Morrill	„	1858
Israel Washburn	„	1861
Abner Coburn	„	1863

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[1] An article in the Act relating to the separation of Maine from Massachusetts stipulated that the lands within the District of Maine which prior to the separation had belonged to Massachusetts should after the separation belong one-half to Maine and one-half to Massachusetts. In 1826 the wild lands of Maine were surveyed and divided between the two states; and in 1853 Maine acquired from Massachusetts, for $362,500, all of this land still remaining in possession of the latter state.

[2] According to Art. V. of the constitution a majority of the total number of votes cast was required for election; in case no candidate should receive a majority, it was prescribed that the "House of Representatives shall, by ballot, from the persons having the four highest numbers of votes on the lists, if so many there be, elect two persons and make returns of their names to the Senate, of whom the Senate shall, by ballot, elect one, who shall be declared the governor." An amendment, which became a part of the constitution on the 9th of November 1880, provided that a plurality of the total number of votes cast should be sufficient for election.

Samuel Cony	Republican	1864
Joshua Lawrence Chamberlain	„	1867
Sidney Perham	„	1871
Nelson Dingley	„	1874
Selden Connor	„	1876
Alonzo Garcelon	Democrat	1879
Daniel F. Davis	Republican	1880
Harris Merrill Plaisted	Democrat-Greenback	1881
Frederick Robie	Republican	1883
Joseph R. Bodwell	„	1887
Sebastian S. Marble (acting)	„	1887
Edwin C. Burleigh	„	1889
Henry B. Cleaves	„	1893
Llewellyn Powers	„	1897
John Fremont Hill	„	1901
William T. Cobb	„	1905
Bert M. Fernald	„	1909
Frederick W. Plaisted	Democrat	1911

See S. L. Boardman, *Climate, &c., of Maine* (Washington, 1884); Walton Wells, *The Water Power of Maine* (Augusta, 1869); G. H. Hitchcock, *General Report on the Geology of Maine* (Augusta, 1861); G. H. Stone, *The Glacial Gravels of Maine and their Associated Deposits* (Washington, 1899); T. Nelson Dale, *The Granites of Maine* (Washington, 1907), being Bulletin 313 of the U. S. Geological Survey; B. F. De Costa, *Sketches of the Coast of Maine and Isle of Shoals* (New York, 1869); H. D. Thoreau, *The Maine Woods* (Boston, 1881); L. L. Hubbard, *Woods and Lakes of Maine* (Boston, 1883); T. S. Steele, *Canoe and Camera, a Two Hundred Mile Tour through the Maine Forests* (New York, 1882); William MacDonald, *The Government of Maine, Its History and Administration* (New York, 1902); *Maine Historical Society Collections* (Portland, 1831–   ); W. D. Williamson, *History of the State of Maine* (Hallowell, 1832); J. P. Baxter, *Sir Ferdinando Gorges and his Province of Maine* (Boston, 1890) and *George Cleeve of Casco Bay* (Portland, 1885); George Folsom, *History of Saco and Biddeford, with notices of other Early Settlements and of the Proprietary Governments in Maine* (Saco, 1830); J. L. Chamberlain, *Maine, Her Place in History* (Augusta, 1877); E. S. Whitin, *Factory Legislation in Maine* (New York, 1908).

MAINE DE BIRAN, FRANÇOIS-PIERRE-GONTHIER (1766–1824), French philosopher, was born at Bergerac, on the 29th of November, 1766. The name Maine he assumed (some time before 1787) from an estate called Le Maine, near Mouleydier. After studying with distinction under the *doctrinaires* of Périgueux, he entered the life-guards of Louis XVI., and was present at Versailles on the memorable 5th and 6th of October 1789. On the breaking up of the *gardes du corps* Biran retired to his patrimonial inheritance of Grateloup, near Bergerac, where his retired life preserved him from the horrors of the Revolution. It was at this period that, to use his own words, he "passed *per saltum* from frivolity to philosophy." He began with psychology, which he made the study of his life. After the Reign of Terror Maine de Biran took part in political affairs. Having been excluded from the council of the Five Hundred on suspicion of royalism, he took part with his friend Lainé in the commission of 1813, which gave expression for the first time to direct opposition to the will of the emperor. After the Restoration he held the office of treasurer to the chamber of deputies, and habitually retired during the autumn recess to his native district to pursue his favourite study. He died on the 20th (16th, or 23rd, according to others) of July 1824.

Maine de Biran's philosophical reputation has suffered from two causes—his obscure and laboured style, and the fact that only a few, and these the least characteristic, of his writings appeared during his lifetime. These consisted of the essay on habit (*Sur l'influence de l'habitude*, 1803), a critical review of P. Laromiguière's lectures (1817), and the philosophical portion of the article "Leibnitz" in the *Biographie universelle* (1819). A treatise on the analysis of thought (*Sur la décomposition de la pensée*), although sent to press, was never printed. In 1834 these writings, together with the essay entitled *Nouvelles considérations sur les rapports du physique et du moral de l'homme*, were published by Victor Cousin, who in 1841 added three volumes, under the title *Œuvres philosophiques de Maine de Biran*. But the publication (in 1859) by E. Naville (from MSS. placed at his father's disposal by Biran's son) of the *Œuvres inédites de Maine de Biran*, in three volumes, first rendered possible a connected view of his philosophical development. At first a sensualist, like Condillac and Locke, next an intellectualist, he finally shows himself a mystical theosophist. The *Essai sur les fondements de la psychologie* represents the second or completest stage of his philosophy, the fragments of the *Nouveaux essais d'anthropologie* the third.

Maine de Biran's first essays in philosophy were written avowedly from the point of view of Locke and Condillac, but even in them he was brought to signalize the essential fact on which his later speculation turns. Dealing with the formation of habits, he is compelled to note that passive impressions, however transformed, do not furnish a complete or adequate explanation. With Laromiguière he distinguishes attention as an active effort, of no less importance than the passive receptivity of sense, and with Butler distinguishes passively formed customs from active habits. He finally arrived at the conclusion that Condillac's notion of passive receptivity as the one source of conscious experience was not only an error in fact but an error of method—in short, that the mechanical mode of viewing consciousness as formed by external influence was fallacious and deceptive. For it he proposed to substitute the genetic method, whereby human conscious experience might be exhibited as growing or developing from its essential basis in connexion with external conditions. The essential basis he finds in the real consciousness, of self as an active striving power, and the stages of its development, corresponding to what one may call the relative importance of the external conditions and the reflective clearness of self-consciousness he designates as the affective, the perceptive and the reflective. In connexion with this Biran treats most of the obscure problems which arise in dealing with conscious experience, such as the mode by which the organism is cognized, the mode by which the organism is distinguished from extra-organic things, and the nature of those general ideas by which the relations of things are known to us—cause, power, force, &c.

In the latest stage of his speculation Biran distinguishes the animal existence from the human, under which the three forms above noted are classed, and both from the life of the spirit, in which human thought is brought into relation with the supersensible, divine system of things. This stage is left imperfect. Altogether Biran's work presents a very remarkable specimen of deep metaphysical thinking directed by preference to the psychological aspect of experience.

The *Œuvres inédites* of Maine de Biran by E. Naville contain an introductory study; in 1887 appeared *Science et psychologie: nouvelles œuvres inédites*, with introduction by A. Bertrand. See also O. Merton, *Étude critique sur Maine de Biran* (1865); E. Naville, *Maine de Biran, sa vie et ses pensées* (1874); J. Gérard, *Maine de Biran, essai sur sa philosophie* (1876); Mayonade, *Pensées et pages inédites de Maine de Biran* (Périgueux, 1896); G. Allievo, "Maine de Biran e la sua dottrina antropologica" (Turin, 1896, in *Memorie dell' accademia delle scienze*, 2nd ser., xlv, pt. 2); A. Lang, *Maine de Biran und die neuere Philosophie* (Cologne, 1901); monographs by A. Kühtmann (Bremen, 1901) and M. Couailhac (1905); N. E. Truman in *Cornell Studies in Philosophy*, No. 5 (1904) on Maine de Biran's Philosophy of Will.

MAINE-ET-LOIRE, a department of western France, formed in 1790 for the most part out of the southern portion of the former province of Anjou, and bounded N. by the departments of Mayenne and Sarthe, E. by Indre-et-Loire, S.E. by Vienne, S. by Deux-Sèvres and Vendée, W. by Loire-Inférieure, and N.W. by Ille-et-Vilaine. Area, 2786 sq. m. Pop. (1906), 513,490. Maine-et-Loire is made up of two distinct regions, the line of demarcation running roughly from north to south along the valley of the Sarthe, then turning south-west and passing Brissac and Doué; that to the west consists of granites, felspars, and a continuation of the geological formations of Brittany and Vendée; to the east, schists, limestone and chalk prevail. The department is traversed from east to west by the majestic valley of the Loire, with its rich orchards, nurseries and market-gardens. The highest altitudes are found in the south-west, where north-east of Cholet one eminence reaches 689 ft. Elsewhere the surface is low and undulating in character. The department belongs entirely to the basin of the Loire, the bed of which is wide but shallow, and full of islands, the depth of the water in summer being at some places little more than 2 ft. Floods are sudden and destructive. The chief affluent of the Loire within the department is the Maine, formed a little above Angers by the junction of the Mayenne and the Sarthe, the latter having previously received the waters of the Loire. All three are navigable. Other tributaries of the Loire are the Thouet (with its tributary the Dive), the Layon, the Evre, and the Divatte on the left, and the Authion on the right. The Mayenne is joined on the right by the Oudon, which can be navigated below Segré. The Erdre, which joins the Loire at Nantes, and the Moine, a tributary of the Sèvre-Nantaise, both rise within this department. The climate is very mild. The mean annual temperature of Angers is about 53°, slightly exceeding that of Paris; the rainfall (between 23 and 24 in. annually) is distinctly lower than that of the rest of France. Notwithstanding this deficiency, the frequent fogs, combined with the peculiar nature of the soil in the south-east of the department, produce a degree of moisture which is highly favourable to meadow growths. The winter colds are never severe, and readily permit the cultivation of certain trees which cannot be reared in the adjoining departments.

The agriculture of the department is very prosperous. The produce of cereals, chiefly wheat, oats and barley, is in excess of its needs, and potatoes and mangels also give good returns. Extensive areas in the valley of the Loire are under hemp, and the vegetables, melons and other fruits of that region are of the finest quality. Good wine is produced at Serrant and other places near Angers, and on the right bank of the Layon and near Saumur, the sparkling white wine of which is a rival of the cheaper brands of champagne. Cider is also produced, and the cultivation of fruit is general. Forests and woodland in which oak and beech are the chief trees cover large tracts. The fattening of cattle is an important industry round Cholet, and horses much used for light cavalry are reared. Several thousand workmen are employed in the slate quarries in the vicinity of Angers, tufa is worked in the river valleys, and freestone and other stone, mispickel, iron and coal are also found. Cholet, the chief industrial town, and its district manufacture pocket-handkerchiefs, as well as linen cloths, flannels, cotton goods, and hempen and other coarse fabrics, and similar industries are carried on at Angers, which also manufactures liqueurs, rope, boots and shoes and parasols. Saumur, besides its production of wine, makes beads and enamels. The commerce of Maine-et-Loire comprises the exportation of live stock and of the various products of its soil and industries, and the importation of hemp, cotton, and other raw materials. The department is served by the railways of the state and the Orléans and Western companies. The Mayenne, the Sarthe and the Loir, together with some of the lesser rivers, provide about 130 m. of navigable waterway. In the south-east the canal of the Dive covers some 10 m. in the department.

There are five arrondissements—Angers, Baugé, Cholet, Saumur and Segré, with 34 cantons and 381 communes. Maine-et-Loire belongs to the académie (educational division) of Rennes, to the region of the VIII. army corps, and to the ecclesiastical province of Tours. Angers (*q.v.*), the capital, is the seat of a bishopric and of a court of appeal. Other principal places are Cholet, Saumur, and Fontevrault, which receive separate treatment. For architectural interest there may also be mentioned the châteaux of Brissac (17th century), Serrant (15th and 16th centuries), Montreuil-Bellay (14th and 15th centuries), and Ecuillé (15th century), and the churches of Puy-Notre-Dame (13th century) and St Florent-le-Vieil (13th, 17th, and 19th centuries), the last containing the fine monument to Charles Bonchamps, the Vendean leader, by David d'Angers. Gennes has remains of a theatre and other ruins of the Roman period, as well as two churches dating in part from the 10th century. Ponts-de-Cé, an interesting old town built partly on islands in the Loire, is historically important, because till the Revolution its bridges formed the only way across the Loire between Saumur and Nantes.

MAINPURI, or Mynpooree, a town and district of British India, in the Agra division of the United Provinces. The town has a station on a branch of the East Indian railway recently opened from Shikohabad. Pop. (1901), 19,000. It consists of two separate portions, Mainpuri proper and Mukhamganj. Holkar plundered and burned part of the town in 1804, but was repulsed by the local militia. Since the British occupation the population has rapidly increased and many improvements have been carried out. The Agra branch of the Grand Trunk road runs through the town, forming a wide street lined on both sides by shops, which constitute the principal bazaar. Mainpuri has a speciality in the production of carved wooden articles inlaid with brass wire. The American Presbyterian mission manages a high school.

The District of Mainpuri lies in the central Doab. Area, 1675 sq. m. Pop. (1901), 829,357, an increase of 8·8% in the decade. It consists of an almost unbroken plain, intersected by small rivers, with a few undulating sand ridges. It is wooded throughout with mango groves, and isolated clumps of *bábul* trees occasionally relieve the bareness of its saline *usar* plains. On the south-western boundary the Jumna flows in a deep alluvial bed, sometimes sweeping close to the high banks which overhang its valley, and elsewhere leaving room for a narrow strip of fertile soil between the river and the upland plain. From the low-lying lands thus formed a belt of ravines stretches inland for some 2 m., often covered with jungle, but affording good pasturage for cattle. The district is watered by two branches of the Ganges canal, and is traversed by the main line of the East Indian railway.

Mainpuri anciently formed part of the great kingdom of Kanauj, and after the fall of that famous state it was divided into a number of petty principalities, of which Rapri and Bhongaon were the chief. In 1194 Rapri was made the seat of a Moslem governor. Mainpuri fell to the Moguls on Baber's invasion in 1526, and, although temporarily wrested from them by the short-lived Afghan dynasty of Shere Shah, was again occupied by them on the reinstatement of Humayun after the victory of Panipat. Like the rest of the lower Doab, Mainpuri passed, towards the end of the 18th century, into the power of the Mahrattas, and finally became a portion of the province of Oudh. When this part of the country was ceded to the British, in 1801, Mainpuri town became the headquarters of the extensive district of Etawah, which was in 1856 reduced by the formation of Etah and Mainpuri into separate collectorates. On the outbreak of the Mutiny in 1857 the regiment stationed at Mainpuri revolted and attacked the town, which was successfully defended by the few Europeans of the station for a week, until the arrival of the Jhansi mutineers made it necessary to abandon the district.

MAINTENANCE (Fr. *maintenance*, from *maintenir*, to maintain, support, Lat. *manu tenere*, to hold in the hand). The action of giving support, supplying means of subsistence, keeping efficient or in working order. In English law maintenance is an officious intermeddling in an action that in no way belongs to one by maintaining or assisting either party, with money or otherwise, to prosecute or defend it. It is an indictable offence, both at common law and by statute, and punishable by fine and imprisonment. It invalidates all contracts involving it. It is also actionable. There are, however, certain cases in which maintenance is justifiable, *e.g.* any one who has an interest, even if it be only contingent, in the matter at variance can maintain another in an action concerning the matter; or several parties who have a common interest in the same thing may maintain one another in a suit concerning the same. Neither is it reckoned maintenance to assist another in his suit on charitable grounds, or for a master to assist his servant, or a parent his son, or a husband his wife. The law with regard to the subject is considered at length in *Bradlaugh* v. *Newdegate*, 1883, 11 Q.B.D. 1. See also Champerty. For the practice of "livery and maintenance" see English History, §§ v. and vi.

A cap of maintenance, *i.e.* a cap of crimson velvet turned up with ermine, is borne, as one of the insignia of the British sovereign, immediately before him at his coronation or on such state occasions as the opening of parliament. It is carried by the hereditary bearer, the marquess of Winchester, upon a white wand. A similar cap is also borne before the lord mayor of London. The origin of this symbol of dignity is obscure. It is stated in the *New English Dictionary* that it was granted by the pope to Henry VII. and Henry VIII. It is probably connected with the "cap of estate" or "dignity," sometimes also styled "cap of maintenance," similar to the royal symbol with two peaks or horns behind, which is borne as a heraldic charge by certain families. It seems originally to have been a privilege of dukes. Where it is used the crest is placed upon it, instead of on the usual wreath.

MAINTENON, FRANÇOISE D'AUBIGNÉ, Marquise de (1635–1719), the second wife of Louis XIV., was born in a prison at Niort, on the 27th of November 1635. Her father, Constant d'Aubigné, was the son of Agrippa d'Aubigné, the famous friend and general of Henry IV., and had been imprisoned as a Huguenot malcontent, but her mother, a fervent Catholic, had the child baptized in her religion, her sponsors being the duc de la Rochefoucauld, father of the author of the *Maxims*, and the comtesse de Neuillant. In 1639 Constant d'Aubigné was released from prison and took all his family with him to Martinique, where he died in 1645, after having lost what fortune remained to him at cards. Mme d'Aubigné returned to France, and from sheer poverty unwillingly yielded her daughter to her sister-in-law, Mme de Villette, who made the child very happy, but converted or pretended to convert her to Protestantism. When this was known an order of state was issued that she should be entrusted to Mme de Neuillant, her godmother. Every means was now used to convert her back to Catholicism, but at the last she only yielded on the condition that she need not believe that the soul of Mme de Villette was lost. Once reconverted, she was neglected and sent home to live with her mother, who had only a small pension of 200 livres a year, which ceased on her death in 1650. The chevalier de Meré, a man of some literary distinction, who had made her acquaintance at Mme de Neuillant's, discovered her penniless condition, and introduced his "young Indian," as he called her, to Scarron, the famous wit and comic writer, at whose house all the literary society of the day assembled. Scarron took a fancy to the friendless girl, and offered either to pay for her admission to a convent, or, though he was deformed and an invalid, to marry her himself. She accepted his offer of marriage, and became Mme Scarron in 1651. For nine years she was not only his most faithful nurse, but an attraction to his house, where she tried to bridle the licence of the conversation of the time. On the death of Scarron, in 1660, Anne of Austria continued his pension to his widow, and even increased it to 2000 livres a year, which enabled her to entertain and frequent the literary society her husband had made her acquainted with; but on the queen-mother's death in 1666 the king refused to continue her pension, and she prepared to leave Paris for Lisbon as lady attendant to the queen of Portugal. But before she started she met Mme de Montespan, who was already, though not avowedly, the king's mistress, and who took such a fancy to her that she obtained the continuance of her pension, which put off for ever the question of going to Portugal. Mme de Montespan did yet more for her, for when, in 1669, her first child by the king was born, Mme Scarron was established with a large income and a large staff of servants at Vaugirard to bring up the king's children in secrecy as they were born. In 1674 the king determined to have his children at court, and their governess, who had now made sufficient fortune to buy the estate of Maintenon, accompanied them. The king had now many opportunities of seeing Mme Scarron, and, though at first he was prejudiced against her, her even temper contrasted so advantageously with the storms of passion and jealousy exhibited by Mme de Montespan, that she grew steadily in his favour, and had in 1678 the gratification of having her estate at Maintenon raised to a marquisate and herself entitled Mme de Maintenon by the king. Such favours brought down the fury of Mme de Montespan's jealousy, and Mme de Maintenon's position was almost unendurable, until, in 1680, the king severed their connexion by making the latter second lady in waiting to the dauphiness, and soon after Mme de Montespan left the court. The new *amie* used her influence on the side of decency, and the queen openly declared she had never been so well treated as at this time, and eventually died in Mme de Maintenon's arms in 1683. The queen's death opened the way to yet greater advancement; in 1684 Mme de Maintenon was made first lady in waiting to the dauphiness, and in the winter of 1685–1686 she was privately married to the king by Harlay, archbishop of Paris, in the presence, it is believed, of Père la Chaise, the king's confessor, the marquis de Montchevreuil, the chevalier de Forbin, and Bontemps. No written proof of the marriage is extant, but that it took place is nevertheless certain. Her life during the next thirty years can be fully studied in her letters, of which many authentic examples are extant. As a wife she was wholly admirable; she had to entertain a man who would not be amused, and had to submit to that terribly strict court etiquette of absolute obedience to the king's inclination, which Saint-Simon so vividly describes, and yet be always cheerful and never complain of weariness or ill-health. Her political influence has probably been exaggerated, but it was supreme in matters of detail. The ministers of the day used to discuss and arrange all the business to be done with the king beforehand with her, and it was all done in her cabinet and in her presence, but the king in more important matters often chose not to consult her. Such mistakes as, for instance, the replacing of Catinat by Villeroi may be attributed to her, but not whole policies—notably, according to Saint-Simon, not the policy with regard to the Spanish succession. Even the revocation of the edict of Nantes and the dragonnades have been laid to her charge, but recent investigations have tended to show that in spite of ardent Catholicism, she at least opposed, if not very vigorously, the cruelties of the dragonnades, although she was pleased with the conversions they procured. She was apparently afraid to imperil her great reputation for devotion, which had in 1692 obtained for her from Innocent XII. the right of visitation over all the convents in France. Where she deserves blame is in her use of her power for personal patronage, as in compassing the promotions of Chamillart and Villeroi, and the frequent assistance given to her brother Comte Charles d'Aubigné. Her influence was on the whole a moderating and prudent force. Her social influence was not as great as it might have been, owing to her holding no recognized position at court, but it was always exercised on the side of decency and morality, and it must not be forgotten that from her former life she was intimate with the literary people of the day. Side by side with this public life, which wearied her with its shadowy power, occasionally crossed by a desire to be recognised as queen, she passed a nobler and sweeter private existence as the foundress of St Cyr. Mme de Maintenon was a born teacher; she had so won the hearts of her first pupils that they preferred her to their own mother, and was similarly successful later with the young and impetuous duchess of Burgundy, and she had always wished to establish a home for poor girls of good family placed in such straits as she herself had experienced. As soon as her fortunes began to mend she started a small home for poor girls at Ruel, which she afterwards moved to Noisy, and which was the nucleus of the splendid institution of St Cyr, which the king endowed in 1686, at her request, out of the funds of the Abbey of St Denis. She was in her element there. She herself drew up the rules of the institution; she examined every minute detail; she befriended her pupils in every way; and her heart often turned from the weariness of Versailles or of Marly to her "little girls" at St Cyr. It was for them that Racine wrote his *Esther* and his *Athalie*, and it was because he managed the affairs of St Cyr well that Michel Chamillart became controller-general of the finances. The later years of her power were marked by the promotion of her old pupils, the children of the king and Mme de Montespan, to high dignity between the blood royal and the peers of the realm, and it was doubtless under the influence of her dislike for the duke of Orleans that the king drew up his will, leaving the personal care of his successor to the duke of Maine, and hampering the duke of Orleans by a council of regency. On or even before her husband's death she retired to St Cyr, and had the chagrin of seeing all her plans for the advancement of the duke of Maine overthrown by means of the parliament of Paris. However, the regent Orleans in no way molested her, but, on the contrary, visited her at St Cyr and continued her pension of 48,000 livres. She spent her last years at St Cyr in perfect seclusion, but an object of great interest to all visitors to France, who, however, with the exception of Peter the Great, found it impossible to get an audience with her. On the 15th of April 1719 she died, and was buried in the choir at St Cyr, bequeathing her estate at Maintenon to her niece, the only daughter of her brother Charles and wife of the maréchal de Noailles, to whose family it still belongs.

L. A. la Beaumelle published the *Lettres de Madame de Maintenon*, but much garbled, in 2 vols. in 1752, and on a larger scale in 9 vols. in 1756. He also, in 1755, published *Mémoires de Madame de Maintenon*, in 6 vols., which caused him to be imprisoned in the Bastille. All earlier biographies were superseded by Théophile Lavallée's *Histoire de St Cyr*, reviewed in *Causeries du lundi*, vol. viii., and by his edition of her *Lettres historiques et édifiantes*, &c., in 7 vols.

and of her *Correspondance générale*, in 4 vols. (1888), which latter must, however, be read with the knowledge of many forged letters, noticed in P. Grimblot's *Faux autographes de Madame de Maintenon*. Saint-Simon's fine but biased account of the court in her day and of her career is contained in the twelfth volume of Chéruel and Regnier's edition of his *Mémoires*. See also Mademoiselle d'Aumale's *Souvenirs sur Madame de Maintenon*, published by the Comte d'Haussonville and G. Hanotaux (Paris, 3 vols., 1902–1904); an excellent account by A. Geffroy, *Madame de Maintenon d'après sa correspondance authentique* (Paris, 2 vols., 1887); P. de Noailles, *Histoire de Madame de Maintenon et des principaux événements du règne de Louis XIV*. (4 vols., 1848–1858); A. de Boislisle, *Paul Scarron et Françoise d'Aubigné d'après des documents nouveaux* (1894); É. Pilastre, *Vie et caractère de Madame de Maintenon d'après les œuvres du duc de Saint-Simon et des documents anciens ou récents* (1907); A. Rosset, *Madame de Maintenon et la révocation de l'édit de Nantes* (1897). (H. M. S.)

MAINZ (Fr. Mayence) a city, episcopal see and fortress of Germany, situated on the left bank of the Rhine, almost opposite the influx of the Main, at the junction of the important main lines of railway from Cologne to Mannheim and Frankfort-on-Main, 25 m. W. of the latter. Pop. (1905), 91,124 (including a garrison of 7500 men), of whom two-thirds are Roman Catholic. The Rhine, which here attains the greatest breadth of its upper course, is crossed by a magnificent bridge of five arches, leading to the opposite town of Castel and by two railway bridges. The old fortifications have recently been pushed farther back, and their place occupied by pleasant boulevards. The river front has been converted into a fine promenade, commanding extensive views of the Taunus range of mountains, and the "Rheingau," the most favoured wine district of Germany. Alongside the quay are the landing-places of the steamboats navigating the Rhine. The railway, which formerly incommoded the bank, has been diverted, and now, following the ceinture of the new line of inner fortifications, runs into a central station lying to the south of the city. The interior of the old town consists chiefly of narrow and irregular streets, with many quaint and picturesque houses. The principal street of the new town is the Kaiserstrasse, leading from the railway station to the river.

The first object of historical and architectural interest in Mainz is the grand old cathedral, an imposing Romanesque edifice with numerous Gothic additions and details (for plan, &c. see ARCHITECTURE: *Romanesque and Gothic in Germany*). It was originally erected between 975 and 1009, but has since been repeatedly burned down and rebuilt, and in its present form dates chiefly from the 12th, 13th and 14th centuries. The largest of its six towers is 300 ft. high. The whole building was restored by order of Napoleon in 1814, and another thorough renovation was made more recently. The interior contains the tombs of Boniface, the first archbishop of Mainz, of Frauenlob, the Minnesinger, and of many of the electors. Mainz possesses nine other Roman Catholic churches, the most noteworthy of which are those of St Ignatius, with a finely painted ceiling, of St Stephen, built 1257–1328, and restored after an explosion in 1857, and of St Peter. The old electoral palace (1627–1678), a large building of red sandstone, now contains a valuable collection of Roman and Germanic antiquities, a picture gallery, a natural history museum, the Gutenberg Museum, and a library of 220,000 volumes. Among the other principal buildings are the palace of the grand duke of Hesse, built in 1731–1739 as a lodge of the Teutonic order, the theatre, the arsenal, and the government buildings. A handsome statue of Gutenberg, by Thorwaldsen, was erected at Mainz in 1837. Mainz still retains many relics of the Roman period, the most important of which is the Eigelstein, a monument believed to have been erected by the Roman legions in honour of Drusus. It stands within the citadel, which occupies the site of the Roman castrum. A little to the south-west of the town are the remains of a large Roman aqueduct, of which upwards of sixty pillars are still standing. The educational and scientific institutions of Mainz include an episcopal seminary, two gymnasia and other schools, a society for literature and art, a musical society, and an antiquarian society. The university, founded in 1477, was suppressed by the French in 1798.

The site of Mainz would seem to mark it out naturally as a great centre of trade, but the illiberal rule of the archbishops and its military importance seriously hampered its commercial and industrial development, and prevented it from rivalling its neighbour Frankfort. It is now, however, the chief emporium of the Rhenish wine traffic, and also carries on an extensive transit trade in grain, timber, flour, petroleum, paper and vegetables. The natural facilities for carriage by water are supplemented by the extensive railway system. Large new harbours to the north of the city were opened in 1887. The principal manufactures are leather goods, furniture, carriages, chemicals, musical instruments and carpets, for the first two of which the city has attained a wide reputation. Other industries include brewing and printing. Mainz is the seat of the administrative and judicial authorities of the province of Rhein-Hessen, and also of a Roman Catholic bishop.

History.—Mainz, one of the oldest cities in Germany, was originally a Celtic settlement. Its strategic importance was early recognized by the Romans, and about 13 B.C. Drusus, the son-in-law of Augustus, erected a fortified camp here, to which the *castellum Mattiacorum* (the modern Castel) on the opposite bank was afterwards added, the two being connected with a bridge at the opening of the Christian era. The Celtic name became latinized as *Maguntiacum*, or *Moguntiacum*, and a town gradually arose around the camp, which became the capital of Germania Superior. During the Völkerwanderung Mainz suffered severely, being destroyed on different occasions by the Alamanni, the Vandals and the Huns. Christianity seems to have been introduced into the town at a very early period, and in the 6th century a new Mainz was founded by Bishop Sidonius. In the middle of the 8th century under Boniface it became an archbishopric, and to this the primacy of Germany was soon annexed. Charlemagne, who had a palace in the neighbourhood, gave privileges to Mainz, which rose rapidly in wealth and importance, becoming a free city in 1118. During the later middle ages it was the seat of several diets, that of 1184 being of unusual size and splendour. In 1160 the citizens revolted against Archbishop Arnold, and in 1163 the walls of the city were pulled down by order of the emperor Frederick I. But these events did not retard its progress. In 1244 certain rights of self-government were given to the citizens; and in 1254 Mainz was the centre and mainspring of a powerful league of Rhenish towns. Owing to its commercial prosperity it was known as *goldene* Mainz, and its population is believed to have been as great as it is at the present day. But soon a decline set in. In 1462 there was warfare between two rival archbishops, Diether or Dietrich II. of Isenburg (d. 1463) and Adolph II. of Nassau (d. 1475). The citizens espoused the cause of Diether, but their city was captured by Adolph; it was then deprived of its privileges and was made subject to the archbishop. Many of the inhabitants were driven into exile, and these carried into other lands a knowledge of the art of printing, which had been invented at Mainz by Johann Gutenberg in 1450. During the Thirty Years' War Mainz was occupied by the Swedes in 1631 and by the French in 1644, the fortifications being strengthened by the former under Gustavus Adolphus; in 1688 it was captured again by the French, but they were driven out in the following year. In 1792 the citizens welcomed the ideas of the French Revolution; they expelled their archbishop, Friedrich Karl Joseph d'Erthal, and opened their gates to the French troops. Taken and retaken several times during the next few years, Mainz was ceded to France by the treaty of Campo Formio in 1797, and again by the Treaty of Lunéville in 1801. In 1814 it was restored to Germany and in 1816 it was handed over to the grand duke of Hesse; it remained, however, a fortress of the German confederation and was garrisoned by Prussian and Austrian troops. Since 1871 it has been a fortress of the German Empire. There were disturbances in the city in 1848.

See Brühl, *Mainz, geschichtlich, topographisch und malerisch* (Mainz, 1829); C. A. Schaab, *Geschichte der Stadt Mainz* (Mainz, 1841–1845); K. Klein, *Mainz und seine Umgebungen* (1868); C. G. Bockenheimer, *Beiträge zur Geschichte der Stadt Mainz* (1874); Neeb, *Führer durch Mainz und Umgebung* (Stuttgart, 1903); and O. Beck, *Mainz und sein Handel* (Mainz, 1881).

The **Archbishopric of Mainz**, one of the seven electorates of the Holy Roman Empire, became a powerful state during the middle ages and retained some of its importance until the dissolution of the empire in 1806. Its archbishop was president of the electoral college, arch-chancellor of the empire and primate of Germany. Its origin dates back to 747, when the city of Mainz was made the seat of an archbishop, and a succession of able and ambitious prelates, obtaining lands and privileges from emperors and others, made of the district under their rule a strong and vigorous state. Among these men were Hatto I. (d. 913), Siegfried III. of Eppstein (d. 1249), Gerhard of Eppstein (d. 1305), and Albert of Brandenburg (d. 1545), all of whom played important parts in the history of Germany. There were several violent contests between rivals anxious to secure so splendid a position as the electorate, and the pretensions of the archbishops occasionally moved the citizens of Mainz to revolt. The lands of the electorate lay around Mainz, and were on both banks of the Rhine; their area at the time of the French Revolution was about 3200 sq. m. The last elector was Karl Theodor von Dalberg. The archbishopric was secularized in 1803, two years after the lands on the left bank of the Rhine had been seized by France. Some of those on the right bank of the river were given to Prussia and to Hesse; others were formed into a grand duchy for Dalberg. The archbishopric itself was transferred to Regensburg.

For the history of the electorate see the *Scriptores rerum moguntiacarum*, edited by G. C. Joannis (Frankfort, 1722–1727); Schunk, *Beiträge zur Mainzer Geschichte* (Frankfort, 1788–1791); Hennes, *Die Erzbischöfe von Mainz* (Mainz, 1879); Ph. Jaffé, *Monumenta moguntina* (Berlin, 1866), and J. F. Böhmer and C. Will, *Regesta archiepiscoporum moguntinensium* (Innsbruck, 1877–1886).

MAIRET, JEAN DE (1604–1686), French dramatist, was born at Besançon, and baptized on the 10th of May 1604. His own statement that he was born in 1610 has been disproved. He went to Paris to study at the Collège des Grassins about 1625, in which year he produced his first piece *Chriséide et Arimand*, followed in 1626 by *Sylvie*, a "pastoral tragi-comedy." In 1634 appeared his masterpiece, *Sophonisbe*, which marks, in its observance of the rules, the beginning of the "regular" tragedies. Mairet was one of the bitterest assailants of Corneille in the controversy over *The Cid*. It was perhaps his jealousy of Corneille that made him give up writing for the stage. He was appointed in 1648 official representative of the Franche-Comté in Paris, but in 1653 he was banished by Mazarin. He was subsequently allowed to return, but in 1668 he retired to Besançon, where he died on the 31st of January 1686. His other plays include *Silvanire ou la Morte-vive*, published in 1631 with an elaborate preface on the observance of the unities, *Les Galanteries du duc d'Orsonne* (1632), *Virginie* (1633), *Marc-Antoine* (1635), and *Le Grand et dernier Solyman* (1637).

See G. Bizos, *Étude sur la vie et les œuvres de Jean de Mairet* (1877). *Sophonisbe* was edited by K. Vollmöller (Heilbronn, 1888), and *Silvanire* by R. Otto (Bamberg, 1890).

MAISTRE, JOSEPH DE (1754–1821), French diplomatist and polemical writer, was born at Chambéry on the 1st of April 1754. His family was an ancient and noble one, enjoying the title of count, and is said to have been of Languedocian extraction. The father of Joseph was president of the senate of Savoy, and held other important offices. Joseph himself, after studying at Turin, received various appointments in the civil service of Savoy, finally becoming a member of the senate. In 1786 he married Françoise de Morand. The invasion and annexation of Savoy by the French Republicans made him an exile. He did not take refuge in that part of the king of Sardinia's domains which was for the time spared, but betook himself to the as yet neutral territory of Lausanne. There, in 1796, he published his first important work (he had previously written certain discourses, pamphlets, letters, &c.), *Considérations sur la France*. In this he developed his views, which were those of a Legitimist, but a Legitimist entirely from the religious and Roman Catholic point of view. The philosophism of the 18th century was Joseph de Maistre's lifelong object of assault.

After the still further losses which, in the year of the publication of this book, the French Revolution inflicted on Sardinia, Charles Emmanuel summoned Joseph de Maistre to Turin, and he remained there for the brief space during which the king retained a remnant of territory on the mainland. Then he went to the island of Sardinia, and held office at Cagliari. In 1802 he was appointed envoy extraordinary and minister plenipotentiary at St Petersburg, and journeyed thither the next year. Although his post was no sinecure, its duties were naturally less engrossing than the official life, with intervals of uneasy exile and travelling, which he had hitherto known, and his literary activity was great. He only published a single treatise, on the *Principe générateur des Constitutions*; but he wrote his best and most famous works, *Du Pape*, *De L'église gallicane* and the *Soirées de St Pétersbourg*, the last of which was never finished. *Du Pape*, which the second-named book completes, is a treatise in regular form, dealing with the relations of the sovereign pontiff to the Church, to temporal sovereigns, to civilization generally, and to schismatics, especially Anglicans and the Greek Church. It is written from the highest possible standpoint of papal absolutism. The *Soirées de St Pétersbourg*, so far as it is anything (for the arrangement is somewhat desultory), is a kind of *théodicée*, dealing with the fortunes of virtue and vice in this world. It contains two of De Maistre's most famous pieces, his panegyric on the executioner as the foundation of social order, and his acrimonious, and in part unfair, but also in part very damaging, attack on Locke. The *Du Pape* is dated May 1817; on the *Soirées* the author was still engaged at his death. Besides these works he wrote an examination of the philosophy of Bacon, some letters on the Inquisition (an institution which, as may be guessed from the remarks just noticed about the executioner, was no stumbling-block to him), and, earlier than any of these, a translation of Plutarch's "Essay on the Delay of Divine Justice," with somewhat copious notes. After 1815 he returned to Savoy, and was appointed to high office, while his *Du Pape* made a great sensation. But the world to which he had returned was not altogether in accordance with his desires. He had domestic troubles; and chagrin of one sort and another is said to have had not a little to do with his death by paralysis on the 26th of February 1821 at Turin. Most of the works mentioned were not published till after his death, and it was not till 1851 that a collection of *Lettres et opuscules* appeared, while even since that time fresh matter has been published.

Joseph de Maistre was one of the most powerful, and by far the ablest, of the leaders of the neo-Catholic and anti-revolutionary movement. The most remarkable thing about his standpoint is that, layman as he was, it was entirely ecclesiastical. Unlike his contemporary Bonald, Joseph de Maistre regarded the temporal monarchy as an institution of altogether inferior importance to the spiritual primacy of the pope. He was by no means a political absolutist, except in so far as he regarded obedience as the first of political virtues, and he seldom loses an opportunity of stipulating for a tempered monarchy. But the pope's power is not to be tempered at all, either by councils or by the temporal power or by national churches, least of all by private judgment. The peculiarity of Joseph de Maistre is that he supports his conclusions, or if it be preferred his paradoxes, by the hardest and heaviest argument. Although a great master of rhetoric, he never makes rhetoric do duty for logic. Every now and then it is possible to detect fallacies in him, but for the most part he has succeeded in carrying matters back to those fundamental differences of opinion which hardly admit of argument, and on which men take sides in consequence chiefly of natural bent, and of predilection for one state of things rather than for another. The absolute necessity of order may be said to have been the first principle of this thinker, who, in more ways than one, will invite comparison with Hobbes. He could not conceive such order without a single visible authority, reference to which should settle all dispute. He saw that there could be no such temporal head, and in the pope he thought that he saw a spiritual substitute. The anarchic tendencies of the Revolution in politics and religion were what offended him. It ought to be added that he was profoundly and accurately learned in history and philosophy, and that the superficial blunders of the 18th-century *philosophes* irritated him as much as their doctrines. To Voltaire in particular he shows no mercy.

Of the two works named as his masterpieces, *Du Pape* and the *Soirées de St Pétersbourg*, editions are extremely numerous. No complete edition of his works appeared till 1884–1887, when one was published at Lyons in 14 volumes. This had been preceded, and has been followed, by numerous biographies and discussions: C. Barthélemy, *L'Esprit de Joseph de Maistre* (1859); R. de Sézeval, *Joseph de Maistre* (1865), and J. C. Glaser, *Graf Joseph Maistre* (same year); L. I. Moreau, *Joseph de Maistre* (1879); F. Paulhan, *Joseph de Maistre et sa philosophie* (1893); L. Cogordan, "Joseph de Maistre" in the *Grands écrivains français* (1894); F. Descostes, *Joseph de Maistre avant la révolution* (1896), and other works by the same writer; J. Mandoul, *Un Homme d'état italien: Joseph de Maistre et la politique de la maison de Savoie* (1900); and E. Grasset, *Joseph de Maistre* (1901). (G. Sa.)

MAISTRE, XAVIER DE (1763–1852), younger brother of Joseph de Maistre, was born at Chambéry in October 1763. He served when young in the Piedmontese army, and wrote his delightful fantasy, *Voyage autour de ma chambre* (published 1794) when he was under arrest at Turin in consequence of a duel. Xavier shared the politics and the loyalty of his brother, and on the annexation of Savoy to France, he left the service, and took a commission in the Russian army. He served under Suvarov in his victorious Austro-Russian campaign and accompanied the marshal to Russia. He shared the disgrace of his general, and supported himself for some time in St Petersburg by miniature painting. But on his brother's arrival in St Petersburg he was introduced to the minister of marine. He was appointed to several posts in the capital, but also saw active service, was wounded in the Caucasus, and attained the rank of major-general. He married a Russian lady and established himself in his adopted country, even after the overthrow of Napoleon, and the consequent restoration of the Piedmontese dynasty. For a time, however, he lived at Naples, but he returned to St Petersburg and died there on the 12th of June 1852. He was only once in Paris (in 1839), when Sainte-Beuve, who has left some pleasant reminiscences of him, met him. Besides the *Voyage* already mentioned, Xavier de Maistre's works (all of which are of very modest dimensions) are *Le Lépreux de la cité d'Aoste* (1811), a touching little story of human misfortune; *Les Prisonniers du Caucase*, a powerful sketch of Russian character, *La Jeune Sibérienne*, and the *Expédition nocturne*, a sequel to the *Voyage autour de ma chambre* (1825). His style is of remarkable ease and purity.

His works, with the exception of some brief chemical tractates, are included in the collections of Charpentier, Garnier, &c. See Sainte-Beuve's *Portraits contemporains*, vol. iii.

MAITLAND, EDWARD (1824–1897), English humanitarian writer, was born at Ipswich on the 27th of October 1824, and was educated at Caius College, Cambridge. The son of Charles David Maitland, perpetual curate of St James's Chapel, Brighton, he was intended for the Church, but his religious views did not permit him to take holy orders. For some years he lived abroad, first in California and then as a commissioner of Crown-lands in Australia. After his return to England in 1857 he took up an advanced humanitarian position, and claimed to have acquired a new sense by which he was able to discern the spiritual condition of other people. He was associated with Mrs Anna Kingsford (1846–1888), the lady-doctor and supporter of vegetarianism and anti-vivisectionism, who, besides being one of the pioneers of higher education for women, had become a devotee of mystical theosophy; with her he brought out *Keys of the Creeds* (1875), *The Perfect Way: or the Finding of Christ* (1882), and founded the Hermetic Society in 1884. After her death he founded the Esoteric Christian Union in 1891, and wrote her *Life and Letters* (1896). He died on the 2nd of October 1897.

MAITLAND, FREDERIC WILLIAM (1850–1906), English jurist and historian, son of John Gorham Maitland, was born on the 28th of May 1850, and educated at Eton and Trinity, Cambridge, being bracketed at the head of the moral sciences tripos of 1872, and winning a Whewell scholarship for international law. He was called to the bar (Lincoln's Inn) in 1876, and made himself a thoroughly competent equity lawyer and conveyancer, but finally devoted himself to comparative jurisprudence and especially the history of English law. In 1884 he was appointed reader in English law at Cambridge, and in 1888 became Downing professor of the laws of England. Though handicapped in his later years by delicate health, his intellectual grasp and wide knowledge and research gradually made him famous as a jurist and historian. He edited numerous volumes for the Selden Society, including *Select Pleas for the Crown, 1200–1225*, *Select Pleas in Manorial Courts* and *The Court Baron*; and among his principal works were *Gloucester Pleas* (1884), *Justice and Police* (1885), *Bracton's Note-Book* (1887), *History of English Law* (with Sir F. Pollock, 1895; new ed. 1898; see also his article English Law in this encyclopaedia), *Domesday Book and Beyond* (1897), *Township and Borough* (1898), *Canon Law in England* (1898), *English Law and the Renaissance* (1901), the *Life of Leslie Stephen* (1906), besides important contributions to the *Cambridge Modern History*, the *English Historical Review*, the *Law Quarterly Review*, *Harvard Law Review* and other publications. His writings are marked by vigour and vitality of style, as well as by the highest qualities of the historian who recreates the past from the original sources; he had no sympathy with either legal or historical pedantry; and his death at Grand Canary on the 19th of December 1906 deprived English law and letters of one of their most scholarly and most inspiring representatives, notable alike for sweetness of character, acuteness in criticism, and wisdom in counsel.

See P. Vinogradoff's article on Maitland in the *English Historical Review* (1907); Sir F. Pollock's in the *Quarterly Review* (1907); G. T. Lapsley's in *The Green Bag* (Boston, Mass., 1907); A. L. Smith, *F. W. Maitland* (1908); H. A. L. Fisher, *F. W. Maitland* (1910).

MAITLAND, SIR RICHARD (Lord Lethington) (1496–1586), Scottish lawyer, poet, and collector of Scottish verse, was born in 1496. His father, Sir William Maitland of Lethington and Thirlestane, fell at Flodden; his mother was a daughter of George, Lord Seton. He studied law at the university of St Andrews, and afterwards in Paris. His castle at Lethington was burnt by the English in 1549. He was in 1552 one of the commissioners to settle matters with the English about the debateable lands. About 1561 he seems to have lost his sight, but this did not render him incapable of attending to public business, as he was the same year admitted an ordinary lord of session with the title of Lord Lethington, and a member of the privy council; and in 1562 he was appointed keeper of the Great Seal. He resigned this last office in 1567, in favour of John, prior of Coldingham, his second son, but he sat on the bench till he attained his eighty-eighth year. He died on the 20th of March 1586. His eldest son, by his wife Mary Cranstoun of Crosbie, was William Maitland (*q.v.*): his second son, John (*c.* 1545–1595), was a lord of session, and was made a lord of parliament in 1590, with the title of Lord Maitland of Thirlestane, in which he was succeeded by his son John, also for some time a lord of session, who was created earl of Lauderdale in 1624. One of Sir Richard's daughters, Margaret, assisted her father in preparing his collection of old Scots verse

The poems of Sir Richard Maitland, none of them lengthy, are for the most part satirical, and are principally directed against the social and political abuses of his time. He is chiefly remembered as the industrial collector and preserver of many pieces of Scots poetry. These were copied into two large volumes, one in folio and another in quarto, the former written by himself, and the latter by his daughter. After being in the possession of his descendant the duke of Lauderdale, these volumes were purchased at the sale of the duke's library by Samuel Pepys, and have since been preserved in the Pepysian Library, Magdalene College, Cambridge. They lay there unnoticed for many years till Bishop Percy published one of the poems in his *Reliques of English Poetry*. Several of the prices were then transcribed by John Pinkerton, who afterwards published them under the title of *Ancient Scottish Poems* (2 vols., 1786.)

For an account of the Maitland Folio MS. see Gregory Smith's *Specimens of Middle Scots*, 1902 (p. lxxiii.). The Scottish Text Society has undertaken an edition of the entire manuscript. Maitland's own poems were reprinted by Sibbald in his *Chronicle of Scottish Poetry* (1802), and in 1830 by the Maitland Club, named after him, and founded for the purpose of continuing his efforts to preserve the remains of early Scots literature. Sir Richard left in manuscript a history of the family of Seton, and a volume of legal decisions collected by him between the years 1550 and 1565. Both are preserved in the Advocates' Library, Edinburgh; the former was published by the Maitland Club, in 1829.

MAITLAND (MAITLAND OF LETHINGTON), **WILLIAM** (c. 1528–1573), Scottish statesman, eldest son of the preceding, was educated at St Andrews. At an early age he entered public life and began in various ways to serve the regent, Mary of Lorraine, becoming her secretary of state in 1558. In 1559, however, he deserted her and threw in his lot with the lords of the congregation, to whom his knowledge of foreign, and especially of English, politics and his general ability were assets of the highest value. The lords sent him to England to ask for assistance from Elizabeth, and his constant aim throughout his political career was to bring about a union between the two crowns. He appears to have feared the return of Mary Queen of Scots to Scotland, but after her arrival in 1561 he was appointed secretary of state, and for about six years he directed the policy of Scotland and enjoyed the confidence of the queen. His principal antagonist was John Knox; there were several tussles between them, the most famous, perhaps, being the one in the general assembly of 1564, and on the whole Maitland held his own against the preachers. He was doubtless concerned in the conspiracy against David Rizzio, and after the favourite's murder he was obliged to leave the court and was himself in danger of assassination. In 1567, however, he was again at Mary's side. He was a consenting party to the murder of Darnley, although he had favoured his marriage with Mary, but the enmity between Bothwell and himself was one of the reasons which drove him into the arms of the queen's enemies, among whom he figured at Langside. He was one of the Scots who met Elizabeth's representatives at York in 1568; here he showed a desire to exculpate Mary and to marry her to the duke of Norfolk, a course of action probably dictated by a desire to avoid all revelations about the Darnley murder. But this did not prevent him from being arrested in September 1569 on account of his share in the crime. He was, however, delivered from his captors by a ruse on the part of his friend, Sir William Kirkcaldy of Grange, and was brought into Edinburgh Castle, while his trial was put off because the city was thronged with his adherents. Maitland now became the leader of the remnant which stood by the cause of the imprisoned queen. Already a physical wreck, he was borne into Edinburgh Castle in April 1571 and with Kirkcaldy he held this fortress against the regent Morton and his English auxiliaries. The castle surrendered in May 1573 and on the 7th or the 9th of June following Maitland died at Leith, there being very little evidence for the theory that he poisoned himself. "Secretary Maitland" was a man of great learning with a ready wit and a caustic tongue. He was reputed to be the most versatile and accomplished statesman of his age, and almost alone among his Scottish contemporaries he placed his country above the claims of either the Roman Catholic or the Protestant religions. Among the testimonies to his great abilities are those of Queen Elizabeth, of William Cecil and of Knox. By his second wife, Mary Fleming, one of Queen Mary's ladies, whom he married in 1567, he had a son and daughter. His son James died without issue about 1620.

See John Skelton, *Maitland of Lethington* (1894); A. Lang, *History of Scotland*, vol. ii. (1902).

MAITLAND, EAST and **WEST**, adjoining municipalities in Northumberland county, New South Wales, Australia, 120 m. by rail N. of Sydney. Pop. (1901), West Maitland, 6798; East Maitland, 3287. These towns are situated in a valley on the Hunter River, which is liable to sudden floods, to guard against which the river is protected by stone embankments at West Maitland, while there are flood-gates at East Maitland. Maitland is the centre of the rich agricultural district of the Hunter valley, which produces maize, wheat and other cereals, lucerne, tobacco, fruit and wine; excellent coal also is worked in the vicinity. East Maitland is the see of a Roman Catholic bishop, whose cathedral (St John's), however, is situated in the larger town. Besides this, West Maitland contains several handsome public and commercial buildings.

MAITREYA, the name of the future Buddha. In one of the works included in the Pali canon, the *Digha Nikāya*, a prophecy is put into the Buddha's mouth that after the decay of the religion another Buddha, named Metteyya, will arise who will have thousands of followers instead of the hundreds that the historical Buddha had. This is the only mention of the future Buddha in the canon. For some centuries we hear nothing more about him. But when, in the period just before and after the Christian era, some Buddhists began to write in Sanskrit instead of Pali, they composed new works in which Maitreya (the Sanskrit form of Metteyya) is more often mentioned, and details are given as to his birthplace and history. These are entirely devised in imitation of the details of the life of the historical Buddha, and have no independent value. Only the names differ. The document in which the original prophecy occurs was put together at some date during the 1st century after the Buddha's death (see NIKĀYA). It is impossible to say whether tradition was, at that time, correct in attributing it to the Buddha. But whoever chose the name (it is a patronymic or family, not a personal name), had no doubt regard to the etymological connexion with the word for "love," which is Mettā in Pali. This would only be one of those punning allusions so frequent in Indian literature.

Long afterwards, probably in the 6th or 7th century, a reformer in south India, at a time when the incoming flood of ritualism and superstition threatened to overwhelm the simple teaching of the earlier Buddhism, wrote a Pali poem, entitled the *Anāgata Vaṃsa*. In this he described the golden age of the future when, in the time of Metteyya, kings, ministers and people would vie one with the other in the maintenance of the original simple doctrine, and in the restoration of the good times of old. The other side also claimed the authority of the future Buddha for their innovations. Statues of Maitreya are found in Buddhist temples, of all sects, at the present day; and the belief in his future advent is universal among Buddhists.

AUTHORITIES.—*Digha Nikāya*, vol. iii., edited by J. E. Carpenter, (London, 1908); "*Anāgata Vaṃsa*," edited by J. Minayeff in *Journal of the Pali Text Society* (1886); *Watters on Yuan Chwang*, edited by Rhys Davids and S. W. Bushell (London, 1904–1905).

(T. W. R. D.)

MAIWAND, a village of Afghanistan, 50 m. N.W. of Kandahar. It is chiefly notable for the defeat inflicted on a British brigade under General Burrows by Ayub Khan on the 27th of July 1880 during the second Afghan War (see AFGHANISTAN). Ayub Khan, Shere Ali's younger son, who had been holding Herat during the British operations at Kabul and Kandahar, set out towards Kandahar with a small army in June 1880, and a brigade under General Burrows was detached from Kandahar to oppose him. Burrows advanced to the Helmund, opposite Girishk, to oppose Ayub Khan, but was there deserted by the troops of Shere Ali, the wali of Kandahar, and forced to retreat to Kushk-i-Nakhud, half way to Kandahar. In order to prevent Ayub passing to Ghazni, Burrows advanced to Maiwand on the 27th of July, and attacked Ayub, who had already seized that place. The Afghans, who numbered 25,000, outflanked the British, the artillery expended their ammunition, and the native portion of the Brigade got out of hand and pressed back on the few British infantry. The British were completely routed, and had to thank the apathy of the Afghans for escaping total annihilation. Of the 2476 British troops engaged, 934 were killed and 175 wounded or missing. This defeat necessitated Sir Frederick Roberts' famous march from Kabul to Kandahar.

See Lord Roberts, *Forty-one Years in India* (1896).

MAIZE, or INDIAN CORN, *Zea Mays* (from ζεά or ζειά, which appears to have been "spelt," *Triticum spelta*, according to the description of Theophrastus), a plant of the tribe Maydeae of the order Gramineae or grasses (see fig. 1). It is unknown in the native state, but is most probably indigenous to tropical America. Small grains of an unknown variety have been found in the ancient tombs of Peru, and Darwin found heads of maize embedded on the shore in Peru at 85 ft. above the present sea-level. Bonafous, however (*Histoire naturelle du maïs*), quotes authorities (Bock, 1532, Ruel and Fuchs) as believing that it came from Asia, and maize was said by Santa Rosa de Viterbo to have been brought by the Arabs into Spain in the 13th century. A drawing of maize is also given by Bonafous from a Chinese work on natural history, *Li-chi-tchin*, dated 1562, a little over sixty years after the discovery of the New World. It is not figured on Egyptian monuments, nor was any mention made of it by Eastern travellers in Africa or Asia prior to the 16th century. Humboldt, Alphonse de Candolle and others, however, do not hesitate to say that it originated solely in America, where it had been long and extensively cultivated at the period of the discovery of the New World; and that is the generally accepted modern view. Some hold the view that maize originated from a common Mexican fodder grass, *Euchlaena mexicana*, known as Teosinte, a closely allied plant which when crossed with maize yields a maize-like hybrid.

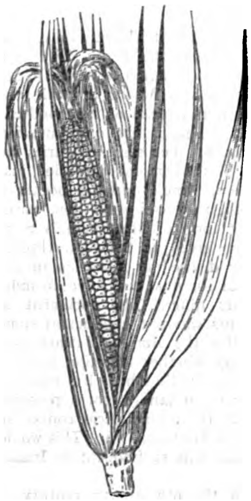

FIG. 1.

Maize—*Zea Mays*—unripe cob. The membranous spathes have been cut and drawn aside, revealing the spike of fruit which bears the long silky styles. One-third nat. size.

The plant is monoecious, producing the staminate (male) flowers in a large feathery panicle at the summit, and the (female) dense spikes of flowers, or "cobs," in the axils of the leaves below, the long pink styles hanging out like a silken tassel. They are invested by the sheaths of leaves, much used in packing oranges in south Europe, and the more delicate ones for cigarettes in South America. Fig. 2 shows a branch of the terminal male inflorescence. Fig. 3 is a single spikelet of the same, containing two florets, with the three stamens of one only protruded. Fig. 4 is a spike of the female inflorescence, protected by the sheaths of leaves—the blades being also present. Usually the sheaths terminate in a point, the blades being arrested. Fig. 5 is a spikelet of the female inflorescence, consisting of two outer glumes, the lower one ciliated, which enclose two florets—one (*a*) barren (sometimes fertile), consisting of a flowering glume and pale only, and the other (*b*) fertile, containing the pistil with elongated style. The mass of styles from the whole spike is pendulous from the summit of the sheaths, as in fig. 4. Fig. 6 shows the fruit or grain. More than three hundred varieties are known, which differ more among themselves than those of any other cereal. Some come to maturity in two months, others require seven months; some are as many feet high as others are inches; some have kernels eleven times larger than others. They vary similarly in shape and size of ears, colour of the grain, which may be white, yellow, purple, striped, &c., and also in physical characters and chemical composition. Dr E. Lewis Sturtevant, who has made an extended study of the forms and varieties, classes into seven groups those grown primarily for the grain, the distinguishing characters of which are based on the grains or kernels; there are, in addition, forms of horticultural interest grown for ornament. Pod corn (var. *tunicata*) is characterized by having each kernel enclosed in a husk. Pop corn (var. *everta*) has a very large proportion of the "endosperm"—the nutritious matter which with the small embryo makes up the grain—of a horny consistency, which causes the grain to pop when heated, that is to say, the kernel becomes turned inside out by the explosion of the contained moisture. It is also characterized by the small size of the grain and ear. Flint corn (var. *indurata*) has a starchy endosperm enclosed in a horny layer of varying thickness in the different varieties. The colour of the grain is white, yellow, red, blue or variegated. It is commonly cultivated in Canada and northern United States, where the seasons are too short for Dent corn, and has been grown as far north as 50° N. lat. Dent or field corn (var. *indentata*) has the starchy endosperm extending to the summit of the grain, with horny endosperm at the sides. The top of the grain becomes indented, owing to the drying and shrinkage of the starchy matter; the character of the indented surface varies with the height and thickness of the horny endosperm. This is the form commonly grown in the United States; the varieties differ widely in the size of the plants and the appearance of the ear.

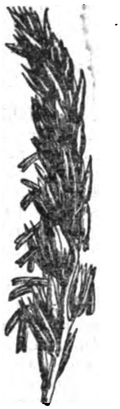

FIG. 2.—Spike of Male Flowers.

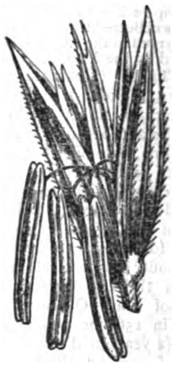

FIG. 3.—Male Spikelet.

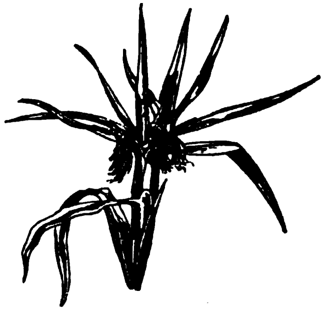

FIG. 4.—Female Spike.

The colour of the grain varies greatly, being generally white, yellow, mottled red, or less commonly red. Soft corn (var. *amylacea*) has no horny endosperm, and hence the grains shrink uniformly. It is cultivated only to a limited extent in the United States, but seems to have been commonly grown by the Indians in many localities in North and South America. Sweet corn (var. *saccharata*) is characterized by the translucent horny appearance of the grains and their more or less wrinkled condition. It is pre-eminently a garden vegetable, the ear being used before the grain hardens, when it is well filled but soft and milky. It is often cooked and served in the cob; when canned it is cut from the cob. Canned sweet corn is an important article of domestic commerce in Canada and the United States. In starchy sweet corn (var. *amylea-saccharata*) the grain has the external appearance of sweet corn, but examination shows the lower half to be starchy, the upper horny and translucent. A form of flint corn, with variegated leaves, is grown for ornament under the name *Zea japonica* or Japanese striped corn.

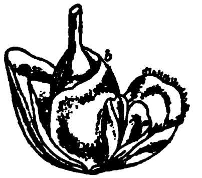

FIG. 5.—Female Spikelet.

Chemical analysis, like common experience, shows that Indian corn is a very nutritious article of food, being richer in albuminoids than any other cereals when ripe (calculated in the dry weight). It can be grown in the tropics from the level of the sea to a height equal to that of the Pyrenees and in the south and middle of Europe, but it cannot be grown in England with any chance of profit, except perhaps as fodder. Frost kills the plant in all its stages and all its varieties; and the crop does not flourish well if the nights are cool, no matter how favourable the other conditions. Consequently it is the first crop to disappear as one ascends into the mountain regions, and comparatively little is grown west of the great plains of North America. In Brittany, where it scarcely ripens the grain, it furnishes a strong crop in the autumn upon sandy soil where clover and lucerne will yield but a poor produce. It prefers a deep, rich, warm, dry and mellow soil, and hence the rich bottoms and fertile prairies of the Mississippi basin constitute the region of its greatest production. It is extensively grown throughout India, both for the ripe grain and for use of the unripe cob as a green vegetable. It is the most common crop throughout South Africa, where it is known as mealies, being the staple food of the natives. It is also largely used for fodder and is an important article of export.

FIG. 6.—Grain.

As an article of food maize is one of the most extensively used grains in the world. Although rich in nitrogenous matter and fat, it does not make good bread. A mixture of rye and corn meal, however, makes an excellent coarse bread, formerly much used in the Atlantic states, and a similar bread is now the chief coarse bread of Portugal and some parts of Spain. It is either baked into cakes, called *tortilla* by the Indians of Yucatan, or made into a kind of porridge, as in Ireland. When deprived of the gluten it constitutes oswego, maizena or corn flour. Maize contains more oil than any other cereal, ranging from 3·5 to 9·5% in the commercial grain. This is one of the factors in its value for fattening purposes. In distilling and some other processes this oil is separated and forms an article of commerce. When maize is sown broadcast or closely planted in drills the ears may not develop at all, but the stalk is richer in sugar and sweeter; and this is the basis of growing "corn-fodder." The amount of forage that may be produced in this way is enormous; 50,000 to 80,000 ℔ of green fodder are grown per acre, which makes 8000 to 12,000 ℔ as field-cured. Sugar and molasses have from time to time been manufactured from the corn stalks.

See articles on corn and *Zea Mays* in L. H. Bailey's *Cyclopaedia of American Horticulture* (1900–1902); and for cultivation in India, Watt's *Dictionary of the Economic Products of India*, vi. (1893)

MAJESTY (Fr. *majesté*; Lat. *majestas*, grandeur, greatness, from the base *mag-*, as in *magnus*, great, *major*, greater, &c.), dignity, greatness, a term especially used to express the dignity and power of a sovereign. This application is to be traced to the use of *majestas* in Latin to express the supreme sovereign dignity of the Roman state, the *majestas reipublicae* or *populi Romani*, hence *majestatem laedere* or *minuere*, was to commit high treason, *crimen majestatis*. (For the modern law and usage of *laesa majestas*, *lèse majesté*, *Majestätsbeleidigung*, see TREASON.) From the republic *majestas* was transferred to the emperors, and the *majestas populi Romani* became the *majestas imperii*, and *augustalis majestas* is used as a term to express the sovereign person of the emperor. Honorius and Theodosius speak of themselves in the first person as *nostra majestas*. The term "majesty" was strictly confined in the middle ages to the successors of the Roman emperors in the West, and at the treaty of Cambrai (1529) it is reserved for the emperor Charles V. Later the word is used of kings also, and the distinction is made between imperial majesty (*caesareana majestas*) and kingly or royal majesty. From the 16th century dates the application of "Most Christian and Catholic Majesty" to the kings of France, of "Catholic Majesty" to the kings of Spain, of "Most Faithful Majesty" to the kings of Portugal, and "Apostolic Majesty" to the kings of Hungary. In England the use is generally assigned to the reign of Henry VIII., but it is found, though not in general usage, earlier; thus the *New English Dictionary* quotes from an *Address of the Kings Clerks to Henry II.* in 1171 (Materials for the History of Archbishop Becket, vii. 471, Rolls Series, 1885), where the king is styled *vestra majestas*, and Selden (*Titles of Honour*, part i. ch. 7, p. 98, ed. 1672) finds many early uses in letters to Edward I., in charters of creation of peers, &c. The fullest form in English usage is "His Most Gracious Majesty"; another form is "The King's Most Excellent Majesty," as in the English Prayer-book. "His Sacred Majesty" was common in the 17th century; and of this form Selden says: "It is true, I think, that in our memory or the memory of our fathers, the use of it first began in England." "His Majesty," abbreviated H.M., is now the universal European use in speaking of any reigning king, and "His Imperial Majesty," H.I.M., of any reigning emperor.

From the particular and very early use of "majesty" for the glory and splendour of God, the term has been used in ecclesiastical art of the representation of God the Father enthroned in glory, sometimes with the other persons of the Trinity, and of the Saviour alone, enthroned with an aureole.

MAJLÁTH, JÁNOS, or JOHN, COUNT (1786–1855), Hungarian historian and poet, was born at Pest on the 5th of October 1786. First educated at home, he subsequently studied philosophy at Eger (Erlau) and law at Győr (Raab), his father, Count Joseph Majláth, an Austrian minister of state, eventually obtaining for him an appointment in the public service. Majláth devoted himself to historical research and the translation into German of Magyar folk-tales, and of selections from the works of the best of his country's native poets. Moreover, as an original lyrical writer, and as an editor and adapter of old German poems, Majláth showed considerable talent. During the greater part of his life he resided either at Pest or Vienna, but a few years before his death he removed to Munich, where he fell into a state of destitution and extreme despondency. Seized at last by a terrible infatuation, he and his daughter Henriette, who had long been his constant companion and amanuensis, drowned themselves in the Lake of Starnberg, a few miles south-west of Munich, on the 3rd of January 1855.

Of his historical works the most important are the *Geschichte der Magyaren* (Vienna, 1828–1831, 5 vols.; 2nd ed., Ratisbon, 1852–1853) and his *Geschichte des österreichischen Kaiserstaats* (Hamburg, 1834–1850, 5 vols.). Specially noteworthy among his metrical translations from the Hungarian are the *Magyarische Gedichte* (Stuttgart and Tübingen, 1825); and *Himfy's auserlesene Liebeslieder* (Pest, 1829; 2nd ed., 1831). A valuable contribution to folk-lore appeared in the *Magyarische Sagen, Märchen und Erzählungen* (Brünn, 1825; 2nd ed., Stuttgart and Tübingen, 1837, 2 vols.).

MAJOLICA, a name properly applied to a species of Italian ware in which the body is coated with a tin-enamel, on which is laid and fired a painted decoration. It is also applied to similar wares made in imitation of the Italian ware in other countries. The word in Italian is *maiolica*. Du Cange (*Gloss. s.v.* "Majorica") quotes from a chronicle of Verona of 1368, in which the form *majolica* occurs for the more usual Latin form *majorica*. It has usually been supposed that this type of pottery was first made in the island of Majorca, but it is more probable that the name was given by the Italians to the lustred Spanish ware imported by ships hailing from the Balearic Islands. (See Ceramics: *Medieval and Later Italian*.)

MAJOR (or Mair), **JOHN** (1470–1550), Scottish theological and historical writer, was born at the village of Gleghornie, near North Berwick, Scotland, in the year 1470. He was educated at the school of Haddington, where John Knox was later a pupil. After a short period spent at Cambridge (at God's House, afterwards Christ's College) he entered the university of Paris in 1493, studying successively at the colleges of St Barbe, Montaigu and Navarre, and graduating as master of arts in 1496. Promoted to the doctorate in 1505, he lectured on philosophy at Montaigu College and on theology at Navarre. He visited Scotland in 1515 and returned in 1518, when he was appointed principal regent in the university of Glasgow, John Knox being among the number of those who attended his lectures there. In 1522 he removed to St Andrew's University, where in 1525 George Buchanan was one of his pupils. He returned to the college of Montaigu in 1525, but was once more at St Andrew's in 1531, where he was head of St Salvator's College from 1534 until his death.

Major's voluminous writings may be grouped under (*a*) logic and philosophy, (*b*) Scripture commentary, and (*c*) history. All are in Latin, all appeared between 1503 and 1530, and all were printed at Paris. The first group includes his *Exponabilia* (1503), his commentary on Petrus Hispanus (1505–1506), his *Inclitarum artium libri* (1506, &c.), his commentary on Joannes Dorp (1504, &c.), his *Insolubilia* (1516, &c.), his introduction to Aristotle's logic (1521, &c.), his commentary on the ethics (1530), and, chief of all, his commentary on Peter Lombard's *Sentences* (1509, &c.); the second consists of a commentary on Matthew (1518) and another on the Four Gospels (1529); the last is represented by his famous *Historia Majoris Britanniae tam Angliae quam Scotiae per J. M.* (1521). In political philosophy he maintained the Scotist position, that civil authority was derived from the popular will, but in theology he was a scholastic conservative, though he never failed to show his approbation of Gallicanism and its plea for the reform of ecclesiastical abuses. He has left on record that it was his aim and hope to reconcile realism and nominalism in the interests of theological peace. He had a world-wide reputation as a teacher and writer. Buchanan's severe epigram, perhaps the only unfriendly words in the flood of contemporary praise, may be explained as a protest against the compromise which Major appeared to offer rather than as a personal attack on his teacher. Major takes a more independent attitude in his *History*, which is a remarkable example of historical accuracy and insight. He claims that the historian's chief duty is to write truthfully, and he is careful to show that a theologian may fulfil this condition.

The *History*, on which his fame now rests, was reprinted by Freebairn (Edinburgh, 1740), and was translated in 1892 by Archibald Constable for the Scottish History Society. The latter volume contains a full account of the author by Aeneas J. G. Mackay and a bibliography by Thomas Graves Law.

MAJOR (Lat. for "greater"), a word used, both as a substantive and adjective, for that which is greater than another in size, quality, degree, importance, &c., often opposed correlatively to that to which "minor" is applied in the same connotation. In the categorical syllogism in logic, the major term is the term which forms the predicate of the conclusion, the major premise is that which contains the major term. (For the distinction between major and minor intervals, and other applications in music, see Music and Harmony.)

The use of *Major* as part of an official title in Med. Lat. has given the Span. *mayor*, Fr. *maire*, and Eng. "mayor" (*q.v.*). In English the unadapted form "major" is the title of a military officer now ranking between a captain and a lieutenant-colonel. Originally the word was used adjectivally in the title "sergeant-major," an officer of high rank (third in command of an army) who performed the same duties of administration, drill and encampments on the staff of the chief commander as the sergeant in a company performs as assistant to the captain. This was in the latter half of the 16th century, and very soon afterwards the "sergeant-major" became known as the "sergeant-major-general"—hence the modern title of major-general. By the time of the English Civil War "majors" had been introduced in each regiment of foot, who corresponded in a lesser sphere to the "major-general" of the whole army. The major's sphere of duties, precedence and title have since varied but little, though he has, in the British service, taken the place of the lieutenant-colonel as second in command—the latter officer exercising the command of the cavalry regiment, infantry battalion or artillery brigade, and the colonel being, save for certain administrative functions, little more than the titular chief of his regiment. Junior majors command companies of infantry; squadrons of cavalry and batteries of artillery are also commanded by majors. In most European armies, however, and of late years in the army of the United States also, the major has become a battalion commander under the orders of a regimental commander (colonel or lieutenant-colonel). The word appears also in the British service in "brigade-major" (the adjutant or staff officer of a brigade). "Town-majors" (garrison staff officers) are now no longer appointed. In the French service up to 1871 the "major-general" was the chief of the general staff of a field army, and thus preserved the tradition of the former "sergeant-major" or "sergeant-major-general."

MAJORCA (*Mallorca*), the largest of the group of Spanish islands in the Mediterranean Sea known as the Balearic Islands (*q.v.*). Pop. (1900), 248,191; area, 430 sq. m. Majorca has the shape of a trapezoid, with the angles directed to the cardinal points; and its diagonal, from Cape Grozer in the west to Cape Pera in the east, is about 60 m. On the north-west the coast is precipitous, but on the other sides it is low and sloping. On the north-east there are several considerable bays, of which the chief are those of Alcudia and Pollensa; while on the south-west is the still more important bay of Palma. No fewer than twelve ports or harbours are enumerated round the island, of which may be mentioned Andraitx and Sóller. In the north-west Majorca is traversed by a chain of mountains running parallel with the coast, and attaining its highest elevation in Silla de Torrellas (5154 ft.). Towards the south and east the surface is comparatively level, though broken by isolated peaks of considerable height. The northern mountains afford great protection to the rest of the island from the violent gales to which it would otherwise be exposed, and render the climate remarkably mild and pleasant. The scenery of Majorca has all the picturesqueness of outline that usually belongs to a limestone formation. Some of the valleys, such as those of Valdemosa and Sóller, with their luxuriant vegetation, are delightful resorts. There are quarries of marble of various grains and colours—those near Santañy, in the district of Manacor, being especially celebrated; while lead, iron and cinnabar have also been obtained. Coal of a jet-like character is found at Benisalem, where it was first worked in 1836; at Selva, where it has been mined since 1851; near Santa Maria and elsewhere. It is used in the industrial establishments of Palma, and in the manufacture of lime, plaster and bricks near the mines. A considerable quantity is also exported to Barcelona.

The inhabitants are principally devoted to agriculture, and most of the arable land is cultivated. The mountains are terraced; and the old pine woods have in many places given way to the olive, the vine and the almond tree, to fields of wheat and flax, or to orchards of figs and oranges. For the last-mentioned fruits the valley of Sóller is one of the most important districts, the produce being largely transmitted to France. The yield of oil is very considerable, and Inca is the centre of the oil district. The wines are light but excellent, especially the Muscadel and Montona. During the summer there is often great scarcity of water; but, according to a system handed down by the Moors, the rains of autumn and winter are collected in enormous reservoirs, which contain sufficient water to last through the dry season; and on the payment of a certain rate, each landholder has his fields flooded at certain intervals. Mules are used in the agriculture and traffic of the island. The cattle are small, but the sheep are large and well fleeced. Pigs are reared for export to Barcelona, and there is abundance of poultry and small game. Brandy is made and exported in large quantities. Excellent woollen and linen cloths are woven; the silkworm is reared and its produce manufactured; and canvas, rope and cord are largely made, from both native and foreign materials.

The roads are excellent, the four principal being those from Alcudia, Manacor, Sóller and Andraitx to the capital. Forty-eight miles of railway were open at the beginning of the 20th century. The main line runs from Palma to Manacor and Alcudia. The telegraphic system is fairly complete, and there is regular steam communication with Barcelona and Alicante. The principal towns include—besides Palma (63,937), Felanitx (11,294) and Manacor (12,408), which are described in separate articles—Andraitx (6516), Inca (7579), Llummayor (8859), Pollensa (8308), Santañy (6692) and Sóller (8026).

MAJORIAN (Julius Valerius Majorianus), emperor of the West from 457 to 461. He had distinguished himself as a general by victories over the Franks and Alemanni, and six months after the deposition of Avitus he was declared emperor by the regent Ricimer. After repelling an attack by the Vandals upon Campania (458) he prepared a large force, composed chiefly of barbarians, to invade Africa, which he previously visited in disguise. Having during his stay in Gaul defeated and concluded an alliance with Theodoric the Visigoth, at the beginning of 460 he crossed the Pyrenees for the purpose of joining the powerful fleet which he had collected at Carthagena. The Vandal king Genseric, however, after all overtures of peace had been rejected, succeeded through the treachery of certain officers in surprising the Roman fleet, most of the ships being either taken or destroyed. Majorian thereupon made peace with Genseric. But his ill-success had destroyed his military reputation; his efforts to put down abuses and improve the condition of the people had roused the hatred of the officials; and Ricimer, jealous of his fame and influence, stirred up the foreign troops against him. A mutiny broke out in Lombardy, and on the 2nd of August 461 Majorian was forced to resign. He died five days afterwards, either of dysentery or by violence. Majorian was the author of a number of remarkable laws, contained in the Theodosian Code. He remitted all arrears of taxes, the collection of which was for the future placed in the hands of the local officials. He revived the institution of *defensores*, defenders of cities, whose duty it was to protect the poor and inform the emperor of abuses committed in his name. The practice of pulling down the ancient monuments to be used as building material, which was connived at by venal officials, was strictly prohibited. He also passed laws against compulsory ordination and premature vows of celibacy.

See Sidonius Apollinaris, *Panegyric of Majorian*; Gibbon, *Decline and Fall*, ch. xxxvi. (where an outline of the "novels" of Majorian is given); J. B. Bury, *Later Roman Empire*, bk. iii.

MAJORITY (Fr. *majorité*; Med. Lat. *majoritas*; Lat. *major*, greater), a term signifying the greater number. In legislative and deliberative assemblies it is usual to decide questions by a majority of those present at a meeting and voting. In law, majority is the state of being of full age, which in the United Kingdom is twenty-one years of age. A person attains his majority at twelve o'clock at night of the day preceding his twenty-first birthday (see Infant; Age).

MAJUBA (properly Amajuba, Zulu for "the hill of doves"), a mountain in northern Natal, part of the Drakensberg range, rising about 7000 ft. above the sea and over 2000 ft. above the level of the surrounding country. It overlooks the pass through the Drakensberg known as Laing's Nek, is 8 m. S. of the Transvaal border and 18 m. N. of the town of Newcastle. The railway from Durban to Johannesburg skirts the base of the mountain. During the Boer War of 1880–81 Majuba was occupied on the night of the 26th of February 1881 by some 600 British troops under Sir George Pomeroy Colley. On the following morning the hill was stormed by the Boers under Piet Joubert and the British routed, Colley being among the slain.

MAKALAKA, a general designation used by the Bechuana, Matabele and kindred peoples, for conquered or slave tribes. Thus many of the tribes subjugated by the Makololo chief, Sebituane, about 1830 were called Makalaka (see David Livingstone's *Missionary Travels and Researches in South Africa*, London, 1857). By early writers on south-central Africa certain of the inhabitants of Barotseland were styled Makalaka; the name is more frequently used to designate the Makalanga, one of the tribes now classed as Mashonas (*q.v.*), who were brought into subjection by the Matabele.

MAKARAKA, or Iddio ("Cannibals"), a negroid people of Central Africa, closely related to the powerful Azandeh or Niam-Niam race, occupying the Bahr-el-Ghazal west of Lado. They came originally from the country of the Kibas, north of the Welle. Dr W. Junker described them as among the most trustworthy, industrious and intelligent people of the Bahr-el-Ghazal. They are a reddish-black, with nose less flat and cheek-bones less prominent than the ordinary negroes, and, unlike the latter, do not extract the incisors. Their long silky hair is built up in the most fantastic form by means of vegetable substances. They are well-known for strength and staying power.

See W. Junker, *Travels in Africa* (1890–1892).

MAKART, HANS (1840–1884), Austrian painter, born at Salzburg, was the son of an inspector of the imperial castle. He has been aptly called the first German *painter* of the 19th century. When he, as a youth, entered the Vienna Academy German art was under the rule of Cornelius's cold classicism. It was entirely intellectual and academic. Clear and precise drawing, sculpturesque modelling, and pictorial erudition were the qualities most esteemed; and it is not surprising that Makart, poor draughtsman to the very last, with a passionate and sensual love of colour, and ever impatient to escape the routine of art-school drawing, was found to be "devoid of all talent" and forced to leave the Vienna Academy. He went to Munich, and after two years of independent study attracted the attention of Piloty, under whose guidance he made rapid and astonishing progress. The first picture he painted under Piloty, "Lavoisier in Prison," though timid and conventional, attracted attention by its sense of colour. In the next, "The Knight and the Water Nymphs," he first displayed the decorative qualities to which he afterwards sacrificed everything else in his work. With the "Cupids" and "The Plague in Florence" of the next year his fame became firmly established. "Romeo and Juliet" was soon after bought by the Austrian emperor for the Vienna Museum, and Makart was invited to come to Vienna, where a large studio was placed at his disposal. In Vienna Makart became the acknowledged leader of the artistic life of the city, which in the 'seventies passed through a period of feverish activity, the chief results of which are the sumptuously decorated public buildings of the Ringstrasse.

The enthusiasm of the time, the splendour of the fêtes over which Makart presided, and the very obvious appeal of his huge compositions in their glowing richness of colour, in which he tried to emulate Rubens, made him appear a very giant to his contemporaries in Vienna, and indeed in all Austria and Germany. The appearance of each of his ambitious historical and allegorical paintings was hailed with enthusiasm—the "Catherina Cornaro," "Diana's Hunt," "The Entry of Charles V. into Antwerp," "Abundantia," "Spring," "Summer," "The Death of Cleopatra" and the "Five Senses." He reached the zenith of his fame when, in 1879, he designed, single-handed, the costumes, scenic setting, and triumphal cars of the grand pageant with which the citizens of Vienna celebrated the silver wedding of their rulers. Some 15,000 people participated in the pageant, all dressed in the costumes of the Rubens and Rembrandt period. Makart died in Vienna in October 1884.

Unfortunately Makart was in the habit of using such villainous pigments and mediums that in the few decades which have passed since his death, the vast majority of his large paintings have practically perished. The blues have turned into green; the bitumen has eaten away the rich glow of the colour harmonies; the thickly applied paint has cracked and in some instances crumbled away. And this loss of their chief quality has accentuated the weaknesses of these pictures—the faulty drawing, careless and hasty execution, lack of deeper significance and prevalence of glaring anachronisms. Important examples of his work are to be found at the galleries of Vienna, Berlin, Hamburg and Stuttgart. For the Vienna Museum he also executed a series of decorative lunettes.

MAKING-UP PRICE, a term used in the London and other British Stock Exchanges, to denote the price at which speculative bargains are carried over from one account to the next. The carrying over of a "bull" position in Eries, for example, implies a sale for cash and a simultaneous repurchase for the new account, both bargains being done at the making-up price. This is fixed at noon on carry-over day, in accordance with the market price then current (see ACCOUNT; STOCK EXCHANGE). The term is also used in New York, where the making-up prices are fixed at the end of a day's business, in accordance with the American system of daily settlements.

MAKÓ, a town of Hungary, capital of the county of Csanád 135 m. S.E. of Budapest by rail. Pop. (1900), 33,701. It is situated near the right bank of the Maros, and is a typical Hungarian town of the Alföld. The most noteworthy building is the palace of the bishop of Csanád, whose usual residence is in Temesvár. The town possesses numerous mills, and the surrounding country is fertile. The communal lands are extensive; they afford excellent pasturage for horses and sheep and also for large herds of horned cattle, for the size and quality of which Makó has obtained a high repute.

MAKRAN, or MEKRAN, a province of Baluchistan, fringing the Arabian Sea from Persia almost to Sind for about 200 m. It is subject to the khan of Kalat under British political supervision. Estimated area, 26,000 sq. m.; estimated pop. (1903), 78,000. The long lateral valley of Kej is usually associated with Makran in early geographical records. The Kej-Macoran of Marco Polo is the Makran of to-day.

The long stretch of sandy foreshore is broken on the coastline by the magnificent cliffs of Malan, the hammer-shaped headlands of Ormarah and Gwadar, and the precipitous cliffs of Jebel Zarain, near Pasni. Within them lies the usual frontier band of parallel ridges, alternating with narrow valleys. Amongst them the ranges called Talana and Talur are conspicuous by their height and regular configuration. The normal conformation of the Baluchistan frontier is somewhat emphasized in Makran. Here the volcanic action, which preceded the general upheaval of recent strata and the folding of the edges of the interior highlands, is still in evidence in occasional boiling mud volcanoes on the coast-line. It is repeated in the blazing summit of the Kuh-i-taftān (the burning mountain of the Persian frontier) which is the highest active volcano in Asia (13,000 ft.), and probably the farthest inland. Evidence of extinct mud volcanoes exists through a very wide area in Baluchistan and Seistan. Probably the *miri*, or fort, at Quetta represents one of them. The coast is indented by several harbours. Ormarah, Khor Kalmat, Pasni and Gwadar are all somewhat difficult of approach by reason of a sand-bar which appears to extend along the whole coastline, and which is very possibly the last evidence of a submerged ridge; and they are all subject to a very lively surf under certain conditions of wind. Of these the port of Gwadar (which belongs to Muscat and is therefore foreign territory) is the most important. They all are (or were) stations of the Indo-Persian telegraph system which unites Karachi with Bushire. With the exception of the Kej valley, and that of the Bolida, which is an affluent of the Kej, there are no considerable spaces of cultivation in Makran. These two valleys seem to concentrate the whole agricultural wealth of the country. They are picturesque, with thick groves of date palms at intervals, and are filled with crops and orchards. They are indeed exceedingly beautiful; and yet the surrounding waste of hills is chiefly a barren repetition of sun-cracked crags and ridges with parched and withered valleys intersecting them, where a trickle of salt water leaves a white and leprous streak amongst the faded tamarisk or the yellow stalks of last season's grass. Makran is the home of remnants of an innumerable company of mixed people gathered from the four corners of Asia and eastern Africa. The ancient Dravidians, of whom the Brahui is typical, still exist in many of the districts which are assigned to them in Herodotus. Amongst them there is always a prominent Arab element, for the Arabs held Makran even before they conquered Sind and made the Kej valley their trade highway to India. There are negroes on the coast, bred from imported slaves. The Meds of the Indus valley still form the greater part of the fishing population, representing the Ichthyophagi of Arrian. The old Tajik element of Persia is not so evident in Makran as it is farther north; and the Karak pirates whose depredations led to the invasion of India and the conquest of Sind, seem to have disappeared altogether. The fourth section includes the valleys formed by the Rakshān and Mashkel, which, sweeping downwards from the Kalat highlands and the Persian border east and west, unite to break through the intervening chain of hills northward to form the Mashkel swamps, and define the northern limits of Makran. In these valleys are narrow strips of very advanced cultivation, the dates of Panjgur being generally reckoned superior even to those of the Euphrates. The great Mashkel swamp and the Kharan desert to the east of it, mark the flat phase of southern Baluchistan topography. It is geologically part of an ancient inland lake or sea which included the present swamp regions of the Helmund, but not the central depression of the Lora. The latter is buttressed against hills at a much higher elevation than the Kharan desert, which is separated from the great expanse of the Helmund desert within the borders of Afghanistan by a transverse band of serrated hills forming a distinct watershed from Nushki to Seistan. Here and there these jagged peaks appear as if half overwhelmed by an advancing sea of sand. They are treeless and barren, and water is but rarely found at the edges of their foot-hills. The Koh-i-Sultan, at the western extremity of the northern group of these irregular hills, is over 6000 ft. above sea-level, but the general level of the surrounding deserts is only about 2000 ft., sinking to 1500 ft. in the Mashkel Hamun and the Gaod-i-Zirreh.

The whole of this country has been surveyed by Indian surveyors and the boundary between Persian and British Baluchistan was demarcated by a commission in 1895–1896. In 1898 a column of British troops under Colonel Mayne was despatched to Makran by sea, owing to a rebellion against the authority of the khan of Kalat, and an attack made by some Makran chiefs on a British survey party. The campaign was short and terminated with the capture of the Kej citadel. Another similar expedition was required in 1901 to storm the fort at Nodiz. The headquarters of the native governor, under the khan of Kalat, are at Turbat, with deputies at Tump, Kolwa, Pasni and Panjgur. A levy corps, with two British officers, is stationed along the western frontier. The port of Gwadur forms an enclave belonging to the sultan of Muscat.

Baluchistan District Gazetteer, vol. vii. (Bombay, 1907).
(T. H. H.*)

MAKSOORA, the term in Mahommedan architecture given to the sanctuary or praying-chamber in a mosque, which was sometimes enclosed with a screen of lattice-work; the word is occasionally used for a similar enclosure round a tomb.

MALABAR, a district of British India, in the Madras Presidency. Geographically the name is sometimes extended to the entire western coast of the peninsula. Properly it should apply to the strip below the Ghāts, which is inhabited by people speaking the Malayalam language, a branch of the Dravidian stock, who form a peculiar race, with castes, customs and traditions of their own. It would thus be coextensive with the old kingdom of Chera, including the modern states of

Travancore and Cochin, and part of Kanara. In 1901 the total number of persons speaking Malayalam in all India was 6,029,304.

The district of Malabar extends for 145 m. along the coast, running inland to the Ghāts with a breadth varying from 70 to 25 m. The administrative headquarters are at Calicut. Area, 5795 sq. m. Malabar is singularly diversified in its configuration; from the eastward, the great range of the Western Ghāts, only interrupted by the Palghāt gap, looks down on a country broken by long spurs, extensive ravines, dense forests and tangled jungle. To the westward, gentler slopes and downs, and gradually widening valleys closely cultivated, succeed the forest uplands, till, nearer the seaboard, the low laterite tablelands shelve into rice plains and backwaters fringed with coconut palms. The coast runs in a south-easterly direction, and forms a few headlands and small bays, with a natural harbour in the south at Cochin. In the south there is considerable extent of table-land. The mountains of the Western Ghāts run almost parallel to the coast, and vary from 3000 to 7000 ft. in height. One of the most characteristic features of Malabar is an all but continuous chain of lagoons or backwaters lying parallel to the coast, which have been formed by the action of the waves and shore-currents in obstructing the waters of the rivers. Connected by artificial canals, they form a cheap means of transit; and a large local trade is carried on by inland navigation. Fishing and fishcuring is an important industry. The forests are extensive and of great value, but they are almost entirely private property. The few tracts which are conserved have come into government hands by escheat or by contract. Wild animals include the elephant, tiger, panther, bison, *sambhar*, spotted deer, Nilgiri ibex, and bear. The population in 1901 was 2,800,555, showing an increase of 5·6% in the decade.

The staple crop is rice, the next most important product being coco-nuts. Coffee is grown chiefly in the upland tract known as the Wynaad, where there are also a few acres under tea. The Madras railway crosses the district and has been extended from Calicut to Cannanore along the coast. There are eleven seaports, of which the principal are Calicut, Tellicherry, Cannanore and Cochin. The principal exports are coffee, coco-nut products and timber. There are factories for cleaning coffee, pressing coir and making matting, making tiles, sawing timber and weaving cotton.

See *Malabar District Gazetteer* (Madras, 1908).

MALABARI, BEHRAMJI (1853-), Indian journalist and social reformer, was born in 1853 at Baroda, the son of a poor Parsi in the employment of the state, who died shortly after his birth. His mother took him to Surat, where he was educated in a mission school, but he never succeeded in gaining an academical degree. Coming to Bombay, he fell under the influence of Dr John Wilson, principal of the Scottish College. As early as 1875 he published a volume of poems in Gujarati, followed in 1877 by *The Indian Muse in English Garb*, which attracted attention in England, notably from Tennyson, Max Müller, and Florence Nightingale. His life work began in 1880 when he acquired the *Indian Spectator*, which he edited for twenty years until it was merged in the *Voice of India*. In 1901 he became editor of *East and West*. Always holding aloof from politics, he was an ardent and indefatigable advocate of social reform in India, especially as regards child marriage and the remarriage of widows. It was largely by his efforts, both in the press and in tours through the country, that the Age of Consent Act was passed in 1891. His account of his visits to England, entitled *The Indian Eye on English Life* (1893), passed through three editions, and an earlier book of a somewhat satirical nature, *Gujarat and the Gujaratis* (1883), was equally popular.

See R. P. Karkaria, *India, Forty Years of Progress and Reform*, (London, 1896).

MALABON, a town of the province of Rizal, Luzon, Philippine Islands, 1 m. inland from the shore of Manila Bay and 3 m. N. of the city of Manila, with which it is connected by an electric tramway. Pop. (1903), 20,136. The leading industries are the refining of sugar, fishing, trade, the weaving of jusi cloth, the making of cigars, and the cultivation of ilang-ilang-trees (*Cananga odorata*) for their flowers, from which a fine perfume is distilled; ilang-ilang is one of the principal exports, mostly to France. Tagalog and Spanish are the principal languages. Malabon was formerly known as Tambóbong.

MALACCA, a town on the west coast of the Malay Peninsula, in 2° 14′ N., 102° 12′ E., which, with the territory lying immediately around and behind it forms one of the Straits Settlements, and gives its name to the Straits which divide Sumatra from the Malay Peninsula. Its name, which is more correctly transliterated *mĕlāka*, is that of a species of jungle fruit, and is also borne by the small river on the right bank of which the old Dutch town stands. The Dutch town is connected by a bridge with the business quarter on the left bank, which is inhabited almost exclusively by Chinese, Eurasians and Malays.

Malacca, now a somnolent little town, a favourite resort of rich Chinese who have retired from business, is visited by few ships and is the least important of the three British settlements on the Straits which give their name to the colony. It has, however, a remarkable history. The precise date of its foundation cannot be ascertained, but there is strong reason to believe that this event took place at the earliest in the 14th century. The Roman youth Ludovigo Barthema is believed to have been the first European to visit it, some time before 1503; and in 1509 Diogo Lopez de Siqueira sailed from Portugal for the express purpose of exploiting Malacca. At first he was hospitably received, but disagreements with the natives ensued and word was brought to Siqueira by Magellan, who was one of his company, that a treacherous attack was about to be made upon his ships. Siqueira then sent a native man and woman ashore "with an arrow passed through their skulls" to the sultan, "who was thus informed," says de Barros, "through his subjects that unless he kept a good watch the treason which he had perpetrated would be punished with fire and sword." The sultan retaliated by arresting Ruy de Araujo, the factor, and twenty other men who were ashore with him collecting cargo for the ships. Siqueira immediately burned one of his vessels and sailed direct for Portugal. In 1510 Mendez de Vasconcellos with a fleet of four ships set out from Portugal "to go and conquer Malacca," but d'Alboquerque detained him at Goa, and it was not until 1511 that d'Alboquerque himself found time to visit Malacca and seek to rescue the Portuguese prisoners who all this time had remained in the hands of the sultan. An attack was delivered by d'Alboquerque on the 25th of July 1511, but it was only partially successful, and it was not until the 4th of August, when the assault was repeated, that the place finally fell. Since that time Malacca has continued to be the possession of one or another of the European Powers. It was a Portuguese possession for 130 years, and was the headquarters of their trade and the base of their commercial explorations in south-eastern Asia while they enjoyed, and later while they sought to hold, their monopoly in the East. It was from Malacca, immediately after its conquest, that d'Alboquerque sent d'Abreu on his voyage of discovery to the Moluccas, or Spice Islands, which later were the objective of Magellan's voyage of circumnavigation. During the Portuguese tenure of Malacca the place was attacked at least twice by the Achinese; its shipping was harried by Lancaster in 1592, when the first British fleet made its way into these seas; it was besieged by the Dutch in 1606, and finally fell to a joint attack of the Dutch and the Achinese in 1641. It was under the Portuguese government that St Francis Xavier started a mission in Malacca, the first Christian mission in Malayan lands.

The Dutch held Malacca till 1795, when it was taken from them by Great Britain, and the Dutch system of monopoly in the straits was forthwith abolished. The colony was restored to the Dutch, however, in 1818, but six years later it came finally into the hands of Great Britain, being exchanged by a treaty with Holland for the East India Company's settlement of Benkulen and a few other unimportant places on the western coast of Sumatra. By this treaty the Dutch were precluded from interference in the affairs of the Malay Peninsula, and Great Britain from similar action in regard to the States of Sumatra, with the sole exception of Achin, the right to protect that state being maintained by Great Britain until 1872 when it was finally abandoned by a treaty concluded with Holland in that year. The Dutch took advantage of this immediately to invade Achin, and the strife begun in 1873 still continues and is now a mere war of extermination. It was not until 1833 that the whole territory lying at the back of Malacca was finally brought under British control, and as late as 1887 the Negri Sembilan, or Nine States, which adjoin Malacca territory on the east and north-east, were completely independent. They to-day form part of the Federated Malay States, which are under the protection of Great Britain, and are governed with the assistance and by the advice of British officers.

Malacca, in common with the rest of the Straits Settlements, was administered by the government of India until 1867, when it became a crown colony under the control of the Colonial Office. It is to-day administered by a resident councillor, who is responsible to the governor of the Straits Settlements, and by a number of district officers and other officials under his direction. The population of the town and territory of Malacca in 1901 was 94,487, of whom 74 were Europeans and Americans, 1598 were Eurasians, the rest being Asiatics (chiefly Malays with a considerable sprinkling of Chinese). The population in 1891 was 92,170, and the estimated population for 1905 was 97,000. The birth-rate is about 35 per thousand, and the death-rate about 29 per thousand. The trade of this once flourishing port has declined, most of the vessels being merely coasting craft, and no large line of steamers holding any communication with the place. This is due partly to the shallowness of the harbour, and partly to the fact that the ports of Penang and Singapore, at either entrance to the straits, draw all the trade and shipping to themselves. The total area of the settlement is about 700 sq. m. The colony is wholly agricultural, and the land is almost entirely in the hands of the natives. About 50,000 acres are under tapioca, and about 9000 acres are under rubber (*hevea*). This cultivation is rapidly extending. There are still considerable areas unoccupied which are suitable for rubber and for coco-nuts. The settlement is well opened up by roads; and a railway, which is part of the Federated Malay States railway system, has been constructed from the town of Malacca to Tampin in the Negri Sembilan. There is a good rest-house at Malacca and a comfortable seaside bungalow at Tanjong Kling, seven miles from the town. Malacca is 118 m. by sea from Singapore and 50 m. by rail from Seremban, the capital of the Negri Sembilan. There is excellent snipe-shooting to be had in the vicinity of Malacca.

See *The Commentaries of d'Alboquerque* (Hakluyt Society); *The Voyages and Adventures of Fernand Mendez Pinto* (London, 1653); *An Account of the East Indies*, by Captain Alexander Hamilton (Edinburgh, 1727); Valentyn's *History of Malacca*, translated by Dudley Hervey; *Journal of the Straits Branch of the Royal Asiatic Society*; "Our Tropical Possessions in Malayan India," by the same author, *ibid.*; *Further India*, by Hugh Clifford (London, 1904); *British Malaya*, by Sir Frank Swettenham (London, 1906).

(H. Cl.)

MALACHI, the name assigned to the last book of the Old Testament in English (the last of the "prophets" in the Hebrew Bible), which according to the title (Mal. i. 1) contains the "word of Yahweh to Israel by the hand of Malachi." In form the word means "my messenger." It could be explained as a contraction of Malachiah, "messenger of Yahweh"; but the Septuagint is probably right in not regarding it as a proper name ("by the hand of His messenger"). Not only do we know nothing from internal or external evidence of the existence of a prophet of this name,[1] but the occurrence of the word in the title is naturally explained as derived from iii. 1: "Behold, I send my messenger" (cf. ii. 7). The prophecy must, therefore, be regarded as anonymous; the title was added by the compiler who wrote similar editorial titles to the anonymous prophecies beginning Zech. ix. 1, xii. 1.

The contents of the prophecy fall into a series of clearly marked sections, as in the paragraph division of the Revised Version. These apply, in various ways, the truth emphasized at the outset: Yahweh's love for Israel in contrast with his treatment of Edom (i. 2–5). Israel's response should be a proper regard for the ritual of His worship; yet any offering, however imperfect, is thought good enough for Yahweh's altar (i. 6–14). Let the priests, who are responsible, take warning, and return to their ancient ideals (ii. 1–9). Again, the common Fatherhood of God should inspire a right relation among fellow Israelites, not such conduct as the divorce of Israelite wives in order to marry non-Israelite women (ii. 10–16).[2] The prevalence of wrong-doing has provoked scepticism as to righteous judgment; but the messenger of Yahweh is at hand to purge away indifferentism from worship and immorality from conduct (ii. 17–iii. 6). The payment of tithes now withheld will be followed by the return of prosperity (iii. 7–12). Religion may seem useless, but Yahweh remembers His own, and will soon in open judgment distinguish them from the irreligious (iii. 13–iv. 3). The book closes with an appeal to observe the law of Moses, and with a promise that Elijah shall come before the threatened judgment[3]

The topics noticed clearly relate the prophecy to the period of Ezra and Nehemiah, when the Temple had been rebuilt (i. 10; iii. 1, 10), the province of Judah was under a Persian governor (i. 8), and there had been time enough for the loss of earlier enthusiasm. The majority of modern scholars are agreed that the prophet prepares for the work of those reformers (Ezra, 458; Nehemiah, 444, 432 B.C.). The abuses of which he particularly complains are such as were found rampant by Ezra and Nehemiah—marriage with foreign women (ii. 11; cf. Ezra ix.; Neh. xiii. 23 seq.; Deut. vii. 3) and failure in payment of sacred dues (iii. 8 seq.; cf. Neh. x. 34 seq.; xiii. 10 seq.; Deut. xxvi. 12 seq.). The priests have fallen into contempt (ii. 9) and have neglected what is still one of their chief trusts, the oral law (ii. 6 seq.). The priestly code of written law was not promulgated until 444 B.C. (Neh. viii.–x.); "Malachi" writes under the influence of the earlier Code of Deuteronomy only,[4] and must therefore belong to a date prior to 444. The independent character of the attack on current abuses also suggests priority to the work of Ezra in 458. The prophecy affords an interesting and valuable glimpse of the post-exilic community, with its various currents of thought and life. The completion of the second Temple (516 B.C.) has been followed by disillusionment as to the anticipated prosperity, by indifference to worship, scepticism as to providence, and moral laxity.[5] In view of these conditions, the prophet's message is to reassert the true relation of Israel to Yahweh, and to call for a corresponding holiness, especially in regard to questions of ritual and of marriage. He saw that "the disobedience of his time was the outcome of a lowered morality, not of a clearer spiritual vision."[1] A strong sense of the unique privileges of the children of Jacob, the objects of electing love (i. 2), the children of the Divine Father (ii. 10), is combined with an equally strong assurance of Yahweh's righteousness notwithstanding the many miseries that pressed on the unhappy inhabitants of Judaea. At an earlier date the prophet Haggai had taught that the people could not expect Yahweh's blessing while the Temple lay in ruins. In Malachi's time the Temple was built (i. 10) and the priests waited in their office, but still a curse seemed to rest on the nation's labours (iii. 9). To Malachi the reason of this is plain. The "law of Moses" was forgotten (iv. 4 [iii. 22]); let the people return to Yahweh, and He will return to them. It was in vain to complain, saying, "Every one that doeth evil is good in the eyes of Yahweh," or "Where is the God of judgment?"—vain to ask "Wherein shall we return?" Obedience to the law is the sure path to blessing (ii. 17-iii. 12).

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[1] A Hebrew tradition given in the Targum of Jonathan, and approved by Jerome, identifies Malachi with Ezra the priest and scribe.

[2] Torrey (*Ency. Bib.* c. 2908) holds that the reference here is purely figurative; "Judah has dealt falsely with the wife of his youth, the covenant religion, and is wedding a strange cult." But he assigns the book to the 4th century.

[3] This closing prophecy may possibly be a later addition (so Marti) rounding off the prophetic canon by reference to the two great names of Moses and Elijah, and their characteristic activities. In this case, "Elijah" will represent an early interpretation (cf. Ecclus. xlviii. 10) of the "messenger," originally conceived as a purely ideal figure. The only other passage in the book whose originality is not generally accepted is that referring to mixed marriages (ii. 11, 12).

[4] It is the Deuteronomic law that is most familiar to him, as appears from his use of the name Horeb for the mountain of the law, and the Deuteronomic phrase "statutes and judgments" (iv. 4), from his language as to tithes and offerings (iii. 8, 10; cf. Deut. xii. 11; xxvi. 12), and especially from his conception of the priesthood as resting on a covenant with Levi (ii. 4 seq.). Malachi indeed assumes that the "whole tithe"—the Deuteronomic phrase for the tithe in which the Levites shared—is not stored in each township, but brought into the treasury at the Temple. But this was a modification of the Deuteronomic law naturally called for under the circumstances of the return from Babylon, and Neh. x. and xiii. produce the impression that it was not introduced for the first time by Ezra and Nehemiah, though the collection of the tithe was enforced by them. See further, W.R.S. in *O.T.J.C.* ii. 425–427.

[5] Cf. Stade's reconstruction, *G.V.I.* ii. 128–138.

He calls the people to repentance, and he enforces the call by proclaiming the approach of Yahweh in judgment against the sorcerers, the adulterers, the false swearers, the oppressors of the poor, the orphan and the stranger. Then it shall be seen that He is indeed a God of righteous judgment, distinguishing between those that serve Him and those that serve Him not. The Sun of Righteousness shall shine forth on those that fear Yahweh's name; they shall go forth with joy, and tread the wicked under foot. The conception of the day of final decision, when Yahweh shall come suddenly to His temple (iii. 1) and confound those who think the presumptuous godless happy (iii. 15), is taken from earlier prophets, but is applied wholly within the Jewish nation. The day of Yahweh would be a curse, not a blessing, if it found the nation in its present state: the priests listlessly performing a fraudulent service (i. 7-ii. 9), the people bound by marriage to heathen women, while the tears of the daughters of Israel, thrust aside to make way for strangers, cover the altar (ii. 11-16), all faith in divine justice gone (ii. 17; iii. 14 seq.), sorcery, uncleanness, falsehood and oppression rampant (iii. 5), the house of God deprived of its dues (iii. 8), and the true fearers of God a little flock gathered together in private exercises of religion (perhaps the germ of the later synagogue) in the midst of a godless nation (iii. 16). That the day of Yahweh is delayed in such a state of things is but a new proof of His unchanging love (iii. 6), which refuses to consume the sons of Jacob. Meantime He is about to send His messenger to prepare His way before Him. The prophet Elijah must reappear to bring back the hearts of fathers and children before the great and terrible day of Yahweh come. Elijah was the advocate of national decision in the great concerns of Israel's religion; and it is such decision, a clear recognition of what the service of Yahweh means, a purging of His professed worshippers from hypocritical and half-hearted service (iii. 3) that Malachi with his intense religious earnestness sees to be the only salvation of the nation. In thus looking to the return of the ancient prophet to do the work for which later prophecy is too weak, Malachi unconsciously signalizes the decay of the order of which he was one of the last representatives; and the somewhat mechanical measure which he applies to the people's sins, as for example when he teaches that if the sacred dues were rightly paid prosperous seasons would at once return (iii. 10), heralds the advent of that system of formal legalism which thought that all religious duty could be reduced to a system of set rules. Yet Malachi himself is no mere formalist. To him, as to the Deuteronomic legislation, the forms of legal observance are of value only as the fitting expression of Israel's peculiar sonship and service, and he shows himself a true prophet when he contrasts the worthless ministry of unwilling priests with the pure offering of prayer and praise that rises from the implicit monotheism of even Gentile worship[2] (i. 11), or when he asserts the brotherhood of all Israelites under their one Father (ii. 10), not merely as a ground of separation from the heathen, but as inconsistent with the selfish and cruel freedom of divorce current in his time.[3] The book is a significant landmark in the religious history of Israel. Its emphasis on the observance of ritual finds fullest development in the Priestly Code, subsequently promulgated; its protest against foreign marriages is made effective through the reforms of Ezra and Nehemiah;[4] the influence of its closing words on later expectation is familiar to every reader of the new Testament.[5]

The style of Malachi, like his argument, corresponds in its generally prosaic character to that transformation or decay of prophecy which began with Ezekiel; and Ewald rightly called attention to the fact that the conduct of the argument already shows traces of the dialectic manner of the schools. Yet there is a simple dignity in the manner not unworthy of a prophet, and rising from time to time to poetical rhythm.

LITERATURE.—Nowack, *Die kleinen Propheten* (1897; 2nd ed., 1904); Wellhausen, id. (iii. 1898); G. A Smith, *The Book of the Twelve* (ii. 1898); A. C. Welch, art. "Malachi" in Hastings's *Dict. of the Bible*, iii. 218–222 (1900); C. C. Torrey, id. in *Ency. Bib.* iii. c. 2907–2910 (1902); Marti, *Dodekapropheton* (1904); Stade, *Biblische Theologie des Alten Test.* § 141 (1905); Driver, *The Minor Prophets*, ii. (Century Bible, 1906). (W. R. S.; H. W. R.*)

MALACHITE, a copper-ore of fine green colour, sometimes polished as an ornamental stone. The name is derived from Gr. *μαλάχη*, the mallow; in allusion to the colour of the mineral being rather like that of the mallow-leaf. Malachite was perhaps one of the green minerals described by Theophrastus under the general name of *σμάραγδος*; and according to the late Rev. C. W. King it was probably the *smaragdus medicus* of Pliny, whilst his *molochites* seems to have been a different stone from our malachite and may have been a green jasper. It is suggested by J. L. Myres (*Ency. Bib.*) that malachite may have been the Heb. *soham*, of the high priest's breastplate.

Malachite is a basic cupric carbonate, represented by the formula $CuCO_3 \cdot Cu(HO)_2$, and has usually been formed by the action of meteoric agencies on other copper-minerals; hence it is found in the upper part of ore-deposits, often as an incrustation, and occasionally as a pseudomorph after cuprite, chalcocite, &c. When formed, as commonly happens, by the alteration of copper-pyrites the iron of this mineral usually takes the form of limonite, which may remain associated with the malachite. Occasionally, though but rarely, malachite occurs in small dark-green prismatic crystals of the monoclinic system. Its usual mode of occurrence is in nodular or stalagmitic forms, with a mammillated, reniform or botryoidal surface, whilst in other cases it forms fibrous, compact or even earthy masses. The nodules, though commonly dull on the outside, may display on fracture a beautiful zonary structure, the successive layers often succeeding each other as curved deposits of light and dark tints. The colours include various shades of apple-green, grass-green, emerald-green and verdigris-green. Certain varieties exhibit a finely fibrous structure, producing on the fractured surface a soft silky sheen.

Whilst malachite is found in greater or less quantity in most copper-mines, the finer varieties useful for ornamental purposes are of very limited occurrence, and the lapidary has generally drawn his supply from Russia and Australia. The principal source in recent years has been the Medno-Rudiansk mine near Nizhne Tagilsk, on the Siberian side of the Urals, but it was formerly obtained from mines near Bogoslovsk to the north and Gumishev to the south of this locality. A mass from Gumishev, preserved in the museum of the Mining Institute of St Petersburg weighs 3240 ℔, and still larger masses have been found near Nizhne Tagilsk. The mineral is prized in

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[1] Welch in *D.B.* iii. 220.

[2] This remarkable utterance is sometimes (as by W.R.S.) interpreted of the worship of Jews scattered in the Dispersion: reasons for the above view are given by Driver.

[3] In ii. 16 the Targum renders "If thou hatest her put her away." It is characteristic of later Judaism that an arbitrary exegesis transformed the above anticipation of the doctrine of marriage laid down in the gospel into an express sanction of the right of the husband to put away his wife at will.

[4] "The permanence of Judaism depended on the religious separateness of the Jews" (Ryle, *Ezra and Nehemiah*, p. 143).

[5] Matt. xvii. 3, 4, 10–13; xxvii. 47, 49; John i. 21, 25.

Russia for use in mosaic-work, and for the manufacture of vases, snuff-boxes and various ornamental objects. Even folding doors, mantelpieces, table-tops and other articles of furniture have been executed in malachite, the objects being veneered with thin slabs cleverly fitted together so as to preserve the pattern, and having the interspaces filled up with fragments and powder of malachite applied with a cement. The malachite is sawn into slabs, ground with emery and polished with tripoli. Its hardness is less than 4, but it takes a good polish like marble: it is rather denser than marble, having a specific gravity of 3·7 to 4, but it is more difficult to work, in consequence of a tendency to break along the curved planes of deposition. Exceptionally fine examples of the application of malachite are seen in some of the columns of St Isaac's Cathedral in St Petersburg, which are hollow iron columns encrusted with malachite. Large masses of ornamental malachite have been found in Australia, especially at the old Burra Burra copper-mine in South Australia. The Copper Queen and other mines in Arizona have yielded fine specimens of malachite associated with azurite, and polished slabs of the mixed minerals sometimes show the vivid green and the deep blue carbonate in very striking contrast. This natural association, cut as an ornamental stone, has been named, by Dr G. F. Kunz, azur-malachite. Malachite is occasionally used for cameo-work, and some fine antique examples are known. It was formerly worn as an amulet to preserve the wearer from lightning, contagion and witchcraft.

The mineral, when ground, has been used as a pigment under the name of "mountain green." The coarser masses are extensively used, with other minerals, as ores of copper, malachite containing about 57 % of metal. "Blue malachite" is a name sometimes given to azurite (*q.v.*), whilst "siliceous malachite" is a term inappropriately applied to chrysocolla (*q.v.*). (F. W. R.*)

MALACHOWSKI, STANISLAW (1736–1809), Polish statesman, the younger son of Stanislaw Malachowski, palatine of Posen, the companion in arms of Sobieski. From his youth Malachowski laboured zealously for the good of his country, and as president of the royal court of justice won the honourable title of the "Polish Aristides." He was first elected a deputy to the Coronation Diet of 1764, and the great Four Years' Diet unanimously elected him its speaker at the beginning of its session in 1788. Accurately gauging the situation, Malachowski speedily gathered round him all those who were striving to uphold the falling republic and warmly supported every promising project of reform. He was one of the framers of the constitution of the 3rd of May 1791, exceeding in liberality all his colleagues and advocating the extension of the franchise to the towns and the emancipation of the serfs. He was the first to enter his name as a citizen of Warsaw in the civic register and to open negotiations with his own peasantry for their complete liberation. Disappointed in his hopes by the overthrow of the constitution, he resigned office and left the country in 1792, going first to Italy and subsequently to his estates in Galicia, where he was imprisoned for a time on a false suspicion of conspiracy. In 1807 Malachowski was placed at the head of the executive committee appointed at Warsaw after its evacuation by the Prussians, and when the grand duchy of Warsaw was created Malachowski became president of the senate under King Frederick Augustus of Saxony. In the negotiations with the Austrian government concerning the Galician salt-mines Malachowski came to the assistance of the depleted treasury by hypothecating all his estates as an additional guarantee. In 1809 he died at Warsaw. His death was regarded as a public calamity, and multitudes followed his remains to their last resting-place in the Church of the Holy Cross. In all the other towns of the grand duchy funeral services were held simultaneously as a tribute of the respect and gratitude of the Polish nation.

See August Sokolowski, *Illustrated History of Poland* (Pol.), vol. iv. (Vienna, 1900). *Life and Memoirs of S. Malachowski*, edited by Lucyan Siemienski (Pol; Cracow, 1853). (R. N. B.)

MALACHY, ST (*c.* 1094–1148), otherwise known as Maol-Maodhog (or Maelmaedhog) Ua Morgair, archbishop of Armagh and papal legate in Ireland, was born at Armagh. His father, an Irish clergyman, the *Fearleighlinn*, or *lector*, at the university, was said to have been of noble family. Having been ordained to the priesthood, he for some time acted as vicar of Archbishop Celsus or Ceallach of Armagh, and carried out many reforms tending to increase conformity with the usage of the Church of Rome. In order to improve his knowledge of the Roman ritual he spent four years with Malchus, bishop of Lismore (in Munster), a strong advocate of Romanism. Here he became acquainted with Cormac MacCarthy, king of Desmond, who had sought refuge with Malchus, and, when he subsequently regained his kingdom, rendered great services to Malachy. On his return from Lismore, Malachy undertook the government of the decayed monastery of Bangor (in Co. Down), but very soon afterwards he was elected bishop of Connor (now a small village near Ballymena). After the sack of that place by the king of Ulster he withdrew into Munster; here he was kindly received by Cormac MacCarthy, with whose assistance he built the monastery of Ibrach (in Kerry). Meanwhile he had been designated by Celsus (in whose family the see of Armagh had been hereditary for many years) to succeed him in the archbishopric; in the interests of reform he reluctantly accepted the dignity, and thus became involved for some years in a struggle with the so-called heirs. Having finally settled the diocese, he was permitted, as had been previously stipulated by himself, to return to his former diocese, or rather to the smaller and poorer portion of it, the bishopric of Down. Although the Roman party had by this time obtained a firm hold in the north of Ireland, the organization of the Church had not yet received the sanction of the pope. Accordingly, in 1139, Malachy set out from Ireland with the purpose of soliciting from the pope the pallium (the token of archiepiscopal subjection to Rome) for the archbishop of Armagh. On his way to Rome he visited Clairvaux, and thus began a lifelong friendship with St Bernard. Malachy was received by Innocent II. with great honour, and made papal legate in Ireland, though the pope refused to grant the pallium until it had been unanimously applied for "by a general council of the bishops, clergy and nobles." On his way home Malachy revisited Clairvaux, and took with him from there four members of the Cistercian order, by whom the abbey of Mellifont (in the county of Louth) was afterwards founded in 1141. For the next eight years after his return from Rome Malachy was active in the discharge of his legatine duties, and in 1148, at a synod of bishops and clergy held at Inis-Patrick (St Patrick's Island, near Skerries, Co. Dublin), he was commissioned to return to Rome and make fresh application for the pallium; he did not, however, get beyond Clairvaux, where he died in the arms of St Bernard on the 2nd of November 1148. The object of his life was realized four years afterwards, in 1152, during the legateship of his successor. Malachy was canonized by Clement III. in 1190.

The influence of Malachy in Irish ecclesiastical affairs has been compared with that of Boniface in Germany. He reformed and reorganized the Irish Church and brought it into subjection to Rome; like Boniface, he was a zealous reformer and a promoter of monasticism. But perhaps his chief claim to distinction is that of having opened the first Cistercian monastery in Ireland, five more being soon afterwards established. Several works are attributed to him, but are all probably spurious. The most curious of these is a *Prophecy concerning the Future Roman Pontiffs*, which has produced an extensive literature. It is now generally attributed to the year 1590, and is supposed to have been forged to support the election of Cardinal Simoncelli to the papal chair.

St Bernard's *Life* of Malachy, and two sermons on his death will be found in J. P. Migne, *Patrologia Latina*, clxxxii., clxxxiii.; see also *Annals of the Kingdom of Ireland by the Four Masters*, ed. J. O'Donovan (Dublin, 1851); G. Germano, *Vita, gesti e predittioni del padre san Malachia* (Naples, 1670); the ecclesiastical histories of Ireland by J. Lanigan (1829) and W. D. Killen (1875); A. Bellesheim, *Geschichte der katholischen Kirche in Irland*, Bd. I. (Mainz, 1890); G. T. Stokes, *Ireland and the Celtic Church* (6th ed., 1907); J. O'Hanlon, *Life of Saint Malachy* (Dublin, 1859); articles in *Dictionary of National Biography* and Herzog-Hauck's *Realencyklopädie für protestantische Theologie*. On the *Prophecy*, see the treatise by C. F. Menêtrier (Paris, 1689); Marquis of Bute in *Dublin Review* (1885); A. Harnack in *Zeitschrift für Kirchengeschichte*, Bd. III.

MALACOSTRACA. Under this zoological title are included several groups of Crustacea (*q.v.*), united by characters which attest their common origin, though some, and probably all of them, were already separated in distant geological ages, and some have now attained a peculiar isolation. Throughout the whole, the researches made since 1860 have not only added a great throng of new species, genera and families, but have thrown a flood of light upon questions of their phylogeny, systematic arrangement, horizontal and bathymetric distribution, organization, habits of life and economic importance. There are at least seven orders: the stalk-eyed Brachyura, Macrura, Schizopoda, Stomatopoda, and the sessile-eyed Sympoda, Isopoda, Amphipoda. An ocular segment claimed by the former division is not present or in no case demonstrable in the latter. In neither does the terminal segment or telson, whether large or obsolescent, whether articulated or coalescent, carry appendages, unless occasionally in fusion with itself. Between the eyes and the tail-piece in all the orders nineteen segments are counted, the proof of a segment's existence depending on its separateness, complete or partial, or on a sutural indication, or else on the pair of appendages known to belong to it. All these marks may fail, and then the species must be proved to be Malacostracan by other evidence than the number of its segments; but if some exceptions exhibit fewer, none of the Malacostraca exhibits more than 19 (+ 1 or + 2) segments, unless the Nebaliidae be included. Of the corresponding pairs of appendages thirteen belong to the head and trunk, two pairs of antennae, one pair of mandibles, two pairs of maxillae, followed by three which may be all maxillipeds or may help to swell the number of trunk-legs to which the next five pairs belong. The abdomen or pleon carries the remaining six pairs, of which from three to five are called pleopods and the remainder uropods. Underlying the diversity of names and functions and countless varieties of shape, there is a common standard to which the appendages in general can be referred. In the maxillipeds and the trunk-legs it is common to find or otherwise easy to trace a seven-jointed stem, the endopod, from which may spring two branches, the epipod from the first joint, the exopod from the second.[1] The first antennae are exceptional in branching, if at all, at the third joint. In the mandibles and maxillae some of the terminal joints of the stem are invariably wanting. In the rest of the appendages they may either be wanting or indistinguishable. The latter obscurity results either from coalescence, to which all joints and segments are liable, or from subdivision, which occasionally affects joints even in the trunk-legs. The carapace, formerly referred only to the antennar-mandibular segments, may perhaps in fact contain elements from any number of other segments of head and trunk, Huxley, Alcock, Bouvier giving support to this opinion by the sutural or other divisional lines in *Potamobius*, *Nephrops*, *Thalassina*, and various fossil genera. Not all questions of classification internal to this division are yet finally settled. Between the Brachyura and Macrura some authors uphold an order Anomura, though in a much restricted sense, the labours of Huxley, Boas, Alcock and conjointly Alphonse Milne-Edwards and Bouvier, having resulted in restoring the Dromiidea and Raninidae to the Brachyura, among which de Haan long ago placed them. The French authors argue that from the macruran lobsters (*Nephropsidae*) anciently diverged two lines: one leading through the Dromiidea to the genuine Brachyura; or crabs, the other independently to the Anomura proper, which may conveniently be named and classed as *Macrura anomala*. Spence Bate maintained that the Schizopoda ought not to form a separate order, but to be ranged as a macruran tribe, "more nearly allied to the degraded forms of the Penaeidea than to those of any other group" ("*Challenger*" *Reports*, "Macrura," p. 472, 1888). According to Sars, the Sympoda (or Cumaceans), in spite of their sessile eyes, have closer affinities with the stalk-eyed orders. H. J. Hansen and others form a distinct order Tanaidea for the decidedly anomalous group called by Sars *Isopoda chelifera*.

1. Brachyura.—For the present, as of old, the true Brachyura are divided into four tribes: *Cyclometopa*, with arched front as in the common eatable crab; *Catometopa*, with front bent down as in the land-crabs and the little oyster-crab; *Oxyrhyncha*, with sharpened beak-like front as in the various spider-crabs; *Oxystomata*, including the Raninidæ, and named not from the character of the front but from that of the buccal frame which is usually narrowed forwards. In these tribes the bold and active habits, the striking colours, or the fantastic diversities of structure, have so long attracted remark that recent investigations, while adding a multitude of new species and supplying the specialist with an infinity of new details, have not materially altered the scientific standpoint. New light, however, has been thrown upon the "intellectual" capacity of Crustacea by the proof that the spider-crabs deliberately use changes of raiment to harmonize with their surroundings, donning and doffing various natural objects as we do our manufactured clothes. Others have the power of producing sounds, one use to which they put this faculty being apparently to signal from their burrow in the sand that they are "not at home" to an inopportune visitor. Deep-sea exploration has shown that some species have an immensely extended range, and still more, that species of the same genus, and genera of the same family, though separated by great intervals of space, may be closely allied in character. A curious effect of parasitism, well illustrated in crabs, though not confined to them, has been expounded by Professor Giard, namely, that it tends to obliterate the secondary sexual characters. Modern research has discovered no crab to surpass *Macrocheira kämpferi*, De Haan, that can span between three and four yards with the tips of its toes, but at the other end of the scale it has yielded *Collodes malabaricus*, Alcock, "of which the carapace, in an adult and egg-laden female, is less than one-sixth of an inch in its greatest diameter." The most abyssal of all crabs yet known is *Ethusina abyssicola*, Smith, or what is perhaps only a variety of it, *E. challengeri*, Miers. Of the latter the "Albatross" obtained a specimen from a depth of 2232 fathoms (Faxon, 1895), of the former from 2221 fathoms, and of this S. I. Smith remarks that it has "distinctly faceted black eyes," although in them "there are only a very few visual elements at the tips of the immobile eye-stalks."

The *Brachyura anomola*, or Dromiidea, "have preserved the external characters and probably also the organization of the Brachyura of the Secondary epoch" (Milne-Edwards and Bouvier, 1901). They agree with the true crabs in not having appendages (uropods) to the sixth segment of the pleon, the atrophy being complete in the Homolidae and Homolodromiidae, whereas in the Dromiidae and Dynomenidae a pair of small plates appear to be vestiges of these organs. In the family Homolidae stands the strange genus *Latreillia*, Roux, with long slender limbs and triangular carapace after the fashion of oxyrhynch spider-crabs. In *Homola* the carapace is quadrilateral. Between these two a very interesting link was discovered by the "Challenger" in the species *Latreillopsis bispinosa*. Henderson. Bouvier (1896) has shown that *Palaeinachus longipes*, Woodward, from the Forest Marble of Wiltshire, is in close relationship, not to the oxyrhynch Inachidae, but to the genera *Homolodromia* and *Dicranodromia* of the Homolodromiidae, and that the Jurassic crabs in general, of the family Prosoponidae (Meyer), are Dromiidea.

2. Macrura.—The *Macrura anomala*, or Anomura in restricted sense, are popularly known through the hermit-crabs alone. These only partially represent one of the three main divisions, Paguridea, Galatheidea, Hippidea. The first of these is subdivided into *Pagurinea*, *Lithodinea*, *Lomisinea*, each with a literature of its own. Among the Pagurinea is the *Birgus latro*, or robber-crab, whose expertness in climbing the coco-nut palm need no longer be doubted, since in recent years it has been noted and photographed by trustworthy naturalists in the very act. Alcock "observed one of these crabs drinking from a runnel of rain-water, by dipping the fingers of one of its chelipeds into the water and then carrying the wet fingers to its mouth." Hermits of the genus *Coenobita* he found feeding voraciously on nestling sea-terns. That pagurids must have the usually soft pleon or abdomen protected by the shell of a mollusc is now known to be subject to a multitude of exceptions. *Birgus* dispenses with a covering; *Coenobita* can make shift with half the shell of a coco-nut; *Chlaenopagurus* wraps itself up in a blanket of colonial polyps; *Cancellus tanneri*, Faxon, was found in a piece of dead coral rock; *Xylopagurus rectus*, A. Milne-Edwards, lodges in tubes of timber or bits of hollow reed. The last-named species has a straight symmetrical abdomen, with the penultimate segment expanded and strongly calcified to form a back-door to the very unconventional habitation. This it enters head-foremost from the rear, while "hermits" in general are forced to go backwards into their spiral or tapering shelters by the front. Some of the species can live in the ocean at a depth of two or three miles. Some can range inland up to a considerable height on mountains. The advantage that this group has derived from the adoption of mollusc

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[1] In Huxley's terminology the first two or three joints of the stem constitute a "protopodite," from which spring the "endopodite" and "exopodite."

shells as houses or fortresses, ready built and light enough for easy transport, is obviously discounted by a twofold inconvenience. There is nothing to ensure that the supply will be equal to the demand, and Nature has not arranged that the borrowed tenement shall continue to grow with the growth of its new tenant. To meet these defects it is found that numerous species encourage or demand the companionship of various zoophytes, simple or colonial. These sometimes completely absorb the shell on which they are settled, but then act as a substitute for it, and in any case by their outgrowth they extend the limits of the dwelling, so that the inmate can grow in comfort without having to hunt or fight for a larger abode. Among the *Lithodinea*, or stone crabs, besides important readjustments of classification (Bouvier, 1895, 1896), should be noticed the evidence of their cosmopolitan range, and the species *Neolithodes agassizii* (Smith) and *N. grimaldii*, Milne-Edwards and Bouvier, which carry to an extreme the spinosity characteristic of the group (fig. 1). S. I. Smith's investigations on the early stages of *Hippa talpoida*, Say, were published in 1877.

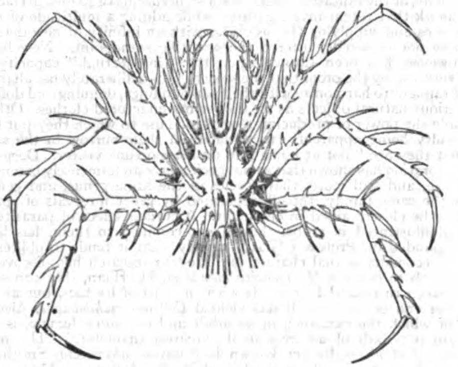

FIG. 1.—*Neolithodes grimaldii*, A. Milne-Edwards and Bouvier.

With regard to the accessions to knowledge in the enormous group of the genuine Macrura, reference need only be made to the extensive reports in which Spence Bate, S. I. Smith, Faxon, Wood-Mason, Alcock, and others have made known the results of celebrated explorations. Various larval stages have been successfully investigated by Sars. Alcock (1901) describes from his own observation the newly hatched *Phyllosoma* larva of *Thenus orientalis*, Fabricius. An admirable discrimination of the larval and adult characters of the genus *Sergestes* has been given by H. J. Hansen (*Proc. Zool. Soc.*, London, 1896). Singularity excites our wonder in *Thaumastocheles zaleucus*, v. Willemoes Suhm, which makes up for its vanished eyes by its extraordinarily elongate and dentated claws; in *Psalidopus huxleyi*, Wood-Mason and Alcock (1892), bristling with spikes from head to tail; in the Nematocarcinidae, with their long thread-like limbs and longer antennae; in species of *Aristaeopsis* reported by Chun from deep water off the east coast of Africa, bright red prawns nearly a foot long, with antennae about five times the length of the body. That certain species, particularly many from deep water, have disproportionately large eggs, is explained by the supposition that the young derive the advantage of being hatched in an advanced stage of development.

3. SCHIZOPODA.—This order of animals for the most part delicately beautiful, has for the moment five families—Lophogastridae, Eucopiidae, Euphausiidae, Mysidae and Anaspididae. In the Euphausiidae the digitiform-arborescent branchiae, as if conscious of their own extreme elegance, remain wholly uncovered. In the two preceding families they are partially covered. In the Mysidae the branchiae are wanting, and some would form this family into a separate order, Mysidacea. In *Anaspides*, a peculiar fresh-water genus discovered in 1892 by G. M. Thomson on Mount Wellington, in Tasmania, the gills are not arborescent, and there are seven segments of the trunk free of the carapace (fig. 2). A membranaceous carapace separates the Eucopiidae from the more solidly invested Lophogastridae. Among many papers that the student will find it necessary to consult may be mentioned the "*Challenger*" *Report* on Schizopoda, by Sars, 1885, dealing with the order at large; "British Schizopoda," by Norman. *Ann. Nat. Hist*, (1892); "Decapoden und Schizopoden," *Plankton-Expedition* (Ortmann, 1893); "Euphausiidae," by Stebbing, *Proc. Zool. Soc.* (London, 1900); *Mysidae of the Russian Empire*, by Czerniavski (1882–1883); and *Mysidae of the Caspian*, by Sars (1893-1895-1897).

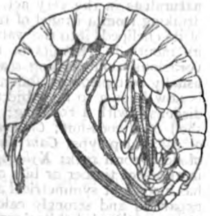

FIG. 2.—*Anaspides tasmaniae*, Thomson.

4. STOMATOPODA.—This order, at one time a medley of heterogeneous forms, is now confined to the singularly compact group of the Squillidae. Here the articulation of the ocular segment is unusually distinct, and here two characters quite foreign to all the preceding groups come into view. The second maxillipeds are developed into powerful prehensile organs, and the branchiae, instead of being connected with the appendages of head and trunk, are developed on the pleopods, appendages of the abdomen. At least three segments of the trunk are left uncovered by the carapace. The developing eggs are not carried about by the mother, but deposited in her subaqueous burrow, "where they are aerated by the currents of water produced by the abdominal feet of the parent." An excellent synopsis of the genera and species is provided by R. P Bigelow (*Proc. U.S. Mus.* vol. xvii., 1894). For the habits and peculiarities of these and many other Crustaceans, A. E. Verrill and S. I. Smith on the *Invertebrates of Vineyard Sound* should be consulted (1874). The general subject has been illuminated by the labours of Claus, Miers, Brooks ("*Challenger*" *Report*, 1886), and the latest word on the relationship between the various larvae and their respective genera has been spoken by H. J. Hansen (*Plankton-Expedition Report*, 1895). The striking forms of *Alima* and *Erichthus*, at one time regarded as distinct genera, are now with more or less certainty affiliated to their several squillid parents.

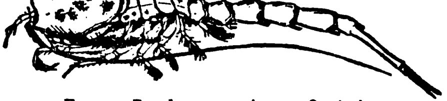

FIG. 3.—*Pseudocuma pectinatum*, Sowinsky.

5. SYMPODA.—This order of sessile-eyed decapods was absolutely unknown to science till 1779. A species certainly belonging to it was described by Lepekhin in 1780, but the obscure *Gammarus esca*, "food Gammarus" beloved of herrings, described by J. C. Fabricius in the preceding year, may also be one of its members. Nutritious possibilities are implied in *Diastylis rathkii*, Kröyer, one of the largest forms, which, though slender and rarely an inch long, in its favourite Arctic waters is found "in incalculable masses, in thousands of specimens" (Stuxberg, 1880). Far on in the 19th century eminent naturalists were still debating whether in this group there were eyes or no eyes, whether the eyes were stalked or sessile, whether the animals observed were larval or adult. The American T. Say in 1818 gave a good description of a new species and founded the premier genus *Diastylis*, but other investigators derived little credit from the subject till more than sixty years after its introduction by the Russian Lepekhin. Then Goodsir, Kröyer, Lilljeborg, Spence Bate and one or two others made considerable advances, and in 1865 a memorable paper by G. O. Sars led the way to the great series of researches which he has continued to the present day. The name *Cumacea*, however, which he uses cannot be retained, being founded on the preoccupied name *Cuma* (Milne-Edwards, 1828). The more recent name *Sympoda* (see Willey, *Results*, pt. v. p. 609, 1900) alludes to the huddling together of the legs, which is conspicuous in most of the species. Ten families are now distinguished—Diastylidae, Lampropidae, Platyaspidae, Pseudocumidae, all with an articulated telson; without one, the Bodotriidae (formerly called *Cumidae*), Vaunthompsoniidae, Leuconidae, Nannastacidae, Campylaspidae, Procampylaspidae. All the Leuconidae and Procampylaspidae are blind, and some species in most of the other families. Usually the sides of the carapace are strangely produced into a mock rostrum in front of the ocular lobe, be it oculiferous or not. The last four or five segments of the trunk are free from the carapace. The slender pleon has always six distinct segments, the sixth carrying two-branched uropods, the preceding five armed with no pleopods in the female, whereas in the male the number of pairs varies from five to none. The resemblance of these creatures to miniature Macrura is alluded to in the generic name *Nannastacus*, meaning dwarf-lobster. In this genus alone of the known Sympoda the eyes sometimes form a pair, in accordance with the custom of all other malacostracan orders except this and of this order itself in the embryo (Sars, 1900). The most but not the only remarkable character lies in the first maxillipeds. These, with the main stem more or less pediform, have the epipod and exopod modified for respiratory purposes. The backward-directed epipods usually carry branchial vesicles. The forward-directed exopods either act as valves or form a tube (rarely two tubes), protensile and retractile, for regulating egress of water from the branchial regions. This mechanism as a whole is unique, although, as Sars observes, the epipod of the first maxillipeds has a respiratory function also in the Lophogastridae and Mysidae and in the cheliferous isopods. As a rule armature of

the carapace is much more developed in the comparatively sedentary female than in the usually more active male. Only in the male do the second antennae attain considerable length, with strong resemblance to what is found in some of the Amphipoda. About 150 species distributed among thirty-four genera are now known, many from shallow water and from between tide-marks, some from very great depths. H. J. Hansen concludes that "they are all typically ground animals, and as yet no species has been taken under such conditions that it could be reckoned to the pelagic plankton." As they have been found in all zones and chiefly by a very few observers, it is probable that a great many more species remain to be discovered. In recent years thirteen species, all belonging to the same genus *Pseudocuma* (fig. 3), have been recorded by Sars from the Caspian Sea. A bibliography of the order is given in that author's *Crustacea of Norway*, vol. iii. (1899–1900).

6. Isopoda.—This vast and populous order can be traced far back in geological time. It is now represented in all seas and lands, in fresh-water lakes and streams, and even in warm springs. It adapts itself to parasitic life not only in fishes, but in its own class Crustacea, and that in species of every order, its own included. In this process changes of structure are apt to occur, and sometimes unimaginable sacrifices of the normal appearance. The order has been divided into seven tribes, of which a fuller summary than can here be given will be found in Stebbing, *History of Crustacea* (1893). The first tribe, called Chelifera, from the usually chelate or claw-bearing first limbs, may be regarded as *Isopoda anomala*, of which some authors would form a separate order, Tanaidea. Like the genuine isopods, they have seven pairs of trunk-legs, but instead of having seven segments of the middle body (or peraeon) normally free, they have the first one or two of its segments coalesced with the head. Instead of the breathing organs being furnished by the appendages of the pleon with the heart in their vicinity, the respiration is controlled by the maxillipeds, with the heart in the peraeon (see Delage, *Arch. Zool. expér. et gén.*, vol. ix., 1881). There are two families, Tanaidae and Apseudidae. Occasionally the ocular lobes are articulated.

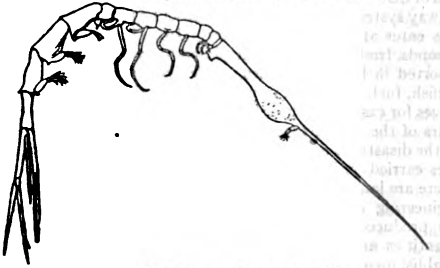

Fig. 4.—*Rhabdosoma piratum*, Stebbing.

The genuine Isopoda are divided among the *Flabellifera*, in which the terminal segment and uropods form a flabellum or swimming fan; the *Epicaridea*, parasitic on Crustaceans; the *Valvifera*, in which the uropods fold valve-like over the branchial pleopods; the *Asellota*, in which the first pair of pleopods of the female are usually transformed into a single opercular plate; the *Phreatoicidea*, a fresh-water tribe, known as yet only from subterranean waters in New Zealand and an Australian swamp nearly 6000 ft. above sea-level; and lastly, the *Oniscidea*, which are terrestrial. Only the last of these, under the contemptuous designation of wood-lice, has established a feeble claim to popular recognition. Few persons hear without surprise that England itself possesses more than a score of species in this air-breathing tribe. Those known from the world at large number hundreds of species, distributed among dozens of genera in six families. That a wood-louse and a land-crab are alike Malacostracans, and that they have by different paths alike become adapted to terrestrial life, are facts which even a philosopher might condescend to notice. Of the other tribes which are aquatic there is not space to give even the barest outline. Their swarming multitudes are of enormous importance in the economy of the sea. If in their relation to fish it must be admitted that many of them plague the living and devour the dead, in return the fish feed rapaciously upon them. Among the most curious of recent discoveries is that relating to some of the parasitic *Cymothoidae*, as to which Bullar has shown that the same individual can be developed first as a male and then as a female. Of lately discovered species the most striking is one of the deep-sea Cirolanidae, *Bathynomus giganteus*, A. M. Edwards (1879), which is unique in having supplementary ramified branchiae developed at the bases of the pleopods. Its eyes are said to contain nearly 4000 facets. The animal attains what in this order is the monstrous size of 9 in. by 4. A general uniformity of the trunk-limbs in Isopoda justifies the ordinal name, but the valviferous Astacillidae, and among the Asellota the Munnopsidae, offer some remarkable exceptions to this characteristic. Among many essential works on this group may be named the *Monogr. Cymothoarum* of Schiödte and Meinert (1879–1883); "*Challenger*" *Report*, Beddard (1884–1886); *Cirolanidae*, H. J. Hansen (1890); *Isopoda Terrestria*, Budde-Lund (1885); *Bopyridae*, Bonnier (1900); *Crustacea of Norway*, vol. ii. (Isopoda), Sars (1896–1899), while their multitude precludes specification of important contributions by Benedict, Bovallius, Chilton, Dohrn, Dollfus, Fraisse, Giard and Bonnier, Harger, Haswell, Kossmann, Miers, M'Murrich, Norman, Harriet Richardson, Ohlin, Studer, G. M. Thomson, A. O. Walker, Max Weber and many others.

7. Amphipoda.—As in the genuine Isopoda, the eyes of Amphipoda are always sessile, and generally paired, and, in contrast to crabs and lobsters, these two groups have only four pairs of mouth-organs instead of six, but seven pairs of trunk-legs instead of five. From the above-named isopods the present order is strongly differentiated by having heart and breathing organs not in the pleon, but in the peraeon, or middle body, the more or less simple branchial vesicles being attached to some or all of the last six pairs of trunk-legs. Normally the pleon carries six pairs of two-branched appendages, of which the first three are much articulated flexible swimming feet, the last three few-jointed comparatively indurated uropods. There are three tribes, *Gammaridea*, *Caprellidea*, *Hyperiidea*. The middle one contains but two families, the cylindrical and often thread-like skeleton shrimps, Caprellidae, and their near cousins, the broad, flattened, so-called whale-lice, Cyamidae. This tribe has the pleon dwindled into insignificance, whereas in the other two tribes it is powerfully developed. The Hyperiidea are distinguished by having their maxillipeds never more than three-jointed. In the companion tribes these appendages have normally seven joints, and always more than three. The order thus sharply divided is united by an intimate interlacing of characters, and forms a compact whole at present defying intrusion from any other crustacean group. Since 1775, when J. C. Fabricius instituted the genus *Gammarus* for five species, of which only three were amphipods, while he left five other amphipods in the genus *Oniscus*, from this total of eight science has developed the order, at first very slowly, but of late by great leaps and bounds, so that now the *Gammaridea* alone comprise more than 1300 species, distributed among some 300 genera and 39 families. They burrow in the sands of every shore; they throng the weeds between tide-marks; they ascend all streams; they are found in deep wells, in caverns, in lakes; in Arctic waters they swarm in numbers beyond computation; they find lodgings on crabs, on turtles, on weed-grown buoys; they descend into depths of the ocean down to hundreds or thousands of fathoms; they are found in mountain streams as far above sea-level as some of their congeners live below it. The Talitridae, better known as sandhoppers, can forgo the briny shore and content themselves with the damp foliage of inland forests or casual humidity in the crater of an extinct volcano. Over the ocean surface, as well as at various depths, float and swim innumerable *Hyperiidea*—the wonderful *Phronima*, glass-like in its glassy barrel hollowed out of some Tunicate; the *Cystisoma*, 4 or 5 in. long, with its eye-covered head; the *Rhabdosoma*, like a thin rod of glass, with needle-like head and tail, large eyes, but limbs and mouth-organs all in miniature, and the second antennae of the male folding up like a carpenter's rule (fig. 4). On jelly-fishes are to be found species of *Hyperia* and their kindred, so fat and wholesome that they have been commended to shipwrecked men in open boats as an easily procurable resource against starvation. Many of the Amphipoda are extremely voracious. Some of them are even cannibals. The Cyamidæ afflict the giant whale by nibbling away its skin; the *Chelura terebrans* is destructive to submerged timber. But, on the other hand, they largely help to clear the sea and other waters of refuse and carrion, and for fishes, seals and whales they are food desirable and often astoundingly copious. From the little flea-like species, scarcely a tenth of an inch long, up to the great and rare but cosmopolitan *Eurythenes gryllus*, Lichtenstein, and the still larger *Alicella gigantea*, Chevreux, nearly half a foot long, captured by the prince of Monaco from a depth of 2936 fathoms, not one of these ubiquitous, uncountable hordes has ever been accused of assailing man. For the naturalist they have the recommendation that many are easy to obtain, that most, apart from the very minute, are easy to handle, and that all, except as to the fleeting colours, are easy to preserve.

A nearly complete bibliography of the order down to 1888 will be found in the "*Challenger*" *Reports*, vol. xxviii., and supplementary notices in Della Valle's *Monograph of the Gammarini* (1893), the scope of his work, however, not covering the Hyperiidea and Oxycephalidae of Bovallius (1889, 1890); but since these dates very numerous additions to the literature have been made by Birula, Bonnier, Norman, Walker and others, especially the *Crustacea of Norway*, vol. i. (*Amphipoda*), Sars (1890–1895), demanding attention, and the quite recent *Amphipoda of the Hirondelle*, Chevreux (1900), and *Hyperiidea of the Plankton-Expedition*, Vosseler (1901). (T. R. R. S.)

MALAGA, a maritime province of southern Spain, one of the eight modern subdivisions of Andalusia; bounded on the W. by Cadiz, N. by Seville and Cordova, E. by Granada, and S. by the Mediterranean Sea. Pop. (1900), 511,989; area, 2812 sq. m. The northern half of Malaga belongs to the great

Andalusian plain watered by the Guadalquivir, the southern is mountainous, and rises steeply from the coast. Of the numerous sierras may be mentioned that of Alhama, separating the province from Granada, and at one point rising above 7000 ft.; its westward continuation in the Sierra de Abdalajis and the Axarquia between Antequera and Malaga; and not far from the Cadiz boundary the Sierras de Ronda, de Mijas, de Tolox and Bermeja, converging and culminating in a summit of nearly 6500 ft. The rivers which rise in the watershed formed by all these ranges reach the sea after a short and precipitous descent, and in rainy seasons are very liable to overflow their banks. In 1907 great loss of life and destruction of property were caused in this manner. The principal river is the Guadalhorce, which rises in the Sierra de Alhama, and, after a westerly course past the vicinity of Antequera, bends southward through the wild defile of Peñarrubia and the beautiful *vega* or vale of Malaga, falling into the sea near that city. The only other considerable stream is the Guadiaro, which has the greater part of its course within the province and flows past Ronda. There is an extensive salt lagoon near the northern boundary. The mountains are rich in minerals, lead, and (in the neighbourhood of Marbella) iron, being obtained in large quantities. There are warm sulphurous springs and baths at Carratraca. Though the methods of agriculture are for the most part rude, the yield of wheat in good seasons is considerably in excess of the local demand; and large quantities of grapes and raisins, oranges and lemons, figs and almonds, are annually exported. The oil and wines of Malaga are also highly esteemed, and after 1870 the manufacture of beet and cane sugar developed into an important industry. In 1905 there were about 500 flour mills and 230 oil factories beside 95 stills and 100 wine-presses in the province. Malaga has suffered severely from the agricultural depression prevalent throughout southern Spain, but its manufacturing industries tend to expand. The fisheries are important; a fleet of about 300 boats brings in 18,000,000 lb annually, of which 25% is exported. The internal communications are in many parts defective, owing to the broken nature of the surface; but the province is traversed from north to south by the Cordova-Malaga railway, which sends off branches from Bobadilla to Granada and Algeciras. A branch line along the coast from Malaga to Vélez Malaga was opened in 1908.

Malaga, the capital (pop. 130,109), Antequera (31,609), Vélez Malaga (23,586), Ronda (20,995), Coín (12,326), and Alora (10,325), are described in separate articles. Other towns with more than 7000 inhabitants are Marbella (9629), Estepona (9310), Archidona (8880) and Nerja (7112). The population of the province tends gradually to decrease, as many families emigrate to South America, Algeria and Hawaii.

MALAGA, the capital of the province of Malaga, an episcopal see; and next to Barcelona, the most important seaport of Spain, finely situated on the Mediterranean coast, at the southern base of the Axarquia hills and at the eastern extremity of the fertile *vega* (plain) of Malaga in 36° 43′ N. and 4° 25′ W. Pop. (1900), 130,109. From the clearness of its sky, and the beautiful sweep of its bay, Malaga has sometimes been compared with Naples. The climate is one of the mildest and most equable in Europe, the mean annual temperature being 66·7° Fahr. The principal railway inland gives access through Bobadilla to all parts of Spain, and a branch line along the coast to Vélez-Malaga was opened in 1908. Malaga lies principally on the left bank of a mountain torrent, the Guadalmedina ("river of the city"); the streets near the sea are spacious and comparatively modern, but those in the older part of the town, where the buildings are huddled around the ancient citadel, are narrow, winding and often dilapidated. Well-built suburbs have also spread on all sides into the rich and pleasant country which surrounds Malaga, and several acres of land reclaimed from the sea have been converted into a public park. There are various squares or plazas and public promenades; of the former the most important are the Plaza de Riego (containing the monument to General José Maria Torrijos, who, with forty-eight others, was executed in Malaga on the 11th of December 1831, for promoting an insurrection in favour of the constitution) and the Plaza de la Constitucion; adjoining the quays is the fine Paseo de la Alameda. The city has no public buildings of commanding architectural or historical importance. The cathedral, on the site of an ancient mosque, was begun about 1528; after its construction had been twice interrupted, it was completed to its present state in the 18th century, and is in consequence an obtrusive record of the degeneration of Spanish architecture. The woodwork of the choir, however, is worthy of attention. The church of El Cristo de la Victoria contains some relics of the siege of 1487. There are an English church and an English cemetery, which dates from 1830; up to that year all Protestants who died in Malaga were buried on the foreshore, where their bodies were frequently exposed by the action of wind and sea. Of the old Moorish arsenal only a single horse-shoe gateway remains, the rest of the site being chiefly occupied by an iron structure used as a market; the Alcazába, or citadel, has almost disappeared. The castle of Gibralfaro, on a bold eminence to the north-east dates from the 13th century, and is still in fairly good preservation.

During the 19th century so much silt accumulated in the harbour that vessels were obliged to lie in the roads outside, and receive and discharge cargo by means of lighters; but new harbour works were undertaken in 1880, and large ships can now again load or discharge at the quays, which are connected with the main railway system by a branch line. About 2150 ships of 1,750,000 tons enter at Malaga every year. Iron, lead, wine, olive oil, almonds, fresh and dried fruit, palmetto hats and canary seed are exported in large quantities, while the imports include grain, codfish, fuel, chemicals, iron and steel, machinery, manures and staves for casks. Although trade was impeded during the early years of the 20th century by a succession of bad harvests and by the disastrous floods of September 1907, the number of industries carried on in and near Malaga tends steadily to increase. There are large cotton mills, iron foundries, smelting works and engineering works. Pottery, mosaic, artificial stone and tiles are produced chiefly for the home market, though smaller quantities are sent abroad. There is a chromo-lithographic establishment, and the other industries include tanning, distilling and the manufacture of sugar, chocolate, soap, candles, artificial ice, chemical products, white lead and pianos. Foreign capital has played a prominent part in the development of Malaga; a French syndicate owns the gas-works, and the electric lighting of the streets is controlled by British and German companies.

Malaga is the Μάλακα of Strabo (iii. 156) and Ptolemy (ii. 4, 7) and the *Malaca foederatorum* of Pliny (iii. 3). The place seems to have been of some importance even during the Carthaginian period; under the Romans it became a municipium, and under the Visigoths an episcopal see. In 711 it passed into the possession of the Moors, and soon came to be regarded as one of the most important cities of Andalusia. It was attached to the caliphate of Cordova, but on the fall of the Omayyad dynasty it became for a short time the capital of an independent kingdom; afterwards it was dependent on Granada. In 1487 it was taken and treated with great harshness by Ferdinand and Isabella after a protracted siege. In 1810 it was sacked by the French under General Sebastiani. The citizens of Malaga are noted for their opposition to the Madrid government; they took a prominent part in the movements against Espartero (1843), against Queen Isabella (1868) and in favour of a republic (1873).

MALAKAND PASS, a mountain pass in the North-West Province of India, connecting the British district of Peshawar with the Swat Valley. It is now a military post and the headquarters of a political agency. It came into prominence for the first time in 1895 during the Chitral campaign, when 7000 Pathans held it against Sir Robert Low's advance, but were easily routed. After the campaign was over a fortified camp was formed on the Malakand to guard the road to Chitral. During the frontier risings of 1897 the Swatis made a determined attack on the Malakand, where 700 were killed, and on the adjacent post of Chakdara, where 2000 were killed. This was the origin of the Malakand Expedition of the same year. (See SWAT.)

MALALAS (or **Malelas**) (Syriac for "orator"), **JOHN** (*c.* 491–578), Byzantine chronicler, was born at Antioch. He wrote a Χρονογραφία in 18 books, the beginning and the end of which are lost. In its present state it begins with the mythical history of Egypt and ends with the expedition to Africa under Marcianus, the nephew of Justinian. Except for the history of Justinian and his immediate predecessors, it possesses little historical value; it is written without any idea of proportion and contains astonishing blunders. The writer is a supporter of Church and State, an upholder of monarchical principles. The work is rather a chronicle written round Antioch, which he regarded as the centre of the world, and (in the later books) round Constantinople. It is, however, important as the first specimen of a chronicle written not for the learned but for the instruction of the monks and the common people, in the language of the vulgar, with an admixture of Latin and Oriental words. It obtained great popularity, and was conscientiously exploited by various writers until the 11th century, being translated even into the Slavonic languages. It is preserved in an abridged form in a single MS. now at Oxford.

For the authorities consulted by Malalas, the influence of his work on Slavonic and Oriental literature, the state of the text, the original form and extent of the work, the date of its composition, the relation of the concluding part to the whole, and the literature of the subject, see C. Krumbacher's *Geschichte der byzantinischen Litteratur* (1897). See also the *editio princeps*, by E. Chilmead (Oxford, 1691), containing an essay by Humphrey Hody and Bentley's well-known letter to Mill; other editions in the Bonn *Corpus scriptorum hist. byz.*, by L. Dindorf (1831), and in J. P. Migne *Patrologia graeca*, xcvii.

MALAN, SOLOMON CAESAR (1812–1894), British divine and orientalist, was by birth a Swiss descended from an exiled French family, and was born at Geneva on the 22nd of April 1812, where his father, Dr Henry Abraham Caesar Malan (1787–1864) enjoyed a great reputation as a Protestant divine. From his earliest youth he manifested a remarkable faculty for the study of languages, and when he came to Scotland as tutor in the marquis of Tweeddale's family at the age of 18 he had already made progress in Sanskrit, Arabic and Hebrew. In 1833 he matriculated at St Edmund Hall, Oxford; and English being almost an unknown tongue to him, he petitioned the examiners to allow him to do his paper work of the examination in French, German, Spanish, Italian, Latin or Greek, rather than in English. But his request was not granted. After gaining the Boden and the Pusey and Ellerton scholarships, he graduated 2nd class in *Lit. hum.* in 1837. He then proceeded to India as classical lecturer at Bishop's College, Calcutta, to which post he added the duties of secretary to the Bengal branch of the Royal Asiatic Society; and although compelled by illness to return in 1840, laid the foundation of a knowledge of Tibetan and Chinese. After serving various curacies, he was presented in 1845 to the living of Broadwindsor, Dorset, which he held until 1886. During this entire period he continued to augment his linguistic knowledge, which he carried so far as to be able to preach in that most difficult language, Georgian, on a visit which he paid to Nineveh in 1872. His translations from the Armenian, Georgian and Coptic were numerous. He applied his Chinese learning to the determination of important points connected with Chinese religion, and published a vast number of parallel passages illustrative of the Book of Proverbs. In 1880 the university of Edinburgh conferred upon him the honorary degree of D.D. No modern scholar, perhaps, has so nearly approached the linguistic omniscience of Mezzofanti; but, like Mezzofanti, Dr Malan was more of a linguist than a critic. He made himself conspicuous by the vehemence of his opposition to Westcott and Hort's text of the New Testament, and to the transliteration of Oriental languages, on neither of which points did he in general obtain the suffrages of scholars. His extensive and valuable library, some special collections excepted, was presented by him in his lifetime to the Indian Institute at Oxford. He died at Bournemouth on the 25th of November 1894. His life has been written by his son.

MÄLAR, a lake of Sweden, extending 73 m. westward from Stockholm, which lies at its junction with the Saltsjö, an arm of the Baltic Sea. The height of the lake is normally only from 11 in. to 2 ft. above sea-level, and its outflow is sometimes reversed. The area is 449 sq. m. The bottom consists of a series of basins separate by ridges from which rise numerous islands. The deepest sounding is 210 ft. The outline is very irregular, the mean breadth being about 15 m., but an arm extends northward for 30 m. nearly to the city of Upsala with many ramifications. The area of the drainage basin is 8789 sq. m., of which 1124 are occupied by lakes. The navigable connexions with the lake are—(1) with lake Hjelmar to the south-west by the Arboga river and the Hjelmar canal; and by the Eskilstuna river and the Thorshälla canal; (2) with the Baltic southward through the Södertelge canal, the route followed by the Göta canal steamers; (3) with the Baltic by two channels at Stockholm. The more important towns, besides Stockholm, are Vesterås on the north, Södertelge and Eskilstuna near the south shore. The lake offers a field for recreation fully appreciated by the inhabitants of the capital, and many of those whose business lies at Stockholm have their residences on the shores of Mälar. On Drottningholm (Queen's Island, named from Catherine, wife of John III.) is a palace with a fine park and formal gardens. John III. built a palace at the close of the 16th century, but the existing building, by Nicodemus Tessin and his son Nicodemus, dates from the second half of the 17th century. At Mariefred on the south shore there is the castle of Gripsholm (1537), built by Gustavus Vasa, a picturesque erection with four towers, richly adorned within, and containing a large collection of portraits. Strengnäs, on the same shore, became an episcopal see in 1291, when the fine cathedral, much altered since, was consecrated. In the episcopal palace, a building of the 15th century now used as a school, Gustavus Vasa was elected to the throne of Sweden in 1523. On the northward arm of the lake is the palace of Rosenberg, used as a school of gunnery, in a well-wooded park. On a branch of the same arm is Sigtuna, a village whose ruined churches are a memorial of its rank among the principal towns of Sweden after its foundation in the 11th century. Remains prove that on Björkö, an island in the eastern part of the lake, there was a large settlement of earlier importance than Sigtuna. Here a cross commemorates the preaching of Christianity by St Ansgar in 829. Finally, on the northern arm about 10 m. south of Upsala, there is the château of Skokloster, occupying the site of a monastery, and presented by Gustavus Adolphus to Marshal Herman Wrangel, whose son Charles Gustavus Wrangel stored it with a remarkable collection of trophies from Germany, taken during the Thirty Years' War; including a library, an armoury, and a great accumulation of curios.

MALARIA, an Italian colloquial word (from *mala*, bad, and *aria*, air), introduced into English medical literature by Macculloch (1827) as a substitute for the more restricted terms "marsh miasm" or "paludal poison." It is generally applied to the definite unhealthy condition of body known by a variety of names, such as ague, intermittent (and remittent) fever, marsh fever, jungle fever, hill fever, "fever of the country" and "fever and ague." A single paroxysm of simple ague may come upon the patient in the midst of good health or it may be preceded by some malaise. The ague-fit begins with chills proceeding as if from the lower part of the back, and gradually extending until the coldness overtakes the whole body. Tremors of the muscles more or less violent accompany the cold sensations, beginning with the muscles of the lower jaw (chattering of the teeth), and extending to the extremities and trunk. The expression has meanwhile changed: the face is pale or livid; there are dark rings under the eyes; the features are pinched and sharp, and the whole skin shrunken; the fingers are dead white, the nails blue.

All those symptoms are referable to spasmodic constriction of the small surface arteries, the pulse at the wrist being itself small, hard and quick. In the interior organs there are indications of a compensating accumulation of blood, such as swelling of the spleen, engorgement (very rarely rupture) of the heart, with a feeling of oppression in the chest, and a copious flow of clear and watery urine from the congested kidneys. The body temperature will have risen suddenly from the normal to 103° or higher. This first or cold stage of the paroxysm varies much in length; in temperate climates it lasts from one to two hours, while in tropical and subtropical countries it may be shortened. It is followed by the stage of dry heat, which will be prolonged in proportion as the previous stage is curtailed. The feeling of heat is at first an internal one, but it spreads outwards to the surface and to the extremities; the skin becomes warm and red, but remains dry; the pulse becomes softer and more full, but still quick; and the throbbings occur in exposed arteries, such as the temporal. The spleen continues to enlarge; the urine is now scanty and high-coloured; the body temperature is high, but the highest temperatures occur during the chill; there is considerable thirst; and there is the usual intellectual unfitness, and it may be confusion, of the feverish state. This period of dry heat, having lasted three or four hours or longer, comes to an end in perspiration, at first a mere moistness of the skin, passing into sweating that may be profuse and even drenching. Sleep may overtake the patient in the midst of the sweating stage, and he awakes, not without some feeling of what he has passed through, but on the whole well, with the temperature fallen almost or altogether to the normal, or it may be even below the normal; the pulse moderate and full; the spleen again of its ordinary size; the urine that is passed after the paroxysm deposits a thick brick-red sediment of urates. The three stages together will probably have lasted six to twelve hours. The paroxysm is followed by a definite interval in which there is not only no fever, but even a fair degree of bodily comfort and fitness; this is the intermission of the fever. Another paroxysm begins at or near the same hour next day (quotidian ague), which results from a double tertian infection, or the interval may be forty-eight hours (tertian ague), or seventy-two hours (quartan ague). It is the general rule, with frequent exceptions, that the quotidian paroxysm comes on in the morning, the tertian about noon, and the quartan in the afternoon. Another rule is that the quartan has the longest cold stage, while its paroxysm is shortest as a whole; the quotidian has the shortest cold stage and a long hot stage, while its paroxysm is longest as a whole. The point common to the various forms of ague is that the paroxysm ceases about midnight or early morning. Quotidian intermittent is on the whole more common than tertian in hot countries; elsewhere the tertian is the usual type, and quartan is only occasional.

If the first paroxysm should not cease within the twenty-four hours, the fever is not reckoned as an intermittent, but as a remittent.

Remittent is a not unusual form of the malarial process in tropical and subtropical countries, and in some localities or in some seasons it is more common than intermittent. It may be said to arise out of that type of intermittent in which the cold stage is shortened while the hot stage tends to be prolonged. A certain abatement or remission of the fever takes place, with or without sweating, but there is no true intermission or interval of absolute apyrexia. The periodicity shows itself in the form of an exacerbation of the still continuing fever, and that exacerbation may take place twenty-four hours after the first onset, or the interval may be only half that period, or it may be double. A fever that is to be remittent will usually declare itself from the outset: it begins with chills, but without the shivering and shaking fit of the intermittent; the hot stage soon follows, presenting the same characters as the prolonged hot stage of the quotidian, with the frequent addition of bilious symptoms, and it may be even of jaundice and of tenderness over the stomach and liver. Towards morning the fever abates; the pulse falls in frequency, but does not come down to the normal; headache and aching in the loins and limbs become less, but do not cease altogether; the body temperature falls, but does not touch the level of apyrexia. The remission or abatement lasts generally throughout the morning; and about noon there is an exacerbation, seldom ushered in by chills, which continues till the early morning following, when it remits or abates as before. A patient with remittent may get well in a week under treatment, but the fever may go on for several weeks; the return to health is often announced by the fever assuming the intermittent type, or, in other words, by the remissions touching the level of absolute apyrexia. Remittent fevers (as well as intermittents) vary considerably in intensity; some cases are intense from the outset, or pernicious, with aggravation of all the symptoms—leading to stupor, delirium, collapse, intense jaundice, blood in the stools, blood and albumen in the urine, and, it may be, suppression of urine followed by convulsions. The severe forms of intermittent are most apt to occur in the very young, or in the aged, or in debilitated persons generally. Milder cases of malarial fever are apt to become dangerous from the complications of dysentery, bronchitis or pneumonia. Severe remittents (pernicious or bilious remittents) approximate to the type of yellow fever (*q.v.*), which is conventionally limited to epidemic outbreaks in western longitudes and on the west coast of Africa.

Of the mortality due to malarial disease a small part only is referable to the direct attack of intermittent, and chiefly to the fever in its pernicious form. Remittent fever is much more fatal in its direct attack. But probably the greater part of the enormous total of deaths set down to malaria is due to the *malarial cachexia*. The dwellers in a malarious region like the Terai (at the foot of the Himalayas) are miserable, listless and ugly, with large heads and particularly prominent ears, flat noses, tumid bellies, slender limbs and sallow complexions; the children are impregnated with malaria from their birth, and their growth is attended with aberrations from the normal which practically amount to the disease of rickets. The malarial cachexia that follows definite attacks of ague consists in a state of ill-defined suffering, associated with a sallow skin, enlarged spleen and liver, and sometimes with dropsy.

Causation.—From the time of Hippocrates onwards the malarial or periodical fevers have engaged the attention of innumerable observers, who have suggested various theories of causation, and have sometimes anticipated—vaguely, indeed, but with surprising accuracy—the results of modern research; but the true nature of the disease remained in doubt until the closing years of the 19th century. It has now been demonstrated by a series of accurate investigations, contributed by many workers, that malaria is caused by a microscopic parasite in the blood, into which it is introduced by the bites of certain species of mosquito. (See PARASITIC DISEASES and MOSQUITOES.)

History of Discovery.

The successive steps by which the present position has been reached form an interesting chapter in the history of scientific progress. The first substantial link in the actual chain of discovery was contributed in 1880 by Laveran, a French army surgeon serving in Algeria. On the 6th of November in that year he plainly saw the living parasites under the microscope in the blood of a malarial patient, and he shortly afterwards communicated his observations to the Paris Académie de Médecine. They were confirmed, but met with little acceptance in the scientific world, which was preoccupied with the claims of a subsequently discredited *Bacillus malariae*. In 1885 the Italian pathologists came round to Laveran's views, and began to work out the life history of his parasites. The subject has a special interest for Italy, which is devastated by malaria, and Italian science has contributed materially to the solution of the problem. The labours of Golgi, Marchiafava, Celli and others established the nature of the parasite and its behaviour in the blood; they proved the fact, guessed by Rasori so far back as 1846, that the periodical febrile paroxysm corresponds with the development of the organisms; and they showed that the different forms of malarial fever have their distinct parasites, and consequently fall into distinct groups, defined on an etiological as well as a clinical basis—namely, the mild or spring group, which includes tertian and quartan ague, and the malignant or "aestivo-autumnal" group, which includes a tertian or a semi-tertian and the true quotidian type. Three distinct parasites, corresponding with the tertian, quartan and malignant types of fever, have been described by Italian observers, and the classification is generally accepted; intermediate types are ascribed to mixed and multiple infections. So far, however, only half the problem, and from the practical point of view the less important half, had been solved. The origin of the parasite and its mode of introduction into the blood remained to be discovered. An old popular belief current in different countries, and derived from common observation, connected mosquitoes with malaria, and from time to time this theory found support in more scientific quarters on general grounds, but it lacked demonstration and attracted little attention. In 1894, however, Sir Patrick Manson, arguing with greater precision by analogy from his own discovery of the cause of filariasis and the part played by mosquitoes, suggested that the malarial parasite had a similar intermediate host outside the human body, and that a suctorial insect, which would probably be found to be a particular mosquito, was required for its development. Following up this line of investigation, Major Ronald Ross in 1895 found that if a mosquito sucked blood containing the parasites they soon began to throw out flagellae, which broke away and became free; and in 1897 he discovered peculiar pigmented cells, which afterwards turned out to be the parasites of aestivo-autumnal malaria in an early stage of development, within the stomach-wall of mosquitoes which had been fed on malarial blood. He further found that only mosquitoes of the genus *Anopheles* had these cells, and that they did not get them when fed on healthy blood. Then, turning his attention to the malaria of birds, he worked out the life-history of these cells within the body of the mosquito. "He saw that they increased in size, divided, and became full of filiform spores, then ruptured and poured out their multitudinous progeny into the body-cavity of their insect host. Finally, he saw the spores accumulate within the cells of the salivary glands, and discovered that they actually passed down the salivary ducts and along the grooved hypopharynx into the seat of puncture, thus causing infection in a fresh vertebrate host" (Sambon). To apply these discoveries to the malaria of man was an obvious step. In working out the details the Italian school have again taken a prominent part.

Experiment.

Thus we get a complete scientific demonstration of the causation of malaria in three stages: (1) the discovery of the parasite by Laveran; (2) its life-history in the human host and connexion with the fever demonstrated by the Italian observers; (3) its life-history in the alternate host, and the identification of the latter with a particular species of mosquito by Ross and Manson. The conclusions derived from the microscopical laboratory were confirmed by actual experiment. In 1898 it was conclusively shown in Italy that if a mosquito of the *Anopheles* variety bites a person suffering from malaria, and is kept long enough for the parasite to develop in the salivary gland, and is then allowed to bite a healthy person, the latter will in due time develop malaria. The converse proposition, that persons efficiently protected from mosquito bites escape malaria, has been made the subject of several remarkable experiments. One of the most interesting was carried out in 1900 for the London School of Tropical Medicine by Dr Sambon and Dr Low, who went to reside in one of the most malarious districts in the Roman Campagna during the most dangerous season. Together with Signor Terzi and two Italian servants, they lived from the beginning of July until the 19th of October in a specially protected hut, erected near Ostia. The sole precaution taken was to confine themselves between sunset and sunrise to their mosquito-proof dwelling. All escaped malaria, which was rife in the immediate neighbourhood. Mosquitoes caught by the experimenters, and sent to London, produced malaria in persons who submitted themselves to the bites of these insects at the London School of Tropical Medicine. Experiments in protection on a larger scale, and under more ordinary conditions, have been carried out with equal success by Professor Celli and other Italian authorities. The first of these was in 1899, and the subjects were the railwaymen employed on certain lines running through highly malarious districts. Of 24 protected persons, all escaped but four, and these had to be out at night or otherwise neglected precautions; of 38 unprotected persons, all contracted malaria except two, who had apparently acquired immunity. In 1900 further experiments gave still better results. Of 52 protected persons on one line, all escaped except two, who were careless; of 52 protected on another line, all escaped; while of 51 unprotected persons, living in alternate houses, all suffered except seven. Out of a total of 207 persons protected in these railway experiments, 197 escaped. In two peasants' cottages in the Campagna, protected with wire netting by Professor Celli, all the inmates—10 in number—escaped, while the neighbours suffered severely; and three out of four persons living in a third hut, from which protection was removed owing to the indifference of the inmates, contracted malaria. In the malarious islet of Asinara a pond of stagnant water was treated with petroleum and all windows were protected with gauze. The result was that the houses were free from mosquitoes and no malaria occurred throughout the entire season, though there had been 40 cases in the previous year. Eight Red Cross ambulances, each with a doctor and attendant, were sent into the most malarious parts of the Campagna in 1900. By living in protected houses and wearing gloves and veils at night all the staff escaped malaria except one or two attendants. These and other experiments, described by Dr Manson in the *Practitioner* for March 1900, confirming the laboratory evidence as they do, leave no doubt whatever of the correctness of the mosquito-parasitic theory of malaria.

It is possible, though not probable, that malaria may also be contracted in some other way than by mosquito bite, but there are no well-authenticated facts which require any other theory for their explanation. The alleged occurrence of the disease in localities free from mosquitoes or without their agency is not well attested; its absence from other localities where they abound is accounted for by their being of an innocent species, or—as in England—free from the parasite. The old theory of paludism or of a noxious miasma exhaled from the ground is no longer necessary. The broad facts on which it is based are sufficiently accounted for by the habits of mosquitoes. For instance, the swampy character of malarial areas is explained by their breeding in stagnant water; the effect of drainage, and the general immunity of high-lying, dry localities, by the lack of breeding facilities; the danger of the night air, by their nocturnal habits; the comparative immunity of the upper storeys of houses, by the fact that they fly low; the confinement of malaria to well-marked areas and the diminution of danger with distance, by their habit of clinging to the breeding-grounds and not flying far. Similarly, the subsidence of malaria during cold weather and its seasonal prevalence find an adequate explanation in the conditions governing insect life. At the same time it should be remembered that many points await elucidation, and it is unwise to assume conclusions in advance of the evidence.

Parasites.

With regard to the parasites, which are the actual cause of malaria in man, an account of them is given under the heading of Parasitic Diseases, and little need be said about them here. They belong to the group of Protozoa, and, as already explained, have a double cycle of existence: (1) a sexual cycle in the body of the mosquito, (2) an asexual cycle in the blood of human beings. They occupy and destroy the red corpuscles, converting the haemoglobin into melanin; they multiply in the blood by sporulation, and produce accessions of fever by the liberation of a toxin at the time of sporulation (Ross). The number in the blood in an acute attack is reckoned by Ross to be not less than 250 millions. A more general and practical interest attaches to the insects which act as their intermediate hosts. These mosquitoes or gnats—the terms are synonymous—belong to the family *Culicidae* and the genus *Anopheles*, which was first classified by Meigen in 1818. It has a wide geographical distribution, being found in Europe (including England), Asia Minor, Burma, Straits Settlements, Java, China, Formosa, Egypt; west, south and Central Africa; Australia, South America, West Indies, United States and Canada, but is generally confined to local centres in those countries. About fifty species are recognized at present. It is believed that all of them may serve as hosts of the parasite. The species best known in connexion with malaria are *A. maculipennis* (Europe and America), *A. funestus* and *A. costales* (Africa). In colour *Anopheles* is usually brownish or slaty, but sometimes buff, and the thorax frequently has a dark stripe on each side. The wings in nearly all species have a dappled or speckled appearance, owing to the occurrence of blotches on the front margin and to the arrangement of the scales covering the veins in alternating light and dark patches (Austen). The genus with which *Anopheles* is most likely to be confounded is *Culex*, which is the commonest of all mosquitoes, has a world-wide distribution, and is generally a greedy blood-sucker. A distinctive feature is the position assumed in resting; *Culex* has a humpbacked attitude, while in *Anopheles* the proboscis, head and body are in a straight line, and in many species inclined at an angle to the wall, the tail sticking outwards. In the female of *Culex* the palpi are much shorter than the proboscis; in *Anopheles* they are of the same length. The wings in *Culex* have not the same dappled appearance. *Anopheles* is also a more slender insect, with a smaller head, narrower body and thinner legs. There are further differences in the other stages of life. Mosquitoes go through four phases: (1) ovum, (2) larva, (3) nympha, (4) complete insect. The ova of *Anopheles* are tiny black rod-shaped objects, which are deposited on the water of natural puddles, ponds, or slowly moving streams, by preference those which are well supplied with vegetation; they float, singly or attached to other objects or clustered together in patterns. They can live in brackish and even in sea water. The larva has no breathing-tube, and floats horizontally at the surface, except when feeding; it does not frequent sewage or foul water. The ova of *Culex*, on the other hand, are deposited in any stagnant water, including cesspools, drains, cisterns, or water collected in any vessel; they float in boat-shaped masses on the surface. The larva has a breathing-tube, and floats head downwards; when disturbed it wriggles to the bottom (Christy). Some observers maintain that *Anopheles* does not "sing," like the common mosquito, and its bite is much less irritating. Only the females suck blood; the act is believed to be necessary for fertilization and reproduction. *Anopheles* rarely bites by day, and then only in dark places. In the daytime "the gorged females rest motionless on the walls and ceilings of rooms, choosing always the darkest situations for this purpose" (Austen). In temperate climates the impregnated females hibernate during the winter in houses, cellars, stables, the trunks of trees, &c., coming out to lay their eggs in the spring. The four phases are passed in thirty days in a favourable season, and consequently there are ordinarily four or five generations from April to September (Celli).

The most important question raised by the mosquito-parasitic theory of malaria is that of prevention. This may be considered under two heads: (1) individual prophylaxis; (2) administrative prevention on a large scale.

Prophylaxis.

(1) In the first place, common sense suggests the avoidance, in malarious countries, of unhealthy situations, and particularly the neighbourhood of stagnant water. Among elements of unhealthiness is next to be reckoned the proximity of native villages, the inhabitants of which are infected. In the tropics "no European house should be located nearer to a native village than half a mile" (Manson), and, since children are almost universally infected, "the presence of young natives in the house should be absolutely interdicted" (Manson). When unhealthy situations cannot be avoided, they may be rendered more healthy by destroying the breeding-grounds of mosquitoes in the neighbourhood. All puddles and collections of water should be filled in or drained; as a temporary expedient they may be treated with petroleum, which prevents the development of the larvae. When a place cannot be kept free from mosquitoes the house may be protected, as in the experiments in Italy, by wire gauze at the doors and windows. The arrangement used for the entrance is a wire cage with double doors. Failing such protection mosquito curtains should be used. Mosquitoes in the house may be destroyed by the fumes of burning sulphur or tobacco smoke. According to the experiments of Celli and Casagrandi, these are the most effective culicides; when used in sufficient quantity they kill mosquitoes in one minute. The same authorities recommend a powder, composed of larvicide (an aniline substance), chrysanthemum flowers, and valerian root, to be burnt in bedrooms. Anointing the skin with strong-smelling substances is of little use in the open air, but more effective in the house; turpentine appears to be the best. Exposure at night should be avoided. All these prophylactic measures are directed against mosquitoes. There remains the question of protection against the parasite. Chills are recognized as predisposing both to primary infection and to relapses, and malnutrition is also believed to increase susceptibility; both should therefore be avoided. Then a certain amount of immunity may be acquired by the systematic use of quinine. Manson recommends five to ten grains once or twice a week; Ross recommends the same quantity every day before breakfast. There is some evidence that arsenic has a prophylactic effect. An experiment made on the railway staff at Bovino, a highly malarious district on the Adriatic, gave a striking result. The number of persons was 78, and they were divided into two equal groups of 39 each. One group was treated with arsenic, and of these 36 escaped altogether, while three had mild attacks; the remaining 39 who were not treated, all had fever. In a more extended experiment on 657 railway-men 402 escaped. This was in 1889; but in spite of the encouraging results the use of arsenic does not appear to have made any further progress. Experiments in immunizing by sero-therapeutic methods have not as yet met with success.

Administrative Measures.

(2) Much attention has been directed in scientific circles to the possibility of "stamping out" epidemic malaria by administrative measures. The problem is one of great practical importance, especially to the British Empire. There are no data for estimating the damage inflicted by malaria in the British colonies. It is, indeed, quite incalculable. In Italy the annual mortality from this cause averages 15,000, which is estimated to represent two million cases of sickness and a consequent loss of several million francs. In British tropical possessions the bill is incomparably heavier. There is not only the heavy toll in life and health exacted from Europeans, but the virtual closing of enormous tracts of productive country which would otherwise afford scope for British enterprise. The "deadly" climates, to which so much dread attaches, generally mean malaria, and the mastery of this disease would be equivalent to the addition of vast and valuable areas to the empire. The problem, therefore, is eminently one for the statesman and administrator. A solution may be sought in several directions, suggested by the facts already explained. The existence of the parasite is maintained by a vicious interchange between its alternate hosts, mosquitoes and man, each infecting the other. If the cycle be broken at any point the parasite must die out, assuming that it has no other origin or mode of existence. The most effective step would obviously be the extermination of the *Anopheles* mosquito. A great deal may be done towards this end by suppressing their breeding-places, which means the drying of the ground. It is a question for the engineer, and may require different methods in different circumstances. Put comprehensively, it involves the control of the subsoil and surface waters by drainage, the regulation of rivers and floods, suitable agriculture, the clearing of forests or jungles, which tend to increase the rainfall and keep the ground swampy.

The city of Rome is an example of what can be done by drainage; situated in the midst of malaria, it is itself quite healthy. Recent reports also show us how much may be done in infected districts. At Ismailia malaria was reduced from 1551 cases in 1902 to 37 cases in 1905. The cost of operations amounted to an initial expenditure of 6·25 francs, and an annual expenditure of about 2·3 francs per head of the population. "The results are due to mosquito reduction together with cinchonization." The following is a tabulated list of the cases. The population of Ismailia is about 6000.

Year	1900	1901	1902[1]	1903	1904	1905
Cases of Malaria. .	2250	1990	1548	214	90	37 [2]

Klang and Port Swettenham are contiguous towns in the Federated Malay States, having a population of 4000 and a rainfall of 100 in. a year. At Klang the expenditure has been £3100, with an annual expenditure of £270, devoted to clearing and draining 332 acres. At Port Swettenham £7000, with an annual upkeep of £240, has been devoted to treating 110 acres. In Hong-Kong similar measures were carried out, with the result that the hospital admissions for malaria diminished from 1294 in 1901, the year when operations were begun, to 419 in 1905.

Klang and Port Swettenham.

Year	1900	1901[1]	1902	1903	1904	1905
Cases of Malaria. .	510	610	199	69	32	23

A systematic campaign for the destruction of breeding-places has been inaugurated in the British West African colonies, with encouraging results. The planting of eucalyptus trees is out of favour at present, but it appears to have been successful in Portugal, not from any prophylactic virtues in the plant, but through the great absorption of moisture by its deep roots, which tends to dry the subsoil. Treating the breeding-ponds with petroleum or similar preparations seems to be hardly applicable on a large scale, and in any case can only be a temporary expedient. H. Ziemann advocates the destruction of mosquito larvae by the growing of such plants as the water-pest (*Anacharis alsinatrum*) which covers the surface of the water and suffocates larvae and nymphae. Short of suppressing mosquitoes, the parasitic cycle may theoretically be broken by preventing them from giving the infection to man or taking it from him. The means of accomplishing the former have been already pointed out, but they are obviously difficult to carry out on a large scale, particularly in native communities. It is one thing to protect individuals from mosquito bites, another to prevent the propagation of the parasite in a whole community. Perhaps the converse is more feasible in some circumstances—that is to say, preventing mosquitoes from having access to malarial persons, and so propagating the parasite in themselves. It could be carried out where the infected persons are few, by isolating and protecting them, but not where many are infected, as in native villages. Koch has suggested that the disinfection of malarial persons by quinine would have the desired effect, but other authorities of greater experience do not consider it practicable. In spite of the difficulties, however, there is no doubt that a great deal can be done to reduce, if not stamp out, malaria by the methods indicated, which should be applied according to circumstances. An encouraging example is afforded by the remarkable fact that malaria, which was once rife in certain districts of England, has now died out, although the *Anopheles maculipennis* mosquito still exists there. The parasitic cycle has been broken, and the insect is no longer infected. The suggested causes are (1) reduction of insects by drainage, (2) reduced population, (3) the use of quinine. Sir Patrick Manson has suggested that the problem of stamping out malaria may be assisted by the discovery of some at present unknown factors. He has pointed out that certain areas and certain islands are entirely free from the disease, while neighbouring areas and islands are devastated. This immunity is apparently not due to the absence of favourable conditions, but rather to the presence of some inimical factor which prevents the development of the parasite. If this factor could be discovered it might be applied to the suppression of the disease in malarious localities.

A few other points may be noted. The pathological changes in malaria are due to the deposition of melanin and the detritus of red corpuscles and haemoglobin, and to the congregation of parasites in certain sites (Ross). In chronic cases the eventual effects are anaemia, melanosis, enlargement of the spleen and liver, and general cachexia. Apparently the parasites may remain quiescent in the blood for years and may cause relapses by fresh sporulation. Recent discoveries have done little or nothing for treatment. Quinine still remains the one specific. In serious cases it should not be given in solid form, but in solution by the stomach, rectum, or—better—hypodermically (Manson). According to Ross, it should be given promptly, in sufficient doses (up to 30 grains), and should be continued for months. Euquinine is by some preferred to quinine, but it is more expensive. Nucleogen and Aristochin have also been recommended instead of quinine. The nature of immunity is not known. Some persons are naturally absolutely immune (Celli), but this is rare; immunity is also sometimes acquired by infection, but as a rule persons once infected are more predisposed than others. Races inhabiting malarious districts acquire a certain degree of resistance, no doubt through natural selection. Children are much more susceptible than adults.

Malaria in the Lower Vertebrates.—Birds are subject to malaria, which is caused by blood parasites akin to those in man and having a similar life-history. Two species, affecting different kinds of birds, have been identified. Their alternate hosts are mosquitoes of the *Culex* genus. Oxen, sheep, dogs, monkeys, bats, and probably horses also suffer from similar parasitic diseases. In the case of oxen the alternate host of the parasite is a special tick (Smith and Kilborne). In the other animals several parasites have been described by different observers, but the alternate hosts are not known.

AUTHORITIES.—Celli, *Malaria*; Christy, *Mosquitoes and Malaria*; Manson, *Tropical Diseases*; Allbutt's *System of Medicine*; Ross, "Malaria," Quain's *Dictionary of Medicine*, 3rd ed.; *The Practitioner*, March, 1901 (Malaria Number); *Lancet* (Sept. 29, 1907); *British Medical Journal* (Oct. 19, 1907); *Indian Medical Gazette* (February 1908). (A. SL.; H. L. H.)

MALATIA (MALATIEH or ASPUZU) the chief town of a sanjak of the same name in the Mamuret el-Aziz vilayet of Asia Minor, and a military station on the Samsun-Sivas-Diarbekr road, altitude 2900 ft., situated about 10 m. S.W. of the junction of the Tokhma Su (med. Kubakib) with the Euphrates, near the south end of a fertile plain, and at the northern foot of the Taurus. Pop. about 30,000, including, besides many Armenian Christians, bodies of Kurds and "Kizilbash." It is a wholly modern place, rebuilt since the earthquake of 1893, contains fine public buildings, and is noted for its fruit orchards. There are Protestant (American) and Roman Catholic missions, and an Armenian Catholic archbishop has his seat here. Eski-shehr or Old Malatia (*Melitene*), 5 m. N.E. and 3 m. from the great medieval bridge (Kirkgeuz) over the Tokhma Su, is said to owe its present desolation largely to its occupation by Hafiz Pasha as his headquarters in 1838 before his advance to fight the disastrous battle of Nizib with the Egyptian, Ibrahim. But it has still many inhabitants and large gardens and many ruinous mosques, baths, &c., relics of Mansur's city. It was the residence of von Moltke for some months, while attached to Hafiz's army. The earliest site was possibly Arslan Tepe about 2 m. south of Eskishehr were two "Hittite" stelae, representing hunting scenes, now in the Constantinople and Paris museums, were found in 1894.

In the time of Strabo (xii. 537) there was no town in the district of Melitene, which was reckoned part of Cappadocia. Under Titus the place became the permanent station of the 12th ("Thundering") legion; Trajan raised it to a city. Lying in a very fertile country at the crossing point of important routes, including the Persian "Royal Road," and two imperial military highways from Caesarea and along the Euphrates bank, it grew in size and importance, and was the capital of Armenia Minor or Secunda. Justinian, who completed the walls commenced by Anastasius, made it the capital of Armenia Tertia; it was then a very great place (Procop., *De aed.*, iii. 4). The town was burnt by Chosroes on his retreat after his great defeat there in 577. Taken by the Saracens, retaken and destroyed by Constantine Copronymus, it was presently recovered to Islam, and rebuilt under Mansur (A.D. 756). It again changed hands more than once, being reckoned among the frontier towns of Syria (Istakhry, pp. 55, 62). At length the Greeks recovered it in 934, and Nicephorus II., finding the district much wasted, encouraged the Jacobites to settle in it, which they did in great numbers. A convent of the Virgin, and the great church which bears his name, were erected by the bishop Ignatius (Isaac the Runner). From this time Malatia continued to be a great seat of the Jacobites, and it was the birthplace of their famous maphrian Barhebraeus (or Abulfaragius). At the commencement of the 11th century the population was said to number 60,000 fighting men (Assem., *Bib. Or.*, ii. 149; cf. Barheb., *Chr. Eccl.*, i. 411, 423). At the time of the first crusade, the city, being hard pressed by the Turks under Ibn Danishmend, was relieved by Baldwin, after Bohemund had failed and lost his liberty in the attempt. But the Jacobites had no cause to love Byzantium, and the Greek governor Gabriel was so cruel and faithless that the townsmen were soon glad to open their gates to Ibn Danishmend (1102), and the city subsequently became part of the realm of Kilij Arslan, sultan of Iconium.

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[1] Drainage works begun.
[2] Nearly all were relapses of previous infection.

See H. C. B. v. Moltke, *Briefe über Zustände, &c. in der Türkei* (1835–1839). (D. G. H.)

MALAYALAM, a language of the Dravidian family, spoken on the west coast of southern India. It is believed to have developed out of Tamil as recently as the 9th century. It possesses a large literature, in which words borrowed from Sanskrit are conspicuous. In 1901 the total number of speakers of Malayalam in all India was just about six millions.

MALAY ARCHIPELAGO[1] (variously called *Malaysia*, the *Indian Archipelago*, the *East Indies*, *Indonesia*, *Insulinde*), the largest group of islands in the world, lying south-east of Asia and north and north-west of Australia. It includes the Sunda Islands, the Moluccas, New Guinea, and the Philippine Islands, but excludes the Andaman-Nicobar group. The equator passes through the middle of the archipelago; it successively cuts Sumatra, Borneo, Celebes and Halmahera, four of the most important islands. A. R. Wallace (who includes the Solomon Islands as well as New Guinea in the group) points out that the archipelago "includes two islands larger than Great Britain; and in one of them, Borneo, the whole of the British Isles might be set down, and would be surrounded by a sea of forests. Sumatra is about equal in extent to Great Britain; Java, Luzon, and Celebes are each about the size of Ireland. Eighteen more islands are on the average as large as Jamaica; and more than a hundred are as large as the Isle of Wight."

	Area.	Estimated Population.
Sunda Islands	459,578	32,632,400
Moluccas, with Celebes .	115,334	3,000,000
New Guinea	312,329	800,000
Philippine Islands . . .	115,026	7,635,400

The islands of the archipelago nearly all present bold and picturesque profiles against the horizon, and at the same time the character of the scenery varies from island to island and even from district to district. The mountains are arranged for the most part in lines running either from north-west to south-east or from west to east. In Sumatra and in the islands between Sumatra and Borneo the former direction is distinctly marked, and the latter is equally noticeable in Java and the other southern islands. The mountains of Borneo, however, rise rather in short ridges and clusters. Nothing in the general physiognomy of the islands is more remarkable than the number and distribution of the volcanoes, active or extinct. Running south-east through Sumatra, east through Java and the southern islands to Timor, curving north through the Moluccas, and again north, from the end of Celebes through the whole line of the Philippines, they follow a line roughly resembling a horseshoe narrowed towards the point. The loftiest mountain in the archipelago would appear to be Kinabalu in Borneo (13,698 ft.). An important fact in the physical geography of the archipelago is that Java, Bali, Sumatra and Borneo, and the lesser islands between them and the Asiatic mainland, all rest on a great submerged bank, nowhere more than 100 fathoms below sea-level, which may be considered a continuation of the continent; while to the east the depth of the sea has been found at various places to be from 1000 to 2500 fathoms. As the value of this fact was particularly emphasized by Wallace, the limit of the shallow water, which is found in the narrow but deep channel between Bali and Lombok, and strikes north to the east of Borneo, has received the name of "Wallace's Line." The Philippines on the other hand, "are almost surrounded by deep sea, but are connected with Borneo by means of two narrow submarine banks" (A. R. Wallace, *Island Life*). The archipelago, in effect, is divided between two great regions, the Asiatic and the Australian, and the fact is evident in various branches of its geography—zoological, botanical, and even human. It is believed that there was a land-connexion between Asia and Australia in the later part of the Secondary epoch, and that the Australian continent, when separated, became divided into islands before the south-eastern part of the Asiatic did so.

The most notable fact in the geological history of the archipelago is the discovery in Java of the fossil remains of *Pithecanthropus erectus*, a form intermediate between the higher apes and man. In its structure and cranial capacity it is entitled to a higher place in the zoological scale than any anthropoid, for it almost certainly walked erect; and, on the other hand, in its intellectual powers it must have been much below the lowest of the human race at present known. The strata in which it was found belong to the Miocene or Upper Pliocene. Among the rocks of economic importance may be mentioned granite of numerous kinds, syenite, serpentine, porphyry, marble, sandstones and marls. Coal is worked in Sumatra, Borneo and Labuan. Diamonds are obtained in Borneo, garnets in Sumatra, Bachian and Timor, and topazes in Bachian, antimony in Borneo and the Philippines; lead in Sumatra, Borneo and the Philippines; copper and malachite in the Philippines, Timor, Borneo and Sumatra; and, most important of all, tin in Banka, Billiton and Singkep. Iron is pretty frequent in various forms. Gold is not uncommon in the older ranges of Sumatra, Banka, Celebes, Bachian, Timor and Borneo. Manganese could be readily worked in Timor, where it lies in the Carboniferous Limestone. Platinum is found in Landak and other parts of Borneo. Petroleum is a valuable product of Sumatra and Java, and is also found in Borneo.

Climate, Flora, Fauna.—The most striking general fact as regards climate in the archipelago is that wherever that part of the south-east monsoon which has passed over Australia strikes, the climate is comparatively dry, and the vegetation is less luxuriant. The east end of Java, *e.g.* has a less rainfall than the west; the distribution of the rain on the north coast is quite different from that on the south, and a similar difference is observed between the east and the west of Celebes. The north-west monsoon, beginning in October and lasting till March, brings the principal rainy season in the archipelago.

Most of the islands of the archipelago belong to the great equatorial forest-belt. In its economical aspect the vegetation, whether natural or cultivated, is of prime interest. The list of fruits is very extensive, though few of them are widely known. These, however, include the orange, mango, mangosteen, shaddock, guava and the durian. The variety of food-plants is equally notable. Not only are rice and maize, sugar and coffee, among the widely cultivated crops, but the coco-nut, the bread-fruit, the banana and plantain, the sugar-palm, the tea-plant, the sago-palm, the coco-tree, the ground-nut, the yam, the cassava, and others besides, are of practical importance. The cultivation of sugar and coffee owes its development mainly to the Dutch; and to them also is due the introduction of tea. They have greatly encouraged the cultivation of the coco-nut among the natives, and it flourishes, especially in the coast districts, in almost every island in their territory. The oil is largely employed in native cookery. Pepper, nutmegs and cloves were long the objects of the most important branch of Dutch commerce; and gutta-percha, camphor, dammar, benzoin and other forest products have a place among the exports.

To the naturalist the Malay Archipelago is a region of the highest interest; and from an early period it has attracted the attention of explorers of the first rank. The physical division between the Asiatic and Australian regions is clearly reflected in the botany and zoology. The flora of the Asiatic islands (thus distinguished) "is a special development of that prevailing from the Himalayas to the Malay Peninsula and south China. Farther east this flora intermingles with that of Australia" (F. H. H. Guillemard, *Australasia*). Similarly, in the Asiatic islands are found the great mammals of the continent—the elephant, tiger, rhinoceros,

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[1] For more detailed information respecting the several islands and groups of the archipelago, see the separate articles BORNEO; JAVA; PHILIPPINE ISLANDS; SUMATRA, &c.

anthropoid ape, &c., which are wanting in the Australian region, with which the eastern part of the archipelago is associated. (For details concerning flora and fauna, see separate articles, especially **Java**.)

Inhabitants.—The majority of the native inhabitants of the Malay Archipelago belong to two races, the Malays and the Melanesians (Papuans). As regards the present racial distribution, the view accepted by many anthropologists, following A. H. Keane, is that the Negritos, still found in the Philippines, are the true aborigines of Indo-China and western Malaysia, while the Melanesians, probably their kinsmen, were the earliest occupants of eastern Malaysia and western Polynesia. At some date long anterior to history it is supposed that Indo-China was occupied first by a fair Caucasian people and later by a yellow Mongolian race. From these two have come all the peoples—other than Negrito or Papuan—found to-day from the Malay Peninsula to the farthest islands of Polynesia. The Malay Archipelago was thus first invaded by the Caucasians, who eventually passed eastward and are to-day represented in the Malay Archipelago only by the Mentawi islanders. They were followed by an immigration of Mongol-Caucasic peoples with a preponderance of Caucasic blood—the Indonesians of some, the pre-Malays of other writers—who are to-day represented in the archipelago by such peoples as the Dyaks of Borneo and the Battas of Sumatra. At a far later date, probably almost within historic times, the true Malay race, a combination of Mongol and Caucasic elements, came into existence and overran the archipelago, in time becoming the dominant race. A Hindu strain is evident in Java and others of the western islands; Moors and Arabs (that is, as the names are used in the archipelago, Mahommedans from various countries between Arabia and India) are found more or less amalgamated with many of the Malay peoples; and the Chinese form, from an economical point of view, one of the most important sections of the community in many of the more civilized districts. Chinese have been established in the archipelago from a very early date: the first Dutch invaders found them settled at Jacatra; and many of them, as, for instance, the colony of Ternate, have taken so kindly to their new home that they have acquired Malay to the disuse of their native tongue. Chinese tombs are among the objects that strike the traveller's attention at Amboyna and other ancient settlements.

There is a vast field for philological explorations in the archipelago. Of the great number of distinct languages known to exist, few have been studied scientifically. The most widely distributed is the Malay, which has not only been diffused by the Malays themselves throughout the coast regions of the various islands, but, owing partly to the readiness with which it can be learned, has become the common medium between the Europeans and the natives. The most cultivated of the native tongues is the Javanese, and it is spoken by a greater number of people than any of the others. To it Sundanese stands in the relation that Low German holds to High German, and the Madurese in the relation of a strongly individualized dialect. Among the other languages which have been reduced to writing and grammatically analysed are the Balinese, closely connected with the Javanese, the Batta (with its dialect the Toba), the Dyak and the Macassarese. Alfurese, a vague term meaning in the mouths of the natives little else than non-Mahommedan, has been more particularly applied by Dutch philologists to the native speech of certain tribes in Celebes. The commercial activity of the Buginese causes their language to be fairly widely spoken—little, however, by Europeans.

Political Division.—Politically the whole of the archipelago, except British North Borneo, &c. (see **Borneo**), part of Timor (Portuguese), New Guinea east of the 141st meridian (British and German), and the Philippine Islands, belongs to the Netherlands. The Philippine Islands which had been for several centuries a Spanish possession, passed in 1898 by conquest to the United States of America. For these several political units see the separate articles; a general view, however, is here given of the government, economic conditions, &c., of the Dutch possessions, which the Dutch call *Nederlandsch-Indië*.

NETHERLANDS INDIA

Administration.—The Dutch possessions in Asia lie between 6° N. and 11° S. and 95° E. and 141° E. Politically they are divided into lands under the direct government of the Netherlands vassal lands and confederated lands. Administratively they are further divided into residencies, divisions, regencies, districts, and *dessas* or villages. In the principal towns and villages there are parish councils, and in some provinces county councils have been established. Natives, Chinese and Arabs, are given seats, and in certain instances some of the members are elected, but more generally they are appointed by government. The islands are often described as of two groups, Java and Madura forming one, and the other consisting of Sumatra, Borneo, Riouw-Lingga Archipelago, Banka, Billiton, Celebes, Molucca Archipelago, the small Sunda Islands, and a part of New Guinea—the Outposts as they are collectively named. The Outposts are divided into 20 provinces. A governor-general holds the superior administrative and executive authority, and is assisted by a council of five members, partly of a legislative and partly of an advisory character, but with no share in the executive work of the government. In 1907 a Bill was introduced to add four extraordinary members to the council, but no immediate action was taken. The governor-general not only has supreme executive authority, but can of his own accord pass laws and regulations, except in so far as these, from their nature, belong of right to the home government, and as he is bound by the constitutional principles on which, according to the *Regulations for the Government of Netherlands India*, passed by the king and States-General in 1854, the Dutch East Indies must be governed. There are nine departments, each under a director: namely, justice; interior; instruction, public worship and industry; agriculture (created in 1905); civil public works; government works (created in 1908); finance; war; marine. The administration of the larger territorial divisions (*gouvernement, residentie*) is in the hands of Dutch governors, residents, assistant residents and *contrôleurs*. In local government a wide use is made of natives, in the appointment of whom a primary consideration is that if possible the people should be under their own chieftains. In Surakarta and Jokjakarta in Java, and in many parts of the Outposts, native princes preserve their positions as vassals; they have limited power, and act generally under the supervision of a Dutch official. In concluding treaties with the vassal princes since 1905, the Dutch have kept in view the necessity of compelling them properly to administer the revenues of their states, which some of them formerly squandered in their personal uses. Provincial banks have been established which defray the cost of public works.

Population.—The following table gives the area and population of Java (including Madura) and of the Outposts:—

		Area: English sq. m.	Pop.	
			1900.	1905.
Java and Madura		50,970	28,746,688	30,098,008
Sumatra	Sumatra, West Coast	31,649	1,527,297	4,029,505
	Sumatra, East Coast	35,312	421,090	
	Benkulen	9,399	162,396	
	Lampong Districts	11,284	142,426	
	Palembang	53,497	804,299	
	Achin	20,471	110,804	
Riouw-Lingga Archipelago		16,301	86,186	112,216
Banka		4,446	106,305	115,189
Billiton		1,863	43,386	36,858
Borneo, West Coast		55,825	413,067	1,233,655
Borneo, South and East Districts		156,912	716,822	
Celebes	Celebes	49,390	454,368	415,499
	Menado	22,080	429,773	436,406
Molucca Islands		43,864	410,190	407,419
Timor Archipelago		17,698	119,239	308,600
Bali and Lombok		4,065	1,041,696	523,535
New Guinea to 141° E.		151,789	200,000	....
Total		736,815	36,000,000	37,717,377[1]

In no case are the above figures for population more than fairly accurate, and in some instances they are purely conjectural. The population is legally divided into Europeans and persons assimilated to them, and natives and persons assimilated to them. The first class includes half-castes (who are numerous, for the Dutch are in closer relationship with the natives than is the case with most colonizing peoples), and also Armenians, Japanese, &c. The total number of this class in 1900 was 75,833; 72,019 of these were called Dutch, but 61,022 of them were born in Netherlands India; there were also 1382 Germans, 441 British and 350 Belgians. Among the natives and persons assimilated to them were about 537,000 Chinese and 27,000 Arabs. In the decade 1890–1900 the increase of the European population was 30·9%, of the Arabs 26·6%, and of the Chinese 16·5%. A large proportion of the Europeans are government officials, or retired officials, for many of the Dutch, once established in the colonies, settle there for life. The remaining Europeans are mostly planters and heads of industrial establishments; the Arabs are nearly all traders, as are some of the Chinese, but a large number of the latter are labourers in the Sumatra tobacco plantations and the tin mines of Banka, Billiton, &c. The bulk of the natives are agriculturists.

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[1] Including 487 in Merauke, the capital of Dutch New Guinea.

Religion and Instruction.—Entire liberty is granted to the members of all religious confessions. The Reformed Church has about 40 ministers and 30 assistants, the Roman Catholic 35 curates and 20 priests, not salaried out of the public funds. There are about 170 Christian missionaries, and the progress of their work may be illustrated by showing that the number of Christians among the natives and foreign Orientals was:—

	In 1873.	In 1896.	In 1903.
In Java and Madura . . .	5,673	19,193	About 34,000
In the Outposts	148,672	290,065	„ 390,000

About 10,000 natives go annually to Mecca on pilgrimage.

Both the government and private enterprise maintain vernacular schools. Large sums have been voted in Holland for the establishment of primary and secondary schools, and the government has undertaken to assist in the establishment of parochial schools, the object being that every village, at least in Java, should possess one. There are schools for higher education at Batavia, Surabaya and Semarang; at the first two of these towns are government schools for mechanical engineering, and at Batavia a crafts school and a medical school for natives. There are five colleges for native schoolmasters and four for sons of native officials. Government schools for the European education of Chinese children are established in the principal towns. Private mechanical and crafts schools are established at Jokjakarta, Surabaya and Semarang, and there is an agricultural school at Buitenzorg.

Justice.—As regards the administration of justice, the distinction is maintained between (1) Europeans and persons assimilated with them (who include Christians and Japanese), and (2) natives, together with Chinese, Arabs, &c. The former are subject to laws closely resembling those of the mother country, while the customs and institutions of natives are respected in connexion with the administration of justice to the latter. In 1906 a bill was passed somewhat modifying the existing status of the classes above mentioned, and especially directing new ordinances with regard to the judicial treatment of Christian natives. A general judicial revision being also in contemplation, this bill did not immediately come into force. Justice for Europeans is administered by European judges, but, as with administration at large so in judicial matters, native chiefs have extensive powers in native affairs. For European justice the High Court of Justice is established at Batavia; there are councils of justice at Batavia, Semarang and Surabaya, with authority not only over Java but over parts of the Outposts; there is a resident court of justice in each residency. For native justice there are courts in the districts and regencies; residents act as police judges; provincial councils have judicial powers, and there are councils of priests with powers in matrimonial disputes, questions of succession, &c.

As regards pauperism, the government subsidizes Protestant and Catholic orphan houses.

Finance.—The revenue of Netherlands India has been derived mainly from customs, excise, ground-tax, licences, poll-tax, &c., from monopolies—opium, salt and pawn-shops (the management of which began to be taken over by the government in 1903, in place of the previous system of farming-out), coffee, &c., railways, tin mines and forests, and from agricultural and other concessions. But attempts have been made, and have been largely successful, to make the revenue dependent to a less extent on monopolies and the products (especially agricultural) of the land; and to abolish licences and substitute direct taxes. There is a progressive income-tax for Europeans, and the system has also been applied in the case of natives.

The following table affords comparisons in the revenue and expenditure:—

Year.	Revenue.	Expenditure.
1880	£12,236,500	£12,244,666
1890	11,482,457	10,644,728
1900	11,832,417	12,313,854
1905	12,951,497	13,844,173

The monetary system is similar to that of Holland (the unit being the *guilder*), but there are also certain silver and copper coins of small value bearing Malay or Javanese inscriptions. The Java Bank, established in 1828, with headquarters at Batavia, is the only bank issuing notes, two-fifths of the amount of which must be covered by specie or bullion. The government has a control over the administration of this bank.

Defence.—The army is purely colonial, *i.e.* distinct from that of the Netherlands. Its strength is a little under 40,000, about one-third being Europeans of various nationalities and two-thirds natives of various races. No portion of the regular army of the Netherlands is allowed to be sent on colonial service, but individual soldiers are at liberty to enlist, by permission of their commanding officers, in the army of Netherlands India, and they form its nucleus. Native and European soldiers are generally mixed together in the same battalions, though in separate companies. The officers were all Dutch till 1908, when a trial was made of native officers from noble Javanese families. The artillery is composed of European gunners, with native riders, while the cavalry are Europeans and natives. A military academy is established at Meester Cornelis, near Batavia. Schools for soldiers are attached to every battalion. There are certain local forces outside the regular army—militia in some of the large towns, native infantry in Madura, and guards of some of the vassal princes. Unlike the army, which is purely colonial, the navy in Netherlands India is partly colonial, partly belonging to the royal navy of the Netherlands, and its expenses are therefore borne partly by the mother country and partly by the colony. About six ironclads and twenty smaller vessels of the royal navy are stationed in colonial waters; the vessels of the colonial marine number about twenty-four, and undertake police supervision, prevention of slave trading, &c.

Trade and Industries.—The principal articles of export are sugar, tobacco, copra, forest products (various gums, &c.), coffee, petroleum, tea, cinchona, tin, rice, pepper, spices and gambier. The average annual value of exports during 1900–1905 was £22,496,468, and of imports £17,050,338. A great proportion of the exports goes to the mother country, though a considerable quantity of rice is exported to China. An indication of the mineral products has already been given; as regards the export trade, tin is the most important of these, but the Ombilin coalfields of Sumatra, connected by a railway with the coast, call for mention here also. Agricultural labour is very carefully regulated by law, in the enforcement of which the residents and lower officials have wide powers. One day's gratuitous labour out of seven or more can be demanded of labourers either on private or on government estates; but in 1882 this form of labour was for the most part abolished as far as government estates were concerned, each labourer so exempted paying one guilder per year. The principal private agricultural estates are in the west of Java, in which island the greater part of the soil is government property. Such estates have increased greatly in number and extent, not only in Java but elsewhere, since the agrarian law of 1870, under which it became possible for settlers to obtain waste lands on hereditary lease for 75 years. In 1899 the total acreage of land ceded was 1,002,766 acres; in 1903 it was 1,077,295. The government ceased to cultivate sugar in 1891, but coffee, and to some extent cinchona, are cultivated on government plantations, though not in equal quantity to that grown on land held on emphyteusis. The average annual yield of sugar in 1900–1905 was 852,400 tons, but it increased steadily during that period. The average annual yield of coffee during the same period was 101,971,132 ℔; it fluctuates greatly. The average annual production of tobacco is about fifty million pounds from each of the islands of Java and Sumatra. The total annual yield of the tin mines is about 15,000 tons, and of the coal mines 240,000 tons. The average output of petroleum annually in 1900–1905 was 120,000,000 gallons; this, again, has fluctuated greatly. There are upwards of 3000 miles of railways and steam tramways in Netherlands India, but these are almost entirely in Java; elsewhere only Sumatra has a few short lines. The principal steamship company in the archipelago is the Royal Packet (*Koninklyke Paketvaart*) Company.

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HISTORY

Portuguese and Spanish Ascendancy, 1511–1595.—Ptolemy and other ancient geographers describe the Malay Archipelago, or part of it, in vague and inaccurate terms, and the traditions they preserved were supplemented in the middle ages by the narratives of a few famous travellers, such as Ibn Batuta, Marco Polo, Odoric of Pordenone and Niccolò Conti. Malay and Chinese records also furnish material for the early history of individual islands, but the known history of the archipelago as a whole begins in the 16th century. At this period a civilization, largely of Hindu origin, had flourished and decayed in Java, where, as in all the more important islands, Mahommedanism had afterwards become the dominant creed. But the smaller islands and the remoter districts, even of Java and Sumatra, remained in a condition of complete savagery.

The Portuguese were the first Europeans to colonize any part of the archipelago. A Portuguese squadron under Diogo Lopes de Sequeira arrived off Sumatra in 1509, explored the north coast for some distance, and noted that the inhabitants of the interior were cannibals, while those of the littoral were civilized and possessed a gold coinage. The main object of the Portuguese was to obtain a share in the lucrative spice trade carried on by the Malays, Chinese and Japanese; the trade-routes of the archipelago converged upon Malacca, which was the point of departure for spice merchants trading with every country on the shores of the Indian Ocean and Arabian Sea. In 1511 the Portuguese under Alphonso d'Albuquerque occupied Malacca, and in November of that year an expedition under Antonio de Abreu was despatched to find a route to the Moluccas and Banda Islands, then famous for their cloves and nutmegs. The explorers reached Amboyna and Ternate, after gaining some knowledge of Java, Madura, Sumbawa and other islands, possibly including New Guinea. During the return voyage the second-in-command, Francisco Serrão, was shipwrecked, but succeeded in making his way in a native boat to Mindanao. Thus the Philippines were discovered. In 1514 a second Portuguese fleet arrived at Ternate, which during the next five years became the centre of Portuguese enterprise in the archipelago; regular traffic with Malacca and Cochin was established, and the native raja became a vassal of Portugal.

Meanwhile the Spanish government was considering whether the Moluccas did not fall within the Spanish sphere of influence as defined by the Treaty of Tordesillas in 1494; and in August 1519 an expedition commanded by Ferdinand Magellan (*q.v.*) sailed from Seville to seek a westward passage to the archipelago. After losing the commander in the Philippines and discovering Borneo, the two surviving ships reached the Moluccas late in 1520. One vessel returned to Seville by the Cape route, thus completing the first voyage round the world; the other attempted to return by the Pacific, but was driven back to Tidore and there welcomed by the natives as a useful ally against the Portuguese. Reinforcements from Spain arrived in 1525 and 1528; but in 1529 a treaty was concluded between the emperor Charles V. and John III. of Portugal, by which, in return for 350,000 gold ducats, the Spanish claim to the Moluccas was withdrawn. The boundary between the Spanish and Portuguese spheres was fixed at 17° E. of the Moluccas, but by a geographical fiction the Philippines were included within the Spanish sphere. Further disputes occurred from time to time, and in 1542 a Spanish fleet came into conflict with the Portuguese off Amboyna; but after 1529 the supremacy of each power in its own sphere was never seriously endangered.

Though the Portuguese traders frequented the coast of Java, they annexed no territory either there or in Sumatra; but farther east they founded numerous forts and factories, notably in Amboyna, the Banda Island, Celebes and Halmahera. Ternate remained the seat of the governor of the Moluccas, who was the highest official in the archipelago, though subordinate to the viceroy or governor of Portuguese India. The first attempt to enter into relations with the states of Borneo was made by D. Jorge de Menezes, who visited Brunei in 1526, and in 1528 sent an envoy to its raja. The embassy failed in a curious manner. Among the gifts sent by Menezes was a piece of tapestry representing the marriage of Catherine of Aragon to Arthur, prince of Wales. The raja was persuaded that these mysterious figures were demons under a spell, which might come to life and kill him as he slept. The envoy was therefore dismissed.

In 1536, after a period of war and anarchy caused by the tyrannical rule of Menezes, Antonio Galvão, the historian, was appointed governor of the Moluccas. He crushed the rebellion and won the affection of the natives by his just and enlightened administration, which had no parallel in the annals of Portuguese rule in the archipelago. He returned to Europe in 1540 (see PORTUGAL: *Literature*), after inaugurating an active missionary movement, which was revived in 1546–1547 by Francis Xavier (*q.v.*). At this period the Portuguese power in the East was already beginning to wane; in the archipelago it was weakened by administrative corruption and by incessant war with native states, notably Bintang and Achin; bitter hostility was aroused by the attempts which the Portuguese made to establish a commercial monopoly and to force Christianity upon their native subjects and allies (see PORTUGAL: *History*). From 1580 to 1640 Portugal was itself united to Spain—a union which differed from annexation in little but name.

The English and Dutch, 1595–1674.—Pirates from Dieppe visited the archipelago between 1527 and 1539. It is possible that they reached Australia[1]—more than sixty years before the first voyage thither of which there is any clear record; but their cruise had no political significance, and the Spaniards and Portuguese remained without European competitors until the appearance of Sir Francis Drake in 1579. An English squadron under Sir James Lancaster came into conflict with the Portuguese in 1591, and an expedition under Sir Henry Middleton traded in the archipelago in 1604. But the English were simple traders or explorers; far more formidable were the Dutch, who came to the East partly to avenge the injuries inflicted on their country by the Spaniards, partly to break the commercial monopoly of the peninsular states. As middlemen they already possessed a large interest in the spice trade, for the Portuguese, having no direct access to the principal European markets, had made a practice of sending cargo to the Netherlands for distribution by way of the Scheldt and Rhine. The Dutch now sought to monopolize not only the distribution but the production of spices—an enterprise facilitated by the co-operation of many exiled Portuguese Jews who had settled in Holland.

The first Dutch fleet sailed from Texel, under the command of Cornelis Houtman, on the 2nd of April 1595 and reached Sumatra on the 1st of January 1596. It visited Madura, and came into conflict with the Portuguese at Bantam in Java, returning to Holland in 1597. Though not a commercial success, the expedition had demonstrated the weakness of the Portuguese. In 1602 the Dutch East India Company (*q.v.*) was incorporated, and for nearly two centuries this organization played the chief part in the history of the archipelago. By 1604 the Dutch could already claim to be the stronger power at sea. They had attacked the Portuguese in Ceylon (1601), established friendly relations with Achin (1602), and defeated a powerful fleet off Banda (1602). In 1606 they concluded a treaty of alliance with the sultan of Johor, and in 1608 they forced the Portuguese to assent to an armistice for twelve years. On the 29th of November 1609 Pieter Both was chosen by the states-general, on the nomination of the Dutch East India Company, as first governor-general of Netherlands India. In 1611 the headquarters of the Dutch was changed from Bantam to Jakatra, which in 1619 was renamed Batavia, and was thenceforward the Dutch capital. Meanwhile the English East India Company, chartered in 1600, had also extended its operations to the archipelago. After 1611 the commercial rivalry between the Dutch and British became acute, and in 1613, 1615 and 1618 commissioners met in London to discuss the matters in dispute. The result of their deliberations was the Treaty of Defence, signed on the 2nd of June 1619 and modified on the 24th of January 1620, which arranged for co-operation between the Dutch and British companies, and especially for the maintenance of a joint fleet. But neither company could restrain its agents in the East from aggressive action, and many fresh causes of dispute arose, the chief being the failure of the British to provide the naval forces required for service against the Portuguese, and the so-called "massacre of Amboyna" (*q.v.*) in 1623. The Treaty of Defence lapsed in 1637, but as early as 1634 the British made peace with Portugal. Even without allies, however, the Dutch continued to extend their trade and to annex fresh territory, for the British were weakened by civil war at home, while, after 1640, the Portuguese were struggling to maintain their independence against Spain. The Dutch company opened up a profitable trade with Japan and China, and prosecuted the war against Portugal with great vigour, invading Portuguese India and capturing Point de Galle in 1640, Malacca in 1641, Cochin and Cannanore in 1663. The war with England in 1652–54 and the renewal of the Anglo-Portuguese alliance by the marriage of Charles II. to Catherine of Braganza in 1661 were unable to check the growth of Dutch power; more serious was the resistance offered by some of the native states. Rebellions in Java (1629) and the Moluccas (1650) were suppressed with great severity, but in 1662 the company suffered a heavy reverse in Formosa, all its colonists being expelled from the island. A new war between Great Britain and Holland broke out in 1672 and was terminated by the Treaty of Westminster (February 17, 1674), by which the points at issue between the two companies were referred first to commissioners and finally to an arbitrator. The full details of the settlement are unknown, but thenceforward the British company devoted its energies chiefly to the development of its Indian possessions, while the Dutch were left supreme in the archipelago. In 1684 the British even evacuated Bantam, their chief settlement, and retired to Benkulen in Sumatra, which remained for more than a century their sole territorial possession in the archipelago.

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[1] See *The Geographical Journal*, ix. 80 seq. (London, 1897).

Dutch Ascendancy, 1674–1749.—The weakness of Spain and Portugal and the withdrawal of the British left the Dutch company free to develop its vast colonial and commercial interests. In 1627 the so-called Dutch "colonial system" had been inaugurated by the fourth governor-general, Jan Pieterszoon Coen (*q.v.*). Under this system, which was intended to provide Netherlands India with a fixed population of European descent, Dutch girls were sent to the archipelago to be married to white settlers, and subsequently marriages between Dutchmen and captive native women were encouraged. As early as 1624 vast fortunes had been acquired by trade: two members of the company who died in that year were stated to possess seven and eight tons of gold respectively, an amount approximately equivalent, in the aggregate, to £2,000,000. The use of slave labour, and the application of the *corvée* system to natives who were nominally free, enabled the company to lower the cost of production, while the absence of competition enabled it to raise prices. The hardship inflicted on the native races provoked an insurrection throughout Java, in which the Chinese settlers participated; but the Dutch maintained naval and military forces strong enough to crush all resistance, and a treaty between the company and the Susuhunan in November 1749 made them practically supreme throughout the island.

Decline of Dutch Power, 1749–1811.—In the second half of the 17th century the monopoly system and the employment of slaves and forced labour gave rise to many abuses, and there was a rapid decline in the revenue from sugar, coffee and opium, while the competition of the British East India Company, which now exported spices, indigo, &c. from India to Europe, was severely felt. The administration was corrupt, largely because of the vast powers given to officials, who were invariably underpaid; and the financial methods of the company precipitated its ruin, large dividends being paid out of borrowed money. The burden of defence could no longer be sustained; piracy and smuggling became so common that the company was compelled to appeal to the states-general for aid. In 1798 it was abolished and its authority vested in a "Council of the Asiatic Possessions." In 1803 a commission met to consider the state of the Dutch colonies, and advocated drastic administrative and commercial reforms, notably freedom of trade in all commodities except firearms, opium, rice and wood—with coffee, pepper and spices, which were state monopolies. Some of these reforms were carried out by H. W. Daendels (1808–1811), who was sent out as governor-general by Louis Bonaparte, after the French conquest of Holland. Daendels, however, maintained the existing restrictions upon trade and even made rice a state monopoly. His harsh rule aroused great antagonism; in 1811 he was recalled and J. W. Janssens became governor-general.

British Occupation, 1811–1816.—Netherlands India was at this time regarded as a part of the Napoleonic Empire, with which Great Britain was at war. A British naval squadron arrived in the Moluccas in February 1810 and captured Amboyna, Banda, Ternate and other islands. In 1811 a strong fleet was equipped by Lord Minto, then governor-general of India, for the conquest of Java; a British force was landed on the 4th of August; Batavia was captured on the 26th, and on the 18th of September Janssens and the remnant of his army surrendered. Lord Minto had issued a proclamation establishing British rule on the 11th of September, and Thomas (afterwards Sir Thomas) Stamford Raffles was appointed lieutenant-governor. Raffles (*q.v.*) held office until March 1816, and introduced many important changes in the departments of revenue, commerce and judicature. He was succeeded by John Fendall, who in 1816 carried out the retrocession of Netherlands India to the Dutch, in accordance with the Treaty of Vienna (1814).

Restoration and Reform of Dutch Power, 1816–1910.—Various disputes between Great Britain and the Netherlands, arising chiefly out of the transfer of power in Java and the British occupation of Singapore (1819), were settled by treaty between the two powers in 1824. By this treaty the Dutch were given almost entire freedom of action in Sumatra, while the Malay Peninsula was recognized as within the British sphere of influence. In 1825–30 a serious rebellion in Java involved the despatch of a large military force from the Netherlands, and was with difficulty suppressed. An outbreak of Mahommedan fanaticism in Sumatra also gave much trouble.

The reform movement inaugurated by the commission of 1803 was resumed in 1830, when Governor-General Johannes van den Bosch endeavoured to improve the conditions of land-tenure and agriculture by introducing the so-called "culture system." The native cultivators were to be exempted from the ground-tax, but were to cultivate one-fifth of their land as the government might direct, the government taking the produce. This culture-system worked fairly during Van den Bosch's tenure of office, but gave rise to many abuses between 1833 and 1844, involving, as it did, a combination of the *métayer* and *corvée* systems.

In 1848 the *Grondwet*, or fundamental law of the Netherlands, recognized for the first time the responsibility of the Dutch nation for its colonial dependencies. The *Grondwet* involved certain important changes, which were embodied in an act passed in 1854 and commonly known as the *Regulations for the Government of Netherlands India*. The *Regulations* substituted statute law for administrative and military despotism, and made the governor-general in council responsible to the minister of the colonies at the Hague. They reformed the judicature, introduced elementary education for the natives, and abolished slavery in Java as from the 1st of January 1860. They also prepared the way for further legislation tending towards the gradual emancipation of the natives from the culture system, and from semi-feudal servitude to their native rulers. That servitude existed in many forms all over the archipelago, but among the most curious must be reckoned the *pandelingschap* or "pledgedom," which originated in Borneo, and according to which a man had the power to make his debtors his serfs until their debts were paid.

The reform movement was aided by the publication in 1860 of *Max Havelaar*, a romance by E. Douwes Dekker (*q.v.*), which contained a scathing indictment of the colonial system. Many important financial and agrarian measures were carried between 1860 and 1890. In 1863 Fransen van de Putte, minister for the colonies, introduced the first of the annual colonial budgets for which the *Regulations* had provided, thus enabling the states-general to control the revenue and expenditure of Netherlands India; in 1865 he reduced and in 1872 abolished the differentiation of customs dues in favour of goods imported from Holland, substituting a uniform import duty of 6% and establishing a number of free ports throughout the archipelago. The import duty was considered so moderate that an increase required for revenue purposes was readily conceded in 1886. In 1876 the practice of paying a yearly surplus (*batig slot*) from the revenues of Netherlands India to the treasury at the Hague was discontinued. The chief reforms in the land system were those introduced by De Waal, then minister for the colonies, in 1870. The cultivation of pepper, cochineal, cinnamon and indigo for the government had already ceased; De Waal restricted the area of the sugar plantations (carried on by forced native labour) as from 1878, and provided for their abolition after 1890. He also enabled natives to secure proprietary rights over the land they cultivated, and legalized the leasing of Crown forest-lands to Europeans.

The extension of Dutch political power—notably in Java, Sumatra, Celebes, the Moluccas, Borneo, the Sunda Islands and New Guinea—proceeded simultaneously with the reform movement, and from time to time involved war with various native states. A large expedition was sent to Lombok in 1894, and almost the whole of that island was incorporated in the Dutch dominions. The long and costly war with Achin (*q.v.*) began in 1873 and reached its climax in the military occupation of the country after 1905, when the native sultan surrendered and was deported. A guerrilla war was still carried on by his subjects, but their principal leader, the chief Panglima Polim, was captured in 1907; in 1908–1910 the condition of Achin under the military rule of General Swart was one of almost unbroken peace, and taxes were regularly paid.

While the Dutch were thus consolidating their authority, other countries were acquiring new commercial or colonial interests in the archipelago. Immigration from China and Japan steadily increased, especially towards the end of the period 1816–1910. The enterprise of Sir James Brooke (*q.v.*) led, after 1838, to the establishment of British sovereignty in North Borneo; in 1895 New Guinea was divided between Great Britain, Germany and the Netherlands; and the Spanish-American War of 1898 resulted in the cession of the Philippines, Sulu Island and the largest of the Mariana Islands to the United States, and the sale of the Caroline group to Germany. Australian and Japanese trade in the archipelago was stimulated by the establishment of the Australian Commonwealth (1901) and the Russo-Japanese War (1904–5). In 1910 the nations most directly interested in the future of the archipelago were the Netherlands, Great Britain, the United States, Germany, Japan, China and Portugal.

BIBLIOGRAPHY.—For the period 1511–1595, the chief Portuguese authorities are the chronicles of Barros, Corrêa, Castanheda and Couto (see PORTUGAL: *History*), with the letters of Xavier (*q.v.*), and the *Tratado* of A. Galvão (Lisbon, 1563 and 1731), of which a translation entitled *Discoveries of the World* was made for Richard Hakluyt and reprinted by the Hakluyt Society (London, 1862). See also M. F. de Navarette, *Coleccion de los viages* (vols. 4 and 5, Madrid, 1837). For later history see John Crawfurd, *History of the Indian Archipelago* (Edinburgh, 1820), which quotes from native as well as European records, and *Twentieth-Century Impressions of Netherlands India* (ed. A. Wright, London, 1910), which gives references to the principal English and Dutch authorities. Further bibliography will be found in J. A. van der Chijs, *Proeve eener nederlandsch-indische Bibliografie, 1659–1870* (Batavia, 1875).

(K. G. J.)

MALĀYIR, a small province of Persia, situated between Hamadan and Burujird. It has a population of about 70,000, and, together with the district Tusirkhan, pays a yearly revenue of about £13,000. It produces much corn and fruit; a great quantity of the latter, dried, is exported. Its capital and seat of government is Doletabad (Dowletabad), a thriving little city, with a population of about 5000, situated at an elevation of 5680 ft., 38 m. from Hamadan and 32 m. from Burujird. It has post and telegraph offices.

MALAY PENINSULA (called by the Malays *Tanah Malayu*, *i.e.* the Malay Land), a lozenge-shaped strip of land projecting into the China Sea, and forming the most southerly portion of the continent of Asia. Geographically, the peninsula begins at the isthmus of Kra, 10° N., at which point it is only between 60 and 70 m. in width, and the distance from sea to sea is further diminished by a large irregular salt-water inlet. Politically and anthropologically, however, this upper portion must be regarded as a continuation of the kingdom of Siam rather than as a section of Malaya. From the isthmus of Kra the peninsula extends south with a general inclination towards the east, the most southerly point being Tanjong Bulus in 1° 16½′ N. A line drawn diagonally down the centre from the isthmus of Kra to Cape Romania (Ramunya) gives the extreme length at about 750 miles. The breadth at the widest point, from Tanjong Pen-unjut in Trengganu to Tanjong Hantu in the Dindings territory, is about 200 m. The area is estimated at about 70,000 sq. m. The peninsula is bounded on the N. by Siam, on the S. by the island and strait of Singapore, on the E. by the China Sea, and on the W. by the Strait of Malacca.

Physical Characteristics.—A range of granite mountains forms a backbone which divides the peninsula into two unequal portions, the larger of which lies to the east and the smaller to the west of the chain. Smaller ranges run parallel to the main mountain chain in many places, and there are numerous isolated spurs which have no connexion with either. The country is covered with limestone in many parts, and large isolated bluffs of this formation stand up in the plains both on the eastern and the western slopes. The descent from the summits of the range into the plain is somewhat less abrupt on the western than it is on the eastern side, and between the foot of the mountains and the Strait of Malacca the largest known alluvial deposits of tin are situated. On the eastern side of the range, after a steep descent, the granite formation speedily gives place to slates of vast depth, intersected here and there by fissures of quartz containing gold, and in many places covered by limestone which has been superimposed upon the slates. The highest known peak in the main range is that of Gunong Korbu, 7217 ft. above sea-level. The highest mountain is believed to be Gunong Tahan, which forms part of an isolated range on the eastern side, between Pahang and Kelantan, and is estimated at about 8000 ft. The west coast throughout its whole length is covered to a depth of some miles with mangrove swamps, with only a few isolated stretches of sandy beach, the dim foliage of the mangroves and the hideous mud flats presenting a depressing spectacle. On the east coast the force of the north-east monsoon, which beats upon the shores of the China Sea annually from November to February, has kept the land for the most part free from mangroves, and the sands, broken here and there by rocky headlands thickly wooded, and fringed by *casuarina* trees, stretch for miles without interruption. The islands on each coast present the features of the shore to which they are adjacent. On both the east and the west coast the islands are thickly wooded, but whereas the former are surrounded by beautiful sands and beaches, the latter are fringed by mangrove-swamps. The whole peninsula may be described as one vast forest, intersected in every direction by countless streams and rivers which together form the most lavish water-system in the world. Only an insignificant fraction of these forests has ever been visited by human beings, the Malays and even the aboriginal tribe having their homes on the banks of the rivers, and never, even when travelling from one part of the country to another, leaving the banks of a stream except for a short time when passing from one river-system to another. The bulk of the jungle, therefore, which lies between stream and stream, has never been trodden by the foot of man. The principal rivers on the west coast are the Perak, the Bernam and the Muar. The first-named is far finer than its fellows, and is navigable for steamers for about 40 m. from its mouth, and for native craft for over 250 m. It is exceedingly shallow, however, and is not of much importance as a waterway. The Bernam runs through flat swampy country for the greater part of its course, and steam-launches can penetrate to a distance of over 100 m. from its mouth, and it is therefore probably the deepest river. The country which it waters, however, is not of any value, and it is not much used. The Muar waters a very fertile valley, and is navigable for native boats for over 150 m. On the east coast the principal streams are the Petani, Telubin, Kelantan, Besut, Trengganu, Dungun, Kmamun, Kuantan, Pahang, Rompin, Endau and Sedeli, all guarded by difficult bars at their mouths, and dangerous during the continuance of the north-east monsoon. The deepest rivers are the Kuantan and Rompin; the largest are the Kelantan and the Pahang, both of which are navigable for native boats for a distance of over 250 m. The Trengganu river is obstructed by impassable rapids at a distance of about 30 m. from its mouth. The rivers on the east coast are practically the only highways, the Malays always travelling by boat in preference to walking, but they serve their purpose very indifferently, and their great beauty is their chief claim to distinction. Magnificent caves are found on both slopes of the peninsula, those at Batu in Selangor being the finest on the west coast, while those of Chadu and Koto Glanggi in Pahang are the most extensive yet visited by Europeans on the east coast. They are all of limestone formation. So far as is known, the Malay Peninsula consists of an axial zone of crystalline rocks, flanked on each side by an incomplete band of sedimentary deposits. Granite is the most widely spread of the crystalline rocks; but dikes of various kinds occur, and gneiss, schist and marble are also met with. These rocks form the greater part of the central range, and they are often—especially the granite—decomposed and rotten to a considerable depth. The sedimentary deposits include slate, limestone and sandstone. Impure coal has also been recorded. The limestone has yielded *Proetus*, *Chonetes* and other fossils, and is believed to be of Carboniferous age. In the sandstone Myophoria and other Triassic fossils have been found, and it appears to belong to the Rhaetic or Upper Trias.[1] The minerals produced are tin, gold, iron, galena and others, in insignificant quantities.

The tin occurs in the form of cassiterite, and is found chiefly in or near the crystalline rocks, especially the granite. As stream tin it occurs abundantly in some of the alluvial deposits derived from the crystalline area, especially on the west coast. Only two tin lodes are worked, however, and both are situated on the east coast, the one at Kuantan in Pahang, the other at Bandi in Trengganu territory. On the west coast no true lode has yet been discovered, though the vast alluvial deposits of tin found there seem to make such a discovery probable in the future. Since 1890 the tin produced from these alluvial beds has supplied between 50% and 75% of the tin of the world. Gold is worked with success in Pahang, and has been exploited from time immemorial by the natives of that state and of Kelantan. Small quantities have also been found on the western slope in Perak.

Climate, &c.—It was formerly the custom to speak of the Malay Peninsula as an unhealthy climate, and even to compare it with the west coast of Africa. It is now generally admitted, however, that, though hot, it compares favourably with that of Burma. The chief complaint which Europeans make concerning it is the extreme humidity, which causes the heat to be more oppressive than is the case where the air is dry. On the other hand, the thermometer, even at Singapore on the southern coast, which is the hottest portion of the peninsula, seldom rises above 98° in the shade, whereas the mean for the year at that place is generally below 80°. On the mainland, and more especially on the eastern slope, the temperature is cooler, the thermometer seldom rising above 93° in the shade, and falling at night below 70°. On an average day in this part of the peninsula the temperature in a European house ranged from 88° to 68°. The number of rainy days throughout the peninsula varies from 160 to over 200 in each year, but violent gusts of wind, called "Sumatras," accompanied by a heavy downpour of short duration, are more common than persistent rain. The rainfall on the west coast varies from 75 to 120 in. per annum, and that of the east coast, where the north-east monsoon breaks with all its fury, is usually about 155 in. per annum. Malarial fevers make their appearance in places where the forest has been recently felled, or where the surface earth has been disturbed. It is noticed that labourers employed in deep mines worked by shafts suffer less from fever than do those who are engaged in stripping the alluvial deposits. This, of course, means that a new station, where clearing, digging, and building are in progress, is often unhealthy for a time, and to this must be attributed the evil reputation which the peninsula formerly enjoyed. To Europeans the climate is found to be relaxing and enervating, but if, in spite of some disinclination for exertion, regular exercise is taken from the beginning, and ordinary precautions against chills, more especially to the stomach, are adopted, a European has almost as good a chance of remaining in good health in the peninsula as in Europe. A change of climate, however, is imperatively necessary every five or six years, and the children of European parents should not be kept in the peninsula after they have attained the age of four or five years. The Chinese immigrants suffer chiefly from fever of a malarial type, from beri-beri, a species of tropical dropsy, and from dysentery. The Malays formerly suffered severely from small-pox epidemics, but in the portion of the peninsula under British rule vaccination has been introduced, and the ravages of the disease no longer assume serious dimensions. Occasional outbreaks of cholera occur from time to time, and in the independent states these cause terrible loss of life, as the natives fly from the disease and spread the infection in every direction. As a whole, the Malays are, however, a remarkably healthy people, and deformity and hereditary diseases are rare among them. There is little leprosy in the peninsula, but there is a leper hospital near Penang on Pula Deraja and another on an island on the west coast for the reception of lepers from the Federated Malay States.

Flora and Fauna.—The soil of the peninsula is remarkably fertile both in the plains and on the mountain slopes. In the vast forests the decay of vegetable matter during countless ages has enriched the soil to the depth of many feet, and from it springs the most marvellous tangle of huge trees, shrubs, bushes, underwood, creepers, climbing plants and trailing vines, the whole hung with ferns, mosses, and parasitic growths, and bound together by rattans and huge rope-like trailers. In most places the jungle is so dense that it is impossible to force a way through it without the aid of a wood-knife, and even the wild beasts use well-worn game-tracks through the forest. In the interior brakes of bamboos are found, many of which spread for miles along the river banks. Good hard-wood timber is found in plenty, the best being the *merabau*, *penak*, *rasok* and *chengal*. Orchids of countless varieties abound. The principal fruit trees are the *duri-an*, mangosteen, custard-apple, pomegranate, *rambut-an*, *pulas-an*, *langsat*, *rambai*, jack-fruit, coco-nut, areca-nut, sugar-palm, and banana. Coffee, tobacco, sugar-cane, rice, pepper, gambier, cotton and sago are cultivated with success. Great developments have been made of recent years in the cultivation of rubber in British Malaya. The principal jungle products are gutta and rubber of several varieties, and many kinds of rattan. The mangrove grows on the shores of the west coast in profusion. Agila-wood, the camphor tree, and ebony are also found in smaller quantities.

The fauna of the peninsula is varied and no less profuse than is the vegetable life. The Asiatic elephant; the *seladang*, a bison of a larger type than the Indian gaur; two varieties of rhinoceros; the honey bear (*bruang*), the tapir, the sambhur (*rusa*); the speckled deer (*kijang*), three varieties of mouse-deer (*napoh*, *plandok* and *kanchil*); the gibbon (*ungka* or *wawa'*), the *siamang*, another species of anthropoid ape, the *brok* or coco-nut monkey, so called because it is trained by the Malays to gather the nuts from the coco-nut trees, the *lotong*, *kra*, and at least twenty other kinds of monkey; the *binturong* (*arctictis binturong*), the lemur; the Asiatic tiger, the black panther, the leopard, the large wild cat (*harimau akar*), several varieties of jungle cat; the wild boar, the wild dog; the flying squirrel, the flying fox; the python, the cobra, and many other varieties of snake, including the hamadryad; the alligator, the otter and the gavial, as well as countless kinds of squirrel, rat, &c., are found throughout the jungles of the peninsula in great numbers. On the east coast peafowl are found, and throughout the interior the argus pheasant, the firebacked pheasant, the blue partridge, the adjutant-bird, several kinds of heron and crane, duck, teal, cotton-teal, snipe, wood-pigeon, green-pigeon of several varieties, swifts, swallows pied-robins, hornbills, parakeets, fly-catchers, nightjars, and many other kinds of bird are met with frequently. A few specimens of solitary goose have been procured, but the bird is rarely met with. The forests literally swarm with insects of all kinds, from *cicadae* to beautiful butterflies, and from stick- and leaf-insects to endless varieties of ants. The scorpion and the centipede are both common. The study of the insect life of the peninsula opens a splendid field for scientific research, and the profusion and variety of insects found in these forests probably surpass those to be met with anywhere else in the world.

Political Divisions and Population.—Politically the Malay Peninsula is divided into four sections: the colony of the Straits Settlements and the Federated Malay States; the independent Malay State of Johor, which is within the British sphere of influence; the non-federated states under British protection; and the groups of states to the north of Perak and Pahang which are now recognized as lying within the sphere of influence of Siam. The colony of the Straits Settlements consists of the islands of Singapore, Penang and the Dindings, the territory of Province Wellesley, on the mainland opposite to Penang, the insignificant territory of the Dindings, and the town and territory of Malacca. The Federated Malay States under British protection consist of the sultanates of Perak, Selangor and the Negri Sambilan on the west coast, and the sultanate of Pahang on the east coast. Johor is the only Malay state in the southern portion of the peninsula, the whole of which is within the British sphere, which has been suffered to remain under native rule. The non-federated states under British protection (since 1909) are Kelantan, Trengganu, Kedah and Perlis (Palit). The population of the peninsula numbers about 2,000,000, of whom about 600,000 inhabit the colony of the Straits Settlements, about 900,000 the Federated Malay States, about 200,000 the Malay State of Johor, and about 250,000 to 300,000 the remainder of the peninsula. The population of the peninsula includes about 850,000 Chinese, mostly immigrants or descendants of immigrants from the southern provinces of China, of whom about 300,000 reside in the colony of the Straits Settlements, 365,000 in the Federated Malay States, 150,000 in Johor, and the remainder in smaller communities or as isolated traders scattered throughout the villages and small towns of the peninsula. The Malay population of the peninsula, including immigrants from the eastern archipelago, number some 750,000 to 800,000, while the Tamils and other natives of India number about 100,000, the aboriginal natives of the peninsula perhaps 20,000, Europeans and Americans about 6500, and Eurasians about 9000. The colony of the Straits Settlements, and to a lesser extent the towns of the Federated Malay States, carry a considerable heterogenous population, in which most of the races of Asia find their representatives.

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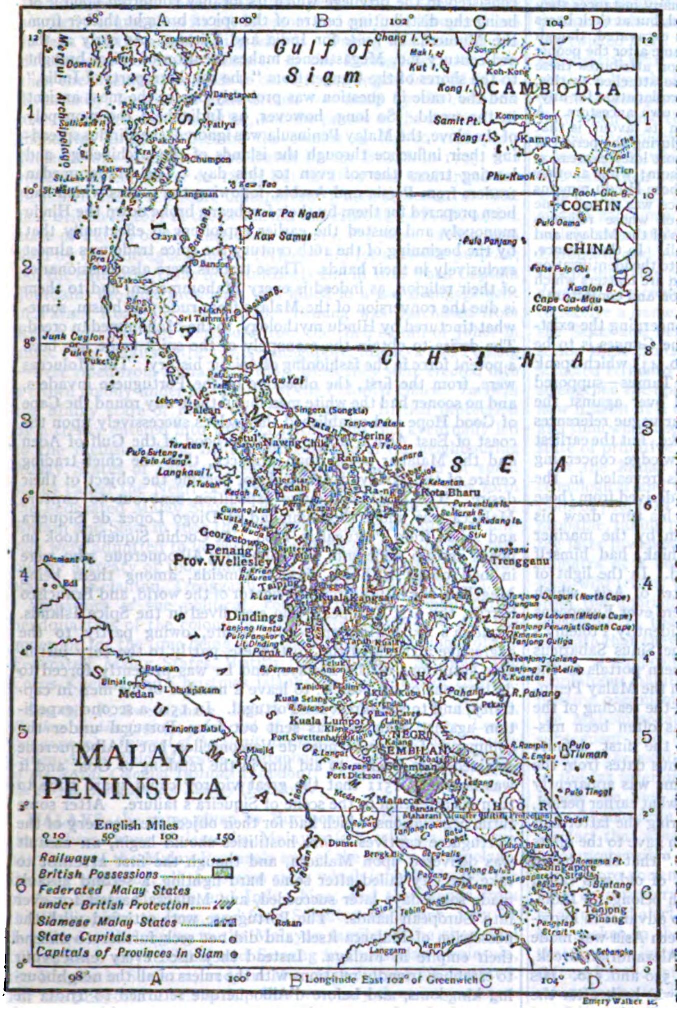
[1] See R. B. Newton, "Notes on Literature bearing upon the Geology of the Malay Peninsula; with an Account of a Neolithic Implement from that Country" (*Geol. Mag.*, 1901, pp. 128–134). See also the various reports by J. B. Scrivenor in *Suppl. Perak Gov. Gazette*, 1905.



Races of the Peninsula.—Excluding the Tai, or Siamese, who are undoubtedly recent intruders from the north, there are three races which for an extended period of time have had their home in the Malay Peninsula. These are the Semang or Pangan, the Sakai or Jakun, and the Malays. The Semang, as they are most usually called by the Malays, are Negritos—a small, very dark people, with features of the negroid type, very prognathous, and with short, woolly hair clinging to the scalp in tiny crisp curls. These people belong to the race which would seem to be the true aboriginal stock of southern Asia. Representatives of it are found scattered about the islands from the Andaman group southwards. The state of civilization to which they have attained is very low. They neither plant nor have they any manufactures except their rude bamboo and rattan vessels, the fish and game traps which they set with much skill, and the bows, blow-pipes and bamboo spears with which they are armed. They are skilful hunters, however, catch fish by ingeniously constructed traps, and live almost entirely on jungle-roots and the produce of their hunting and fishing. The most civilized of these people is found in Upper Perak, and the members of this clan have acquired some knowledge of the art of planting, &c. They cannot, however, be taken as typical of their race, and other specimens of this people are seldom seen even by the Sakai. From time to time they have been raided by the latter, and many Negritos are to be found in captivity in some of the Malayan villages on the eastern side of the peninsula. The mistake of speaking of the Sakai tribes as practically identical with the Semang or Pangan has very frequently been made, but as a matter of fact the two races are absolutely distinct from one another. It has also been customary to include the Sakai in the category of Malayan races, but this too is undoubtedly incorrect. The Sakai still inhabit in greatest numbers the country which forms the interior of Pahang, the Plus and Kinta districts of Perak, and the valley of Nenggiri in Kelantan. Representatives of their race are also found scattered among the Malayan villages throughout the country, and also along the coast, but these have intermixed so much with the Malays, and have acquired so many customs, &c., from their more civilized neighbours, that they can no longer be regarded as typical of the race to which they belong. The pure Sakai in the interior have a good knowledge of planting rice, tapioca, &c., fashion pretty vessels from bamboos, which they decorate with patterns traced by the aid of fire, make loin-cloths (their only garment) from the bark of the *trap* and *ipoh* trees; are very musical, using a rude lute of bamboo, and a nose-flute of a very sweet tone, and singing in chorus very melodiously; and altogether have attained in their primitive state to a higher degree of civilization than have the Semang. They are about as tall as the average Malay, are slimly built, light of colour, and have wavy fine hair. In their own language they usually have only three numerals, viz. *na-nun*, one; *nar*, two; and *ne'*, three, or variants of these; all higher arithmetical ideas being expressed by the word *kerpn*, which means "many." A few cases have been recorded, however, of tribes who can count in their own tongue up to four and five. Among the more civilized, however, the Malay numerals up to ten are adopted by the Sakai. An examination of their language seems to indicate that it belongs to the Mon-Khmer group of languages, and the anthropological information forthcoming concerning the Sakai points to the conclusion that they show a greater affinity to the people of the Mon-Khmer races than to the Malayan stock. Though they now use metal tools imported by the Malays, it is noticeable that the names which they give to those weapons which most closely resemble in character the stone implements found in such numbers all over the peninsula are native names wholly unconnected with their Malay equivalents. On account of this, it has been suggested that in a forgotten past the Sakai were themselves the fashioners of the stone implements, and certain it is that all tools which have no representatives among the stone kelts are known to the Sakai by obvious corruptions of their Malayan names. The presence of the Sakai, a people of the Mon-Khmer stock, in the interior of the peninsula has also been considered as one of many proofs that the Malays intruded from the south and approached the peninsula by means of a sea-route, since had they swept down from the north, being driven thence by the people of a stronger breed, it might be expected that the fringe of country dividing the two contending races would be inhabited by men of the more feeble stock. Instead, we find the Sâkai occupying this position, thus indicating that they have been driven northward by the Malays, and that the latter people has not been expelled by the Mon-Khmer races from the countries now represented by Burma, Siam and French Indo-China. The Sakai population is dying out, and must eventually disappear. (With regard to the Malay, see MALAYS.)

Archaeology.—The only ancient remains found in the peninsula are the stone implements, of which mention has already been made, and some remarkable ancient mines, which are situated in the Jelai valley in Pahang. The stone implements are generally of one or two types: a long rectangular adze or wedge rudely pointed at one end, and used in conjunction with a mallet or flat stone, and a roughly triangular axe-head, which has evidently been fixed in the cleft of a split stick. A few stones, which might perhaps be arrow-heads, have been found, but they are very rare. The mines, which have been constructed for the purpose of working quartz lodes containing gold, are very extensive, and argue a high stage of civilization possessed by the ancient miners. They consist of a number of circular or rectangular pits sunk from the cap of a hill, and going down to a depth of in some cases as much as 120 ft., until in fact the miners have been stopped by being unable to cope with the quantity of water made when the level of the valley was reached. The shafts are placed so close together that in many instances they are divided by only a couple of feet of solid ground, but at their bases a considerable amount of gallery work has been excavated, though it is possible that this was done by miners who came after the people who originally sank the shafts. Native tradition attributes these mines to the Siamese, but no importance can be attached to this, as it is very general for the Malays to give this explanation for anything which is obviously not the work of their own ancestors. A theory, which seems to have some probability in its favour, is that these mines were worked by the Khmer people during the period of power, energy and prosperity which found its most lofty expression in the now ruined and deserted city of Angkor Thom; while another attributes these works to the natives of India whose Hindu remains are found in Java and elsewhere, whose influence was at one time widespread throughout Malayan lands, and of whose religious teaching remnants still linger in the superstitions of the Malays and are preserved in some purity in Lombok and Bali. In the absence, however, of any relics of a kind which might lead to the identification of the ancient miners, their nationality and origin are matters which must continue to be mere questions of speculation and conjecture.

History.—The first hint to reach Europe concerning the existence of habitable lands to the eastward of the Ganges is to be found in the writings of Pomponius Mela (A.D. 43) which speak of Chryse, or the Golden Isle, as lying off Cape Tamus—supposed to be the most easterly point in Asia—and over against the estuary of the Ganges. Thereafter there occur vague references to Chryse in the *Periplus of the Erythrean Sea*, &c., but the earliest trace of anything resembling first-hand knowledge concerning the peninsula of Indo-China and Malaya is revealed in the writings of Ptolemy, whose views were mainly derived from those of his predecessor Marinus of Tyre, who in his turn drew his deductions from information supplied to him by the mariner Alexander who, there is every reason to think, had himself voyaged to the Malay Peninsula and beyond. In the light of present knowledge concerning the trade-routes of Asia, which had been in existence for thousands of years ere ever Europeans attempted to make use of them, it is safe to identify Ptolemy's Sinus Perimulicus with the Gulf of Siam, the Sinus Sabaricus with the Straits of Malacca from their southern portals to the Gulf of Martaban, the Aurea Chersonesus with the Malay Peninsula, and the island of Iabadius or Sabadius—the reading of the name is doubtful—with Sumatra, not as has often been mistakenly attempted with Java. Although the first definite endeavour to locate the Golden Chersonese thus dates from the middle of the 2nd century of our era, the name was apparently well known to the learned of Europe at a somewhat earlier period, and in his *Antiquities of the Jews*, written during the latter half of the 1st century, Josephus says that Solomon gave to the pilots furnished to him by Hiram of Tyre commands "that they should go along with his stewards to the land that of old was called Ophir, but now the Aurea Chersonesus, which belongs to India, to fetch gold." After the time of Ptolemy no advance in knowledge concerning the geography of south-eastern Asia was made until Cosmas Indicopleustes, a monk and an Alexandrian Greek, wrote from personal knowledge between A.D. 530 and 550. His primary object was to prove that the world was built after the same shape and fashion as the Ark made by the Children of Israel in the desert; but he was able to show that the Malay Peninsula had to be rounded and thereafter a course steered in a northerly direction if China was to be reached. Meanwhile inter-Asiatic intercourse by means of sea-routes had been steadily on the increase since the discovery of the way to utilize the monsoons and to sail directly to and fro across the Indian Ocean (attributed to the Greek pilot Hippalus) had been made. After the decline of the power of Rome, the dominant force in Asiatic commerce and navigation was Persia, and from that time onward, until the arrival of the Portuguese upon the scene early in the 16th century the spice trade, whose chief emporia were in or near the Malay Peninsula, was in Persian or Arab hands. There is considerable reason to think, however, that the more frequent ports of call in the Straits of Malacca were situated in Sumatra, rather than on the shores of the Malay Peninsula, and two famous medieval travellers, Marco Polo and Ibn Batuta, both called and wintered at the former, and make scant mention of the latter.

The importance of the Malay Peninsula, as has been noted, consisted in the privilege which its locality conferred upon it of being the distributing centre of the spices brought thither from the Moluccas *en route* for India and Europe. As early as the 3rd century B.C. Megasthenes makes mention of spices brought to the shores of the Ganges from "the southern parts of India," and the trade in question was probably one of the most ancient in the world. So long, however, as India held the monopoly of the clove, the Malay Peninsula was ignored, the Hindus spreading their influence through the islands of the archipelago and leaving traces thereof even to this day. The Mahommedan traders from Persia and Arabia, following the routes which had been prepared for them by their forebears, broke down the Hindu monopoly and ousted the earlier exploiters so effectually that by the beginning of the 16th century the spice trade was almost exclusively in their hands. These traders were also missionaries of their religion, as indeed is every Mahommedan, and to them is due the conversion of the Malays from rude pantheism, somewhat tinctured by Hindu mythology, to the Mahommedan creed. The desire to obtain the monopoly of the spice trade has been a potent force in the fashioning of Asiatic history. The Moluccas were, from the first, the objective of the Portuguese invaders, and no sooner had the white men found their way round the Cape of Good Hope and established themselves successively upon the coast of East Africa, in the neighbourhood of the Gulf of Aden and the Malabar coast, than Malacca, then the chief trading centre of the Malayan Archipelago, became the object of their desire. The first Portuguese expedition sent out to capture Malacca was under the command of Diogo Lopez de Siqueira and sailed from Portugal in 1508. At Cochin Siqueira took on board certain adherents of Alphonso d'Alboquerque who were in bad odour with his rival d'Almeida, among them being Magellan, the future circumnavigator of the world, and Francisco Serrão, the first European who ever lived in the Spice Islands. Siqueira's expedition ended in failure, owing partly to the aggressive attitude of the Portuguese, partly to the very justifiable suspicions of the Malays, and he was presently forced to destroy one of his vessels, to leave a number of his men in captivity, and to sail direct for Portugal. In 1510 a second expedition against Malacca was sent out from Portugal under the command of Diogo Mendez de Vasconcellos, but d'Alboquerque retained it at Cochin to aid him in the retaking of Goa, and it was not until 1511 that the great viceroy could spare time to turn his attention to the scene of Siqueira's failure. After some futile negotiations, which had for their object the recovery of the Portuguese captives before hostilities should begin, an assault was delivered upon Malacca, and though the first attempt to take the city failed after some hard fighting, a second assault made some days later succeeded, and Malacca passed for ever into European hands. The Portuguese were satisfied with the possession of Malacca itself and did not seek further to extend their empire in Malaya. Instead they used every endeavour to establish friendly relations with the rulers of all the neighbouring kingdoms, and before d'Alboquerque returned to India he despatched embassies to China, Siam, and several kingdoms of Sumatra, and sent a small fleet, with orders to assume a highly conciliatory attitude toward all natives, in search of the Moluccas. Very soon the spice trade had become a Portuguese monopoly, and Malacca was the great headquarters of the trade. It should moreover be noted that Magellan's famous expedition had for its object not the barren feat of circumnavigation but the breaking down of this monopoly, without violating the terms of the papal bull which gave to Spain the conquest of the West, to Portugal the possession of the East. In 1528 a French expedition sailed from Dieppe, penetrated as far as Achin in Sumatra, but returned without reaching the Malay Peninsula. It was, however, the first attempt ever made to defy the papal bull. In 1591, three years after the defeat of the Armada, Raymond and Lancaster rounded the Cape, and after cruising off Penang, decided to winter in Achin. They subsequently hid among the Pulau Sambilan near the mouth of the Perak river, and thence captured a large Portuguese vessel which was sailing from Malacca in company with two Burmese ships. In 1595 the first Dutch expedition sailed from the Texel, but it took a more southerly course than its predecessors and confined its operations to Java and the neighbouring islands. During this period Achin developed a determined enmity to the Portuguese, and more than one attempt was made to drive the strangers from Malacca. Eventually, in 1641, a joint attack was made by the Achinese and the Dutch, but the latter, not the people of the sturdy little Sumatran kingdom, became the owners of the coveted port. Malacca was taken from the Dutch by the British in 1795; was restored to the latter in 1818; but in 1824 was exchanged for Benkulen and a few more unimportant places in Sumatra. The first British factory in the peninsula was established in the native state of Patani on the east coast in 1613, the place having been used by the Portuguese in the 16th century for a similar purpose; but the enterprise came to an untimely end in 1620 when Captain Jourdain, the first president, was killed in a naval engagement in Patani Roads by the Dutch. Penang was purchased from Kedah in 1786, and Singapore from the then sultan of Johor in 1819. The Straits Settlements—Singapore, Malacca and Penang—were ruled from India until 1867, when they were erected into a crown colony under the charge of the Colonial Office. In 1874 the Malay state of Perak was placed under British protection by a treaty entered into with its sultan; and this eventually led to the inclusion in a British protectorate of the neighbouring Malay States of Selangor, Sungei Ujong, the cluster of small states called the Negri Sembilan and Pahang, which now form the Federated Malay States. By a treaty made between Great Britain and Siam in 1902 the northern Malay states of the peninsula were admitted to lie within the Siamese sphere of influence, but by a treaty of 1909 Siam ceded her suzerain rights over the states of Kelantan, Trengganu, Kedah and Perlis to Britain.

Singapore is the political, commercial and administrative headquarters of the colony of the Straits Settlements, and the governor for the time being is *ex officio* high commissioner of the Federated Malay States, British North Borneo, Sarawak, the Cocos-Keeling and Christmas Islands, and governor of Labuan.

See Sir F. Swettenham, *British Malaya* (1906); H. Clifford, *Further India* (1904); *Journal of the Malay Archipelago*, Logan (Singapore); *Journal of the Straits Branch of the Royal Asiatic Society* (Singapore); Weld, Maxwell, Swettenham and Clifford in the *Journal of the Royal Colonial Institute* (London); Clifford in the *Journal of the Royal Geographical Society* (London). (H. Cl.)

MALAYS, the name given by Europeans to the people calling themselves *Orang Malayu*, *i.e.* Malayan folk, who are the dominant race of the Malay Peninsula and of the Malay Archipelago. Broadly speaking, all the brown races which inhabit the portion of Asia south of Siam and Indo-China, and the islands from the Philippines to Java, and from Sumatra to Timor, may be described as belonging to the Malayan family, if the aboriginal tribes, such as the Sakai and Semang in the Malay Peninsula, the Bataks in Sumatra, and the Muruts in Borneo, be excepted. For the purposes of this article, however, only those among these races which bear the name of Orang Malayu, speak the Malayan language, and represent the dominant people of the land, can be included under the title of Malays. These people inhabit the whole of the Malayan Peninsula to the borders of lower Siam, the islands in the vicinity of the mainland, the shores of Sumatra and some portions of the interior of that island, Sarawak and Brunei in Borneo, and some parts of Dutch Borneo, Batavia and certain districts in Java, and some of the smaller islands of the archipelago. Though in these lands they have for not less than a thousand years enjoyed the position of the dominant race, they all possess a tradition that they are not indigenous, and that their first rulers "came out of the sea," with a large band of Malayan warriors in their train. In the peninsula especially, where the presence of the Malays is more recent than elsewhere, many traditions exist which point to a comparatively recent occupation of the country. It has been remarked that there is evidence that the Malays had attained to a certain stage of civilization before ever they set foot in Malaya. For instance, the names which they give to certain fruits, such as the *duri-an*, the *rambut-an* and the *pulas-an*, which are indigenous in the Malayan countries, and are not found elsewhere, are all compound words meaning respectively the thorny, the hairy and the twisted fruit. These words are formed by the addition of the substantial affix "*-an*," the use of which is one of the recognized methods by which the Malays turn primitive words into terms of more complex meaning. This may be taken to indicate that when first the Malays became acquainted with the fruits which are indigenous in Malayan lands they already possessed a language in which most primary words were represented, and also that their tongue had attained to a stage of development which provided for the formation of compound words by a system sanctioned by custom and the same linguistic instinct which causes a Malay to-day to form similar compounds from European and other foreign roots. For any aboriginal race inhabiting these countries, such important articles of diet as the *duri-an*, &c., could not fail to be among the first natural objects to receive a name, and thus we find primary terms in use among the Sakai and Semang, the aborigines of the Peninsula, to describe these fruits. The use by the Malays of artificially constructed terms to denote these things may certainly be taken to strengthen the opinion that the Malays arrived in the lands they now inhabit at a comparatively late period in their history, and at a time when they had developed considerably from the original state of primitive man.

In the Malay Peninsula itself there is abundant evidence, ethnological and philological, of at least two distinct immigrations of people of the Malayan stock, the earlier incursions, it is probable, taking place from the eastern archipelago to the south, the later invasion spreading across the Straits of Malacca from Sumatra at a comparatively recent date. The fact that the semi-wild tribes, which are ethnologically Malayan and distinct from the aboriginal Semang and Sakai, are met with almost invariably in the neighbourhood of the coast would seem to indicate that they reached the peninsula by a sea, not by a land route, a supposition which is strengthened by their almost amphibious habits. Many of these tribes have retained their pristine paganism, but many others it is certain have adopted the Mahommedan religion and have been assimilated by the subsequent and stronger wave of Sumatran immigrants. A study of the local dialects to be met with in some of the districts of the far interior, *e.g.* the Tembeling valley in Pahang, whose people are now Mahommedans and in many respects indistinguishable from the ordinary Malays of the peninsula, reveals the fact that words, current in the archipelago to the south but incomprehensible to the average peninsula Malays, by whom these more ancient populations are now completely surrounded, have been preserved as local words, whereas they really belong to an older dialect once spoken widely in the peninsula, as to-day it is spoken in the Malayan islands. This would seem to show that in some instances the earlier Malay immigrants fell or were driven by the later invaders back from the coast and sought refuge in the far interior.

Theories of Origin.

Until recently many eminent scientists held the theory that the Malayan peoples were merely an offspring of the Mongol stock, and that their advance into the lands they now inhabit had taken place from the cradle of the Mongolian race—that is to say, from the north. In the fifth edition of his *Malay Archipelago*, A. R. Wallace notes the resemblance which he traced between the Malays and the Mongolians, and others have recorded similar observations as to the physical appearance of the two races. To-day, however, fuller data are available than when Wallace wrote, and the more generally accepted theory is that the Malayan race is distinct, and came from the south, until it was stayed by the Mongolian races living on the mainland of southern Asia. The cranial measurements of the Malays and an examination of their hair sections seem to bear out the theory that they are distinct from the Mongolian races. Their language, which is neither monosyllabic nor tonic, has nothing in common with that of the Mon-Annam group. It has, moreover, been pointed out that had the Malays been driven southwards by the stronger races of the mainland of Asia, it might be expected that the people inhabiting the country nearest to the border between Siam and Malaya would belong to the Malayan and not to the Mon-Annam or Mon-Khmer stock. As a matter of fact the Sâkai of the interior of the peninsula belong to the latter race. It might also be anticipated, were the theory of a southward immigration to be sustained, that the Malays would be new-comers in the islands of the archipelago, and have their oldest settlements on the Malayan Peninsula. The facts, however, are in exact contradiction to this; and accordingly the theory now most generally held by those who have studied the question is that the Malays form a distinct race, and had their original home in the south. Where this home lay it is not easy to say, but the facts recorded by many writers as to the resemblance between the Polynesian and the Malayan races, and the strong Malayan element found in the languages of the former (see Tregear's *Maori and Comparative Polynesian Dictionary*, London, 1891), have led some students to think that the two races may have had a common origin. John Crawfurd, in the Dissertation to his *Dictionary of the Malay Language*, published in 1840, noted the prevalence of Malayan terms in the Polynesian languages, and attributed the fact to the casting away of ships manned by Malays upon the islands of the Polynesian Archipelago. The appearance of the same Malayan words in localities so widely separated from each other, however, cannot be satisfactorily accounted for by any such explanation, and the theory is now more generally held that the two races are probably allied and may at some remote period of history have shared a common home. It has been suggested that their separation did not take place until after the continent which once existed in the north Pacific had become submerged, and that the Malays wandered northward, while the Polynesian race spread itself over the islands of the southern archipelago. All this, however, must necessarily be of the nature of the purest speculation, and the only facts which we are able to deduce in the present state of our knowledge of the subject may be summed up as follows: (*a*) That the Malays ethnologically belong to a race which is allied to the Polynesians; (*b*) that the theory formerly current to the effect that the Sakai and other similar races of the peninsula and archipelago belonged to the Malayan stock cannot be maintained, since recent investigations tend to identify them with the Mon-Annam or Mon-Khmer family of races; (*c*) that the Malays are, comparatively speaking, new-comers in the lands which they now inhabit; (*d*) that it is almost certain that their emigration took place from the south; (*e*) and that, at some remote period of their history, they came into close contact with the Polynesian race, probably before its dispersion over the extensive area which it now occupies.

Religion and Superstitions.

The Malays to-day are Sunni Mahommedans of the school of Shafi'i, and they habitually use the terms *Orang Malayu*, *i.e.* a Malay, and *Orang Islam*, *i.e.* a Mahommedan, as synonymous expressions. Their conversion from paganism took place during the 13th, 14th and 15th centuries of our era. The raja of Achin, in northern Sumatra, is said to have been converted as early as 1206, while the Bugis people in Celebes are supposed not to have become Mahommedans until 1495. Mahommedanism undoubtedly spread to the Malays of the peninsula from Sumatra, but their conversion was slow and gradual, and may even now in some respects be regarded as imperfect. Upon the bulk of the Malayan peoples their religion sits but lightly. Few are found to observe the law concerning the Five Hours of Prayer, and many fail to put in an appearance at the Friday congregational services in the mosques. The Fast of Ramadhân, however, is generally observed with some faithfulness. Compared with other Mahommedan peoples, the Malays are not fanatical, though occasionally an outbreak against those of a different creed is glorified by them into a holy war. The reason of such outbreaks, however, is usually to be found in political and social rather than in religious grievances. Prior to their conversion to Mahommedanism the Malays were subjected to a considerable Hindu influence, which reached them by means of the traders who visited the archipelago from India. In the islands of Bali and Lombok the people still profess a form of Hinduism, and Hindu remains are to be found in many other parts of the archipelago, though their traces do not extend to the peninsula. Throughout, however, the superstitions of the Malays show indications of this Hindu influence, and many of the demons whom their medicine-men invoke in their magic practices are clearly borrowed from the pantheon of India. For the rest, a substratum of superstitious beliefs, which survives from the days when the Malays professed only their natural religion, is to be found firmly rooted in the minds of the people, and the influence of Mahommedanism, which regards such things with horror, has been powerless to eradicate this. Mr W. W. Skeat's *Malay Magic* (London, 1900) is a compilation of all the writings on the subject of Malay superstitions by the best authorities and contains considerable original matter.

Mode of Life, &c.

The Malays of the coast are a maritime people, and were long famous for the daring character of their acts of piracy. They are now peaceable fisher-folk, who show considerable ingenuity in their calling. Inland the Malays live by preference on the banks of rivers, building houses on piles some feet from the ground, and planting groves of coco-nut, betel-nut, sugar-palm and fruit-trees around their dwellings. Behind their villages the rice-fields usually spread, and rice, which is the staple food of the people, is the principal article of agriculture among them. Sugar-cane, maize, tapioca and other similar products are grown, however, in smaller quantities. In planting rice three methods are in use: the cultivation of swamp-rice in irrigated fields; the planting of ploughed areas; and the planting of hill-rice by sowing each grain separately in holes bored for the purpose. In the irrigated fields the rice plants are first grown in nurseries, and are subsequently transplanted when they have reached a certain stage of development. The Malays also work jungle produce, of which the most important are gutta, rattans, agila wood, camphor wood, and the beautiful *kamuning* wood which is used by the natives for the hilts of their weapons. The principal manufactures of the Malays are cotton and silk cloths, earthenware and silver vessels, mats and native weapons. The best cotton cloths are those manufactured by the Bugis people in Celebes, and the *batek* cloths which come from Java and are stamped with patterns. The best silks are produced by the natives of Pahang, Kĕlantan and Johor in the Malay Peninsula. Lord Leighton pronounced the silver ware from Malaya to be the most artistic of any exhibited at the Colonial Exhibition held in London in 1886. The pottery of the Malays is rude but curious. When the first Europeans visited the Malay Archipelago the Malays had already acquired the art of manufacturing gunpowder and forging canon. The art of writing also appears to have been independently invented by the Malayan races, since numerous alphabets are in use among the peoples of the archipelago, although for the writing of Malay itself the Arabic character has been adopted for some hundreds of years. The Malays are excellent boat-builders.

Character, &c.

While the Malays were famous almost exclusively for their piratical expeditions they naturally bore an evil reputation among Europeans, but now that we have come into closer contact with them, and have learned to understand them better, the old opinions concerning them have been greatly modified. They used to be described as the most cruel and treacherous people in the world, and they certainly are callous of the pain suffered by others, and regard any strategy of which their enemies are the victims with open admiration. In ordinary circumstances, however, the Malay is not treacherous, and there are many instances recorded in which men of this race have risked their own lives on behalf of Europeans who chanced to be their friends. As a race they are exceedingly courteous and self-respecting. Their own code of manners is minute and strict, and they observe its provisions faithfully. Unlike many Orientals, the Malays can be treated with a friendly familiarity without such treatment breeding lack of respect or leading to liberties being taken with the superior. The Malays are indolent, pleasure-loving, improvident beyond belief, fond of bright clothing, of comfort, of ease, and they dislike toil exceedingly. They have no idea of the value of money, and little notion of honesty where money is concerned. They would always borrow rather than earn money, and they feel no shame in adopting the former course. They will frequently refuse to work for a wage when they most stand in need of cash, and yet at the invitation of one who is their friend they will toil unremittingly without any thought of reward. They are much addicted to gambling, and formerly were much given to fighting, though they never display that passion for war in the abstract which is characteristic of some of the white races, and their courage on the whole is not high if judged by European standards. It is notorious, however, on the coasts that a Malay gang on board a ship invariably gets the better of any fight which may arise between it and the Chinese crew. The sexual morality of the Malays is very lax, but prostitution is not common in consequence. Polygamy, though allowed by their religion, is practised for the most part among the wealthy classes only. The Malays are an intensely aristocratic people, and show a marvellous loyalty to their rajas and chiefs. Their respect for rank is not marred by any vulgarity or snobbery. The ruling classes among them display all the vices of the lower classes, and few of the virtues except that of courtesy. They are for the most part, when left to their own resources, cruel, unjust, selfish and improvident.

Much has been written concerning the acts of homicidal mania called amuck (*amok*), which word in the vernacular means to attack. It was formerly believed that these outbursts were to be attributed to madness *pur et simple*, and some cases of *amok* can certainly be traced to this source. These are not, however, in any sense typical, and might equally have been perpetrated by men of another race. The typical *amok* is usually the result of circumstances which render a Malay desperate. The motive is often inadequate from the point of view of a European, but to the Malay it is sufficient to make him weary of life and anxious to court death. Briefly, where a man of another race might not improbably commit suicide, a Malay runs *amok*, killing all whom he may meet until he himself is slain.

The nervous affliction called *latah*, to which many Malays are subject, is also a curious trait of the people. The victims of this affliction lose for the time all self-control and all sense of their own identity, imitating the actions of any person who chances to rivet their attention. Accounts of these manifestations will be found in Swettenham's *Malay Sketches* (London, 1895) and Clifford's *Studies in Brown Humanity* (London, 1897).

Costume, Weapons, &c.

The Malays wear a loose coat and trousers, and a cap or head-kerchief, but the characteristic item of their costume is the *sarong*, a silk or cotton cloth about two yards long by a yard and a quarter wide, the ends of which are sewn together, forming a kind of skirt. This is worn round the waist folded in a knot, the women allowing it to fall to the ankle, the men, when properly dressed in accordance with ancient custom, folding it over the hilt of their waist-weapon, and draping it around them so that it reaches nearly to the knee. In the hall of a raja on state occasions a head-kerchief twisted into a peak is worn, and the coat is furnished with a high collar extending round the back of the neck only. This coat is open in front, leaving the chest bare. The trousers are short and of a peculiar cut and material, being coloured many hues in parallel horizontal lines. The *sarong* is of Celebes manufacture and made of cotton, to the surface of which a high polish is imparted by friction with a shell. The typical fighting costume of the Malay is a sleeveless jacket with texts from the Koran written upon it, short tight drawers reaching to the middle of the thigh, and the *sarong* is then bound tightly around the waist, leaving the hilt of the dagger worn in the girdle exposed to view. The principal weapon of the Malays is the *kris*, a short dagger with a small wooden or ivory handle, of which there are many varieties. The blade of a *kris* may either be wavy or straight, but if wavy the number of waves must always be uneven in number. The *kris* most prized by the Malays are those of Bugis (Celebes) manufacture, and of these the kind called *tuasek* are of the greatest value. Besides the short *kris*, the Malays use long straight *kris* with very narrow blades, shorter straight *kris* of the same form, short broad swords called *sundang*, long swords of ordinary pattern called *pedang*, somewhat shorter swords curved like scimitars with curiously carved handles called *chenangkas*, and short stabbing daggers called *tumbok lada*. The principal tools of the Malays are the *parang* or *gōlok*, a heavy knife used in the jungle, without which no peasant ever stirs abroad from his house, the *beliong* or native axe, and the *pisau raut*, which is used for scraping rattan. Their implements are very primitive, consisting of a plough fashioned from a fork of a tree, and a rude harrow. Reaping is usually performed by the aid of a curious little knife which severs each ear of grain separately. The fisherfolk use many kinds of nets, which they manufacture themselves. Sails, paddles, oars and punting-poles are all in use.

MALAY LANGUAGE AND LITERATURE

The Malay language is a member of the Malayan section of the Malayo-Polynesian class of languages, but it is by no means a representative type of the section which has taken its name from it. The area over which it is spoken comprises the peninsula of Malacca with the adjacent islands (the Rhio-Lingga Archipelago), the greater part of the coast districts of Sumatra and Borneo, the seaports of Java, the Sunda and Banda Islands. It is the general medium of communication throughout the archipelago from Sumatra to the Philippine Islands, and it was so upwards of three hundred and fifty years ago when the Portuguese first appeared in those parts.

There are no Malay manuscripts extant, no monumental records with inscriptions in Malay, dating from before the spreading of Islam in the archipelago, about the end of the 13th century. By some it has been argued from this fact that the Malays possessed no kind of writing prior to the introduction of the Arabic alphabet (W. Robinson, J. J. de Hollander); whereas others have maintained, with greater show of probability, that the Malays were in possession of an ancient alphabet, and that it was the same as the Rechang (Marsden, Friederich), as the Kawi (Van der Tuuk), or most like the Lampong (Kern)—all of which alphabets, with the Battak, Bugi and Macassar, are ultimately traceable to the ancient Cambojan characters. With the Mahommedan conquest the Perso-Arabic alphabet was introduced among the Malays; it has continued ever since to be in use for literary, religious and business purposes. Where Javanese is the principal language, Malay is sometimes found written with Javanese characters; and in Palembang, in the Mĕnangkabo country of Middle Sumatra, the Rechang or Renchong characters are in general use, so called from the sharp and pointed knife with which they are cut on the smooth side of bamboo staves. It is only since the Dutch have established their supremacy in the archipelago that the Roman character has come to be largely used in writing and printing Malay. This is also the case in the Straits Settlements.

By the simplicity of its phonetic elements, the regularity of its grammatical structure, and the copiousness of its nautical vocabulary, the Malay language is singularly well fitted to be the *lingua franca* throughout the Indian archipelago. It possesses the five vowels *a, i, u, e, o*, both short and long, and one pure diphthong, *au*. Its consonants are *k, g, ng, ch, j, ñ, t, d, n, p, b, m, y, r, l, w, s, h*. Long vowels can only occur in open syllables. The only possible consonantal nexus in purely Malay words is that of a nasal and mute, a liquid and mute and vice versa, and a liquid and nasal. Final *k* and *h* are all but suppressed in the utterance. Purely Arabic letters are only used in Arabic words, a great number of which have been received into the Malay vocabulary. But the Arabic character is even less suited to Malay than to the other Eastern languages on which it has been foisted. As the short vowels are not marked, one would, in seeing, *e.g.* the word *bntng*, think first of *bintang*, a star; but the word might also mean a large scar, to throw down, to spread, rigid, mutilated, enceinte, a kind of cucumber, a redoubt. according as it is pronounced, *bantang, banting, bentang, buntang, buntung, bunting, bonteng, benteng*.

Malay is essentially, with few exceptions, a dissyllabic language, and the syllabic accent rests on the penultimate unless that syllable is open and short; *e.g.* dātang, namā́ña, bĕsár, diumpatkannā́lah. Nothing in the form of a root word indicates the grammatical category to which it belongs; thus, *kāsih*, kindness, affectionate, to love; *ganti*, a proxy, to exchange, instead of. It is only in derivative words that this vagueness is avoided. Derivation is effected by infixes, prefixes, affixes and reduplication. Infixes occur more rarely in Malay than in the cognate tongues. Examples are—*gūruh*, a rumbling noise, *gumūruh*, to make such a noise; *tunjuḳ*, to point, *telunjuḳ*, the forefinger; *chūchuk*, to pierce, *cherūchuḳ*, a stockade. The import of the prefixes—mĕ (mĕng, mĕñ, mĕn, mĕm), pĕ (pĕng, pĕñ, pĕn, pĕm), bĕr (bĕl), pĕr, pĕl, ka, di, tĕr,—and affixes—an, kan, i, lah—will best appear from the following examples —root word *ājar*, to teach, to learn; *mĕngājar*, to instruct (expresses an action); *bĕlājar*, to study (state or condition); *mĕngajāri*, to instruct (some one, trans.); *mĕngājarkan*, to instruct (in something, causative); *pĕngājar*, the instructor; *pĕlājar*, the learner; *pĕngajāran*, the lesson taught, also the school; *pĕlajāran*, the lesson learnt; *diājar*, to be learnt; *tĕrājar*, learnt; *tĕrājarkan*, taught; *tĕrajāri*, instructed; [*pĕrāja* (from *rāja*, prince), to recognize as prince; *pĕrajākan*, to crown as prince; *karajāan*, royalty]; *ājarkanlah*, teach! Examples of reduplication are—*ājar-ājar*, a sainted person; *ājar-bĕrājar* (or *bĕlājar*), to be learning and teaching by turns; similarly there are forms like *ājar-mĕngājar, bĕrājār-ajāran, ājar-ajāri, mĕmpĕrājar, mĕmpĕrājarkan, mĕmpĕrajāri, tĕrbĕlājarkan, pĕrbĕlājarkan*, &c. Altogether there are upwards of a hundred possible derivative forms, in the idiomatic use of which the Malays exhibit much skill. See especially H. von Dewall, *De vormveranderingen der Maleische taal* (Batavia, 1864) and J. Pijnappel, *Maleisch-Hollandsch Woordenboek* (Amsterdam, 1875), "Inleiding." In every other respect the language is characterized by great simplicity and indefiniteness. There is no inflexion to distinguish number, gender or case. Number is never indicated when the sense is obvious or can be gathered from the context; otherwise plurality is expressed by adjectives such as *sagāla*, all, and *bāñak*, many; more rarely by the repetition of the noun, and the indefinite singular by *sa* or *sātu*, one, with a class-word. Gender may, if necessary, be distinguished by the words *laki-lāki*, male, and *pĕrampūan*, female, in the case of persons, and of *jantan* and *bĕtīna* in the case of animals. The genitive case is generally indicated by the position of the word after its governing noun. Also adjectives and demonstrative pronouns have their places after the noun. Comparison is effected by the use of particles. Instead of the personal pronouns, both in their full and abbreviated forms, conventional nouns are in frequent use to indicate the social position or relation of the respective interlocutors, as, *e.g. hamba tuan*, the master's slave, *i.e.* I. These nouns vary according to the different localities. Another peculiarity of Malay (and likewise of Chinese, Shan, Talaing, Burmese and Siamese) is the use of certain class-words or coefficients with numerals, such as *orang* (man), when speaking of persons, *ekor* (tail) of animals, *kĕping* (piece) of flat things, *bīji* (seed) of roundish things; *e.g. līma bīji, tĕlor*, five eggs. The number of these class-words is considerable. Malay verbs have neither person or number nor mood or tense. The last two are sometimes indicated by particles or auxiliary verbs; but these are generally dispensed with if the meaning is sufficiently plain without them. The Malays avoid the building up of long sentences. The two main rules by which the order of the words in a sentence is regulated are—subject, verb, object; and qualifying words follow those which they qualify. This is quite the reverse of what is the rule in Burmese.

The history of the Malays amply accounts for the number and variety of foreign ingredients in their language. Hindus appear to have settled in Sumatra and Java as early as the 4th century of our era, and to have continued to exercise sway over the native populations for many centuries. These received from them into their language a very large number of Sanskrit terms, from which we can infer the nature of the civilizing influence imparted by the Hindu rulers. Not only in words concerning commerce and agriculture, but also in terms connected with social, religious and administrative matters that influence is traceable in Malay. See W. E. Maxwell, *Manual of the Malay Language* (1882), pp. 5–34, where this subject is treated more fully than by previous writers. This Sanskrit element forms such an integral part of the Malay vocabulary that in spite of the subsequent infusion of Arabic and Persian words adopted in the usual course of Mahommedan conquest it has retained its ancient citizenship in the language. The number of Portuguese, English, Dutch and Chinese words in Malay is not considerable; their presence is easily accounted for by political or commercial contact.

The Malay language abounds in idiomatic expressions, which constitute the chief difficulty in its acquisition. It is sparing in the use of personal pronouns, and prefers impersonal and elliptical diction. As it is rich in specific expressions for the various aspects of certain ideas, it is requisite to employ always the most appropriate term suited to the particular aspect. In Maxwell's *Manual*, pp. 120 seq., no less than sixteen terms are given to express the different kinds of striking, as many for the different kinds of speaking, eighteen for the various modes of carrying, &c. An unnecessary distinction has been made between *High Malay* and *Low Malay*. The latter is no separate dialect at all, but a mere brogue or jargon, the medium of intercourse between illiterate natives and Europeans too indolent to apply themselves to the acquisition of the language of the people; its vocabulary is made up of Malay words, with a conventional admixture of words from other languages; and it varies, not only in different localities, but also in proportion to the individual speaker's acquaintance with Malay proper. A few words are used, however, only in speaking with persons of royal rank—*e.g. santap*, to eat (of a raja) instead of *mākan*; *bĕrādu*, to sleep, instead of *tidor*; *gring*, unwell, instead of *sākit*; *mangkat*, to die, instead of *māti*, &c. The use is different as regards the term *Jāwi* as applied to the Malay language. This has its origin in the names Great Java and Lesser Java, by which the medieval Java and Sumatra were called, and it accordingly means the language spoken along the coasts of the two great islands.

Literature.

The Malays cannot, strictly speaking, be said to possess a literature, for none of their writings can boast any literary beauty or value. Their most characteristic literature is to be found, not in their writings, but in the folk-tales which are transmitted orally from generation to generation, and repeated by the wandering minstrels called by the people *Pĕng-lipor Lāra*, *i.e.* "Soothers of Care." Some specimens of these are to be found in the *Journal of the Straits Branch of the Asiatic Society* (Singapore). The collections of *Malay Proberbs* made by Klinkert, Maxwell and Clifford also give a good idea of the literary methods of the Malays. Their verse is of a very primitive description, and is chiefly used for purposes of love-making. There are numerous rhymed fairy tales, which are much liked by the people, but they are of no literary merit. The best Malay books are the *Hikāyat Hang Tūak*, *Bĕstāmam* and the *Hikāyat Abdullah*. The latter is a diary of events kept during Sir Stâmford Raffle's administration by his Malay scribe.

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MALAY STATES (BRITISH). The native states of the Malay Peninsula under British protection are divided into two groups: (1) federated, and (2) non-federated.

I.—FEDERATED STATES

The federated states, under the protection of Great Britain, but not British possessions, are Perak, Selangor and the confederation of small states known as the Negri Sembilan (*i.e.* Nine States) on the west coast, and the state of Pahang on the east coast. Each state is under the rule of a sultan, who is assisted in his legislative duties by a state council, upon which the resident, and in some cases the secretary to the resident, has a seat, and which is composed of native chiefs and one or more Chinese members nominated by the sultan with the advice and consent of the resident. The council, in addition to legislative and other duties, revises all sentences of capital punishment. The administrative work of each state is carried on by the resident and his staff of European officials, whose ranks are recruited by successful candidates in the competitive examinations held annually by the Civil Service commissioners. The sultan of each state is bound by treaty with the British government to accept the advice of the resident, who is thus practically paramount; but great deference is paid to the opinions and wishes of the sultans and their chiefs, and the British officials are pledged not to interfere with the religious affairs of the Mahommedan community. In the actual administration of the Malay population great use is made of the native aristocratic system, the peasants being governed largely by their own chiefs, headmen and village elders, under the close supervision of British district officers. The result is a benevolent autocracy admirably adapted to local conditions and to the character and traditions of the people. A recognition of the fact that the welfare of the Malays, who are the people of the land and whose sultans have never ceded their territories to the British, must be regarded as the first consideration has been the guiding principle of the administration of the Malay States, and this has resulted in an extraordinary amelioration of the condition of the natives, which has proceeded concurrently with a notable development of the country and its resources, mineral and agricultural. To the work of development, however, the Malays have themselves contributed little, sound administration having been secured by the British officials, enterprise and capital having been supplied mainly by the Chinese, and the labour employed being almost entirely Chinese or Tamil. Meanwhile the Malays have improved their ancestral holdings, have enjoyed a peace and a security to which their past history furnishes no parallel, have obtained easy access to new and important markets for their agricultural produce, and for the rest have been suffered to lead the lives best suited to their characters and their desires. Each principal department of the administration has its federal head, and all the residents correspond with and are controlled by the resident-general, who, in his turn, is responsible to the high commissioner, the governor of the Straits Settlements for the time being.

The estimated aggregate area of the Federated Malay States is 28,000 sq. m., and the estimated population in 1905 was 860,000, as against 678,595 in 1901. Of these only about 230,000 are Malays. The revenue of the federation in 1905 was $23,964,593 (about (£2,795,000), and the expenditure was $20,750,395 (about £2,460,000). The imports for the same year were valued at $50,575,455 (about £5,900,000), and the exports at $80,057,654 (about £9,340,000), making a total trade of nearly 15¼ millions sterling. The principal sources of revenue are an export duty on tin, the rents paid for the revenue farms of the right to collect import duties on opium, wine and spirits, and to keep licensed gambling-houses for the exclusive use of the Chinese population, railway receipts, land and forest revenue and postal revenue. The tin is won from large alluvial deposits found in the states of the western seaboard, and the mines are worked almost exclusively by Chinese capital and labour. Since 1889 the Federated Malay States have produced considerably more than half the tin of the world. Recently there has been a great development in agricultural enterprise, especially with regard to rubber, which is now grown in large quantities, the estates being mainly in the hands of Europeans, and the labour mostly Tamil. The states are opened up by over 2500 m. of some of the best metalled cart-roads in the world, and by a railway system, 350 m. of which, extending from the mainland opposite Penang to the ancient town of Malacca, are open to traffic. Another 150 m. of railway is under construction. The government offices at Kuala Lumpor, the federal capital of the states, are among the finest buildings of the kind in Asia. The whole of this extraordinary development, it should be noted, has been effected by careful, sound and wise administration coupled with a courageous and energetic policy of expenditure upon public works. Throughout, not one penny of debt has been incurred, the roads, railways, &c., being constructed entirely from current balances. This of course has only been rendered possible by the extraordinary mineral wealth which the states on the western seaboard have developed in the hands of Chinese miners amid the peace and security which British rule has brought to these once lawless lands. The value of the tin output for the year 1905 amounted to $69,460,993 (£8,104,199). Although agricultural enterprise in the Malay States is assuming considerable proportions and a growing importance, the total value of the principal agricultural products, including timber, for the year 1905 only aggregated $2,435,513 (£289,143).

The whole of the Malay Peninsula is one vast forest, through which flow countless streams that form one of the most lavish water-systems in the world. The rivers, though many of them are of imposing appearance and of considerable length, are uniformly shallow, only a few on the west coast being navigable by ships for a distance of some 40 m. from their mouths. In spite of the notable development above referred to, only a very small fraction of the entire area of the states has as yet been touched either by mining or agricultural enterprise. It is not too much to assert that the larger half of the forest-lands has never been trodden by the foot of man. (For information concerning the botany, geology, &c., of the Malay States see MALAY PENINSULA. For the ethnology see MALAYS.)

PERAK is situated between the parallels 3° 37′ and 6° 5′ N. and 100° 3′ to 101° 51′ E. on the western side of the Malay Peninsula. It is bounded on the N. by the British possession of Province Wellesley and the Malay state of Kedah; on the S. by the protected native state of Selangor; on the E. by the protected native state of Pahang and the independent states of Kelantan and Petani; and on the W. by the Straits of Malacca. The coast-line is about 90 m. in length. The extreme distance from the most northerly to the most southerly portions of the state is about 172 m., and the greatest breadth from east to west is about 100 m. The total area of the country is estimated at about 10,000 sq. m.

The Perak river, which runs in a southerly direction almost parallel with the coast for nearly 150 m. of its course, is navigable for small steamers for about 40 m. from its mouth, and by native trading boats for nearly 200 m. The Plus, Batang, Padang and Kinta rivers are its principal tributaries, all of them falling into the Perak on its left bank. The other principal rivers of the state are the Krian, Kurau, Larut and Bruas to the north of the mouth of the Perak, and the Bernam to the south. None of these rivers is of any great importance as a waterway, although the Bernam River is navigable for small steamers for nearly 100 m. of its course. The mountain ranges, which cover a considerable area, run from the north-east to the south-west. The highest altitudes attained by them do not exceed 7500 ft., but they average about 2500 ft. They are all thickly covered with jungle. The ranges are two, running parallel to one another, with the valley of the Perak between them. The larger is a portion of the main chain, which runs down the peninsula from north to south. The lesser is situated in the district of Larut. There are several hill sanatoria in the state at heights which vary from 2500 to 4700 ft. above sea-level, but the extreme humidity of the atmosphere renders the coolness thus obtainable the reverse of enjoyable.

Geology.

Mr Leonard Wray, curator of the Perak museum, writes as follows on the subject of the geological formation of the state: "There are really only four formations represented—firstly, the granitic rocks; secondly, a large series of beds of gneiss, quartzite, schist and sandstone, overlaid in many places by thick beds of crystalline limestone; thirdly, small sheets of trap rock; and fourthly, river-gravels and other Quaternary deposits. The granites are of many varieties, and also, in all probability, of several different geological periods. The series of quartzites, schists, and limestone are of great age, but as no fossils have ever been found in any of them, nothing definite can be stated as to their exact chronological position. Their lithological characteristics and the total absence of all organic remains point to the Archaean period. The failure to discover signs of life in them is, of course, merely negative evidence, and the finding of a single fossil would at once upset it. However, until this happens they may be conveniently classed as Laurentian. It is at present impossible to form anything approaching an accurate estimate of the thickness of this extensive series, but it is probable that it is somewhere between 4000 and 5000 ft. Unconformability has been noticed between the limestones and the beds beneath, but whether this is sufficient to separate them or not is a matter for future investigation. . . . The taller hills are exclusively composed of granite, as also are some of the lower ones. . . . The ores of the following metals have been found in the formations named: Granite—tin, lead, iron, arsenic, tungsten and titanium; Laurentian—tin, gold, lead, silver, iron, arsenic, copper, zinc, tungsten, manganese and bismuth; Quaternary—tin, gold, copper, tungsten, iron and titanium. This is not to be considered a complete list, as small quantities of other metals have also been found."

History.

The early history of Perak is obscure, the only information on the subject being obtained from native traditions, which are altogether untrustworthy. According to these authorities, however, a settlement was first made by Malays in Perak at Bruas, and the capital was later moved to the banks of the Perak River, the site chosen being a little village called Temong, which lies some miles up stream from Kuala Kangsar, the present residence of the sultan. When the Malacca sultanate fell, owing to the invasion of the Portuguese in 1511, a member of that royal house is said to have migrated to Perak, and the present dynasty claims to have been descended from him. As this boast is also made by almost every ruling family in the peninsula, the tradition is not worthy of any special attention. What is more certain is the tradition that Perak was twice invaded by the Achinese, and its rulers carried off into captivity, one of them, Sultan Mansur Shah, subsequently becoming the ruler of Achin. The first European settlement in Perak was made by the Dutch in 1650, under a treaty entered into with the Achinese, but the natives of the country rose against the Dutch again and again, and it was abandoned in 1783, though it was afterwards reoccupied, the Dutch being finally ejected by the British in 1795. In 1818 the Siamese conquered Perak, but its independence was secured by a treaty between the British and Siamese governments in 1824. From that date until 1874 Perak was ruled by its own sultans, but in that year, owing to internal strife, Sultan Abdullah applied to the then governor of the Straits Settlements, Sir Andrew Clarke, for the assistance of a British Resident. The treaty of Pangkor was concluded on the 20th of January 1874, and the first resident, Mr J. W. W. Birch, was murdered on the 2nd of November 1875. A punitive expedition became necessary; sultan Abdullah and the other chiefs concerned in the murder were banished, the actual murderers were hanged, and Raja Muda Jusuf was declared regent. He died in 1888, and was succeeded by the sultan Raja Idris, K.C.M.G., a most enlightened ruler, who was from the first a strong and intelligent advocate of British methods of administration. Sir Hugh Low was appointed resident, a position which he held until 1889, when he was succeeded by Sir Frank Swettenham. Since then the history of Perak has been one of continuous peace and growing prosperity and wealth. Although the federal capital is Kuala Lumpor in Selangor, Perak still enjoys the honour of being the senior and leading state of the federation.

Population.

By the census taken on the 5th of April 1891 the population of Perak was shown to be as follows: Europeans, 366; Eurasians, Jews and Armenians, 293; Malays, 96,719; Chinese, 94,345; Tamils, 13,086; aborigines, 5779; other nationalities, 3666; thus making a grand total of 214,254, of whom 156,408 were males and 57,846 were females. The estimated population in 1905 was 400,000, of whom 200,000 were Chinese and 160,000 were Malays, but owing to the disparity of the proportions between the sexes the deaths in each year largely outnumber the births, and the increase in the population is accounted for solely by the number of immigrants, chiefly from the mainland of China, and to a lesser extent from India also.

The revenue of Perak in 1874 amounted to $226,333. That for 1905 amounted to $12,242,897. Of this latter sum $4,876,400 was derived from duty on exported tin, $2,489,300 from railway receipts, $505,300 from land revenue and $142,800 from postal and telegraphic revenue. The remainder is mainly derived from the revenue farms, which are leased to Chinese capitalists for a short term of years, conveying to the lessee the right to collect import duties upon opium, wine and spirits, to keep pawnbroking shops, and to keep public licensed gambling-houses for the use of Chinese only. The expenditure for 1905 amounted to $10,141,980. Of this sum $4,236,000 was expended upon railway upkeep and construction and $2,176,100 upon public works. The value of the imports into Perak during 1905 was over $20,000,000, and that of the exports exceeded $40,000,000, making a total of over $60,000,000, equivalent to about seven million sterling. The output of tin from Perak ranged between 18,960 tons, valued at $23,099,506 in 1899, and 26,600 tons, valued at $35,500,000, in 1905. The fluctuating character of the output is due, not to any exhaustion of the mineral deposits of the state—that is not to be anticipated for many years yet to come—but to the uncertainty of the labour supply. The mining population is recruited exclusively from the districts of southern China, and during certain years an increased demand for labourers in China itself, in French Indo-China, in the Dutch colonies, and in South Africa temporarily and adversely affected immigration to the Straits of Malacca. The output has, moreover, been affected from time to time by the price of tin, which was $32.20 per pikul in 1896, rose to $42.96 in 1898, to $74.15 in 1900, and averaged $80.60 in 1905. Exclusive of tin, the principal exports were $108,000 worth of Para rubber, $181,000 of copra, $54,000 of hides, $48,000 of patchouli, and considerable quantities of timber, rattans and other jungle produce. The agricultural development of the state is still in its infancy, but rubber is cultivated in rapidly increasing areas, and the known fertility of the soil, the steady and regular rainfall, the excellent means of communication, and the natural and artificial conditions of the country, justify the expectation that the future of Perak as an agricultural country will be prosperous.

Although so much has been done to develop the resources of Perak, by far the greater portion of the state is still covered by dense and virgin forest. In 1898 it was calculated that only 330,249 acres of land were occupied or cultivated out of a total acreage of 6,400,000.

General.

The area of agricultural holdings has notably increased, but a considerable period must yet elapse before it will amount to even one-tenth of the whole. A line of railway connects the port of Teluk Anson with the great mining district of Kinta, whence the line runs crossing the Perak River at Enggor, to Kuala Kangsar, the residence of the sultan, thence to Taiping, the administrative capital of the state, and via Krian to a point opposite to the island of Penang. A second line runs south from Perak and connects with the railway system of Selangor, which in its turn connects with the Negri Sembilan and Malacca line, thus giving through railway communication between the last-named town and Penang. Perak also possesses some 600 miles of excellent metalled cart-road, and the length of completed road is annually increasing.

For administrative purposes the state is divided into six districts: Upper Perak, Kuala Kangsar and Lower Perak, on the Perak River; Kinta; Batany Padang and Larut and Krian. Of these, Larut and Kinta are the principal mining centres, while Krian is the most prosperous agricultural district. The districts on the Perak River are mostly peopled by Malays. The administrative capital is Taiping, the chief town of Larut. Kuala Kangsar is chiefly memorable as having been the scene of the first federal meeting of native chiefs, who, with the British Residents from each state, met together in 1897 for friendly discussion of their common interests for the first time in history, under the auspices of the high commissioner, Sir Charles H. B. Mitchell. This, in the eyes of those who are acquainted with the character of the Malays and of the relations which formerly subsisted between the rulers of the various states, is perhaps the most signal token of the changes which British influence has wrought in the peninsula.

Selangor is situated between the parallels 2° 32′ and 3° 37′ N. and 100° 38′ and 102° E., on the western side of the Malay Peninsula. It is bounded on the N. by the protected native state of Perak, on the S. by the protected states of the Negri Sembilan, on the E. by Pahang and the Negri Sembilan, and on the W. by the Straits of Malacca. The coast-line is about 100 m. in length, greatest length about 104 m., and greatest breadth about 48 m., total area estimated at about 3000 sq. m.

The state consists of a narrow strip of land between the mountain range which forms the backbone of the peninsula and the Straits of Malacca. Compared with other states in the peninsula, Selangor is poorly watered. The principal rivers are the Selangor, the Klang and the Langat. The principal port of the state is Port Swettenham, situated at the mouth of the Klang River, and is connected with the capital, Kuala Lumpor, by a railway. The geology of the state closely resembles that of Perak. The state is possessed of most valuable deposits of alluvial tin, and mining for this metal is the chief industry of the population. Kuala Lumpor is also the federal capital of the Malay States.

History.

According to native tradition, the ruling house of Selangor is descended from a Bugis raja, who, with two of his brothers, settled in the state in 1718, the son of the youngest brother eventually becoming ruler of the country. In 1783 the then sultan of Selangor joined with the Iang-di-per-Tuan Muda of Riau in an unsuccessful attack upon the Dutch who then held Malacca. In retaliation the Dutch, under Admiral Van Braam, invaded Selangor and drove the sultan out of his country. In 1785, aided by the Bendahara of Pahang, Sultan Ibrahim of Selangor reconquered his state; but the Dutch blockaded his ports, and eventually forced him to enter into a treaty whereby he consented to acknowledge their sovereignty. The earliest British political communication with Selangor began in 1818, when a commercial treaty was concluded with the governor of Penang. In 1867 Sultan Abdul Samad of Selangor appointed his son-in-law, Tungku Dia Udin, to be viceroy; and this gave rise to a civil war which lasted almost without intermission till 1873, when the enemies of Tungku Dia Udin were finally vanquished, largely by the agency of the Bendahara of Pahang, who, at the invitation of the governor of the Straits Settlements, sent a warlike expedition to the assistance of the viceroy. In 1874 the occurrence of an atrocious act of piracy off the mouth of the Langat River led to the governor, Sir Andrew Clarke, appointing, at the request of the sultan, a British Resident to aid him in the administration of his kingdom. Since that date there has been no further breach of the peace, and the prosperity of Selangor has increased annually.

By the census taken on the 5th of April 1891 the population of Selangor was given at 81,592 souls, of whom 67,051 were males and only 14,541 were females. The census taken on the 5th of April 1901 gave a total population of 168,789 souls, of whom 136,823 were males and 31,966 females. Of these 108,768 were Chinese, 33,997 were Malays, 16,748 were Tamils, and only 487 were Europeans. The returns deal with nearly a score of different nationalities. Since 1901 the population has been much increased and now certainly exceeds 200,000 souls. Now, however, that instead of a single port of entry there exist easy means of access to the state by rail both from the north and the south, it is no longer possible to estimate the annual increase by immigration with any approach to accuracy. It will be noted that the inhabitants of this erstwhile Malayan state were, even at the time of the census of 1901, over 64% Chinese, while the Malays were little more than 20% of the population. In Selangor, as elsewhere in the Malay Peninsula, the deaths annually far outnumber the births recorded (*e.g.* in 1905 births 8293, deaths 12,500). The disproportion of the female to the male sections of the population is greater in Selangor than in any other part of the colony or Malay States. The development of planting enterprise in Selangor, and more especially the cultivation of rubber, has led during recent years to the immigration of a considerable number of Tamil coolies, but the Tamil population is still insignificant as compared with the Chinese.

Finance, Trade, &c.

The revenue of Selangor in 1875 amounted to only $115,656; in 1905 it had increased to $8,857,793. Of this latter sum $3,195,318 was derived from duty on tin exported, $1,972,628 from federal receipts, and $340,360 from land revenue. The balance is chiefly derived from the revenue farms, which include the right to collect import duty on opium and spirits. The expenditure for 1905 amounted to $7,186,146, of which sum $3,717,238 was on account of federal charges and $1,850,711 for public works. The value of the imports in 1905 was $24,643,619 and that of the exports was $26,683,316, making a total of $51,326,935, equivalent to £5,988,000. Tin is the principal export. The amount exported in 1905 was 17,254 tons. The total area of alienated mining land at the end of 1905 amounted to 65,573 acres, and it was estimated that over 60,000 Chinese were employed in the mines.

The main trunk line of the Federated Malay States railways passes through Selangor. It enters the state at Tanjong Malim on the Perak boundary, runs southward through Kuala Lumpor and so into the Negri Sembilan. It runs for 81 m. in Selangor territory. A branch line 27 m. long connects Kuala Lumpor with Port Swettenham on the Klang Straits where extensive wharves, capable of accommodating ocean-going vessels, have been constructed. A second branch line, measuring rather more than 4 m. in length, has been opened to traffic. It connects the caves at Batu with Kuala Lumpor. Frequent communication is maintained by steamer between Port Swettenham and Singapore, and by coasting vessels between the former port and those on the shores of the Straits of Malacca. All the principal places in the state are connected with one another by telegraph.

For administrative purposes Selangor is divided into six districts: Kuala Lumpor, in which the capital and the principal tin-fields are situated; Ulu Selangor, which is also a prosperous mining district; Kuala Selangor, which is agricultural, and poorly populated by Malays; Ulu Langat, mining and agricultural; Kuala Langat, the residence of the late sultan Abdul Samad, agricultural; and Klang, the only prosperous port of the state. Much money has been expended upon the capital, Kuala Lumpor, which possesses some fine public buildings, waterworks, &c., and where the principal residence of the Resident-General is situated. In some sort Kuala Lumpor is the capital not only of Selangor, but also of the whole federation. Its scenery is very attractive.

Negri Sembilan (the Nine States) is a federation of small native states which is now treated as a single entity, being under the control of a British Resident, and is situated between parallels 2° 28′ and 3° 18′ N. and 101° 45′ and 102° 45′ E., on the western side of the Malay Peninsula. It is bounded on the N. by the protected state of Pahang, on the S. by the territory of Malacca, on the E. by Pahang and the independent state of Johor, and on the W. by the Straits of Malacca. The coast-line is about 28 m. in length, and the extreme distance from north to south is 55 m., and that from east to west about 65 m. The estimated area is about 3000 sq. m. Port Dickson, or Arang-Arang, is the only port on the coast. It is connected with the capital, Seremban, by a railway 24 m. in length. Most of the states comprising the federation depend largely for their prosperity upon agriculture, but in some of the districts tin is being worked in considerable quantities, with good results.

History.

As is the case with the history of most Malayan states, much rests upon no surer ground than tradition, in so far as the records of the Negri Sembilan are concerned. At the same time the native story that the states which now form the federation of the Negri Sembilan were originally peopled by tribes of Sakai, or aborigines of the peninsula, who descended from the mountains of the interior and peopled the valleys, is supported by much corroborative evidence. Not only does the Malay's contempt for the Sakai make it exceedingly unlikely that the tradition, which is hardly a matter for pride, should have been preserved if it were not true, but also many of the laws and customs in force in these states are wholly foreign to those of the Malays, and can plainly be traced to the aborigines. As an instance, the custom of inheriting rank and property through the mother instead of through the father may be mentioned. Tradition further relates that towards the end of the

18th century a raja of the royal house of Menangkabu came from Sumatra to rule over the federation of small states, each of which continued to be governed in all its local affairs by its own chief and by the village and other councils sanctioned by ancient custom. The Sumatran raja took the title of Iang-di-per-Tuan of Sri Menanti. Although they bore the name of the "Nine States," only six seem to have belonged to the federation during the time of which history speaks. These are Sri Menanti, Johol, Tampin, Rembau, Jelebu, and Sungei Ujong. Later the two latter separated themselves from the confederation. Ancient tradition says that the names of the nine states were originally Klang, Jelebu, Sungei Ujong, Johol, Segamat, Pasir Besar, Naning, Rembau and Jelai. Of these Klang was annexed by Selangor, Segamat and Pasir Besar by Johor, and Naning by Malacca. During the last years of the 18th century the Iang-di-per-Tuan appointed an Iang-di-per-Tuan Muda to rule Rembau, and the state of Tampin was created to provide for the family of the new chief. In 1887 the governor of the Straits Settlements sent Mr Martin Lister to the Negri Sembilan, which had become disintegrated, and by his influence the ancient federal system was revived under the control of a Resident appointed by the governor. The states which formed this new confederation were Johol, Ulu Muar, Jempol, Terachi, Inas, Gunong Pasir, Rembau, Tampin and Gemencheh. Prior to this, in 1873, owing to a civil war in Sungei Ujong, Sir Andrew Clarke sent a military force to that state, put an end to the disturbances, and placed the country under the control of a British Resident. Jelebu was taken under British protection in 1886, and was thenceforth managed by a magistrate under the orders of the Resident of Sungei Ujong. In 1896, when the federation of all the Malayan states under British control was effected, Sungei Ujong and Jelebu were reunited to the confederation of small states from which they had so long been separated and the whole, under the old name of the Negri Sembilan, or Nine States, was placed under one Resident.

The population of the Negri Sembilan, which according to the census taken in April 1891 was only 70,730, had increased to 96,028 by 1901, and was estimated at 119,454 in 1905. Of these 46,500 are Chinese, 65,000 Malays, 6700 Tamils, and 900 Europeans and Eurasians. The births registered slightly exceed the deaths in number, there being a large Malay population in the Negri Sembilan among whom the proportion of women to men is fair, a condition of things not found in localities where the inhabitants are mostly Chinese immigrants.

Finance and Trade.

The revenue of the Negri Sembilan amounted to only $223,435 in 1888. In 1898 it had increased to $701,334, in 1900 to $1,251,366, and in 1905 to $2,335,534. The revenue for 1905 was derived mainly as follows:—customs $1,268,602, land revenue $145,475, land sales $21,407, while the revenue farms contributed $584,459. The expenditure in 1905 amounted to $2,214,093, of which $1,125,355 was expended upon public works. The trade returns for 1905, which are not, however, complete, show an aggregate value of about $13,000,000. The value of the tin exported during 1905 exceeded $6,900,000, and the value of the agricultural produce, of which gambier represented $211,000 and damar $80,000, amounted to $407,990.

General.

Seremban, the administrative capital of the Negri Sembilan, is connected with Port Dickson by a railway line, owned by the Sungei Ujong Railway Company, which is 24½ m. in length. It is also situated on the trunk line of the Federated Malay States, and is thus joined by rail to Selangor on the north and to Malacca on the south. Frequent steam communication is maintained between Port Dickson and the ports on the Straits of Malacca and with Singapore.

For administrative purposes the Negri Sembilan is divided into five districts, viz. the Seremban District, the Coast District, Jelebu, Kuala Pilah and Tampin. Each of these is under the charge of a European district officer, who is responsible to the Resident. The Iang-di-per-Tuan lives at Kuala Pilah, but the capital of the federation is at Seremban in Sungei Ujong, where the Resident is stationed. The hereditary chiefs of the various states aid in the government of their districts, and have seats upon the state council, over which the Iang-di-per-Tuan presides. The watering-place of Magnolia Bay, where excellent sea-bathing is obtainable, is one of the pleasure resorts of this part of the peninsula.

Pahang, on the east coast of the peninsula, is situated between parallels 2° 28′ and 3° 45′ N. and 101° 30′ and 103° 30′ E. It is bounded on the N. by the independent native states of Kelantan and Trengganu; on the S. by the Negri Sembilan and Johor; on the E. by the China Sea; and on the W. by the protected states of Perak and Selangor. The coast-line is about 112 m. in length; the greatest length is about 210 m., and greatest breadth about 130 m. The state is the largest in the peninsula, its area being estimated at 15,000 sq. m. The ports on the coast are the mouths of the Endau, Rompin, Pahang and Kuantan rivers, but during the north-east monsoon the coast is not easy of approach, and the rivers, all of which are guarded by difficult bars, are impossible of access except at high tides.

The principal river of the state is the Pahang, from which it takes its name. At a distance of 180 m. from the coast this river is formed by two others named respectively the Jelai and the Tembeling. The former is joined 20 m. farther up stream by the Lipis, which has its rise in the mountains which form the boundary with Perak. The Jelai itself has its rise also in a more northerly portion of this range, while its two principal tributaries above the mouth of the Lipis, the Telom and the Serau, rise, the one in the plateau which divides Perak from Pahang, the other in the hills which separate Pahang from Kelantan. The Tembeling has its rise in the hills which divide Pahang from Kelantan, but some of its tributaries rise on the Trengganu frontier, while the largest of its confluents comes from the hills in which the Kuantan River takes its rise. The Pahang is navigable for large boats as far as Kuala Lipis, 200 m. from the mouth, and light-draught launches can also get up to that point. Smaller boats can be taken some 80 m. higher up the Jelai and Telom. The river, however, as a waterway is of little use, since it is uniformly shallow. The Rompin and Kuantan rivers are somewhat more easily navigated for the first 30 m. of their course, but taken as a whole the waterways of Pahang are of little value. The interior of Pahang is chiefly noted for its auriferous deposits. Gunong Tahan is situated on the boundary between Pahang and Kelantan. Its height is estimated at 8000 ft. above sea-level, but it has never yet been ascended. Pahang, like the states on the west coast, is covered almost entirely by one vast forest, but in the Lipis valley, which formerly was thickly populated, there is a considerable expanse of open grass plain unlike anything to be seen on the western sea-board. The coast is for the most part a sandy beach fringed with *casuarina* trees and there are only a few patches of mangrove-swamp throughout its entire length.

History.

The ancient name of Pahang was Indrapura. It is mentioned in the history of *Hang Tuah*, the great Malacca brave, who flourished in the 16th century, and succeeded in abducting a daughter of the then ruling house of Pahang for his master, the sultan of Malacca. Prior to this, Pahang had been ruled by the Siamese. When Malacca fell into the hands of the Portuguese in 1511 the sultan, Muhammad Shah, fled to Pahang, and the present ruling house claims to have been descended from him. The title of the ruler of Pahang was Bendahara until 1882, when the present (1902) ruler, Wan Ahmad, assumed the title of sultan, taking the name of Sultan Ahmad Maatham Shah. Up to that time the Bendahara had been installed on his accession by the sultan of Riau, and held his office by virtue of that chief's letter of authority. About 1855 the father of the present sultan died at Pekan, and his son Bendahara Korish, who succeeded him, drove Wan Ahmad from the country. After making three unsuccessful attempts to conquer the land and to dethrone his elder brother, Wan Ahmad at last succeeded in 1865 in invading the state and wresting the throne from his nephew, who had succeeded his father some years earlier. From that time, in spite of two attempts to shake his power by invasions from Selangor which were undertaken by his nephews Wan Aman and Wan Da, Bendahara Ahmad ruled his country with a rod of iron. In 1887 he consented to enter into a treaty with the governor of the Straits by which he accepted a consular agent at his court. This treaty was finally signed on the 8th of October 1887. In February of the following year a Chinese British subject was murdered at Pekan in circumstances which pointed to the responsibility of the sultan for the crime, and in October 1888 a Resident was appointed to assist the sultan in the administration of his country, that being, in the opinion of the British government, the only guarantee for the safety of the life and property of British subjects which it could accept. In December 1891 disturbances broke out in Pahang, the nominal leaders of which were certain of the sultan's most trusted chiefs. The sultan himself took no part in the outbreak, but it undoubtedly had his sympathy, even if it was not caused by his direct commands. The rebels were driven to seek safety in flight in November 1892, but in June 1894 they gathered strength for a second disturbance, and raided Pahang from Kelantan, in which state they had been given shelter by the Mahommedan rulers. This event, added to the occurrence of other raids from across the border, led to an irregular expedition being led into Trengganu and Kelantan by the Resident of Pahang (Mr Hugh Clifford) in 1895, and this had the desired result. The rebel chiefs were banished to Siam, and no further breach of the peace has troubled the tranquillity of Pahang since that time. Pahang joined the Federated Malay States by a treaty signed in 1895, and the sultan and his principal chiefs were present at the federal durbar held at Kuala Kangsar in Perak in 1897.

Population.

The census taken in April 1901 gave the total population of Pahang at 84,113, of whom 73,462 were Malays, 8695 Chinese, 1227 Tamils and other natives of India, 180 Europeans and Eurasians, and 549 people of other nationalities. The population in 1905 was estimated at 100,000, the increase being due to immigration mainly from the states on the western seaboard. In former days Pahang was far more thickly populated than in modern times, but the long succession of civil wars which racked the land after the death of Bendahara Ali caused thousands of Pahang Malays to fly the country. To-day the valley of the Lebir River in Kelantan and the upper portions of several rivers near the Perak and Selangor boundaries are inhabited by Pahang Malays, the descendants of these fugitives. The Pahang natives are almost all engaged in agriculture. The work of the mines, &c., is performed by Chinese and foreign Malays. In the Lipis valley the descendants of the Rawa Malays, who at one time possessed the whole of the interior in defiance of the Pahang rajas, still outnumber the people of the land.

Finance and Trade.

The revenue of Pahang in 1899 amounted to only $62,077; in 1900 to $419,150. In 1905 it was $528,368. The expenditure in 1905 amounted to $1,208,176. Of this sum $736,886 was expended on public works. Pahang is still a source of expense to the federation, its progress having been retarded by the disturbances which lasted from December 1891 until 1895, with short intervals of peace, but the revenue is now steadily increasing, and the ultimate financial success of the state is considered to be secure. Pahang owes something over $3,966,500 to Selangor and $1,175,000 to Perak, which have financed it now for some years out of surplus revenue. The value of the imports in 1905 was $1,344,346, that of the exports was $3,838,928, thus making a total trade value of $5,183,274. The most valuable export is tin, the value of which in 1905 amounted to $2,820,745. The value of the gutta exported exceeded $140,000, that of dried and salted fish amounted to nearly $70,000, and that of timber to $325,000.

General.

The geological formation of the states lying to the eastward of the main range of mountains which splits the peninsula in twain differs materially from that of the western states. At a distance of about a dozen miles from the summits of the mountains the granite formation is replaced by slates, which in many places are intersected by fissures of quartz, and in others are overlaid by vast thicknesses of limestone. Those of the quartz fissures which have been exploited are found to be auriferous, and several mining companies have attempted to work the deposits. Their efforts, however, have not hitherto been successful. A magnificent road over the mountains, with a ruling grade of 1 in 30, joins Kuala Lipis, the administrative capital of Pahang, to Kuala Kubu, the nearest railway station in Selangor. The road measures 82 m. in length. Pekan, where the sultan has his residence, was the capital of Pahang until the middle of 1898, when the administrative headquarters were transferred to the interior as being more central. None of these towns is of any size or importance. In the Kuantan valley, which lies parallel to the Pahang River, a European company is working tin lodes with considerable success. These lodes are the only mines of the kind being worked in the Federated Malay States. Pahang is fertile and well suited for agriculture of many kinds. The rainfall is heavy and regular. The climate is cooler than that of the west coast, and the full force of the monsoon is felt from October to February in each year. For administrative purposes Pahang is divided into four districts—Ulu Pahang, in which the present capital is situated; Temerloh, which includes 80 odd miles of the Pahang valley and the Semantan River; Pekan, which includes the coast rivers down to Endau; and Kuantan. Each of these is under the charge of a district officer, who is responsible to the resident. The boundary with Johor and the Negri Sembilan was rectified by a commission which sat in London in 1897–1898.

Authorities.—*Journal of the Eastern Archipelago* (Singapore); *Journal of the Straits Branch of the Royal Asiatic Society* (Singapore); Maxwell, *Proceedings of the Royal Colonial Institute*, vol. xxiii.; Swettenham, ibid. vol. xxvii; Clifford, ibid. vol. xxx. (London, 1892, 1895, 1899); Swettenham, *About Perak* (Singapore, 1893); *Malay Sketches* (London, 1895); *The Real Malay* (London, 1899); *British Malaya* (London, 1906); Clifford, *In Court and Kampong* (London, 1897); *Studies in Brown Humanity* (London, 1898); *In a Corner of Asia* (London, 1899); *Bush-whacking* (London, 1901); *Further India* (London, 1904); De la Croix, *Les Mines d'etins de Perak* (Paris, 1882); Bluebook, C. 9524 (London, 1899); *The Straits Directory* (Singapore, 1906); Skeat, *Malay Magic* (London, 1900); Skeat and Blagden, *Pagan Races of the Malay Peninsula* (London, 1906). (H. Cl.)

II.—Non-Federated States

In 1909 a treaty was made between Great Britain and Siam, one provision of which was the cession to the former of the suzerain rights enjoyed by the latter over certain territories in the Malay Peninsula. These territories consisted of the four Siamese Malay States: Kelantan, Trengganu, Kedah and Perlis, very ancient dependencies of Siam, all of which except Trengganu, were in a flourishing condition and had been administered by British officers in the service of Siam for some years prior to their transference. Though the four states were loyal to Siam and wished to retain their former allegiance, the change was effected without disturbance of any kind, the British government on assuming the rights of suzerainty placing an adviser at the court of each raja and guaranteeing the continuance of the administration on the lines already laid down by Siam so far as might be compatible with justice and fair treatment for all. The four states lie to the north of the Federated Malay States, two on the east and two on the west side of the peninsula.

Kelantan.—This state on the east coast, bounded N. and N.E. by the China Sea, E. by Trengganu, S. by Pahang and W. by Perak and Ra-nge, lies between 4° 48′ and 6° 20′ N. and 101° 33′ and 102° 45′ E. The greatest length from north to south is 115 m. and the greatest breadth from east to west 60 m. The area is about 5000 sq. m. The northern part of the state is flat and fertile, but the southern district which comprises more than half the total area, is mountainous and uncultivated.

Next to the Pahang, the Kelantan River is the largest on the east coast. It is 120 miles long and is navigable for shallow-draft launches and big country boats for about 80 miles, and for vessels of 8 ft. draft for about six miles. Its principal tributaries are the Galas, Pergau and Lebir. The Golok and Semarak rivers water the west and east parts of the state, falling into the sea a few miles on either side of the mouth of the Kelantan River. The climate of Kelantan is mild and singularly healthy in the open cultivated regions. The population is about 300,000 of which 10,000 are aboriginal tribes (Sakcis and Jakuns), 10,000 Siamese and Chinese and the rest Malays. The Chinese are increasing and natives of different parts of India are resorting to the state for purposes of trade. Kota Bharu (pop. 10,000) is the only town in the state. It lies on the right bank of the river, about six miles from the sea. Since 1904 it has been laid out with metalled roads and many public and private buildings have been erected. The town is the commercial as well as the administrative centre of the state. Tumpat and Tabar on the coast, with population 4000 and 3000 respectively, are the places next in importance after Kota Bharu. A network of creeks render communication easy in the northern districts, the river and its tributaries afford means of access to all parts of the south; 20 miles of road have been made in the neighbourhood of Kota Bharu. Kelantan is connected by telegraph with Bangkok and Singapore, and maintains regular postal communication with those places. Rice cultivation is the principal industry and is increasing rapidly. Coco-nut and betel-nut growing are also largely practised. Much livestock is raised. About 400,000 acres of land are under cultivation. Though reputed rich in minerals, past misrule prevented mining enterprise in Kelantan until, in 1900, a large concession was given to an Englishman and the country was opened to foreigners. In 1909 three mining syndicates were at work, and several others were in process of formation. Gold, tin and galena have been found in several localities and during the years 1906–1909 28,000 ounces of gold were dredged from the Kelantan River. The Kelantanese are expert fishermen, some 30,000 finding employment in fishing and fish-drying. Silk-weaving is a growing industry. Foreign trade, which in 1909 reached the value of two and a half million dollars, is chiefly with Singapore. Principal exports are copra, rice, fish, cattle and gold; chief imports are cotton goods, hardware and specie. The currency is the Straits Settlements dollar and small silver coin, supplemented by a locally made tin coin of low value.

By virtue of a mutual agreement made in 1902 Siam appointed a resident commissioner to Kelantan and consented, so long as the advice of that officer should be followed, to leave internal affairs to be conducted locally. Under this arrangement a council of state was appointed, departments of government were organized, penal, civil and revenue laws were passed and enforced, courts were established and a police force was raised. Though formerly of an evil reputation, the people were found to be naturally peaceful and law-abiding, and serious crime is rare. The state revenue, which was practically nothing in 1902, amounted to $320,000 in 1907. Islamism was adopted about 300 years ago but the old animistic superstitions are still strong. The state is divided into *mukim* or parishes, but the *imam* no longer exercise temporal authority. There are three schools at Kota Bharu, education in the interior being in the hands of the imam assisted with government grants.

No historical records of Kelantan exist, and the state was not noticed by the European merchants of the 16th and 17th centuries. Consequently little is known of its early history beyond what is to be gathered from brief references in the Malay annals and the old chronicles of Siam. The sites of ancient towns and the remains of former gold diggings are visible here and there, but all knowledge of the men who made these marks has been lost. The present ruling family dates from about 1790. Siam was frequently called upon to maintain internal peace and in 1892 a royal prince was sent to reside in Kelantan as commissioner. Complications brought about by the incapacity of the ruler led to the making of the agreement of 1902 above mentioned, to the fixing of a regular tribute in money to Siam, and ultimately to the merging of the state from chaotic lawlessness into the path of reform. On the 15th of July 1909 the state came under British suzerainty and the commissioner of Siam was replaced by a British adviser, from which date the liability to payment of tribute ceased, though in all other respects the administrative arrangements of Siam remained unaltered.

Trengganu.—This state on the east coast, bounded N. and N.E. by the China Sea, S. by Pahang and W. by Pahang and

Kelantan, lies between parallels 4° 4′ and 4° 46′ N. and 102° 30′ and 103° 26′ E. The greatest length from north to south is 120 m., and the greatest breadth from east to west 50 m. It has a coast-line of 130 m. and an estimated area of about 5000 sq. m. There are several islands off the coast, some of which are inhabited. The surface is generally mountainous.

Principal rivers are the Besut, Stiu, Trengganu, Dungun and Kmamun, none of which is navigable for any distance. The climate is mild and fairly healthy. The population numbers about 180,000, almost all Malays, and mostly clusters round the mouths and lower reaches of the rivers. The capital, which is situated at the mouth of the Trengganu River, contains, with its suburbs, not less than 30,000 people. Difficulty of access by river and by land render the interior districts almost uninhabitable. Communication is maintained by boat along the coast. There are no roads and no postal or telegraphic communications.

The majority of the people are sailors and fishermen. Rice is grown, but not in sufficient quantities to supply local needs. Much pepper and gambier were at one time grown and exported, but about the year 1903 agriculture began to fall off owing to prevailing insecurity of life and property. Not much livestock is raised, the few head of cattle exported from Besut being mostly stolen from across the neighbouring Kelantan border. A successful tin mine under European control exists in the Kmamun district, but as everything possible was done in the past to discourage all foreign enterprise, the probable mineral wealth of the country is still practically untouched. Silk-weaving, carried on entirely by the women, is a considerable industry. The silk is imported raw and is re-exported in the form of Malay clothing (*sarongs*) of patterns and quality which are widely celebrated. The manufacture of native weapons and of brassware was at one time brisk but is declining. The trade of Trengganu is not increasing. It is valued roughly at about one and a half million dollars a year, is chiefly with Singapore, and is to a great extent carried in Trengganu-built ships, which latter also do some carrying trade for other states on the east coast.

The Trengganu sultanate is one of the most ancient in the peninsula and ranks with that of Riau. The state was feudatory to Malacca in the 13th century and during the 14th, 15th and 16th centuries its possession was frequently disputed between Malacca and Siam. The present sultan is the descendant of an ancient family, the members of which have quarrelled and fought with each other for the succession from time immemorial. The last serious disturbance was in 1837 when the grandfather of the present sultan stole the throne from his nephew. Until the acquisition of the state by Great Britain a triennial tribute of gold flowers was paid to Siam, and this with occasional letters of instructions and advice, constituted almost the only tangible evidence of Siamese suzerainty. Of government there was practically none. The sultan, having alienated most of his powers and prerogatives to his relatives, passed his life in religious seclusion and was ruler in no more than name. The revenues were devoured by the relatives, a small part of those accruing from the capital sufficing for the sultan's needs. There were no written laws, no courts and no police. All manner of crime was rampant, the peasantry was mercilessly downtrodden, but the land was full of holy men and the cries of the miserable were drowned in the noise of ostentatious prayer. In fine, Trengganu presented in the beginning of the year 1909 the type of untrammelled Malay rule which had fortunately disappeared from every other state in the peninsula. In July of that year, however, the first British adviser or agent arrived in the state, which was shortly afterwards visited by the governor of the Straits Settlements, who discussed with the sultan the changed conditions consequent upon the Anglo-Siamese treaty and laid the foundations of future reform.

Kedah.—This state, on the west coast of the peninsula, lies between parallels 5° 20′ and 6° 42′ N., and is bounded, N. by Palit and Songkla, E. by Songkla and Raman, S. by Province Wellesley and Perak, and W. by the sea. The coast-line is 65 m. long, the greatest distance from north to south is 115 m. and the greatest breadth 46 m. Off the coast lies a group of islands, the largest of which is Langkawi, well peopled and forming a district of the state.

The total area of Kedah is about 4000 sq. m. The land is low-lying and swampy near the coast except towards the south where the height known as Kedah Hill rises from the shore opposite Penang, flat and fertile farther inland, and mountainous towards the eastern border. The rivers are small, the Sungei Kedah, navigable for a few miles for vessels of 50 tons, and the S. Muda, which forms the boundary with Province Wellesley, being the only streams worthy of notice. The plains are formed of marine deposit, and in the mountains limestone and granite preponderate. The population is estimated at 220,000, of whom about 100,000 are Malays, 50,000 Siamese and Samsams and 70,000 Chinese and Madrassis (Klings). There are three towns of importance. Alor Star, the capital, on the Kedah river, 10 miles from the sea, in a flat, unhealthy, but fertile locality, is a well laid out town with good streets, many handsome public and private buildings, and good wharfage for small vessels. The population is about 20,000, of whom more than half are Chinese and the remainder government servants and retainers of the local aristocracy. Kuala Muda (pop. 10,000) and Kulim (pop. 8000) situated in the south, are unimposing collections of small birch houses and thatched bamboo huts; the latter is the centre of the Kedah tin mining industry. The bulk of the population is scattered over the plains in small villages. A good road runs north from Alor Star to the border of the state, a distance of 40 miles, and other roads are being constructed. The state has 185 miles of telegraph line and 75 miles of telephone line. Mails are closed daily at Alor Star for Penang and there is a good internal postal service. The chief industry is rice cultivation. Coco-nut, betel-nut and fruit plantations are many, and the cultivation of rubber has recently been taken up with prospects of success. The estimated area under cultivation is about 300,000 acres. There are rice-mills at Alor Star and at Kuala Muda. The principal exports are rice, cattle and tin. The chief imports are cotton goods, provisions, hardware and raw silk. Accurate trade statistics are not available. The ruler holds the rank of sultan and is assisted in the government by a council and by the British adviser who since the state passed from Siamese to British protection in 1909, has replaced the officer formerly appointed by Siam. The sultan comes of a family long recognized by Siam as having hereditary right to the rulership. The penal and civil laws are administered in accordance with the precepts of Islamism, the official religion of the state. Though much has been done to improve the courts, justice is not easily obtainable. A land registration system is in force but is in a state of confusion, though a land law passed in 1905 gives security of tenure over lands newly acquired. The mining laws are similar to those of Siam. In 1905 the Siamese government advanced two and a half million dollars to Kedah, to pay the debts of the state, which sum was refunded by the British Government on assuming the position of protector. The annual revenue is $1,000,000 and the expenditure about the same. Chief heads of revenue are opium and land tax. Many revenue monopolies, created in the past, have not yet expired; but for this the revenue would be greater than it is. There is no army. In 1906 the police service was reorganized under British officers, resulting in great improvement to this department. The state is divided into a number of administrative districts under Malay officials. Each district comprises several *mukim* or parishes, the *imam* of which exercise both spiritual and temporal control. There are schools in the chief towns, but education has not yet been seriously undertaken.

Kedah was founded by colonists from India in A.D. 1200, about which time the Siamese had subdued Nakhon Sri Tammarat and claimed the whole Malay Peninsula. When the rise of Malacca shook Siamese authority in the peninsula, Kedah oscillated between them, and on the conquest of Malacca by the Portuguese, fell to Siam, though the capital was raided and burnt by the Europeans. The ruler and his people were converted to Islam in the 15th century. In 1768, the Siamese kingdom being disorganized, the sultan of Kedah entered into direct political relations with the Hon. East India Company, leasing the island of Penang to the latter. Further treaties followed in 1791 and 1802, but in 1821 Siam reasserted her control, expelling the rebellious sultan after a sanguinary war. The sultan made several fruitless efforts to recover the state, and at length made full submission, when he was reinstated. In 1868 an agreement between Great Britain and Siam was substituted for the treaties of the East India Company with the sultan. The present sultan succeeded in 1881, and for 14 years governed well, but in 1895 he began to contract debts and to leave the government to his minions. The result was chaos, and in 1905 the Siamese government had to intervene to avert a condition of bankruptcy, adjusting the finances and reorganizing the general administration to such effect that when, four years later, the state became a British dependency, a government was found established on a sound basis and requiring nothing but the presence of a firm and experienced officer as adviser to maintain its efficiency and assist its further advance.

Perlis (*Palit*).—This small state, consisting of the left bank drainage area of the Perlis River, lies between Setul and Kedah, which bound it on the N. and W. and on the E. respectively. It touches the sea only round the mouth of the river.

The population is about 10,000, Malays and Chinese. The chief town, Perlis, is situated about 12 m. up the river. A good deal of tin is worked, and rice and pepper are grown and exported. In the early part of the 19th century Perlis was a district of Kedah, but during a period of disturbance in the latter state it established itself as a separate chiefdom. In 1897 Siam restored the nominal authority of Kedah, but the measure was not productive of good. In 1905 the Siamese government advanced a loan of $200,000 to Perlis, and appointed an English adviser to assist in the general administration. This money was refunded to Siam and the adviser relieved by a British officer when the state became British in July 1909. The condition of the state has improved, but the revenue, $80,000, is not sufficient for the immediate needs of government.

Authorities.—Norman, *The Far East* (London, 1895); H. Clifford, in the *Geographical Journal* (London, 1896); Carter, *The*

Kingdom of Siam (London, 1904); Graham, *Reports on Kelantan* (Bangkok, 1905–1909); Skeat and Blagden, *Pagan Races of the Malay Peninsula* (London, 1906); Hart, *Reports on Kedah* (Calcutta, 1907–1909); Graham, *Kelantan, a Handbook* (Glasgow, 1907).

(W. A. G.)

MALAY STATES (Siamese). The authority of Siam, which at one time covered the whole of the Malay peninsula, now extends southward to an irregular line drawn across the Peninsula at about 6° 30′ N. Between that line and the Isthmus of Kra, usually accepted as the northernmost point of the Malay Peninsula, there lie some 20,000 sq. m. of territory inhabited by a mixed population of Siamese and Malays with here and there a few remnants of the aboriginal inhabitants clinging to the wilder districts, and with a few Chinese settlers engaged in commerce. Formerly this tract was divided into a number of states, each of which was ruled by a chief (Siamese, *Chao Muang*; Malay, *raja*), who held his title from the king of Siam, but, subject to a few restrictions, conducted the affairs of his state in accordance with his own desires; the office of chief, moreover, was hereditary, subject always to the approval of the suzerain. The states formed two groups: a northern, including Langsuan, Chaya, Nakhon Sri Tammarat, Songkla, Renawng, Takoapa, Pang Nga, Tongka and Trang, in which the Siamese element predominated and of which the chiefs were usually Siamese or Chinese; and a southern, including Palean, Satun (Setul), Patani, Raman, Jering, Sai (Teloban), Re Nge (Legeh), Yala (Jalor) and Nong Chik, in which the population was principally Malay and the ruler also Malay. Four other states of the southern group, Kelantan, Trengganu, Kedah and Perlis, of which the population is entirely Malay, passed from Siamese to British protection in 1909.

With the gradual consolidation of the Siamese kingdom all the states of the northern group have been incorporated as ordinary provinces of Siam (*q.v.*), the hereditary *Chao Muang* having died or been pensioned and replaced by officials of the Siamese Civil Service, while the states themselves now constitute provinces of the administrative divisions of Chumpon, Nakhon Sri Tammarat and Puket. The states of the southern group, however, retain their hereditary rulers, each of whom presides over a council and governs with the aid of a Siamese assistant commissioner and with a staff of Siamese district officials, subject to the general control of high commissioners under whom the states are grouped. This southern group, with a total area of about 7000 sq. m. and a population of 375,000, constitutes the Siamese Malay States. A British consul with headquarters at Puket, and a vice-consul who resides at Songkla, watch over the interests of British subjects in the states of the west and east sides of the peninsula respectively. Other foreign powers are unrepresented.

Palean.—This small state on the west coast, bounded N. by the province of Trang, E. by the Songkla division, S. by the state of Setul, and W. by the sea, is about 900 sq. m. in area, and has a population of about 20,000. It is attached for administrative purposes to the province of Trang, and its people are chiefly engaged in the cultivation of pepper, of which about 150 tons are annually exported. A few tin mines are also worked.

Satun (*Setul*).—This small state, bounded N. by Palean, E. by Songkla, S. by Perlis, and W. by the sea, contains about 1000 sq. m. area with a population of about 25,000, Malays, Siamese and a few Chinese. The principal production is pepper, which is exported in junks and in the small Penang steamers which ply on the west coast of the peninsula. In 1897 Setul was placed under the control of Kedah, then a Siamese dependency, but the arrangement was not a success, and in 1907 the Siamese government was forced, owing to prevailing corruption and misrule, to restrict the powers of the chief and, cancelling the authority of Kedah, to place him to some extent under the orders of the high commissioner of Songkla. By the terms of the Anglo-Siamese treaty of 1909 about half of the state of Perlis was added to Satun, an arrangement by which the importance of the latter was considerably increased.

Patani.—The seven Malay states of Nawng Chik, Patani, Jering, Yala (Jalor), Sai (Teloban), Raman and Ra-ngé (Legeh) were constituted from the old state of Patani at the beginning of the 19th century. In 1906 they were reunited to form the Patani administrative division of Siam, but each state retains its Malay ruler, who governs jointly with a Siamese officer under the direction of the Siamese high commissioner, and many of the ancient privileges and customs of Malay government are preserved. The group of states is situated between 5° 34′ and 6° 52′ N. and 100° 54′ and 101° 58′ E. It is bounded N. by the China Sea, E. by the China Sea and Kelantan, S. by Perak, and W. by Kedah. The total area is about 5000 sq. m. The country is mountainous except close to the coast. The principal rivers are the Patani and the Teloban, long, winding and shallow, and navigable for small boats only. The population is about 335,000, of whom the great majority are Malays. Each state has its capital, but Patani (the headquarters of the high commissioner) is the only town of importance. Communications are poor and are chiefly by river, but roads are under construction. Patani and Sai are in telegraphic communication with Bangkok and Singapore, and regular weekly mails are despatched to those places. The area under cultivation is small except round about Patani and in Nawng Chik, where much rice is grown. Tin mining is a growing industry; many Chinese own mines and several European syndicates are at work in Raman, Ra-ngé and Patani, prospecting for, or mining, this metal. Fishing and salt-evaporation occupy a large proportion of the population. The annual export of tin is about 400 tons, and dried fish, salt, cattle and elephants are other exports. Steamers up to 300 tons maintain frequent communication with Bangkok and Singapore, and the Patani roads afford good anchorage at all seasons.

Mahommedan law is followed in the settlement of inherited property disputes and of matrimonial affairs; otherwise the laws of Siam obtain. Efficient law courts have been established in each state, and there is a serviceable force of gendarmerie recruited from amongst Malays and Siamese alike. The revenue amounts to about 600,000 ticals, or £45,000 a year, one-third being payable to the rulers as private income for themselves and their relatives, one-third expended on the administration, and one-third reserved for special purposes, but it is usually found necessary to devote the last-mentioned third to the expenses of administration. Patani has been subject to Siam from the remotest times. It is said that the old state adopted Islamism in the 16th century, the chief, a relative of the kings of Siam, embracing that religion and at the same time revolting to Malacca. It has several times been necessary to send punitive expeditions to recall the state to its allegiance. The present rulers are mostly descended from the ruling families of the neighbouring state of Kelantan, but the chief of Patani itself is a member of the family which ruled there in the days of its greatness. Throughout the 17th century Patani was resorted to by Portuguese, Dutch and English merchants, who had factories ashore and used the place as an emporium for trade with Siam. In 1621 an engagement took place in the Patani roads between three Dutch and two British ships, the latter being taken after the president of the British merchants, John Jourdain, had been killed. In 1899 the border between the state of Perak and Raman was fixed by an agreement between England and Siam, a dispute of old standing being thereby settled, but the question was reopened in the negotiations which preceded the Anglo-Siamese treaty of 1909, when a new border line was fixed between British and Siamese possessions in the Peninsula.

(W. A. G.)

MALCHIN, a town of Germany, in the grand-duchy of Mecklenburg-Schwerin, on the river Peene, between lakes Malchin and Kummerow, 28 m. by rail N.W. of Neu-Brandenburg. Pop. (1900), 7449. It is, alternately with Sternberg, the place of assembly of the Diet of Mecklenburg. Here are the châteaux of Remplin, Basedow and Schlitz; a church dating from the 14th century, and a fine town-hall. The well-wooded and undulating country, environing the shores of Lake Malchin, is known as the "Mecklenburg Switzerland," and is increasing in favour as a summer resort. A canal unites Lake Kummerow with the Peene. The industries of the town include the manufacture of sugar and bricks, and brewing and malting. Malchin became a town in 1236.

MALCOLM, the name of four kings of the Scots, two of whom, Malcolm I., king from 943 to 954, and Malcolm II., king from 1005 to 1034, are shadowy and unimportant personages.

Malcolm III. (d. 1093), called Canmore or the "large-headed," was a son of King Duncan I., and became king after the defeat of the usurper Macbeth in July 1054, being crowned at Scone in April 1057. Having married as his second wife, (St) Margaret (*q.v.*), a sister of Edgar Ætheling, who was a fugitive at his court, he invaded England in 1070 to support the claim of Edgar to the English throne, returning to Scotland with many captives after harrying Northumbria. William the Conqueror answered this attack by marching into Scotland in 1072, whereupon Malcolm made peace with the English king at Abernethy and "was his man." However, in spite of this promise he ravaged the north of England again and again, until in 1091 William Rufus invaded Scotland and received his submission. Then in 1092 a fresh dispute arose between the two kings, and William summoned Malcolm to his court at Gloucester. The

Scot obeyed, and calling at Durham on his southward journey was present at the foundation of Durham Cathedral. When he reached Gloucester Rufus refused to receive him unless he did homage for his kingdom; he declined and returned home in high dudgeon. Almost at once he invaded Northumbria, and was killed at a place afterwards called Malcolm's Cross, near Alnwick, on the 13th of November 1093. Four of Malcolm's sons, Duncan II., Edgar, Alexander I., and David I., became kings of Scotland; and one of his daughters, Matilda, became the wife of Henry I. of England, a marriage which united the Saxon and the Norman royal houses.

MALCOLM IV. (*c.* 1141–1165) was the eldest son of Henry, earl of Huntingdon (d. 1152), son of King David I., and succeeded his grandfather David as king of Scotland in 1153. He is called the "Maiden," and died unmarried on the 9th of December 1165.

See E. A. Freeman, *The Norman Conquest*, vols. iv. and v. (1867–1879), and *The Reign of William Rufus* (1882); W. F. Skene, *Celtic Scotland* (1876–1880); E. W. Robertson, *Scotland under her Early Kings* (1862); and A. Lang, *History of Scotland*, vol. i. (1900).

MALCOLM, SIR JOHN (1769–1833), Anglo-Indian soldier, diplomatist, administrator and author, was born at Burnfoot on the Esk, near Langholm, Dumfriesshire, Scotland, on the 2nd of May 1769. His father was a humble farmer, but three of his sons attained the honour of knighthood. At the age of twelve he received a cadetship in the Indian army, and in April 1783 he landed at Madras, shortly afterwards joining his regiment at Vellore. In 1792, having for some time devoted himself to the study of Persian, he was appointed to the staff of Lord Cornwallis as Persian interpreter, but two years afterwards was compelled by ill health to leave for England. On his return to India in 1796 he became military secretary to Sir Alured Clarke, commander-in-chief at Madras, and afterwards to his successor General Harris; and in 1798 he was appointed by Lord Wellesley assistant to the resident at Hyderabad. In the last-mentioned capacity he highly distinguished himself by the manner in which he gave effect to the difficult measure of disbanding the French corps in the pay of the nizam. In 1799, under the walls of Seringapatam, began his intimacy with Colonel Arthur Wellesley, which in a short time ripened into a life-long friendship. In the course of the same year he acted as first secretary to the commission appointed to settle the Mysore government, and before its close he was appointed by Lord Wellesley to proceed as envoy to the court of Persia for the purpose of counteracting the policy of the French by inducing that country to form a British alliance. Arriving at Teheran in December 1800, he was successful in negotiating favourable treaties, both political and commercial, and returned to Bombay by way of Bagdad in May 1801. He now for some time held the interim post of private secretary to Lord Wellesley, and in 1803 was appointed to the Mysore residency. At the close of the Mahratta War, in 1804, and again in 1805, he negotiated important treaties with Sindhia and Holkar, and in 1806, besides seeing the arrangements arising out of these alliances carried out, he directed the difficult work of reducing the immense body of irregular native troops. In 1808 he was again sent on a mission to Persia, but circumstances prevented him from getting beyond Bushire; on his reappointment in 1810, he was successful indeed in procuring a favourable reception at court, but otherwise his embassy, if the information which he afterwards incorporated in his works on Persia be left out of account, was (through no fault of his) without any substantial result. He sailed for England in 1811, and shortly after his arrival in the following year was knighted. His intervals of leisure he devoted to literary work, and especially to the composition of a *History of Persia*; which was published in two quarto volumes in 1815. On his return to India in 1817 he was appointed by Lord Moira his political agent in the Deccan, with eligibility for military command; as brigadier-general under Sir T. Hislop he took a distinguished part in the victory of Mehidpur (December 21, 1817), as also in the subsequent work of following up the fugitives, determining the conditions of peace and settling the country. In 1821 he returned once more to England, where he remained until 1827, when he was appointed governor of Bombay. His influence in this office was directed to the promotion of various economical reforms and useful administrative measures. Leaving India for the last time in 1830, he shortly after his arrival in England entered parliament as member for Launceston, and was an active opponent of the Reform Bill. He died of paralysis on the 30th of May 1833.

Besides the work mentioned above, Sir John Malcolm published *Sketch of the Political History of India since . . . 1784* (in 1811 and 1826); *Sketch of the Sikhs* (1812); *Observations on the Disturbances in the Madras Army in 1809* (1812); *Persia, a Poem*, anonymous (1814); *A Memoir of Central India* (2 vols., 1823); and *Sketches of Persia*, anonymous (1827). A posthumous work, *Life of Robert, Lord Clive*, appeared in 1836. See *Life and Correspondence of Sir John Malcolm*, by J. W. Kaye (2 vols., 1856).

MALDA, a district of British India, in the Rajshahi division of Eastern Bengal and Assam. Area, 1899 sq. m.; pop. (1901), 884,030, showing an increase of 8·5 in the decade. The administrative headquarters are at English Bazar (pop. 13,667) near the town of Old Malda. The district is divided into two almost equal parts by the Mahananda river, flowing from north to south. The western tract between the Mahananda and the main stream of the Ganges is an alluvial plain of sandy soil and great fertility. The eastern half is an elevated region broken by the deep valleys of the Tangan and Purnabhaba rivers and their small tributary streams. The soil here is a hard red clay; and the whole is overgrown with thorny tree jungle known as the *kātāl*. Agricultural prosperity centres on the Mahananda, where mango orchards and high raised plots of mulberry land extend continuously along both banks of the river. The Ganges nowhere intersects the district, but skirts it from its north-western corner to the extreme south. The Mahananda flows in a deep well-defined channel through the centre, and joins the Ganges at the southern corner. Its tributaries are the Kalindri on the right, and the Tangan and Purnabhaba on the left bank. The two principal industries are the production of indigo and silk. The first has declined, and so has the second as far as concerns the weaving of piece goods, but the rearing of silkworms and the export of raw silk and silk thread are carried on upon a large scale. No railway touches the district, but the communications by water are good.

Malda supplied two great capitals to the early Mahommedan kings of Bengal; and the sites of Gaur and Pandua exhibit the most interesting remains to be found in the lower valley of the Ganges. (See GAUR.) The connexion of the East India Company with Malda dates from a very early period. As far back as 1676 there was a factory there. In 1770 English Bazar was fixed upon for a commercial residency, the buildings of which at the present day form both the public offices and private residence of the collector.

MALDEN, a city, including several villages, of Middlesex county, Massachusetts, U.S.A., on the Malden river, about 5 m. N. of Boston. Pop. (1890), 23,031, (1900), 33,664, of whom 9513 were foreign-born, 3673 being English Canadians, 870 English, and 617 Swedes; (1910 census) 44,404. Malden had in 1906 a land area of 4·78 sq. m. It is served by the Boston & Maine railroad, and by inter-urban electric railways. Although it is largely a residential suburb of Boston—its post office is a Boston sub-station—it has important manufacturing industries. The most valuable manufactured product is rubber boots and shoes. The capital invested in manufacturing in 1905 was $5,553,432; and the value of the factory product, $11,235,635, was 70.2% greater than the value of the factory product in 1900. Among Malden's institutions are the public library (endowed by Elisha S. Converse), the Malden hospital, the Malden day nursery, a Young Men's Christian Association, and a home for the aged. A fine system of parks is maintained; the best known is possibly Pine Banks. To the north and west is the Middlesex Fells, a state reservation; about 60 acres of this and about 20 acres of the Middlesex Fells Parkway lie within Malden. Malden, when first settled about 1640, was part of Charlestown, and was known for some years as Mystic Side. It was incorporated as a town under the name of "Mauldon" in 1649, and was chartered as a city in 1881. The north part of Malden was set off in 1850 to form Melrose, and the south part in 1870 to form the town of Everett. Malden was the birthplace of Adoniram Judson, the "apostle to Burma." Michael Wigglesworth was pastor here from 1656 until 1705.

See D. P. Corey, *History of Malden* (Malden, 1899); and *Malden, Past and Present* (Malden, 1899).

MALDIVE ISLANDS, an archipelago of coral islets in the Indian Ocean, forming a chain between 7° 6′ N. and 0° 42′ S. It consists of seventeen atolls with an immense number of islands, of which some three hundred are inhabited. In the extreme south are the isolated atolls of Addu and Fua-Mulaku, separated from Suvadiva by the Equatorial Channel, which is itself separated from the main chain of atolls by One-and-a-half-degree Channel.[1] Following the chain northward from this channel we have Haddumati and Kolumadulu, after which the chain becomes double: to the east the chief atolls are Mulaku, Felidu, South Malé, North Malé, Kardiva (where the channel of the same name, 35 m. broad, partly breaks the chain), and Fadiffolu. To the west are South Nilandu, North Nilandu, Ari, South Mahlos, North Mahlos and Miladumadulu. To the north again are Tiladumati and Ihavandifulu. Finally, to the north of Eight-degree Channel is Minikoi, 71 m. from the nearest point of the Maldives, and 110 m. from that of the Laccadives to the north. The main part of the archipelago, north of One-and-a-half-degree Channel, consists of a series of banks either surrounded or studded all over with reefs (see J. S. Gardiner, "Formation of the Maldives," in *Geographical Journ.* xix. 277 seq.). Mr Gardiner regarded these banks as plateaus rising to different elevations beneath the surface of the sea from a main plateau rising steeply from the great depths of the Indian Ocean.

After the Portuguese, from about 1518 onwards, had attempted many times to establish themselves on the islands by force, and after the Maldivians had endured frequent raids by the Mopla pirates of the Malabar coast, they began to send tokens of homage and claims of protection (the first recorded being in 1645) to the rulers of Ceylon, and their association with this island has continued practically ever since. The hereditary sultan of the archipelago is tributary to the British government of Ceylon. The population of the Maldives is estimated at 30,000. All are Mahommedans. By Messrs. Gardiner and Cooper they are classed in four ethnological divisions. (1) Those of the atolls north of the Kardiva Channel. Here the reefs are generally less perfect than elsewhere, seldom forming complete central lagoons, and as they were formerly exposed to the constant attacks of the Mopla pirates from India, the people are hardier and more vigorous than their less warlike southern neighbours. They annually visited the coasts of India or Ceylon, and often married Indian wives, thus acquiring distinct racial characters of an approximately Dravidian type. (2) Those of the central division, comprising the atolls between North Malé and Haddumati, who are under the direct rule of the sultan, and have been more exposed to Arab influences. They formerly traded with Arabia and Malaysia, and many Arabs settled amongst them, so that they betray a strong strain of Semitic blood in their features. (3 and 4) The natives of Suvadiva, Addu, Mulaku and the other southern clusters, who have had little communication with the Central Malé people, and probably preserve more of the primitive type, approximating in appearance to the Sinhalese villagers of Ceylon. They are an intelligent and industrious people, growing their own crops, manufacturing their own cloth and mats, and building their own boats, while many read Arabic more or less fluently, although still believers in magic and witchcraft. The language is a dialect of Sinhalese, but indicating a separation of ancient date and more or less mahommedanized.

The sultan's residence and the capital of the archipelago is the island of Malé. From the earliest notices the production of coir, the collection of cowries, and the weaving of excellent textures on these islands have been noted. The chief exports of the islands besides coir and cowries (a decreasing trade) are coco-nuts, copra, tortoise-shell and dried bonito-fish.

Minikoi atoll, with the numerous wrecks on its reefs, its lighthouse, and its position on the track of all eastward-bound vessels, is a familiar sight to seafarers in these waters. The atoll, which is pear-shaped and disposed in the direction from S.W. to N.E. is 5 m. long, with an extreme breadth of nearly 3 m., with a large but shallow lagoon approached from the north by a passage two fathoms deep. The atoll is growing outwards on every side, and at one place rises 19 ft. above sea-level. The population, which numbers about 3000, is sharply divided into five castes, of which the three highest are pure Maldivians, the lower two the same as in the Laccadives. All are centred in a small village opposite Mou Rambu Point on the west or lagoon side; but most of the men are generally absent, many being employed with the Lascar crews on board the large liners plying in the eastern seas.

In 1899–1900 Messrs. J. Stanley Gardiner and C. Forster Cooper carried out an expedition to the Maldives and Laccadives, for the important results of which see *The Fauna and Geography of the Maldive and Laccadive Archipelagoes*, ed. J. S. Gardiner (Cambridge, 1901–1905), also *Proceedings of the Cambridge Philosophical Society*, vol. xi. pt. 1 (1900), and the *Geographical Journ.*, *loc. cit.*, &c. A French adventurer, François Pyrard de la Val, was wrecked in the Maldives in 1602 and detained there five years; he wrote an interesting account of the archipelago, *Voyage de F. P. de la Val* (Paris, 1679; previous editions 1611, &c.). See also A. Agassiz, "An Expedition to the Maldives," in *Amer. Journ. Science*, vol. xiii. (1902).

MALDON, a market town, municipal borough and port, in the Maldon parliamentary borough of Essex, England, on an acclivity rising from the south side of the Blackwater, 43 m. E.N.E. from London by a branch from Witham of the Great Eastern railway. Pop. (1901), 5565. There are east and west railway stations. The church of All Saints, dating from 1056, but, as it stands, Early English and later, consists of chancel, nave and aisles, with a triangular Early English tower (a unique form) at the west end surmounted by a hexagonal spire. The tower of St Mary's Church shows Norman work with Roman materials. The other public buildings are the grammar school, founded in 1547; the town-hall, formerly D'Arcy's tower, built in the reign of Henry VI.; and the public hall. There are manufactures of crystallized salt, breweries, an oyster fishery and some shipping. On Osea Island, in the Blackwater estuary, there is a farm colony for the unemployed. A mile west of Maldon are remains of Beeleigh Abbey, a Premonstratensian foundation of the 12th century. They consist of the chapter-house and another chamber, and are of fine Early English work. The borough is under a mayor, 4 aldermen and 12 councillors. Area, 3028 acres.

At Maldon (*Maeldune*, *Melduna*, *Mealdon* or *Meaudon*) palaeolithic, neolithic and Roman remains that have been found seem to indicate an early settlement. It is not, however, an important Roman site. An earthwork, of which traces exist, may be Saxon or Danish. The Anglo-Saxon Chronicle relates that Edward the Elder established a "burh" there about 921, and that Ealdorman Brihtnoth was killed there by the Danes in 991. The position of Maldon may have given it some commercial importance, but the fortress is the point emphasized by the Chronicle. Maldon remained a royal town up to the reign of Henry I., and thus is entered as on *terra regis* in Domesday. Henry II. granted the burgesses their first charter, probably in 1155, giving them the land of the borough and suburb with sac and soc and other judicial rights, also freedom from county and forest jurisdiction, danegeld, scutage, tallage and all tolls, by the service of one ship a year for forty days. This charter was confirmed by Edward I. in 1290, by Edward III. in 1344, and by Richard II. in 1378. In 1403 the bishop of London granted further judicial and financial rights, and Henry V. confirmed the charters in 1417, Henry VI. in 1443, and Henry VIII. in 1525. Maldon was incorporated by Philip and Mary in 1554, and received confirmatory charters from Elizabeth in 1563 and 1592, from Charles I. in 1631, Charles II. and James II. In 1768 the incorporation charter was regranted, with modifications in 1810.

MALEBRANCHE, NICOLAS (1638–1715), French philosopher of the Cartesian school, the youngest child of Nicolas

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[1] These and other channels in the locality are named from their position under parallels of latitude.

Malebranche, secretary to Louis XIII., and Catherine de Lauzon, sister of a viceroy of Canada, was born at Paris on the 6th of August 1638. Deformed and constitutionally feeble, he received his elementary education from a tutor, and left home only when sufficiently advanced to enter upon a course of philosophy at the Collège de la Marche, and subsequently to study theology at the Sorbonne. He had resolved to take holy orders, but his studious disposition led him to decline a stall in Notre Dame, and in 1660 he joined the congregation of the Oratory. He was first advised by Père Lecointe to devote himself to ecclesiastical history, and laboriously studied Eusebius, Socrates, Sozomen and Theodoret, but "the facts refused to arrange themselves in his mind, and mutually effaced one another." Richard Simon undertook to teach him Hebrew and Biblical criticism with no better success. At last in 1664 he chanced to read Descartes's *Traité de l'homme* (*de homine*), which moved him so deeply that (it is said) he was repeatedly compelled by palpitations of the heart to lay aside his reading. Malebranche was from that hour consecrated to philosophy, and after ten years' study of the works of Descartes he produced the famous *De la recherche de la vérité*, followed at intervals by other works, both speculative and controversial. Like most of the great metaphysicians of the 17th century, Malebranche interested himself also in questions of mathematics and natural philosophy, and in 1699 was admitted an honorary member of the Academy of Sciences. During his later years his society was much courted, and he received many visits from foreigners of distinction. He died on the 13th of October 1715; his end was said to have been hastened by a metaphysical argument into which he had been drawn in the course of an interview with Bishop Berkeley. For a critical account of Malebranche's place in the history of philosophy, see CARTESIANISM.

WORKS.—*De La recherche de la vérité* (1674; 6th ed., 1712; ed. Bouillier, 1880; Latin trans. by J. Lenfant at Geneva in 1685; English trans. by R. Sault, 1694; and T. Taylor, 1694, 1712); *Conversations chrétiennes* (1677, and frequently; Eng. trans., London, 1695); *Traité de la nature et de la grâce* (1680; Eng. trans., London, 1695); *Méditations chrétiennes et métaphysiques* (1683); *Traité de morale* (1684; separate ed. by H. Joly, 1882; Eng. trans. by Sir J. Shipton, 1699); several polemical works against Arnauld from 1684 to 1688; *Entretiens sur la métaphysique et sur la religion* (1688); *Traité de l'amour de Dieu* (1697); *Entretiens d'un philosophe chrétien et d'un philosophe chinois sur l'existence et la nature de Dieu* (1708); *Réflexions sur la prémotion physique* (1715).

A convenient edition of his works in two volumes, with an introduction, was published by Jules Simon in 1842. A full account by Mrs Norman Smith of his theory of vision, in which he unquestionably anticipated and in some respects surpassed the subsequent work of Berkeley, will be found in the *British Journal of Psychology* (Jan. 1905). For recent criticism see H. Joly, in the series *Les Grands philosophes* (Paris, 1901); L. Ollé-Laprune, *La Philosophie de Malebranche* (1870); M. Novaro, *Die Philosophie des Nicolaus Malebrancke* (1893).

MALER KOTLA, a native state of India, within the Punjab. It ranks as one of the Cis-Sutlej states, which came under British influence in 1809. The territory lies south of Ludhiana. Area, 167 sq. m. Pop. (1901), 77,506, showing an increase of 2% in the decade. Estimated gross revenue, £30,100. The military force numbers 280 men; and there is no tribute. The town Maler Kotla is 30 m. S. of Ludhiana; pop. (1901), 21,122. The nawab or chief is of Afghan descent; his family originally came from Kabul, and occupied positions of trust in Sirhind under the Mogul emperors. They gradually became independent as the Mogul Empire sank into decay in the course of the 18th century. In General Lake's campaign against Holkar in 1805 the nawab of Maler Kotla sided with the British. After the subjugation and flight of Holkar, the English government succeeded to the power of the Mahrattas in the districts between the Sutlej and the Jumna; and in 1809 its protection was formally extended to Maler Kotla, as to the other Cis-Sutlej states, against the formidable encroachments of Ranjit Singh. In the campaigns of 1806, 1807 and 1808 Ranjit Singh had made considerable conquests across the Sutlej; in 1808 he marched on Maler Kotla and demanded a ransom of £10,000 from the nawab. This led to the interference of the British, who addressed an ultimatum to Ranjit Singh, declaring the Cis-Sutlej states to be under British protection. Finally the raja of Lahore submitted, and the nawab was reinstated in February 1809. Owing to the mental incapacity of nawab Ibrahim Ali Khan, the state was administered in recent years for some time by the chief of Loharu; but his son, Ahmed Ali Khan, was made regent in February 1905.

See *Maler Kotla State Gazetteer* (Lahore, 1908).

MALESHERBES, CHRÉTIEN GUILLAUME DE LAMOIGNON DE (1721–1794), commonly known as Lamoignon-Malesherbes, French statesman, minister, and afterwards counsel for the defence of Louis XVI., came of a famous legal family. He was born at Paris on the 6th of December 1721, and was educated for the legal profession. The young lawyer soon proved his intellectual capacity, when he was appointed president of the *cour des aides* in the parlement of Paris in 1750 on the promotion of his father, Guillaume de Lamoignon, to be chancellor. One of the chancellor's duties was to control the press, and this duty was entrusted to Malesherbes by his father during his eighteen years of office, and brought him into connexion with the public far more than his judicial functions. To carry it out efficiently he kept in communication with the literary leaders of Paris, and especially with Diderot, and Grimm even goes so far as to say that "without the assistance of Malesherbes the *Encyclopédie* would probably never have been published." In 1771 he was called upon to mix in politics; the parlements of France had been dissolved, and a new method of administering justice devised by Maupeou, which was in itself commendable as tending to the better and quicker administration of justice, but pernicious as exhibiting a tendency to over-centralization, and as abolishing the hereditary "nobility of the robe," which, with all its faults, had from its nature preserved some independence, and been a check on the royal power. Malesherbes presented a strong remonstrance against the new system, and was at once banished to his country seat at St Lucie, to be recalled, however, with the old parlement on the accession of Louis XVI., and to be made minister of the *maison du roi* in 1775. He only held office nine months, during which, however, he directed his attention to the police of the kingdom, which came under his department, and did much to check the odious practice of issuing *lettres de cachet*. The protest of the *cour des aides* in 1775 is one of the most important documents of the old régime in France. It gives a complete survey of the corrupt and inefficient administration, and presented the king with most outspoken criticism. On retiring from the ministry with Turgot in 1776, he betook himself entirely to a happy country and domestic life and travelled through Switzerland, Germany and Holland. An essay on Protestant marriages (1787) did much to procure for them the civil recognition in France. He had always been an enthusiastic botanist; his avenue at St Lucie was world famous; he had written against Buffon on behalf of the botanists whom Buffon had attacked, and had been elected a member of the *Académie des sciences* as far back as 1750. He was now elected a member of the *Académie française*, and everything seemed to promise a quiet and peaceful old age spent in the bosom of his family and occupied with scientific and literary pursuits, when the king in his difficulties wished for the support of his name, and summoned him back to the ministry in 1787. Lamoignon-Malesherbes held office but a short time, but returned to his country life this time with a feeling of insecurity and disquiet, and, as the troubles increased, retired to Switzerland. Nevertheless, in December 1792, in spite of the fair excuse his old age and long retirement would have given him, he voluntarily left his asylum and undertook with Tronchet and Desèze the defence of the king before the Convention, and it was his painful task to break the news of his condemnation to the king. After this effort he returned once more to the country, but in December 1793 he was arrested with his daughter, his son-in-law M. de Rosambô, and his grandchildren, and on the 23rd of April 1794 he was guillotined, after having seen all whom he loved in the world executed before his eyes for their relationship to him. Malesherbes is one of the sweetest characters of the 18th century; though no man of action, hardly a man of the world, by his charity and unfeigned goodness he became one of the most popular men in France, and it was an act of truest self-devotion in him to sacrifice himself for a king who had done little or nothing for him.

There are in print several scientific works of Malesherbes of varying value, of which the most interesting is his *Observations sur Buffon et Daubenton*, written when he was very young, and published with a notice by Abeille in 1798. There exist also his *Mémoire pour Louis XVI.*, his *Mémoire sur la liberté de la presse* (published 1809) and extracts from his remonstrances, published as *Œuvres choisies de Malesherbes* in 1809. For his life should be read the *Notice historique* (3rd ed., 1806) of Dubois, the *Éloge historique* (1805) of Gaillard, and the interesting *Essai sur la vie, les écrits et les opinions de M. de Malesherbes* (in 2 vols., 1818), of F. A. de Boissy d'Anglas. There are also many *éloges* on him in print, of which the best-known is that of M. Dupin, which was delivered at the Academy in 1841, and was reviewed with much light on Malesherbes's control of the press by Sainte-Beuve in the 2nd volume of the *Causeries du lundi.* The protest of the *cour des aides* has been published with translation by G. Robinson in the *Translations and Reprints of the University of Pennsylvania* (1900). For his defence of Louis XVI. see Marquis de Beaucourt, *Captivité et derniers moments de Louis XVI.* (2 vols., 1892, Soc. d'hist. contemp.), and A. Tuetey, *Répertoire général des sources manuscrites de l'hist. de Paris pendant la Rev. fr.*, vol. viii. (1908).

MALET, LUCAS, the pen-name of Mary St Leger Harrison (1852–), English novelist. She was the eldest daughter of Charles Kingsley, and was born at Eversley on the 4th of June 1852. She studied at the Slade school and at University College, London, and married in 1876 William Harrison, rector of Clovelly. After her husband's death in 1897 she eventually settled in London. She had already written several books—*Mrs Lorimer* (1882), *Colonel Enderby's Wife* (1885), *Little Peter* (1887), *A Counsel of Perfection* (1888)—when she published her powerful story, *The Wages of Sin* (1891), which attracted great attention. Her *History of Sir Richard Calmady* (1901) had an even greater success. Her other novels include *The Carissima* (1896), *The Gateless Barrier* (1900), *On the Far Horizon* (1906).

MALHERBE, FRANÇOIS DE (1555–1628), French poet, critic and translator, was born at Caen in 1555. His family was of some position, though it seems not to have been able to establish to the satisfaction of heralds the claims which it made to nobility older than the 16th century. The poet was the eldest son of another François de Malherbe, *conseiller du roi* in the magistracy of Caen. He himself was elaborately educated at Caen, at Paris, at Heidelberg and at Basel. At the age of twenty-one, preferring arms to the gown, he entered the household of Henri d'Angoulême, grand prior of France, the natural son of Henry II. He served this prince as secretary in Provence, and married there in 1581. It seems that he wrote verses at this period, but, to judge from a quotation of Tallemant des Réaux, they must have been very bad ones. His patron died when Malherbe was on a visit in his native province, and for a time he had no particular employment, though by some servile verses he obtained a considerable gift of money from Henry III., whom he afterwards libelled. He lived partly in Provence and partly in Normandy for many years after this event; but very little is known of his life during this period. His *Larmes de Saint Pierre*, imitated from Luigi Tansillo, appeared in 1587.

It was in the year parting the two centuries (1600) that he presented to Marie de' Medici an ode of welcome, the first of his remarkable poems. But four or five years more passed before his fortune, which had hitherto been indifferent, turned. He was presented by his countryman, the Cardinal Du Perron, to Henry IV.; and, though that economical prince did not at first show any great eagerness to entertain the poet, he was at last summoned to court and endowed after one fashion or another. It is said that the pension promised him was not paid till the next reign. His father died in 1606, and he came into his inheritance. From this time forward he lived at court, corresponding affectionately with his wife, but seeing her only twice in some twenty years. His old age was saddened by a great misfortune. His son, Marc Antoine, a young man of promise, fell in a duel in 1626. His father used his utmost influence to have the guilty parties (for more than one were concerned, and there are grounds for thinking that it was not a fair duel) brought to justice. But he died before the suit was decided (it is said in consequence of disease caught at the camp of La Rochelle, whither he had gone to petition the king), in Paris, on the 16th of October, 1628, at the age of seventy-three.

The personal character of Malherbe was far from amiable, but he exercised, or at least indicated the exercise of, a great and enduring effect upon French literature, though by no means a wholly beneficial one. The lines of Boileau beginning *Enfin Malherbe vint* are rendered only partially applicable by the extraordinary ignorance of older French poetry which distinguished that peremptory critic. But the good as well as bad side of Malherbe's theory and practice is excellently described by his contemporary and superior Regnier, who was animated against him, not merely by reason of his own devotion to Ronsard but because of Malherbe's discourtesy towards Regnier's uncle P. Desportes, whom the Norman poet had at first distinctly copied. These are the lines:—

> " Cependant leur savoir ne s'étend nullement
> Qu'à régratter un mot douteuse au jugement,
> Prendre garde qu'un *qui* ne heurte une diphthongue,
> Epier si des vers la rime est brève ou longue,
> Ou bien si la voyelle à l'autre s'unissant
> Ne rend point à l'oreille un vers trop languissant.
>
> . . . .
>
> C'est proser de la rime et rimer de la prose."

This is perfectly true, and from the time of Malherbe dates that great and deplorable falling off of French poetry in its more poetic qualities, which was not made good till 1830. Nevertheless the critical and restraining tendency of Malherbe was not ill in place after the luxuriant importation and innovation of the *Pléiade*; and if he had confined himself to preaching greater technical perfection, and especially greater simplicity and purity in vocabulary and versification, instead of superciliously striking his pen through the great works of his predecessors, he would have deserved wholly well. As it was, his reforms helped to elaborate the kind of verse necessary for the classical tragedy, and that is the most that can be said for him. His own poetical work is scanty in amount, and for the most part frigid and devoid of inspiration. The beautiful *Consolation à Duperier*, in which occurs the famous line—

> Et, rose, elle a vécu ce que vivent les roses—

the odes to Marie de' Medici and to Louis XIII., and a few other pieces comprise all that is really worth remembering of him. His prose work is much more abundant, not less remarkable for care as to style and expression, and of greater positive value. It consists of some translations of Livy and Seneca, and of a very large number of interesting and admirably written letters, many of which are addressed to Peiresc, the man of science of whom Gassendi has left a delightful Latin life. It contains also a most curious commentary on Desportes, in which Malherbe's minute and carping style of verbal criticism is displayed on the great scale.

The chief authorities for the biography of Malherbe are the *Vie de Malherbe* by his friend and pupil Racan, and the long *Historiette* which Tallemant des Réaux has devoted to him. The standard edition is the admirable one of Ludovic Lalanne (5 vols., Paris, 1862–1869). Of the poems only, there is an excellent and handsome little issue in the *Nouvelle collection Jannet* (Paris, 1874). Of modern works devoted to him, *La Doctrine de Malherbe*, by G. Brunot (1891). is not only the most important but a work altogether capital in regard to the study of French language and literature. Others are A. Gasté, *La Jeunesse de Malherbe* (1890); V. Bourrienne, *Points obscurs dans la vie normande de Malherbe* (1895); and the duc de Broglie's "Malherbe" in *Les Grands écrivains français.* On his position in French and general critical history, G. Saintsbury's *History of Criticism*, vol. ii., may be consulted. (G. Sa.)

MALIBRAN, MARIE FÉLICITÉ (1808–1836), operatic singer, daughter of Manoel Garcia, was born in Paris on the 24th of March 1808. Her father was then a member of the company of the Théâtre des Italiens, and she accompanied him to Italy and London. She possessed a soprano voice of unusual beauty and phenomenal compass, which was carefully cultivated by her father. She was only seventeen when, in consequence of an indisposition of Madame Pasta, she was suddenly asked to take her place in *The Barber of Seville* at Covent Garden. She was forthwith engaged for the remaining six weeks of the season, and then followed her father to New York, where she appeared in *Othello*, *The Barber of Seville*, *Don Juan*, *Romeo and Juliet*, *Tancred*. Her gifts as an actress were on a par with her magnificent voice, and her gaiety made her irresistible in light opera, although her great triumphs were obtained chiefly in tragic parts. She married a French banker of New York, named Malibran, who was much older than herself. The marriage was an unhappy one, and Mme Malibran returned alone to Europe in 1828, when she began the series of representations at the Théâtre des Italiens, which excited an enthusiasm in Paris only exceeded by the reception she received in the principal towns of Italy. She was formally divorced from Malibran in 1835, and married the Belgian violinist, Charles de Beriot; but she died of fever on the 23rd of September 1836.

See *Memoirs of Mme Malibran by the comtesse de Merlin and other intimate friends, with a selection from her correspondence* (2 vols., 1840); and M. Teneo, *La Malibran, d'après des documents inédits*, in *Sammelbände der internationalen Musik-Gesellschaft* (Leipzig, 1906).

MALIC ACID (Hydroxyethylene Succinic Acid), $C_4H_6O_5$, an organic acid found abundantly in the juices of many plants, particularly in mountain-ash berries, in unripe apples and in grapes. The acid potassium salt is also found in the leaves and stalks of rhubarb. Since the acid contains an asymmetric carbon atom, it can exist in three forms, a dextro-rotatory, a laevo-rotatory and an inactive form; the acid obtained in the various synthetical processes is the inactive form. It may be prepared by heating racemic acid (see Tartaric Acid) with fuming hydriodic acid; by heating fumaric acid (*q.v.*) with water at 150–200° C.; by the action of nitrous acid on inactive aspartic acid; and by the action of moist silver oxide on monobromsuccinic acid. It forms deliquescent crystals, which are readily soluble in alcohol and melt at 100° C. When heated for some time at 130° C. it yields fumaric acid (*q.v.*), and on rapid heating at 180° C. gives maleic anhydride and fumaric acid. It yields coumarins when warmed with sulphuric acid and phenols (H. v. Pechmann, *Ber.*, 1884, 17, 929, 1649 et seq.). Potassium bichromate oxidizes it to malonic acid; nitric acid oxidizes it to oxalic acid; and hydriodic acid reduces it to succinic acid. The inactive variety may be split into the component active forms by means of its cinchonine salt (G. J. W. Bremer, *Ber.*, 1880, 13, 352).

MALIGNANT (Lat. *malignus*, evil-disposed, from *maligenus*), wicked, of a malicious or wilfully evil disposition. The word was early applied by the Protestants to the Romanists, with an allusion to the "congregation of evil doers" (Vulgate *Ecclesiam malignantium*) of Psalm xxvi. 5. In English history, during the Great Rebellion, the name was given to the Royalists by the Parliamentary party. In the Great Remonstrance of 1641 occur the words "the malignant partie, wherof the Archbishop (Laud) and the earl of Strafford being heads." The name throughout the period had special reference to the religious differences between the parties. In medical science, the term "malignant" is applied to a particularly virulent or dangerous form which a disease may take, or to a tumour or growth of rapid growth; extension to the lymphatic glands, and recurrence after operation.

MALIK IBN ANAS (*c.* 718–795), the founder of the Malikite school of canon law, was born at Medina about A.D. 718: the precise date is not certain. He studied and passed his life there, and came to be regarded as the greatest local authority in theology and law. (For his legal system and its history see Mahommedan Law.) His life was one of extreme honour and dignity, but uneventful, being given to study, lecturing on law and acting as muftī and judge. Only two episodes stand out in his biography. When Mahommed ibn 'Abdallāh, the 'Alid, rose in A.D. 762 at Medina against the 'Abbāsids, Malik gave a *fatwā*, or legal opinion, that the oath of allegiance to the 'Abbāsids was invalid, as extorted by force. For this independence he was severely scourged by the 'Abbasid governor, who, apparently, did not dare to go beyond scourging with a man of his standing with the people. The second episode gave equal proof of independence. In 795 Hārūn al-Rashīd made the pilgrimage, came with two of his sons to Medina, and sat at the feet of Malik as he lectured in the mosque. The story, legendary or historical, adds that Malik had refused to go to the caliph, saying that it was for the student to come to his teacher. Late in life he seems to have turned to asceticism and contemplation. It is said that he retired from all active, public life and even neglected plain, public duties, replying to reproaches, "Not every one can speak in his own excuse" (Ibn Qutaiba, *Ma 'ārif*, 250). He is also entered among the early ascetic Sūfīs (cf. *Fihrist*, 183). He died in Medina, A.D. 795.

For a description of his principal book, the *Muwaffa'*, see Goldziher's *Muhammedanische Studien*, ii. 213 sqq. He wrote also a Koran commentary, now apparently lost, and a hortatory epistle to Hārūn al-Rashid. See further, de Slane's trans. of Ibn Khallikān, ii. 545 sqq.; von Kremer, *Culturgeschichte*, i. 477 sqq.; Brockelmann, *Gesch. der arab. Litt.*, i. 175 sqq.; Macdonald, *Muslim Theology, &c.*, 99 sqq. and index; *Fihrist*, 198 seq.; Nawawi, 530 sqq. (D. B. Ma.)

MALINES (Flemish, *Mechelen*, called in the middle ages by the Latin name Mechlinia, whence the spelling Mechlin), an ancient and important city of Belgium, and the seat since 1559 of the only archbishopric in that country. Pop. (1904), 58,101. The name is supposed to be derived from *maris linea*, and to indicate that originally the sea came up to it. It is now situated on the Dyle, and is in the province of Antwerp, lying about half-way between Antwerp and Brussels. The chief importance of Malines is derived from the fact that it is in a sense the religious capital of Belgium—the archbishop being the primate of the Catholic Church in that country. The archbishop's palace is in a picturesque situation, and dates from the creation of the dignity. The principal building in the city is the exceedingly fine cathedral dedicated to St Rombaut. This cathedral was begun in the 12th and finished early in the 14th century, and although modified in the 15th after a fire, it remains one of the most remarkable specimens of Gothic architecture in Europe. The massive tower of over 300 ft., which is described as unfinished because the original intention was to carry it to 500 ft., is its most striking external feature. The people of Malines gained in the old distich—"gaudet Mechlinia stultis"—the reputation of being "fools," because one of the citizens on seeing the moon through the dormer windows of St Rombaut called out that the place was on fire, and his fellow-citizens, following his example, endeavoured to put out the conflagration until they realized the truth. The cathedral contains a fine altar-piece by Van Dyck, and the pulpit is in carved oak of the 17th century. Another old palace is that of Margaret of Austria, regent for Charles V., which has been carefully preserved and is now used as a court of justice. In the church of Notre Dame (16th century) is Rubens' masterpiece "the miraculous draught of fishes," and in that of St John is a fine triptych by the same master. Malines, although no longer famous for its lace, carries on a large trade in linen, needles, furniture and oil, while as a junction for the line from Ghent to Louvain and Liége, as well as for that from Antwerp to Brussels and the south, its station is one of the busiest in Belgium, and this fact has contributed to the general prosperity of the city.

The lordship of Malines was conferred as a separate fief by Pippin the Short on his kinsman Count Adon in 754. In the 9th century Charles the Bald bestowed the fief on the bishop of Liége, and after being shared between Brabant and Flanders it passed into the hands of Philip the Bold, founder of the house of Burgundy, in 1384. During the religious troubles of the 16th century Malines suffered greatly, and in 1572 it was sacked by Alva's troops during three days. In the wars of the 17th and 18th centuries it was besieged many times and captured by the French, Dutch and English on several occasions. The French finally removed the fortifications in 1804, since which year it has been an open town.

MALLANWAN, a town in Hardoi district, the United Provinces, India. Pop. (1901), 11,158. Under native rule the town possessed considerable political importance, and upon the British annexation of Oudh it was selected as the headquarters of the district, but was abandoned in favour of Hardoi after the Mutiny. Saltpetre and brass utensils are manufactured.

MALLARMÉ, FRANÇOIS RENÉ AUGUSTE (1755–1835), French Revolutionist, the son of a lawyer, was born at Nancy on the 25th of February 1755. He was brought up in his father's profession, and was appointed *procureur-syndic* of the district of Pont-à-Mousson. During the Revolution he was elected by the department of Meurthe deputy to the Legislative Assembly and the Convention, where he attached himself to the Mountain and voted for the death of Louis XVI. He was elected president of the Convention on the 30th of May 1793, and by his weakness during the crisis of the following day contributed much to the success of the insurrection against the Girondists. He took an active part in the *levée-en-masse*, and in November 1793 was given the task of establishing the revolutionary government in the departments of Meuse and Moselle, where he gained an unenviable notoriety by ordering the execution of the sentence of death decreed by the revolutionary tribunal on some young girls at Verdun who had offered flowers to the Prussians when they entered the town. After the fall of Robespierre he joined the group of "Thermidorians" and was sent on mission to the south of France, where he closed the Jacobin club at Toulouse and set free a number of imprisoned "suspects." On the 1st of June 1795 he was denounced and arrested, but was soon set at liberty. In 1796 he was appointed by the Directory commissioner for the organization of the departments of Dyle and Mont-Tonnerre. Under the empire he was receiver of the *droits réunis* at Nancy, and lost his money in 1814 in raising a levy of volunteers. Appointed sub-prefect of Avesnes during the Hundred Days, he was imprisoned by the Prussians in revenge for the death of the maidens of Verdun, and lived in exile during the Restoration. He returned to France after the revolution of 1830, and died at Richemont (Seine-Inférieure) on the 25th of July 1835.

MALLARMÉ, STÉPHANE (1842–1898), French poet and theorist, was born at Paris, on the 18th of March 1842. His life was simple and without event. His small income as professor of English in a French college was sufficient for his needs, and, with his wife and daughter, he divided the year between a fourth-floor flat in Paris and a cottage on the banks of the Seine. His Tuesday evening receptions, which did so much to form the thought of the more interesting of the younger French men of letters, were almost as important a part of his career as the few carefully elaborated books which he produced at long intervals. *L'Après-midi d'un faune* (1876) and other fragments of his verse and prose had been known to a few people long before the publication of the *Poésies complètes* of 1887, in a facsimile of his clear and elegant handwriting, and of the *Pages* of 1891 and the *Vers et prose* of 1893. His remarkable translation of poems of Poe appeared in 1888, "The Raven" having been published as early as 1875, with illustrations by Manet. *Divagations*, his own final edition of his prose, was published in 1897, and a more or less complete edition of the *Poésies*, posthumously, in 1899. He died at Valvins, Fontainebleau, on the 9th of September 1898. All his life Mallarmé was in search of a new aesthetics, and his discoveries by the way were often admirable. But he was too critical ever to create freely, and too limited ever to create abundantly. His great achievement remains unfinished, and all that he left towards it is not of equal value. There are a few poems and a few pieces of imaginative prose which have the haunting quality of Gustave Moreau's pictures, with the same jewelled magnificence, mysterious and yet definite. His later work became more and more obscure, as he seemed to himself to have abolished limit after limit which holds back speech from the expression of the absolute. Finally, he abandoned punctuation in verse, and invented a new punctuation, along with a new construction, for prose. Patience in the study of so difficult an author has its reward. No one in our time has vindicated with more pride the self-sufficiency of the artist in his struggle with the material world. To those who knew him only by his writings his conversation was startling in its clearness; it was always, like all his work, at the service of a few dignified and misunderstood ideas.

See also Paul Verlaine, *Les Poètes maudits* (1884); J. Lemaître, *Les Contemporains* (5th series, 1891); Albert Mockel, *Stéphane Mallarmé, un héros* (1899); E. W. Gosse, *French Profiles* (1905) and A. Symons, *The Symbolist Movement in Literature* (1900). A complete bibliography is given in the *Poètes d'aujourd'hui* (1880–1900, 11th ed., 1905) of MM. A. van Bever and P. Léautaud. (A. Sy.)

MALLECO, a province of southern Chile, once a part of the Indian territory of Araucania (*q.v.*), lying between the provinces of Bio-Bio on the N. and E., Cautin on the S. and Arauco on the W. Area, 2973 sq. m. Pop. (1895), 98,032. It belongs to the rainy, forested region of southern Chile, and is thinly populated, a considerable part of its population being Araucanian Indians, who occupy districts in the Andean foothills. Gold placer mining has attracted some attention, but the output is small. The principal industries are cattle and wheat raising and timber-cutting. The capital is Angol (pop., 7056 in 1895; estimated at 7638 in 1902), a small town in the northern part of the province, on the Malleco river, and a station on the Traiguen branch of the state railway. Traiguen (pop., 5732 in 1895; estimated at 7099 in 1902) in the southern part of the province is the second town in importance, and Victoria (pop., 6989 in 1895; estimated at 10,002 in 1902), about 20 m. E. of the last-named town, was for a time the terminal station of the main line of the railway.

MALLEMUCK, from the German rendering of the Dutch *Mallemugge* (which originally meant small flies or midges that madly whirl round a light), a name given by the early Dutch Arctic voyagers to the Fulmar (*q.v.*), of which the English form is nowadays most commonly applied by our sailors to the smaller albatrosses, of about the size of a goose, met with in the Southern Ocean—corrupted into "molly mawk," or "mollymauk." A number of species have been identified. *Diomedea irrorata* of West Peru is sooty-brown with white mottlings and a white head; *D. migripes* of the North Pacific is similar in colour but with white only near the eye and at the base of the tail and bill; *D. immutabilis* of Japan is darker but has a white head. *D. melanophrys* of the southern oceans has been found in summer both in California, in England, and as far north as the Faeroes. According to J. Gould the latter is the commonest species of albatross inhabiting the Southern Ocean, and its gregarious habits and familiar disposition make it well known to every voyager to or from Australia, for it is equally common in the Atlantic as well as the Pacific. The back, wings and tail are of a blackish-grey, but all the rest of the plumage is white, except a dusky superciliary streak, whence its name of black-browed albatross, as also its scientific epithet, are taken. The bill of the adult is of an ochreous-yellow, while that of the young is dark. This species breeds on the Falkland Islands. *D. bulleri* of the New Zealand seas is greyish-brown, with white underparts and rump and ashy head. *Diomedea* (or *Thalassogeron*) *culminata* and *chlororhyncha* of the southern seas, *D.* (or *T.*) *cauta* of Tasmania, *salvini* of New Zealand and *layardi* of the Cape resemble *D. bulleri*, but have a strip of naked skin between the plates of the maxilla towards its base. H. N. Moseley (*Notes of a Naturalist*, 130) describes *D. culminata* as making a cylindrical nest of grass, sedge and clay, with a shallow basin atop and an overhanging rim—the whole being about 14 in. in diameter and 10 in height. The bird lays a single white egg, which is held in a sort of pouch, formed by the skin of the abdomen, while she is incubating. The feet of *D. bulleri* are red, of *D. chlororhyncha* flesh-coloured, of the others yellow. (A. N.)

MALLESON, GEORGE BRUCE (1825–1898), Indian officer and author, was born at Wimbledon, on the 8th of May 1825. Educated at Winchester, he obtained a cadetship in the Bengal infantry in 1842, and served through the second Burmese War. His subsequent appointments were in the civil line, the last being that of guardian to the young maharaja of Mysore. He retired with the rank of colonel in 1877, having been created C.S.I. in 1872. He died at Kensington, on the 1st of March 1898. He was a voluminous writer, his first work to attract attention being the famous "Red Pamphlet," published at Calcutta in 1857, when the Mutiny was at its height. He continued, and considerably rewrote the *History of the Indian Mutiny* (6 vols., 1878–1880), which was begun but left unfinished by Sir John Kaye. Among his other books the most valuable are *History of the French in India* (2nd ed., 1893) and *The Decisive Battles of India* (3rd ed., 1888).

MALLET (or MALLOCH), **DAVID** (?1705–1765), Scottish poet and dramatist, the son of a Perthshire farmer, was born in that county, probably in 1705. In 1717 he went to the high school at Edinburgh, and some three years later to the university, where he made the friendship of James Thomson, author of *The Seasons*. As early as 1720 he began to publish short poems in the manner of the period, a number of which appeared during the next few years in collections such as the *Edinburgh Miscellany* and Allan Ramsay's *Tea Table Miscellany*, in which his ballad "William and Margaret" was published in 1724. For some years from 1723 he was private tutor to the duke of Montrose's sons, with whom he travelled on the Continent in 1727. His real name was Malloch; but this he changed to Mallet in 1724. In 1735 he took the M.A. degree at Oxford. He had already made the friendship of Pope, whose vanity he flattered in a poem on *Verbal Criticism*, in 1733; and through Pope he became acquainted with Bolingbroke and other Tory politicians, especially those attached to the party of the prince of Wales, who in 1742 appointed Mallet to be his paid secretary. After Pope's death, in 1744, Mallet, at the instigation of Bolingbroke and forgetful of past favours and friendship, vilified the poet's memory, thereby incurring the resentment of Pope's friends. For his services as a party pamphleteer, in which character he published an attack on Admiral Byng, Mallet received from Lord Bute a lucrative sinecure in 1760. He died on the 21st of April 1765. Mallet was a small man, in his younger days something of a dandy and inordinately vain. He was twice married; by his first wife he had a daughter, Dorothy, who married Pietro Paolo Celesia, a Genoese gentleman, and was the author of several poems and plays, notably *Almida*, produced by Garrick at Drury Lane in 1771.

Mallet's own works included several plays, some of which were produced by Garrick, who was Mallet's personal friend. *Eurydice*, a tragedy, with prologue and epilogue by Aaron Hill, was produced at Drury Lane in 1731; *Mustapha*, also a tragedy, had considerable success at the same theatre in 1739; in 1740, in collaboration with Thomson, he produced the masque *Alfred*, of which he published a new version in 1751, after Thomson's death, claiming it to be almost entirely his own work. This masque is notable as containing the well-known patriotic song, "Rule Britannia," the authorship of which has been attributed to Mallet, although he allowed it to appear without protest in his lifetime with Thomson's name attached. His other writings include *Poems on Several Occasions* (1743); *Amyntor and Theodora, or the Hermit* (1747); another volume of *Poems* (1762).

In 1759 a collected edition of Mallet's *Works* was published in three volumes; and in 1857 his *Ballads and Songs* were edited by F. Dinsdale with notes, and a biographical memoir of the author.

MALLET, PAUL HENRI (1730–1807), Swiss writer, was born on the 20th of August 1730, in Geneva. After having been educated there, he became tutor in the family of the count of Calenberg in Saxony. In 1752 he was appointed professor of *belles lettres* to the academy at Copenhagen. He was naturally attracted to the study of the ancient literature and history of his adopted country, and in 1755 he published the first fruits of his researches, under the title *Introduction à l'histoire du Danemarck où l'on traite de la religion, des mœurs, des lois, et des usages des anciens Danois*. A second part, more particularly relating to the ancient literature of the country, *Monuments de la mythologie et de la poésie des Celtes, et particulièrement des anciens Scandinaves*, was issued in 1756, and was also translated into Danish. A translation into English, with notes and preface, by Bishop Percy, was issued in 1770 under the title of *Northern Antiquities* (republished with additions in 1847). The book had a wide circulation, and attracted much attention on account of its being the first (though a very defective) translation into French of the *Edda*. The king of Denmark showed his appreciation by choosing Mallet to be preceptor of the crown prince. In 1760 he returned to Geneva, and became professor of history in his native city. While there he was requested by the czarina to undertake the education of the heir-apparent of Russia (afterwards the czar Paul I.), but declined the honour. An invitation more congenial to his tastes led to his accompanying Lord Mountstuart in his travels through Italy and thence to England, where he was presented at court and commissioned to write the history of the house of Brunswick. He had previously received a similar commission from the landgrave of Hesse-Cassel for the preparation of a history of the house of Hesse, and both works were completed in 1785. The quietude of a literary life was rudely broken by the shock of the Revolution, to which he was openly hostile. His leanings to the unpopular side were so obnoxious to his fellow-citizens that he was obliged to quit his native country in 1792, and remained in exile till 1801. He died at Geneva, on the 8th of February 1807.

A memoir of his life and writings, by Sismondi, was published at Geneva in 1807. Besides the *Introduction to the History of Denmark*, his principal works are: *Histoire du Danemarck* (3 vols., Copenhagen, 1758–1777); *Histoire de la maison de Hesse* (4 vols., 1767–1785); *Histoire de la maison de Brunswick* (4 vols., 1767–1785); *Histoire de la maison et des états du Mecklenbourg* (1796); *Histoire des Suisses ou Helvétiens* (4 vols., Geneva, 1803) (mainly an abridgment of J. von Müller's great history); *Histoire de la ligue hanséatique* (1805).

MALLET, ROBERT (1810–1881), Irish engineer, physicist and geologist, was born in Dublin, on the 3rd of June 1810. He was educated at Trinity College in that city, and graduated B.A. in 1830. Trained as an engineer, he was elected M.Inst.C.E. in 1842; he built in 1848–1849 the Fastnet Rock lighthouse, south-west of Cape Clear, and was engaged in other important works. Devoting much attention to pure science, he became especially distinguished for his researches on earthquakes, and from 1852–1858 he was engaged (with his son John William Mallet) in the preparation of his great work, *The Earthquake Catalogue of the British Association* (1858). In 1862 he published two volumes, dealing with the *Great Neapolitan Earthquake of 1857* and *The First Principles of Observational Seismology*. He then brought forward evidence to show that the depth below the earth's surface, whence came the impulse of the Neapolitan earthquake, was about 8 or 9 geographical miles. One of his most important essays was that communicated to the Royal Society (*Phil. Trans.* clxiii. 147; 1874), entitled *Volcanic Energy: an Attempt to develop its True Origin and Cosmical Relations*. He sought to show that volcanic heat may be attributed to the effects of crushing, contortion and other disturbances in the crust of the earth; the disturbances leading to the formation of lines of fracture, more or less vertical, down which water would find its way, and if the temperature generated be sufficient volcanic eruptions of steam or lava would follow. He was elected F.R.S. in 1854, and he was awarded the Wollaston medal by the Geological Society of London in 1877. He died at Clapham, London, on the 5th of November 1881.

MALLET DU PAN, JACQUES (1749–1800), French journalist, of an old Huguenot family, was born near Geneva in 1749, the son of a Protestant minister. He was educated at Geneva, and through the influence of Voltaire obtained a professorship at Cassel. He soon, however, resigned this post, and going to London joined H. S. N. Linguet in the production of his *Annales politiques* (1778–1780). During Linguet's imprisonment in the Bastille Mallet du Pan continued the *Annales* by himself (1781–1783); but Linguet resented this on his release, and Mallet du Pan changed the title of his own publication to *Mémoires historiques* (1783). From 1783 he incoporated this work with the *Mercure de France* in Paris, the political direction of which had been placed in his hands. On the outbreak of the French Revolution he sided with the Royalists, and was sent on a mission (1791–1792) by Louis XVI. to Frankfort to try and secure the sympathy and intervention of the German princes. From Germany he travelled to Switzerland and from Switzerland to Brussels in the Royalist interest. He published a number of anti-revolutionary pamphlets, and a violent attack on Bonaparte and the Directory resulted in his being exiled in 1797 to Berne. In 1798 he came to London, where he founded the *Mercure britannique*. He died at Richmond, Surrey, on the 10th of May 1800, his widow being pensioned by the English government. Mallet du Pan has a place in history as a pioneer of modern political journalism. His son JOHN LEWIS MALLET (1775–1861) spent a useful life in the English civil service, becoming secretary of the Board of Audit; and J. L. Mallet's second son, SIR LOUIS MALLET (1823–1890) also entered the civil service in the Board of Trade and rose to be a distinguished economist and a member of the Council of India.

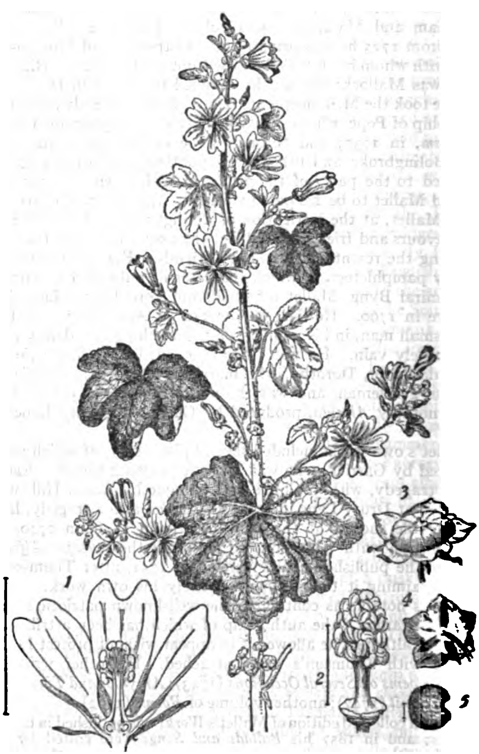
Mallet du Pan's *Mémoires et correspondance* was edited by A. Sayous (Paris, 1851). See *Mallet du Pan and the French Revolution* (1902), by Bernard Mallet, son of Sir Louis Mallet, author also of a biography of his father (1900).

MALLING, EAST and WEST, two populous villages in the Medway parliamentary division of Kent, England, respectively 5 and 6 m. W. by N. of Maidstone, with a station on the South-Eastern and Chatham railway. Pop. (1901), East Malling, 2391; West Malling, 2312. They are situated in a rich agricultural district on the western slope of the valley of the Medway, and East Malling has large paper mills. At West Malling are remains of Malling Abbey, a Benedictine nunnery founded in 1090 by Gundulf, bishop of Rochester. The remains, which are partly incorporated in a modern building, include the Norman west front of the church, the Early English cloisters, the chapter-house, gate-house (the chapel of which is restored to use), and other portions. About Addington near West Malling are considerable prehistoric remains, including mounds, single stones, stone circles and pits in the chalk hills; while at Leybourne are the gateway and other fragments of the castle held by the Leybourne family from the 12th to the 14th century.

MALLOCK, WILLIAM HURRELL (1849–), English author, was born at Cockington Court, Devonshire. He was educated privately, and at Balliol College, Oxford. He won the Newdigate prize in 1872, and took a second class in the final classical schools in 1874. He attracted considerable attention by his satirical story *The New Republic* (2 vols., 1877), in which he introduced characters easily recognized as prominent living men, Mark Pattison, Matthew Arnold, W.K. Clifford and others. His keen logic and gift for acute exposition and criticism were displayed in later years both in fiction and in controversial works. In a series of books dealing with religious questions he insisted on dogma as the basis of religion and on the impossibility of founding religion on purely scientific data. In *Is Life Worth Living?* (1879) and *The New Paul and Virginia* (1878) he attacked Positivist theories, and in a volume on the intellectual position of the Church of England, *Doctrine and Doctrinal Disruption* (1900), he advocated the necessity of a strictly defined creed. Later volumes on similar topics were *Religion as a Credible Doctrine* (1903) and *The Reconstruction of Belief* (1905). He published several brilliant works on economics, directed against Radical and Socialist theories: *Social Equality* (1882), *Property and Progress* (1884), *Labour and the Popular Welfare* (1893), *Classes and Masses* (1896) and *Aristocracy and Evolution* (1898); and among his anti-socialist works should be classed his novel, *The Old Order Changes* (1886). His other novels include *A Romance of the Nineteenth Century* (1881), *A Human Document* (1892), *The Heart of Life* (1895) and *The Veil of the Temple* (1904). He published a volume of *Poems* in 1880, and in 1900 *Lucretius on Life and Death* in verse.

MALLOW, a market town and watering place of Co. Cork, Ireland, on the Blackwater, 144½ m. S.W. from Dublin, and 21 N. from Cork by the Great Southern and Western railway. Pop. (1901), 4542. It is a junction for lines westward to Killarney and Co. Kerry, and eastward to Lismore and Co. Waterford. The town owes its prosperity to its beautiful situation in a fine valley surrounded by mountains, and possesses a tepid mineral spring, considered efficacious in cases of general debility and for scorbutic and consumptive complaints. A spa-house with pump-room and baths was erected in 1828. The parish church dates from 1818, but there are remains of an earlier building adjoining it. There are manufactures of mineral water and condensed milk, corn-mills and tanneries. Mallow received a charter of incorporation from James I. Its name was originally Magh Allo, that is, Plain of the Allo (the old name used by Spenser for this part of the river), and the ford was defended by a castle, built by the Desmonds, the ruins of which remain. A bridge connects the town with the suburb of Ballydaheen. Mallow is a centre for the fine salmon fishing on the Blackwater. The climate is very mild. The town was a parliamentary borough till 1885. It is governed by an urban district council.

MALLOW, botanically *Malva*, the typical genus of the natural order Malvaceae, embracing about sixteen species of annual and perennial herbaceous plants, widely distributed throughout the northern hemisphere. The mallows possess the reniform one-celled anthers which specially characterize the *Malvaceae* (*q.v.*). The petals also are united by their base to the tube formed by the coalesced filaments of the stamens. The special characters which separate the genus *Malva* from others most nearly allied to it are the involucre, consisting of a row of three separate bracts attached to the lower part of the true calyx, and the numerous single-seeded carpels disposed in a circle around a central axis, from which they become detached when ripe. The flowers are



Mallow (*Malva sylvestris*).

1. Flower in section.
2. Stamens showing the union of the filaments into a common tube (monadelphous).
3. Fruit with persistent calyx
   1, 2 and 5 enlarged.
4. Same seen from the back showing the 3-leaved epicalyx.
5. Seed.

mostly white or pinkish, never yellow, the leaves radiate-veined, and more or less lobed or cut. Three species are natives of Britain. The musk mallow (*Malva moschata*) is a perennial herb with five-partite, deeply-cut leaves, and large rose-coloured flowers clustered together at the ends of the branched stems, and is found growing along hedges and borders of fields, blossoming in July and August. It owes its name to a slight musky odour diffused by the plant in warm dry weather when it is kept in a confined situation. The round-leaved dwarf mallow (*Malva rotundifolia*) is a creeping perennial, growing in waste sandy places, with roundish serrate leaves and small pinkish-white flowers produced in the axils of the leaves from June to September. It is common throughout Europe and the north of Africa, extending to western and northern Asia. The common mallow (*Malva sylvestris*), the *mauve* of the French, is an erect biennial or perennial plant with long-stalked roundish-angular serrate leaves, and conspicuous axillary reddish-purple flowers, blossoming from May to September. Like most plants of the order it abounds in mucilage, and hence forms a favourite domestic remedy for colds and sore throats. The aniline dye called mauve derives its name from its resemblance to the colour of this plant.

The marsh mallow (*Althaea officinalis*), the *guimauve* of the French, belongs to another genus having an involucre of numerous bracts. It is a native of marshy ground near the sea or in the neighbourhood of saline springs. It is an erect perennial herb, with somewhat woody stems, velvety, ovate, acute, unequally serrate leaves, and delicate pink showy flowers blooming from July to September. The flowers are said to yield a good deal of honey to bees. The marsh mallow is remarkable for containing asparagin, $C_4H_8N_2O_3,H_2O$, which, if the root be long kept in a damp place, disappears, butyric acid being developed. The root also contains about 25 % of starch and the same quantity of mucilage, which differs from that of gum arabic in containing one molecule less of water and in being precipitated by neutral acetate of lead. It is used in *pâte de guimauve* lozenges. *Althaea rosea* is the hollyhock (*q.v.*).

The mallow of Scripture, Job xxx. 4, has been sometimes identified with Jew's mallow (*Corchorus olitorius*), a member of the closely allied order Tiliaceae, but more plausibly (the word מלח implying a saline plant) with *Atriplex Halimus*, or sea orache. In Syria the *Halimus* was still known by the name *Mallūh* in the time of Ibn Beitar. See Bochart, *Hieroz.* iii. 16.

MALMEDY, a town of Germany, in the Prussian Rhine Province, lying in a wild and deep basin, on the Warche, 20 m. S. of Aix-la-Chapelle by rail via Eupen. It contains two Roman Catholic churches, a modern town-hall and a classical school. Its industries include tanning, dyeing and paper-making. Pop. (1900), 4680. Malmedy was famous for its Benedictine abbey, founded about 675, which was united with that of Stablo, the abbot of the joint house being a prince of the empire. In 1802 the lands of the abbey passed to France, and in 1815 they were divided between Prussia and Netherlands.

See Kellen, *Malmedy und die preussische Wallonie* (Essen, 1897).

MALMESBURY, JAMES HARRIS, 1st Earl of (1746–1820), English diplomatist, was born at Salisbury on the 21st of April 1746, being the son of James Harris (*q.v.*), the author of *Hermes*. Educated at Winchester, Oxford and Leiden, young Harris became secretary in 1768 to the British embassy at Madrid, and was left as *chargé d'affaires* at that court on the departure of Sir James Grey until the arrival of George Pitt, afterwards Lord Rivers. This interval gave him his opportunity; he discovered the intention of Spain to attack the Falkland Islands, and was instrumental in thwarting it by putting on a bold countenance. As a reward he was appointed minister *ad interim* at Madrid, and in January 1772 minister plenipotentiary to the court of Prussia. His success was marked, and in 1777 he was transferred to the court of Russia. At St Petersburg he made his reputation, for he managed to get on with Catherine in spite of her predilections for France, and steered adroitly through the accumulated difficulties of the first Armed Neutrality. He was made a knight of the Bath at the end of 1778, but in 1782 he returned home owing to ill-health, and was appointed by his friend Fox to be minister at the Hague, an appointment confirmed after some delay by Pitt (1784). He did very great service in furthering Pitt's policy of maintaining England's influence on the Continent by the arms of her allies, and held the threads of the diplomacy which ended in the king of Prussia's overthrowing the republican party in Holland, which was inclined to France, and re-establishing the prince of Orange. In recognition of his services he was created Baron Malmesbury of Malmesbury (Sept. 1788), and permitted by the king of Prussia to bear the Prussian eagle on his arms, and by the prince of Orange to use his motto "Je maintiendrai." He returned to England, and took an anxious interest in politics, which ended in his seceding from the Whig party with the duke of Portland in 1793; and in that year he was sent by Pitt, but in vain, to try to keep Prussia true to the first coalition against France. In 1794 he was sent to Brunswick to solicit the hand of the unfortunate Princess Caroline for the prince of Wales, to marry her as proxy, and conduct her to her husband in England. In 1796 and 1797 he was at Paris and Lille vainly negotiating with the French Directory. After 1797 he became partially deaf, and quitted diplomacy altogether; but for his long and eminent services he was in 1800 created earl of Malmesbury, and Viscount Fitzharris, of Heron Court in the county of Hants. He now became a sort of political Nestor, consulted on foreign policy by successive foreign ministers, trusted by men of the most different ideas in political crises, and above all the confidant, and for a short time after Pitt's death almost the political director, of Canning. Younger men were also wont to go to him for advice, and Lord Palmerston particularly, who was his ward, was tenderly attached to him, and owed many of his ideas on foreign policy directly to his teaching. His later years were free from politics, and till his death on the 21st of November 1820 he lived very quietly and almost forgotten. As a statesman, Malmesbury had an influence among his contemporaries which is scarcely to be understood from his writings, but which must have owed much to personal charm of manner and persuasiveness of tongue; as a diplomatist, he seems to have deserved his reputation, and shares with Macartney, Auckland and Whitworth the credit of raising diplomacy from a profession in which only great nobles won the prizes to a career opening the path of honour to ability. He was succeeded as 2nd earl by his son James Edward (1778–1841), under-secretary for foreign affairs under Canning; from whom the title passed to James Howard, 3rd earl of Malmesbury (*q.v.*).

Malmesbury did not publish anything himself, except an account of the Dutch revolution, and an edition of his father's works, but his important *Diaries* (1844) and *Letters* (1870) were edited by his grandson.

MALMESBURY, JAMES HOWARD HARRIS, 3rd Earl of (1807–1889), English statesman, son of the 2nd earl, was born on the 25th of March 1807, and educated at Eton and Oriel College, Oxford. He led a life of travel for several years, making acquaintance with famous people; and in 1841 he had only just been elected to the House of Commons as a Conservative, when his father died and he succeeded to the peerage. His political career, though not one which made any permanent impression on history, attracted a good deal of contemporary attention, partly from his being foreign secretary in 1852 and again in 1858–1859 (he was also lord privy seal in 1866–1868 and in 1874–1876), and partly from his influential position as an active Tory of the old school in the House of Lords at a time when Lord Derby and Mr Disraeli were, in their different ways, moulding the Conservatism of the period. Moreover his long life—he survived till the 17th of May 1889—and the publication of his *Memoirs of an Ex-Minister* in 1884, contributed to the reputation he enjoyed. These *Memoirs*, charmingly written, full of anecdote, and containing much interesting material for the history of the time, remain his chief title to remembrance. Lord Malmesbury also edited his grandfather's *Diaries and Correspondence* (1844), and in 1870 published *The First Lord Malmesbury and His Friends: Letters from 1745 to 1820*. He was succeeded as 4th earl by his nephew, Edward James (1842–1899), whose son, James Edward (b. 1872) became the 5th earl in 1899.

MALMESBURY, a market town and municipal borough in the Chippenham parliamentary division of Wiltshire, England, 94½ m. W. of London by the Great Western railway. Pop (1901),

2854. It lies on a ridge surrounded on all sides except the north-west by the river Avon and a small tributary. The church of St Mary and St Aldhelm, standing high, is a majestic fragment consisting of the greater part of the nave (with aisles) of a Benedictine abbey church. The ruined skeleton of the great tower arches now terminates the building eastward. The nave is transitional Norman, with a Decorated superstructure including the clerestory. The south porch is one of the finest Norman examples extant, both the outer and the inner doorways (especially the first) exhibiting the typical ornament of the period in remarkable exuberance. With the exception of a crypt, the monastic buildings have disappeared. In the market square stands a fine market cross of the 16th century, borne upon an octagonal battlemented basement. Early English fragments of a hospital of St John of Jerusalem appear in the corporation almshouse. Malmesbury has an agricultural trade, with breweries, tanneries and manufactures of silk and pillow lace. It is governed by a mayor, 4 aldermen and 12 councillors. Area, 178 acres.

Maildulphus, a Scottish or Irish monk, who came into England about 635, built a hermitage near the site of the modern Malmesbury (*Maildulphi-urbs*, *Maldelmesburh*, *Malmesbiri*) and gathered disciples round him, thus forming the nucleus of the later abbey of which Aldhelm his pupil became the first abbot. Æthelstan, who was buried here (though his tomb in the church only dates from the 16th century), rebuilt and endowed the monastery. Round the abbey the town of Malmesbury grew up, and by the time of the Domesday Survey it had become one of the only two Wiltshire boroughs. The first charter, said to be a forgery, purports to have been given by Æthelstan. It granted to the burgesses all privileges and free customs such as they held in the time of Edward the Elder, with many additional exemptions, in return for help rendered against the Danes. The castle built at Malmesbury during the reign of Henry I. gave a further impetus to the growth of the town during the 12th and 13th centuries. It was not incorporated, however, until 1645, when it was made a free borough under the title of "aldermen and burgesses of the borough of Malmesbury, County Wilts." By this charter it was governed until 1885. The borough returned two members to parliament from 1295 to 1832 when the number was reduced to one. Finally in 1885 its representation was merged in that of the county. A grant of a yearly fair on the 31st of March, the feast of St Aldhelm, was obtained from William II., and another for three days from the 25th of July from John. In 1792 fairs were held on the 28th of March, the 28th of April and the 29th of June, but in 1891 they had ceased entirely. John also granted a weekly market on Thursday. In the 16th and 18th centuries it was held on Saturday, and in 1891 on the third Wednesday in each month. In the middle ages Malmesbury possessed a considerable cloth manufacture, and at the Dissolution the abbey was bought by a rich clothier and fitted with looms for weaving. The trade in wool still flourished in 1751.

See *Victoria County History: Wiltshire*; and *Registrum malmesburiense* (1879–1880).

MALMÖ, a seaport of Sweden, chief town of the district (*län*) of Malmöhus, on a small bay of the Sound, 384 m. S.S.W. of Stockholm by rail. Pop. (1800), 38,054; (1900), 60,857. It is connected with Copenhagen, 17½ m. W. by N., by steam-ferry, the Sound being kept open in winter by an ice-breaker. It is also the first important station in Sweden on the Berlin-Stockholm route, which crosses the sea between Sassnitz in Rügen and Trelleborg, 20 m. S.E. of Malmö. The town, which stands upon a level plain, formerly had strong fortifications, of which only the citadel (Malmöhus) remains; in it the earl of Bothwell was imprisoned by Frederick II. of Denmark for some time after his departure from Scotland in 1567. The town-hall (1546, largely restored in 1864) contains a handsome chamber, the Knutssal, formerly used by the council of the gild of Canute. The hall fronts the central square (*Stortorg*) which is planted with trees and contains a colossal statue of Charles X. by Johan Helenus Börjeson (b. 1835) erected in 1896. The most notable church is that of St. Peter (*Peterkyrka*), dating in part from 1319. Malmö is second to Stockholm as an industrial centre. There are breweries and large works for the manufacture of machinery, among which may be mentioned the Kockum mechanical works, with yards for the construction of vessels of war, and others; of cotton and woollen goods, gloves, chocolate, sweetmeats and tobacco. A large export trade is carried on in butter and other agricultural produce, and matches. Coal is the chief import. The harborage includes an outer harbour of 22 ft. depth, and two inner basins admitting vessels of 21 ft. draught, with dry dock and patent slip. Malmö returns four members to the second chamber of the Riksdag (parliament).

Malmö (Malmhauge, Malmey, Malmöye, Malmoughe), sometimes called *Ancona Scanorum* or *Ellenbogen*, first appears in history about the middle of the 13th century. During the Hanseatic period it was the most important commercial town on the Sound, but in the 16th and 17th centuries greatly lost ground owing to the decay of its herring fisheries and the rise of its rival, Copenhagen. Its modern prosperity is largely due to the enterprise of Frans Snell, one of its merchants in the second half of the 18th century, who first constructed the harbour.

MALMSEY, a strong sweet wine, originally made at Monemvasia (Gr. *Μονεμβασία*), Napoli di Malvasia, in the Morea, Greece. The name of the place was corrupted in Med. Lat. into *malmasia*, whence the English form of the word. The corruption malvasia gives the O. Fr. *malvesie*, from which comes the alternative English form "malvoisie." The wine is now made not only in Greece but also in Spain, Madeira and the Azores.

MALOCELLO, LANCILOTO ("LANZAROTE, the 'Lancelot Maloisiel' of the French"), leader of the first of modern European oceanic enterprises. This was a Genoese expedition, which about 1270 seems to have sailed into the Alantic, re-discovered the "Fortunate Islands" or Canaries, and made something of a conquest and settlement in one of the most northerly isles of this archipelago, still known (after the Italian captain) as Lanzarote. According to a Spanish authority of about 1345, the anonymous Franciscan's *Conosçimiento de todos los reinos*, "Lancarote" was killed by the Canarian natives; but the castle built by him was standing in 1402–1404, when it was utilized for the storage of grain by the French conquerors under Gadifer de la Salle. To Malocello's enterprise, moreover, it is probable that Petrarch (born 1304) alludes when he tells how, within the memory of his parents, an armed fleet of Genoese penetrated to the "Fortunatae"; this passage some would refer, without sufficient authority, to the expedition of 1291. Malocello's name and nationality are certainly preserved by those early *Portolani* or scientific charts (such as the "Dulcert" of 1339 and the "Laurentian Portolano" of 1351), in which the African islands appear, for the first time in history, in clear and recognizable form. Thus Dulcert reads *Insula de Lanzarotus* and *Marocelus*, the Laurentian map *I. de Lanzarote*, against Lanzarote Island, which is well depicted on both designs, and marked with the cross of Genoa. The *Conosçimiento* (as noticed above) explicitly derives the island-name from the Genoese commander who perished here. Malocello's enterprise not only marks the beginning of the oversea expansion of western Europe in exploration, conquest and colonization (after the age of Scandinavian world-roving had passed); it is also probably not unconnected with the great Genoese venture of 1291 (in search of a waterway to India, which soon follows), with which this attempt at Canarian discovery and dominion has been by some unjustifiably identified.

See the *Conosçimiento*, p. 100, as edited by Marcos Jimenez de la Espada in the *Boletin de la sociedad geográfica de Madrid*, February 1877); *Le Canarien* in P. Margry, *Conquête des . . . Canaries*, p. 177; M. A. P. d'Avezac in vol. vi., part ii., of *L'Univers*, pp. 1–41 (*Îles africaines de l'océan atlantique*); C. R. Beazley, *Dawn of Modern Geography*, iii. 411–413, 449, 451.

MALOLOS, a town and the capital of the province of Bulacán, island of Luzon, Philippine Islands, on a branch of the Pampanga

Grande river. Pop. (1903), after the annexation of Barasoain and Santa Isabel, 27,025. There are thirty-eight villages, or barrios, of which eight had, in 1903, 1000 inhabitants or more. The principal language is Tagalog, but Spanish is spoken to some extent. Malolos is served by the Manila & Dagupan railway, and is a trade centre of considerable importance. The cultivation of rice is an important industry. In 1898–99, during the Filipino revolt, Malolos was the seat of the rebel government, but it was captured and reduced to desolation in March 1899. In 1904 a new municipal school building, a municipal market and a provincial building were erected.

MALONE, EDMOND (1741–1812), Irish Shakespearian scholar and editor, was born in Dublin, on the 4th of October 1741, the son of a barrister and a member of the Irish House of Commons. He was educated at Trinity College, Dublin, and was called to the Irish bar in 1767. The death of his father in 1774 assured him a competency, and he went to London, where he frequented literary and artistic circles. He frequently visited Dr Johnson and was of great assistance to Boswell in revising and proof-reading his *Life*, four of the later editions of which he annotated. He was intimate with Sir Joshua Reynolds, to whom he sat for a portrait now in the National Portrait Gallery. He was one of Reynolds' executors, and published a posthumous collection of his works (1798) with a memoir. Horace Walpole, Burke, Canning, Lord Charlemont, and, at first, George Steevens, were among Malone's friends. Encouraged by the two last he devoted himself to the study of Shakespearian chronology, and the results of his "Attempt to ascertain the Order in which the Plays of Shakespeare were written" (1778) are still largely accepted. This was followed in 1780 by two supplementary volumes to Steevens's version of Dr Johnson's *Shakespeare*, partly consisting of observations on the history of the Elizabethan stage, and of the text of doubtful plays; and this again, in 1783, by an appendix volume. His refusal to alter some of his notes to Isaac Reed's edition of 1785, which disagreed with Steevens's, resulted in a quarrel with the latter. The next seven years were devoted to Malone's own edition of Shakespeare in eleven volumes, of which his essays on the history of the stage, his biography of Shakespeare, and his attack on the genuineness of the three parts of Henry VI., were especially valuable. His editorial work was lauded by Burke, criticized by Walpole and damned by Joseph Ritson. It certainly showed indefatigable research and proper respect for the text of the earlier editions. Malone published a denial of the claim to antiquity of the Rowley poems (see CHATTERTON), and in this (1782) as in his branding (1796) of the Ireland MSS. (see IRELAND, WILLIAM HENRY) as forgeries, he was among the first to guess and state the truth. His elaborate edition of Dryden's works (1800), with a memoir, was another monument to his industry, accuracy and scholarly care. In 1801 the university of Dublin made him an LL.D. At the time of his death, on the 25th of April 1812, Malone was at work on a new octavo edition of Shakespeare, and he left his material to James Boswell the younger; the result was the edition of 1821—generally known as the Third Variorum edition—in twenty-one volumes. Lord Sunderlin (1738–1816), his elder brother and executor, presented the larger part of Malone's splendid collection of books, including dramatic varieties, to the Bodleian Library, which afterwards bought many of his MS. notes and his literary correspondence. The British Museum also owns some of his letters and his annotated copy of Johnson's *Dictionary*.

A memoir of Malone by James Boswell is included in the *Prolegomena* to the edition of 1821. See also Sir J. Prior's *Life of Edmond Malone* (1860).

MALONE, a village and the county-seat of Franklin county, in the township of Malone, in the N.E. part of New York, U.S.A., about 60 m. E.N.E. of Ogdensburg. Pop. (1890), 4986; (1900), 5935 (910 foreign-born); (1905, state census), 6478; (1910), 6467. It is served by the New York Central & Hudson River and the Rutland (N.Y. Central Lines) railways. The village has a Memorial Park, Arsenal Green, on the site of an arsenal and parade-ground sold by the state in 1850, a state armoury, the Northern New York Institute for Deaf Mutes, Franklin Academy, St Joseph's Ursuline Academy, and a detention-house for Chinamen entering the state from Canada. From Malone tourists visit the Great North Woods, in the Adirondack foothills, about 15 m. distant. Iron ore and Potsdam sandstone are found near Malone. In the surrounding region hops, potatoes, &c., are grown, and there are dairying and livestock interests. The village is a centre for the collection of hides and pelts. It manufactures woollen goods, paper and pulp, &c., and has foundry and machine shops and car repair shops. Malone, being on the line of communication between lakes Champlain and Ontario, was of strategic importance in the war of 1812, and later was twice the rendezvous of Fenians for attacks on Canada. The township of Malone was settled and erected from Chateaugay in 1805. The village was first known as Harison, was named Ezraville, in honour of Ezra L'Hommedieu in 1808, received its present name in 1812, and was incorporated in 1853.

MALONIC ACID, $C_3H_4O_4$ or $CH_2(COOH)_2$, occurs in the form of its calcium salt in the sugar beet. It was first prepared in 1858 by V. Dessaignes, who obtained it by oxidizing malic acid (*Ann.*, 1858, 107, p. 251). It may also be obtained by oxidizing allylene and propylene with cold potassium permanganate solution, by the hydrolysis of barbituric acid (malonyl urea) with alkalis (A. Baeyer, *Ann.*, 1864, 130, p. 143); by the hydrolysis of cyanacetic acid (H. Kolbe, *Ann.*, 1864, 131, p. 349; H. Muller, *Ann.*, 1864, 131, p. 352), and by the action of silver oxide on β-di-chloracrylic ester at 125° C. (O. Wallach, *Ann.*, 1878, 193, p. 25)

$$\mathrm{CCl_2{:}CH{\cdot}COOC_2H_5 + Ag_2O + H_2O =}$$
$$\mathrm{2AgCl + HOOC{\cdot}CH_2{\cdot}COOC_2H_5.}$$

It crystallizes in monoclinic tables, and is readily soluble in water, alcohol and ether. The acid melts at 132° C., and at a higher temperature it rapidly decomposes into acetic acid and carbon dioxide. When heated with bromine and water to 100° C. it forms tribromacetic acid, some bromoform being produced at the same time. Malonic acid, as well as its esters, is characterized by the large number of condensation products it can form. In the presence of a dehydrating agent (such as acetic anhydride), it combines with aldehydes to form compounds of the type $R \cdot CH{:}\,C(COOH)_2$, or their decomposition products (formed by loss of CO_2) $R \cdot CH : CH \cdot COOH$.

Many salts of the acid are known and, with the exception of those of the alkali metals, they are difficultly soluble in water. Many esters of malonic acid have been prepared, the most important being the *diethyl ester* (*malonic ester*), $CH_2(COOC_2H_5)_2$, which is obtained by dissolving monochloracetic acid in water, neutralizing the solution with potassium carbonate, and then adding potassium cyanide and warming the mixture until the reaction begins. When the reaction has finished, the whole is evaporated and heated to about 130°–140° C. and then allowed to cool. The mass is then covered with two-thirds of its weight of alcohol, and saturated with hydrochloric acid gas. The whole is then poured into ice-cold water, extracted by ether and the ethereal solution distilled (L. Claisen, *Ann.*, 1883, 218, p. 131). It is a colourless liquid boiling at 197°·7–198°·2 C. (W. H. Perkin). It is a most important synthetic reagent; with sodium or sodium ethylate it forms sodio-malonic ester, which reacts readily with alkyl halides, forming alkyl malonic esters, which are again capable of forming sodium derivatives, that by further treatment with alkyl halides yield the di-alkyl malonic esters. These esters are readily hydrolysed and yield the mono- and di-alkyl malonic acids which, on heating, are readily decomposed, with evolution of carbon dioxide and the formation of mono- and di-alkyl acetic acids. The scheme of reactions is shown thus:

$$\begin{tikzcd}
\mathrm{CH_2(COOR)_2} \arrow[r] & \mathrm{CHNa(COOR)_2} \arrow[r, "\mathrm{R'I}"] & \mathrm{CHR'(COOR)_2} \arrow[d, "\mathrm{NaOH}"] \\
\mathrm{CO_2 + CH_2R'{\cdot}COOH} & & \mathrm{CHR'(COOH)_2} \arrow[ll] \\
\mathrm{[CHR'(COOH)_2NaOH} \arrow[r] & \mathrm{CNaR'(COOR)_2} \arrow[r, "\mathrm{R''I}"] & \mathrm{CR'R''(COOR)_2} \arrow[d, "\mathrm{NaOH}"] \\
& \mathrm{CO_2 + CHR'R''{\cdot}COOH} & \mathrm{CR'R''(COOH)_2} \arrow[l]
\end{tikzcd}$$

When sodio-malonic ester is heated to 145° C., it undergoes condensation, with elimination of alcohol and formation of the benzene derivative, *phloroglucin tricarboxylic ester*. The addition of urea to an alcoholic solution of sodio-malonic ester results in the formation of barbituric acid (A. Michael, *Jour. pr. Chem.*, 1887 [2], 35, p. 456)

The half nitrile of malonic acid is *cyanacetic acid*, $CN\cdot CH_2\cdot COOH$, which, in the form of its ester, may be obtained by the action of a solution of potassium cyanide on monochloracetic acid. The solution obtained is neutralized, concentrated on the water-bath, acidified by sulphuric acid and extracted with ether. It is then converted into the lead salt, which is decomposed by sulphuretted hydrogen and the solution is carefully concentrated (Th. Meves, *Ann.*, 1867, 143, p. 201). It melts at 70° C. and at higher temperatures decomposes, with evolution of carbon dioxide and formation of aceto-nitrile, $CH_3\cdot CN$. The true nitrile of malonic acid is *methylene cyanide*, $CH_2(CN)_2$, which is obtained by distilling a mixture of cyanacetamide and phosphorus pentoxide. It is a crystalline solid, which melts at 29°–30° C. and boils at 218°–219° C., and is readily soluble in alcohol and ether.

MALORY, SIR THOMAS, translator and compiler of the famous English classic, the *Morte d'Arthur*. Previous to the publication of Professor Kittredge's monograph, *Who was Sir Thomas Malory?* the identity of this writer remained an unsolved problem. Mr. Sidney Lee, in the *Dictionary of National Biography*, was compelled to admit that he could find no one of that name fulfilling the necessary conditions. Of direct evidence we have very little; in the concluding passage of the book the author asks the prayers of the reader for "Syr Thomas Maleore knyght," and states that the book was ended "the ix. yere of the reygne of Kyng Edward the fourth." Caxton, in his preface, says that he printed the book "after a copye unto me delivered whyche copye Syr Thomas Malorye dyd take oute of certeyn bookes of frensshe and reduced it in to Englysshe"; in his colophon he repeats this statement, adding that he himself is responsible for the division of the work into books and chapters, and that it was printed in 1485. It will be noted that Caxton does not say that he received the book from Malory, only that he had received a copy made by Malory; from this Professor Kittredge draws the conclusion that the compiler was no longer living. The problem then is to find a Thomas Malory who was (*a*) a knight, (*b*) alive in the ninth year of King Edward IV. (Mar. 4, 1469–Mar. 3, 1470), and (*c*) who was no longer living in July (or June) 1485.

All these conditions Professor Kittredge finds fulfilled in the life of Sir Thomas Malory, knight, of Newbold Revell (or Fenny Newbold), M.P. for Warwickshire in 1445. The date of Sir Thomas's birth is uncertain, but he succeeded his father, Sir John, in 1433 or 1434. Previously to this he had served in France, in the retinue of the earl of Warwick, most probably during the time that that nobleman held the office of captain of Calais. It seems probable that he is also to be identified with a "Thomas Malorie, miles," who in 1468 was, on account of the part played by him in the Wars of the Roses, excluded with several others from the operation of a pardon issued by Edward IV. As, however, on the death of Sir Thomas on the 14th of March 1470, there was no difficulty as to inheritance, his estates passing to his grandson, he must, if this identification be correct, have come under the general amnesty of 1469. It will be seen, therefore, that so far as it is in our power to state the question this Sir Thomas Malory fulfils all the necessary conditions.

It is interesting to note that the career of the earl of Warwick in France was marked by certain picturesque and chivalric features which might well impress the imagination of a young retainer. John Rous, in his *Life of Richard Earl of Warwick*, tells us that at a certain tourney held near Calais at Christmastide, Earl Richard appeared three days running in different armour, overthrowing his adversary on each occasion—an exploit obviously imitated from the chivalric romances of the period.

The work with which Malory's name is connected is an abridged compilation of the great body of Arthurian romance in its latest form. The *Merlin* (Vulgate and Suite), *Tristan*, *Lancelot*, *Queste* and *Mort Artus* are all represented, the only branch omitted is that dealing with the "early history" of the Grail, the *Joseph of Arimathea* and *Grand S. Graal*. Thanks mainly to the labours of Dr Oskar Sommer, we can now assign the majority of the books to their separate sources, although certain stories, such as the adventures of Sir Gareth under the pseudonym of Beaumains, the handling of Sir Urre of Hungary, and the details of the abduction of Guenevere by Meleagaunt, still remain unidentified. But we do not yet know whether Malory himself was responsible for this selection, or whether he found it ready to hand in a MS., the "Frensshe Booke" to which he often refers. To make such a compilation at first hand, considering the extent of the ground covered, would involve an enormous amount of study and selection, and the access to a very large library—conditions which scarcely seem to fit in with the social position and activities of Sir Thomas. On the other hand it is undeniable that the medieval copyists, at the instance of their patrons, did make compilations from the various romances within their reach, such as *e.g.* the enormous codex 112 (*fonds Franç.*) of the Bibliothèque Nationale, which includes large sections of the *Tristan*, the *Lancelot*, and the *Merlin* Suite. Taking into consideration alike what Malory retains and what he omits, it seems most probable that he was in possession, not of complete copies of the romances, but of one or more volumes of compilations from these sources.

From the point of view of matter it must be admitted that the *Morte d' Arthur* does not represent the Arthurian cycle at its best, but rather in the period of its decadence; nor does Malory in any way endeavour to overcome the difficulties caused by the juxtaposition of a number of independent (and often contradictory) versions. This is especially noticeable in his treatment of Gawain; in the section derived from the *Lancelot* and *Mort Artus* he is a good and valiant knight, "a ful noble knyghte as ever was borne," in those derived from the *Tristan* and the *Queste*, he is treacherous, dissolute, and a murderer of good knights.

The great charm of Malory's work lies in his style; stately, earnest and dignified, it has lent to the relations between Lancelot and Guenevere a character of truth and vitality in which the French original is wholly lacking. Malory achieved a remarkable feat—he took the Arthurian story in its worst and weakest form and he imparted to it a moral force and elevation which the cycle, even in its earlier and finer stage, had, save in the unique case of Von Eschenbach's *Parzival*, never possessed. While genuine lovers of the Arthurian cycle must regret that the romances should only be known to the great majority of English readers through the versions of Malory and Tennyson, it is impossible to withhold from the *Morte d' Arthur* the admiration due to an imperishable monument of English language and literature.

See *Who was Sir Thomas Malory?* G. L. Kittredge (*Harvard Studies and Notes*, vol. v., 1896); *Morte d'Arthur*, ed. by Dr Oskar Sommer (an exact reproduction of the original text in 2 vols.)—vol. iii. a study on "*The Sources of Malory*." The sections on *Lancelot* and *Queste* are unfortunately very inadequate; for these cf. *The Legend of Sir Lancelot*, Grimm Library, vol. xii. (J. L. W.)

MALOT, HECTOR HENRI (1830–1907), French novelist and man of letters, the son of a notary, was born at La Bouille (Seine Inférieure) on the 20th of May 1830. He studied law at Rouen and Paris, but literature early absorbed his attention. He collaborated in the *Biographie générale* of Didot, became literary critic of *L'Opinion Nationale*, and dramatic critic of the *Lloyd français*. He is the author of a long series of popular novels dealing with contemporary life, including: a trilogy of domestic novels entitled *Victimes d'amour* (1859, 1865, 1866); *Un Beau frère* (1869); *Madame Obernin* (1870); *Le Docteur Claude* (1879); *Justice* (1889). *Les Aventures de Romain Kalbris* (1869) and *Sans famille* (1888) are excellent stories for children. A complete edition of Hector Malot's works appeared in 1894–1897. He died at Vincennes in July 1907.

MALOU, JULES ÉDOUARD XAVIER (1810–1886), Belgian statesman, one of the leaders of the clerical party, was born at Ypres on the 19th of October 1810. He was a civil servant in the department of justice when he was elected to the Chamber of Deputies by his native constituency in 1841, and was for some time governor of the province of Antwerp. He was minister of finance in the coalition ministry of J. B. Nothomb in 1844, and formed with B. T. de Theux a Catholic cabinet in 1846, which was overthrown in the Liberal victory of 1847. Malou then became a member of the senate, and his party only regained ascendancy in 1870. The extreme clerical ministry of Baron d'Anethan retired in December 1871 after serious rioting in Brussels, and Malou was the real, though not the nominal, head of the more moderate clerical administrations of de Theux and Aspremont-Lynden (1870–1878) He was wise enough to disavow the noisy sympathy of Belgian Ultramontane politicians with the German victims of the *Kulturkampf*, and, retaining in his own hands the portfolio of finance, he subordinated his clerical policy to a useful administration in commercial matters, including a development of the railway system. It was only after the fall of the ministry in 1878 that he adopted a frankly clerical policy, and when he became chief of a new government in June 1884 he proceeded to undo the educational compromise of his predecessors in the Frère-Orban ministry. His legislation in favour of the Catholic schools caused rioting in Brussels, and in October the king demanded the retirement of MM. Jacobs and Woeste, the members of the cabinet against whom popular indignation was chiefly directed. Malou followed them into retirement, and died at Woluwe Saint Lambert, in Brabant, on the 11th of July 1886. He was a financier of great knowledge and experience, and his works (of which a long list is given in Koninck's *Bibliographie nationale de Belgique*) include three series (1874–1880) of memoirs on financial questions, edited by him for the Chamber of Deputies, besides pamphlets on railroad proposals, mining and other practical questions. His brother Jean Baptiste Malou (1809–1864) was a well-known divine.

MALOUET, PIERRE VICTOR, BARON (1740–1814), French publicist and politician, was born at Riom (Puy-de-Dôme) on the 11th of February 1740, the son of a lawyer. He entered the civil service and was employed successively at the French embassy in Lisbon, in the administrative department of the duc de Broglie's army, as commissary in San Domingo from 1767–1774, and, after his return to France, as commissary-general of the marine. In 1776 he was entrusted to carry out plans of colonization in French Guiana, but was superseded in 1779. On his return to France he was well received at court, and the execution of his plans in Guiana was assured. He became intendant of the port of Toulon, and in 1789 was returned to the states-general, where he soon became well known as a defender of the monarchical principle. He emigrated to England in September, 1792, but shortly afterwards sought in vain permission to return to assist in the defence of Louis XVI. His name was erased from the list of emigrants in 1801 by Napoleon, who restored him to his position in the service and sent him to Antwerp as commissioner-general and maritime prefect to superintend the erection of defence works, and the creation of a fleet. He entered the council of state in 1810, but, having offended the emperor by his plainness of speech, he was disgraced in 1812. At the Restoration, Louis XVIII. made him minister of marine; and he died on the 7th of September 1814.

The most important documents for his domestic and colonial policy are a *Collection de ses opinions à l'Assemblée Nationale* (3 vols., 1791–1792); and *Collection de mémoires et correspondances officielles, sur l'administration des colonies et notamment sur la Guiane française et hollandaise* (5 vols. 1802).

MALPIGHI, MARCELLO (1628–1694), Italian physiologist, was born at Crevalcuore near Bologna, on the 10th of March 1628. At the age of seventeen he began the study of philosophy; it appears that he was also in the habit of amusing himself with the microscope. In 1649 he started to study medicine; after four years at Bologna he graduated there as doctor. He at once applied to be admitted to lecture in the university, but it was not till after three years (1656) that his request was granted. A few months later he was appointed to the chair of theoretical medicine at Pisa, where he enjoyed the friendship and countenance of G. A. Borelli. At the end of four years he left Pisa, on the ground of ill-health, and returned to Bologna. A call to be professor primarius at Messina (procured for him through Borelli, who had in the meantime become professor there) induced him to leave Bologna in 1662. His engagement at Messina was for a term of four years, at an annual stipend of 1000 scudi. An attempt was made to retain him at Messina beyond that period, but his services were secured for his native university, and he spent the next twenty-five years there In 1691, being then in his sixty-fourth year, and in failing health, he removed to Rome to become private physician to Pope Innocent XII., and he died there of apoplexy three years later, on the 30th of November 1694. Shortly before his death, he drew up a long account of his academical and scientific labours, correspondence and controversies, and committed it to the charge of the Royal Society of London, a body with which he had been in intimate relations for more than twenty years. The autobiography, along with some other posthumous writings, was published in London in 1696, at the cost of the Society. The personal details left by Malpighi are few and dry. His narrative is mainly occupied with a summary of his scientific contributions and an account of his relations to contemporary anatomists, and is entirely without graces of style or elements of ordinary human interest.

Malpighi was one of the first to apply the microscope to the study of animal and vegetable structure; and his discoveries were so important that he may be considered to be the founder of microscopic anatomy. It was his practice to open animals alive, and some of his most striking discoveries were made in those circumstances. Although Harvey had correctly inferred the existence of the capillary circulation, he had never seen it; it was reserved for Malpighi in 1661 (four years after Harvey's death) to see for the first time the marvellous spectacle of the blood coursing through a network of small tubes on the surface of the lung and of the distended urinary bladder of the frog. We are enabled to measure the difficulties of microscopic observation at the time by the fact that it took Malpighi four years longer to reach a clear understanding of the corpuscles in the frog's blood, although they are the parts of the blood by which its movement in the capillaries is made visible. His discovery of the capillary circulation was given to the world in the form of two letters *De Pulmonibus*, addressed to Borelli, published at Bologna in 1661 and reprinted at Leiden and other places in the years following; these letters contained also the first account of the vesicular structure of the human lung, and they made a theory of respiration for the first time possible. The achievement that comes next both in importance and in order of time was a demonstration of the plan of structure of secreting glands; against the current opinion (revived by F. Ruysch forty years later) that the glandular structure was essentially that of a closed vascular coil from which the secretion exuded, he maintained that the secretion was formed in terminal acini standing in open communication with the ducts. The name of Malpighi is still associated with his discovery of the soft or mucous character of the lower stratum of the epidermis, of the vascular coils in the cortex of the kidney, and of the follicular bodies in the spleen. He was the first to attempt the finer anatomy of the brain, and his descriptions of the distribution of grey matter and of the fibre-tracts in the cord, with their extensions to the cerebrum and cerebellum, are distinguished by accuracy; but his microscopic study of the grey matter conducted him to the opinion that it was of glandular structure and that it secreted the "vital spirits." At an early period he applied himself to vegetable histology as an introduction to the more difficult study of the animal tissues, and he was acquainted with the spiral vessels of plants in 1662. It was not till 1671 that he wrote his *Anatome plantarum* and sent it to the Royal Society, who published it in the following year. An English work under a similar title (*Anatomy of Vegetables*) had been published in London a few months earlier, by Nehemiah Grew; so that Malpighi's priority as a vegetable histologist is not so incontestable as it is in animal histology. The *Anatome plantarum* contained an appendix, *Observations de ovo incubato*, which gave an account (with good plates) of the development of the chick (especially of the later stages) in many points more complete than that of Harvey, although the observations were needlessly lessened in value by being joined to the metaphysical notion of "praedelineation" in the undeveloped ovum.

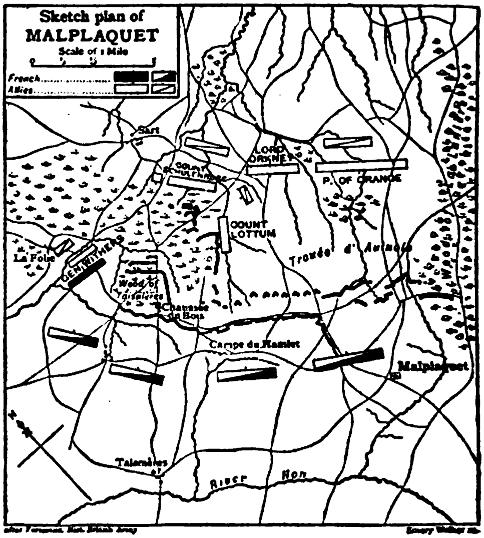
He also wrote *Epistolae anatomicae Marc. Malpighii et Car. Fracassati* (Amsterdam, 1662) (on the tongue, brain, skin, omentum, &c.); *De viscerum structura: exercitatio anatomica* (London, 1669); *De structura glandularum conglobatarum* (London, 1689); *Opera posthuma, et vita a seipso scripta* (London, 1697; another edition, with preface and additions, was published at Amsterdam in 1700.) An edition containing all his works except the last two was published in London in 1687, in 2 vols. folio, with portrait and plates.

MALPLAQUET, a village of France in the department of the Nord, close to the Belgian frontier and about 10 miles S. by E. of Mons, famous as the scene of the battle, September 1709, between the Allies under the duke of Marlborough and Prince

Eugène and the French commanded by Marshal Villars, in which the former were victorious. The country to the west and south of Mons is enclosed by a semicircular wall of woods and broken ground, through which there are only two important gaps—that of Jemappes (famous in 1792) to the west, and that of Aulnois, in which stands the village of Malplaquet, to the south. In the latter gap and the woods on either side Villars took up his position facing north-eastwards, on August 29/September 9. The forces in presence, over 90,000 on each side, were exceptionally large, and the French army in particular represented the spirit of its nation to a degree unusual in the armies of that time. Villars was the best general in the service of Louis XIV. and the veteran Marshal Boufflers, though senior to him, had volunteered to serve as his second in command. Marlborough and Eugène lay with their army between Mons and the French camps, which were almost within cannon shot. Marlborough's own wish was for an immediate battle, but he was opposed by the Dutch deputies at his headquarters, and even by Eugène, so that it was only on August 31/September 11 that the attack actually took place. Villars had made full use of his respite. The French right stood at the fringe of the wood of Lanière, the left was strongly posted in the midst of the wood of Taisnière, and across the two and a half miles of open ground between the woods the position was entrenched with several successive lines of works. The troops were almost equally distributed along the whole line as usual, and the cavalry was massed in rear of the infantry. In the Allied army the mounted troops were also kept back, but for the most part distributed to the various infantry commands.

The intention of Marlborough and Eugène, when on the morning of the battle they examined this formidable position, was to deliver the main attack upon the French left wing, combining the assaults of several columns on its front and flanks. In this quarter the French not only held the interior of the wood but also were thrown forward so as to occupy the edges of its north-eastern salient, and upon the two faces of this salient Count Lottum (1650–1719) with the Prussians, and Count von der Schulenburg (1661–1747) with the Austrian infantry were to deliver a double attack, while farther to the Allied right a column under the English General Withers was detached to make a wide turning movement through the woods. Marlborough took command on the right, Eugène on the left. The centre, which was intended only to observe the enemy until the decision had been forced at the wood of Taisnière, consisted of Lord Orkney's British corps and the prince of Orange's Dutch contingent. These extended across the Trouée d'Aulnois as soon as the combined attack of Lottum and Schulenburg opened. The general advance was covered by a heavy cannonade, and the salient of the Taisnière wood was duly attacked on its two faces by the Prussians and Austrians about 9 a.m. They encountered a sterner resistance than in any of the battles and combats of the past seven campaigns, for on this field the defenders were fighting, not as hitherto for the interests of their king, but to defend their country, and the regiments of Picardie and Champagne which held the salient were the oldest and most famous of the French line. Lottum attacked the works on the eastern edge, again and again without success, until three British battalions had to be sent to reinforce him, and Marlborough placed himself with a corps of cavalry in close support. At last the entrenchments were stormed. Schulenburg, with the Austrians, had by this time fought his way through the woods and undergrowth, and the united force pressed back the French farther and farther into the wood. Still, so stubborn was the defence and so dense the wood that the impetus of the assault died away and the troops on both sides broke up into small disconnected bodies, fighting too fiercely to be amenable to superior control.

But the French were not reinforced from their right wing as Villars expected. The prince of Orange, far from merely observing the hostile right as he had been ordered to do, committed his corps, very early in the battle, to a serious assault upon it, which Boufflers repulsed with enormous loss. The Dutch infantry never recovered from its casualties on this day, and the memory of Malplaquet was strong even at Fontenoy nearly forty years afterwards. Some Hanoverian troops which took part in this futile attack suffered equally heavily. The only advantage to the Allies—an advantage which, as it happened, counted for much—was that Boufflers did not dare to send reinforcements to the hard-pressed left wing. Thanks to this the Austrians and Prussians, with the English detached to their aid, made steady progress in the wood of Taisnière. Villars launched the "Irish brigade" to check the advance of the Allies, and this famous corps charged into the forest. Villars, Eugène and Marlborough personally led their troops in the encounter which followed. Eugène was wounded, but refused to quit the field. Villars was more seriously hurt, and after trying in vain to direct the fighting from a chair was carried insensible from the field. At this crisis General Withers, who commanded the force that had been ordered to turn the French extreme left, and had fought his way through the forest, appeared on the scene. The British 18th regiment (Royal Irish), encountering the French *Royal Irlandais*, put it to the rout, and Villars's counterstroke was at an end. The French maintained themselves on this side only by the aid of troops drawn from the centre and right, and this gave the Allied centre the opportunity which the prince of Orange had so rashly anticipated. The great attack over the open was carried out, in spite of the previous repulse, with the greatest determination. Preceded by forty guns, the corps of the prince of Orange and Lord Orkney swiftly carried the first line of works. The Allied cavalry then pushed out to the front, and horse, foot and artillery were combined in the last advance. Boufflers's cavalry masses, coming into play for the first time, fought hard, and the struggle fluctuated with the arrival of successive reserves on either side, but in the end, shortly before 3 p.m., Boufflers (who had been in command since Villars's fall) decided to retreat. The Allies had no troops left intact for the pursuit, and those engaged had expended their last efforts. Moreover Boufflers, experienced soldier as he was, drew off his men before they had lost their order and discipline.



After Hon. J. W. Fortescue, *History of the British Army*, by permission of Macmillan & Co., Ltd.

Thus this "very murdering battle" as Marlborough called it—the last and greatest pitched battle of the war—was almost barren of results. The Allies lost not less than twenty thousand men, or nearly a quarter of the whole force, the thirty battalions of the Dutch infantry losing half their numbers. On the French side there were some twelve thousand casualties. If further evidence were necessary to prove that the French fought their hardest, it could be found in the fact that whereas in almost every other battle, from 1660 to 1792, there were deserters and prisoners by the thousand, at Malplaquet only 500 of the French fell into the hands of the victors unwounded.

MALSTATT-BURBACH, a town of Germany, in the Prussian Rhine province on the right bank of the Saar (Sarre), which separates it from Saarbrücken. Pop. (1900), 31,195. It lies in the midst of an important coal-mining and industrial district, and is itself little more than a long and narrow row of manufactories and workmen's houses. The largest factories are engaged in the production of iron, steel and cement. There is a large wharf on the river for the export of coal.

Malstatt received municipal rights in 1321. These, however, were afterwards resigned to the newer town of Saarbrücken, and in 1818 Malstatt and Burbach were two small villages with a joint population of only about 800. About the middle of the century the population began to increase rapidly, in consequence of the development of the mining industry of the district and the extension of the railway system, and in 1874 the two villages were united to form a town.

MALT (O. Eng., *mealt*; O. Sax., *malt*; O. Teut., *maltos*; Mod. Ger., *Malz*; Scand., *malt*; probably derived from the Sanskrit *mrdu*, soft, thus having reference to the fact that malt is raw grain rendered soft or tender), the name given to grain in which germination has been caused to proceed to a certain stage and has then been arrested by the removal of water and the application of heat. During this limited germination enzymes are developed (see FERMENTATION), and the constituents of the grain modified so that the finished malt, when ground and submitted to the mashing process (see BREWING), differs from the original raw grain in that the greater portion dissolves. This solubility is, however, a direct one to a slight extent only; it is due for the most part to the action of the malt enzymes, diastase, &c. on the constituents of the grain, the main portion of which are of themselves insoluble. Thus starch, the main constituent of all graminaceous seeds, probably exists in the same condition in raw grain and in malt. When however the malt is mashed, the starch is attacked by the enzyme diastase, and converted by the process of hydrolysis into a mixture of soluble compounds, *e.g.* the crystalline sugar, maltose, and a number of gummy substances known as maltodextrins. But to a certain extent starch and other carbohydrate substances are rendered directly soluble and diffusible during the malting process, some of the products serving the respiratory needs of the growing germ, others being assimilated by the plantlet and reconverted into reserve carbohydrates in the tissues of the germ and rootlets, whilst the remaining portions are retained as such in the finished malt. Similarly certain of the nitrogenous constituents of the grain, the proteins, are broken down and rendered soluble by proteolytic enzymes, the products being assimilated to a certain extent by the germ and rootlets, by the cells of which they are again built up into complex proteins, whilst others remain in their simplified form. It is now known that proteolytic enzymes exist in finished malt, and that, when the mashing process is conducted under certain conditions, these are able to degrade and render soluble some of the higher proteins present in the malt. When germination is allowed to proceed as it does when the grain is planted in the soil, the whole of the contents are rendered soluble by degrees and in turn assimilated by the growing plantlet. By the limited germination which constitutes the malting process, however, the balance of soluble compounds left in the finished malt is from 15 to 25% of the total weight of the corn.

Although other seeds of the natural order Gramineae are occasionally malted, the greater portion of malt is made from the various species of *Hordeum*, known by the name of barley (*q.v.*), bigg, or bere. Indeed ordinary beer derives its characteristic flavour to the greatest extent from barley malt. A small proportion of malted oats or malted wheat is sometimes used in conjunction with barley malt for certain kinds of beer, whilst rye, maize, and even rice are occasionally malted. Barley is, however, the grain best adapted for making malt intended for brewing beer, and accordingly some space will be devoted to a description of those varieties of this grain which are used by the brewer.

Barley belongs to the genus Hordeum, of which there are numerous species and varieties. Linnaeus and the earlier botanists recognized six species of cultivated barleys, but modern botanists usually consider all cultivated barleys as belonging to one species to which the name *H. sativum* has been given. Körnicke regards *H. spontaneum*, a very long thin-grained two-rowed barley (see below) which grows in the East, as being the parent form; but E. S. Beaven inclines to the view that wild species of more than one form were originally used as food and subsequently cultivated. The last-named author has drawn up a scheme of classification for the varieties and races of cultivated barleys.

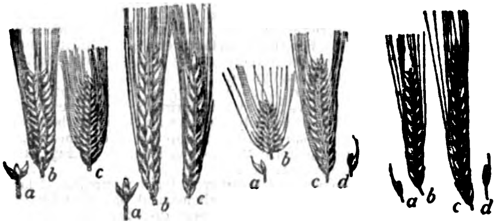


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

Six-rowed barleys.

FIG. 1.—*H. hexastichum.*
a. Three spikelets *in situ* on the rachis, showing short internodes.
b. Spike. Median spikelets uppermost, and with lower awns removed.
c. Spike. Lateral spikelets uppermost, and with lower awns removed.

FIG. 2.—*H. vulgare.*
a. Three spikelets *in situ* on the rachis, showing long internodes.
b. Spike. Median spikelets uppermost.
c. Spike. Lateral spikelets uppermost.

Two-rowed barleys.

FIG. 3.—*H. zeocriton.*
a, d. Spikelets. Rachis edgewise, showing short internodes.
b. Var. *zeocrithum* (fan barley). Spike converging.
c. Var. *erectum* (Goldthorpe). Spike parallel.

FIG. 4.—*H. distichum.*
a, d. Spikelets. Rachis edgewise, showing long internodes.
b. Var. *nutans* (Chevallier).
c. Ouchak barley.

Figures 1-4 redrawn from a paper by E. S. Beaven in *Journ. Fed. Inst. Brewing* (1902), 8. 542.

In an ear of barley the primary axis or rachis is divided into internodes of which there may be any number up to forty. Each internode bears three single-flowered spikelets arranged alternately on either side of the rachis. In the six-rowed varieties the whole of these spikelets attain maturity, whilst in the two-rowed varieties only one on each side of the rachis, viz. the median, develops. British beer is brewed principally from the malt made from home-grown two-rowed barleys. Of late years, however, it has been found advantageous to employ a proportion of malt made from the thinner and more husky foreign barleys, mostly six-rowed varieties. The corns of two-rowed barleys are as a rule plumper than those of six-rowed barleys.

The most favourite barley for malting purposes grown in the United Kingdom is the narrow-eared two-rowed *H. distichum*, commonly known as Chevallier, from the name of the original cultivator, the Rev. John Chevallier. Of late years the quantity of barley of the so-called Goldthorpe type (*H. seocriton*), used for malting, has increased. The paleae or outer coverings of the corns of this variety are somewhat "greasy" in appearance, and do not adhere so closely to the corn as in the Chevallier. The corns of Goldthorpe barley possess a small dimple or transverse furrow near the basal end. Further the basal bristle or rachilla (the prolongation of the axis or point from which the corn was originally developed) is invariably covered with long hairs, whilst in the case of Chevallier it has generally very short hairs. In the variety of Chevallier known as Archer, however, the rachilla has somewhat long hairs. Further the corns of Chevallier barley lie nearly vertical, that is almost parallel to the rachis, whereas in Goldthorpe they are spread out at a greater angle, hence the name fan or peacock barley given to that variety commonly known as sprat. It is believed by some brewers that Goldthorpe barleys never yield malt of so high a quality as do Chevallier barleys. On the other hand, when well matured, Goldthorpes work evenly and freely on the malting floors; and from an agricultural point of view they have the advantage of standing up better against unfavourable weather conditions on account of their stouter straws. Numerous fresh varieties of barley are continually being introduced as a result of artificial cross-fertilization, but cross-fertilization rarely if ever occurs naturally.

Hungarian two-rowed barleys are excellent as regards quality, and command a high price. The so-called Californian Chevallier and Chilean Chevallier contain a certain admixture of the six-rowed *H. vulgare*.

Of the imported thin barleys may be mentioned Brewing Californian, Brewing Chilean, Danubian and Smyrna (Yerli), all for the most part six-rowed varieties; also Ouchak, consisting principally of a two-rowed variety. For the manufacture of grain spirit a malt of high diastatic activity is required, and this is largely made from a very thin barley shipped from Odessa.

In the common six-rowed English barley or Scottish bere (*H. vulgare*), the two lateral rows of spikelets springing from one side of the rachis, either partially or entirely intersect and overlap the alternate lateral spikelets which spring from the opposite side of the rachis. This has given rise to the term "four-rowed barley." Figs. 1–4 show some typical barleys in the ear.

The production of new varieties by cross-fertilization has of late years attained a degree of almost mathematical precision by the application of the law of inheritance first discovered by Gregor Mendel in 1865, and brought to light in 1901 independently by de Vries, Correns and Tschermak.

Constitution of Barley.—A grain of barley is shuttle-shaped; the end containing the germ which was originally attached to the rachis is known as the proximal end, whilst the opposite end of the corn is called the distal end. A deep furrow runs down the more convex side, which is accordingly denoted the ventral side, the opposite side being distinguished as the dorsal side. Within the ventral furrow at the proximal end is the rachilla already referred to. The skin or husk of a barleycorn consists of two paleae, one adhering to the dorsal side (the palea inferior) and the other to the ventral side (the palea superior); the former overlaps the edges of the latter. The awn or beard is merely an elongation of the palea inferior. If the two paleae are removed from a barleycorn after soaking it in water, it will be seen that there are other skins completely enveloping the embryo and endosperm. These are the true skins, and are known as the pericarp and the testa respectively. It may here be mentioned that A. J. Brown has shown recently that the embryo and endosperm of a barleycorn are enclosed in a semi-permeable membrane, *i.e.* one which allows the passage of water to the interior of the corn, but not of certain salts and acids. This property appears to be associated with one of the layers of the testa. Next to these skins will be seen the triple layer of thick-walled square-shaped aleurone cells.

The histology of the barleycorn is best studied by the examination of sections under the microscope. The grain consists of two main portions, the embryo or germ, and the endosperm, the storehouse of reserve materials for the growing plant.

The accompanying illustrations show portions of longitudinal sections of a barleycorn magnified to different degrees.

On examining fig. 5, which represents a section of the germ end of a grain of barley cut through the ventral furrow, it will be noticed that the rudimentary leaves, stem and roots are distinguishable. The embryo lies embedded in a mass of cells, the part dividing it from the endosperm being known as the scutellum. Special note should be taken of the elongated cells known as the absorptive epithelial layer, which has certain very important functions to fulfil during the process of germination, notably in feeding the embryo when it begins to develop into a young plant. Next to this, actually between the scutellum and the endosperm, will be seen a layer of empty cells. These at one time in the history and the development of the corn contained starch granules, but this starch was absorbed during its later development by the embryo. It will be observed further that the endosperm is filled with a network of thin-walled cells closely packed with starch granules, and smaller granules of protein matter (fig. 6). Nearest the skin will be seen the triple layer of aleurone cells already referred to (fig. 7).

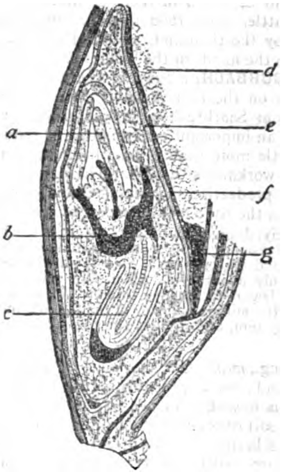


Fig. 5.—Median longitudinal section of a barleycorn showing the germ and its appendages.

a, Rudimentary leaves or plumules;
b, Rudimentary stem;
c, Rudimentary root;
d, Empty starch cells of the endosperm;
e, Absorptive epithelial layer;
f, Compressed layer of empty cells;
g, Starch cells (filled).

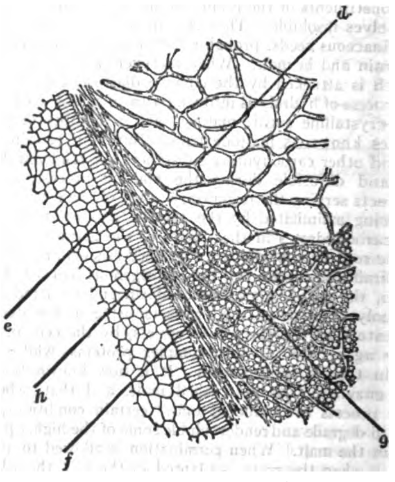


Fig. 6.—Section showing absorptive epithelial layer more highly magnified.

d, Walls of starch cells;
e, Epithelial layer;
f, Compressed layer of empty cells;
g, Cells filled with starch granules,
h, Cells of the scutellum.

Germination.—The barleycorn in its resting stage is in a state which may be described as one of dormant vitality; it respires very slowly and thus loses weight during storage. The best and driest barleys are said to lose 1·3% of their weight in the first year, 0·9% in the second, and 0·5% in the third. The loss is considerably more with coarse and damp samples. When the grain is steeped this dormant vitality gives place to that complicated series of processes comprised under the general term germination. When germination begins, enzymes are secreted, and these act on the reserve materials, starch and proteins of the endosperm, converting them into simpler compounds, capable of diffusing to various parts of the growing germ. Following this, starch and proteins are re-formed, the former being deposited in the tissues of the germ and in the cells of the scutellum, which previously were almost free from starch; the protein matter deposited in the latter disappears to a considerable extent, and the protoplasmic content of the cells assumes a very granular appearance. The pointed mass of cells constituting the root-sheath is pushed forward by the root which protrudes through the base of the grain. It is at this stage that the barley is said by the maltster to "chit." After the first rootlet has broken through the ends of the sheath, it is followed by others. The cotyledonary sheath begins to elongate on the third or fourth day of germination and ruptures the true covering of the seed; it then grows upwards between this and the husk and forms the acrospire or "spire" of the maltster.

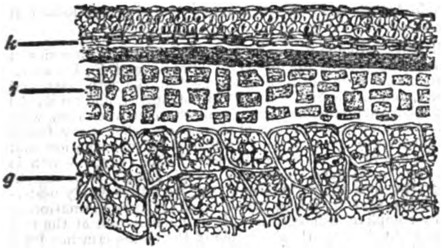


FIG. 7.—Section showing the aleurone layer.

g, Starch cells; j, Aleurone layer; k, Layers which collectively constitute the husk.

[Figs. 5-7 from Sykes & Ling, *Principles and Practice of Brewing* (1907), Charles Griffin & Co., Ltd.]

According to Brown and Morris, when the first rootlet is breaking through the sheath, starch begins to appear in the tissues of the grain, also in the protoplasm of those cells which are nearest the epithelial layer, and it gradually invades the deeper-seated cells. Further the cellulose walls of the endosperm, situated immediately above the secretory layer, are partially dissolved, the dissolved matter passing into the scutellum, there to be transformed into starch. Brown and Morris state that this process gradually extends to the cellulose walls of the endosperm, and until these are affected there is no evidence of any solvent action on the starch granules themselves. Thus according to these authors the first enzyme to be formed is one which dissolves cell walls, and it was consequently termed by them a "cytohydrolyst." They assert further that the so-called mealy or modified condition, which the maltster desires to bring about to the fullest degree, depends on the extent to which the cell walls have been affected, and they enter into a minute description of the entire disappearance of these during the malting process. On the other hand, J. Grüss has pointed out that the action which takes place on the cell walls of the endosperm during germination does not consist in their complete solution. Schulze has shown that these cell walls consist of two carbohydrates, an araban and a xylan. Grüss states that the araban is completely dissolved, whilst the xylan is more or less unattacked. The cell walls become, however, transparent so that they can only be seen in sections which have been stained; Brown and Morris examined unstained sections. The writer (A. R. Ling) has proved that the cell wall is present in the most friable and well modified finished malt.

Condition.—Barley is bought in the open market solely on the evidence of certain external signs, and judgment can only be acquired by long experience. The corns should be plump, even in size, and the colour should be uniform from end to end. The sample should have a sweet odour, and it should be dry to the touch. The presence of light or weevilled corns may be detected by the fact that they float in water. Careless threshing or dressing is responsible for much damage done to barley. In this way many of the corns may be broken, have the paleae partly stripped off or portions removed along with the awn. All broken and dead corns are prone to become mouldy on the malting floors, the contagion thus presented becoming general. E. R. Moritz drew attention in 1895 to the ill effects of close dressing, and more recently (1905) the matter has been brought before the Highland and Agricultural Society, chiefly through Montagu Baird, who with C. H. Babington was instrumental in inducing the Board of Agriculture to publish a leaflet recommending more careful methods of threshing barley. Close dressing was at one time practised as a means of raising the bushel weight, and thus giving a fictitious value to the barley. Immature barley feels cold to the hand, has a greenish-yellow colour, and, when dry, a starved wrinkled appearance. Over-ripeness in barley is distinguished by a white dead appearance of the corn. Mature or dry grains slip through the fingers more readily than unripe or damp ones. The contents of the endosperm should present a white friable or mealy appearance when the corns are bitten or cut in two with a penknife. The condition of the grain may be determined by means of a mechanical cutter, which cuts a certain number of corns (fifty or more) at one time. Some cutters are constructed to cut the corns transversely, others to cut them longitudinally. The so-called transparency test may be used for the same purpose. It is carried out in an apparatus known as the diaphanoscope, which consists of a box fitted with a sliding tray, furnished with a certain number of shuttle-shaped holes (usually 500), each of such a size as just to hold a barleycorn longitudinally. Into the portion of the box below this tray an electric lamp is placed, and the corns are looked at from above. Thoroughly mealy corns are opaque, whilst steely corns are transparent. When certain portions of a corn are steely, these present the appearance of lakes. By this means the percentage of mealy, steely, or half steely corns in a sample may readily be estimated.

E. Prior points out that steeliness of barley is of two kinds, one of which disappears after the grain has been steeped and dried, and therefore does not necessarily influence the malting value of the sample, and the other which is permanent, and therefore retards the modification of the corn. He proposed to determine what he called the coefficient of mellowness of a sample of barley by means of the formula:—

$$A = \frac{(M_1 - M)\,100}{100 - M} + M,$$

in which A is the degree of mellowness, M is the percentage of mealy corns in the original barley, and M_1 is the percentage of mealy corns after steeping and drying the barley. Prior points out that, generally speaking, the degree of mellowness varies inversely as the protein content.

The physical differences between steely and mealy grains were first investigated by Johansen, who arrived at the conclusion that mealiness is always accompanied by the presence of air spaces in the endosperm. Munro and Beaven confirmed and extended this. Their conclusions are as follow: "Mealy grains have a lower specific gravity than steely grains, and contain a larger amount of interstitial air. The total nitrogen content of mealy grains is less than that of steely grains. Steely grains contain a relatively high proportion of nitrogenous substances soluble (*a*) in 5% salt solution, and (*b*) in alcohol of specific gravity 0·9. Mealy barley modifies better than steely during germination. The process of drying damp and under-matured barley intact at 100° F. produced an apparent mellowing or maturation. Other things being equal, maturation, which is physiologically a post-ripening process, is correlated with the mealy appearance of the endosperm." H. T. Brown and his collaborators point out that thin sections of steely corns when examined under the microscope no longer exhibit a translucent appearance, but show the mealy properties as completely as if they had been cut from a mealy grain, and they suggest that in a steely corn the whole of the endosperm is under a state of tensile stress which cannot be maintained in the thin sections. If, however, a thin section of a steely barley be cemented to a slide with Canada balsam and then pared away with a razor, steeliness and translucency may be preserved even in the thinnest sections. The mealy appearance in the endosperm of barley is assumed to be a direct consequence of the formation of interspaces around the cell-contents and within the cell walls. Under ordinary conditions it is conjectured that these interspaces are filled with air, but it is pointed out that they can also be produced under circumstances which suggest that they are at times vacuous or partly so. According to the last-mentioned authors they appear to originate from a system of stresses and strains induced within the endosperm by its gradual loss of water, a break of continuity taking place which gives rise to these interspaces when the cohesive power of the heterogeneous cell-contents falls below a certain point. It is further suggested by them that the most important factor in producing the stresses and strains is probably the shrinkage of the starch granules as their water content is reduced from, say, 40 to about 15%. It is pointed out, however, that actual discontinuity in the cell-contents can only take place when the tensile strength of the protoplasmic matrix in which the starch granules are embedded has been surpassed, and this being so it might be anticipated that those cells which contain the larger amount of proteïn material would probably best resist the internal stresses and strains, a deduction in close agreement with observed facts, steely grains being as a rule richer in proteïn than mealy grains. Brown and his co-workers determine the coefficient of mealiness of a barley as follows: Five hundred corns are cut transversely in a corn cutter and the percentage of mealy, half mealy and steely corns is noted. The number 100 is taken to represent complete mealiness, 1 complete steeliness, and 50 the intermediate class. If the percentage of each class be multiplied by its special value, and the sum of the products divided by 100, the result is the coefficient of mealiness. By steeping and drying a very steely Scottish barley, the coefficient of mealiness was raised from 29·7 to 87·1, whilst concurrently the specific gravity fell from 1·417 to 1·289.

Barley even of the same kind varies widely in its chemical composition, but on an average the proximate constituents of British malting barleys lie within the following limits:—

Moisture	18 —12	per cent.
Nitrogenous matters expressed as proteïns	8 —15	"
Fat	2 — 2·5	"
Starch	60 —65	"
Sugars	1·5— 2·0	"
Gums	1·7— 2·0	"
Fibre (cellulose)	5 — 7	"
Ash	2 — 2·5	"

Any sample of barley which contains more than 20% of moisture would be considered damp. The late Professor Lintner expressed the view several years ago that a good malting barley should not contain more than 10% of proteïn, but R. Wahl asserts that in America six-rowed barleys containing a far higher percentage of proteïn are used successfully, indeed preferably, for malting purposes. The only precise knowledge we possess of the proteïn compounds of barley is due to the researches of T. B. Osborne. According to this observer, barley contains the under-mentioned compounds of this class in the following proportions:—

Soluble in water	Leucosin (albumin) Proteose	0·30 per cent.
Soluble in salt solution:	Edestin (globulin)	1·95 "
Soluble in 75% alcohol	Hordeïn	4·00 "
	Insoluble proteïn	4·50 "
Total		10·75 "

It should be pointed out here that the above are only average values for the particular samples of barley investigated. Undoubtedly the nitrogenous constituents of different barleys vary widely in nature as well as in amount.

Raw barley contains enzymes, thus diastase of translocation, so called by Horace T. Brown and G. H. Morris, and catalase (H. van Laer). Proteolytic enzymes appear only to arise with the beginning of germination; but it has been asserted that raw barley contains proenzymes (zymogens), which can be rendered active by treatment with dilute lactic acid at an appropriate temperature. The action of the diastase of raw barley on starch has been studied by Julian L. Baker.

Barley should not be cut until it is properly ripe, but over-ripeness is much more to be guarded against by the maltster than premature cutting, as it is accompanied by a loss in germinative power. Moreover, unripe corn may to a certain extent be matured in stack, whilst a great improvement in germinative capacity is frequently produced by sweating. Very wet seasons are prejudicial to the ripening of the grain, and when the latter is stacked in too moist a condition it is apt to become what is known as mow burnt. Especially is this the case with barleys containing large percentages of nitrogen and of high enzymatic activities. Such barleys are denoted "warm" by M. Delbrück from their tendency to heat when stored in a moist condition. The effect of this heating is exhibited in the corns becoming black and discoloured at the tips; they are then said to be magpied. Even in an otherwise dry season a large amount of rain during harvest causes the corns to become "weathered," whilst some of them begin germinating and rot. At the same time heavy dews at night whilst the barley lies cut in the field, or even a sprinkling of rain, assists in mellowing the grain, which often in consequence works the more freely on the malting floors. Properly harvested barley is all the better for remaining in stack for two or three months, as was the practice in former years; if, however, it has been stacked too wet the sooner it is broken down the better.

It is difficult to give any specific test for ripeness, but a series of observations has been made by H. T. Brown and F. Escombe. Samples of barley were taken from the field on the 20th, 24th and 29th of July, and on the 2nd, 6th and 10th of August, and preserved in spirit so that they remained in the same state as when they were gathered. Sections were then cut of these corns, when it was found that the progress of maturation is attended by deformation and ultimate disintegration of the cell nuclei. The change which is denoted by the term nuclear senescence is said to begin in the starch-containing cells, near the periphery of the corn, immediately underlying the layer next to the aleurone layer. This deformation is followed by complete disintegration of the nucleus, and at the end of seven or eight days nearly the whole of the endosperm has been involved. Brown and Escombe state that when this nuclear test is properly applied it stamps as immature those corns in a sample which are manifestly unripe owing to premature desiccation as well as those in which the ratio of nitrogen to carbohydrate is unduly high, owing to an excess of nitrogenous manure in the soil, or to sparser sowing with its consequent reduction of root competition. This method, interesting though it be, is not fitted for practical use, and the agriculturist must rely as heretofore upon empirical methods for deciding whether or not the grain has attained ripeness or maturity.

The bushel weight is a useful criterion in arriving at an opinion regarding the value of a sample of barley; but in basing judgment upon this factor regard must be paid to the fact already mentioned that if the grains be dressed closely the bushel weight is increased. The reason of this is that with the removal of the awns the corns pack more closely together. The best British malting barleys should weigh 52–56 lb per bushel, the standard weight for malting barleys being 56 lb.

During the storage of barley access of air is necessary, otherwise the grain dies from asphyxiation. Sound barley after being kiln-dried retains its vitality for a number of years; but the statement that the corns found in the Egyptian mummy cases, in which they had remained for several thousands of years, were still capable of germination, is contrary to modern experience. Moisture must also be carefully excluded, as it initiates germination in a few cells only of the endosperm and causes heating. A constant repetition of wetting such as may take place on account of alterations of the atmospheric temperature, which causes moisture to be deposited, in the form of dew, may ultimately destroy the vitality and foster the growth and development of mould fungi which usually grow on broken and damaged corns. In this connexion the advantage of screening and sweating of barley before storing it will be apparent (see below).

An immense amount of damage is caused to the grain, during storage, by various insects, one of the most destructive of these being the common weevil (*Calandra granaria*). When fully developed this insect measures ⅛th to ⅙th of an inch in length, and is of a bright chestnut colour. The larvae are fleshy legless grubs, shorter than the perfect insect, with a series of tubercles along each side of the body; the head is round with strong jaws. The pupa is white, clear and transparent, showing the form of the future weevil. The female bores a hole in the grain with her snout and deposits an egg. The larva when hatched lives on the contents of the grain and undergoes its changes therein. Windisch asserts that only barley which has ripened in the granary is attacked by weevil. Grain which is only slightly attacked should be kilned at a temperature of 122° F., which destroys the weevil in all stages of development. To detect weevil in a sample of barley, the grain should be spread out on a sheet of white paper in bright sunlight. If weevils are present they soon appear, and betake themselves to a position outside the sunlight, to which they are averse. Treatment of the grain with carbon bisulphide has been suggested as a means of destroying weevil; even if efficacious, however, such a process could not be recommended on account of its danger, carbon bisulphide being highly inflammable. The only practical means of ridding a granary or shop of weevil is to clear out all the grain and leave it empty for a year or more.

The vitality of barley may be determined by causing a sample to germinate in any of the well-known forms of apparatus devised for that purpose, and counting the percentage of germinating and idle corns. The germinative capacity of a sample of barley may frequently be raised by sweating (see below), which, as already mentioned, brings about a kind of artificial maturation.

Malting.—There are two systems of malting used in England: floor malting and pneumatic or drum malting. These systems will be described separately.

A floor malting consists of a rectangular building of several storeys, having the cisterns at one end and the kilns at the other. The uppermost floor is devoted to barley.

The capacity of a malting is described by the number of quarters which are put through it every four days. A fifty quarter malting does not merely mean that the cisterns have a capacity of fifty quarters, but that this quantity of barley goes through the house every four days. The average time the germinating barley is on the floors is twelve days, and, as a rule, kilning occupies four days. If, as sometimes happens, the malt has to be kept on the floors thirteen, fourteen, fifteen days, or even longer, the malting is not being worked at the capacity under which it is described, and the kilns may remain unused for a day or more. Conversely, when the malt is loaded at less than twelve days, a day or two has to be missed in steeping. In the former case when the kilns are not being used for drying and curing malt, advantage may be taken to utilize them for sweating barley.

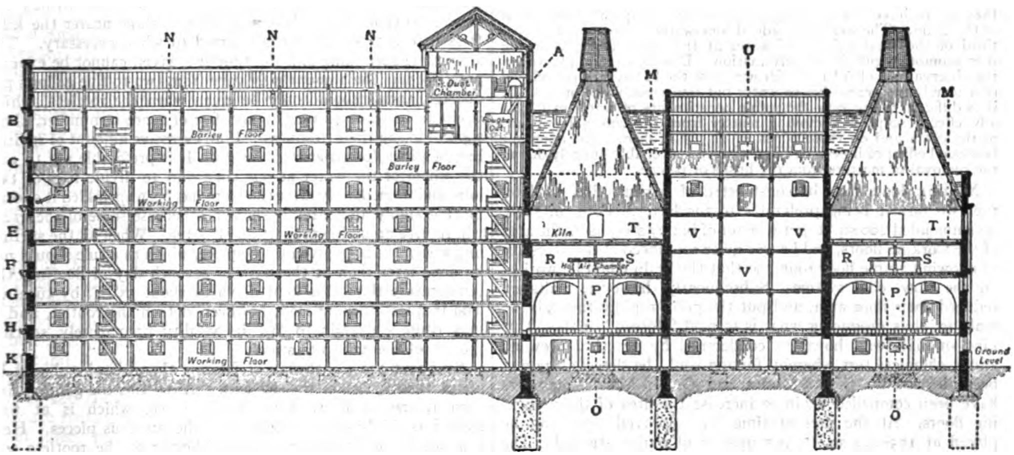


FIG. 8.—Longitudinal section of 200 quarter malting at Mortlake. (Julian L. Baker, architect.)

Figure 8 shows a longitudinal section of Messrs Watney, Combe, Reid & Co.'s 200 quarter malting at Mortlake. The barley is carried to the top of the building by the elevator A, where the screening and dressing machinery is situated. After leaving these machines the grain is conveyed on bands to the barley floors B and C. The floor C contains also the steeping cisterns. The six working floors are D, E, F, G, H, K. The floors are ventilated by louvres, N, N, N. The cisterns are connected to the floors by means of plugs. The "pieces," as they are termed, of germinating barley are gradually worked along the floors to the kilns M, M, on to which they are loaded by rotary bands. The fire-places O, O, are arranged so that the draught may be easily controlled. The hot air and products of combustion pass up the shafts P, P, to the hot-air chamber R, R, where they strike the baffle plates S, S. These plates disperse the hot air and gases evenly beneath the kiln floors T, T, through the green malt. After drying and curing, the malt is allowed to cool and is then carried by bands to the floor U, where by suitable machinery the coombs or rootlets are removed. The finished malt is stored in the bins V, V, V.

On arrival at the malting the barley has to be put through the following operations seriatim: receiving, hoisting and weighing, rough screening, drying and sweating, storing until required for use, screening, grading and removing broken corns, steeping, couching, flooring, withering, drying and curing, dressing and polishing, storing, weighing, sacking and discharging the finished malt.

In sweating barley the temperature should not be allowed to rise above 120° F.; it is usually conducted at 100° F.; and subsequently the barley should be stored for some weeks before it is steeped.

Steeping cisterns were formerly rectangular vessels, of slate, brick or cement, from which the barley had to be discharged by shovelling it out. The forms approved most at the present day are conical and constructed of iron; they have arrangements at the apex of the cone, the lower portion, for discharging the grain by gravitation. The steeping period ranges from 48 to 70 hours; it varies according to the kind of barley, and the time of the year. In some of the older maltings there are no arrangements for heating the steep water, and in the winter steeping has occasionally to be performed with water at a temperature near its freezing-point. Steeping should be carried out at a temperature as near as possible to 55° and not higher than 60° F. The usual practice is to fill the cistern up to a certain height with water and throw the barley into it, stirring it until it is about level; the heavy corns will then sink directly to the bottom, whilst the light corns and refuse float on the surface and may be skimmed off. During the time the barley remains in the cistern it is usual to change the steep water two or three times, generally at intervals of twelve hours or tides. The advantage of this is not merely to keep the grain fresh and sweet, but to bring it into contact with the air during the time it is taking up water. Aëration of the steep has long been recognized in Germany as promoting germination, and several arrangements are on the market enabling air to be passed through the grain while it is in the cistern. It has been recommended by Graham, Stopes, Moritz and Morris, and experimental evidence as to its beneficial effects has been published by Windisch, Bleisch, Will, and Baker and Dick. When the corn is steep ripe it contains some 60% of water. Steeping does not consist, however, merely in the imbibition of a certain amount of water; in order to bring about germination this water must remain within the corn a certain length of time. Thus, although it is quite possible to force the necessary amount of water into the grain in less than the 48–70 hours usually taken up by the steeping process, the grain is not steep-ripe until certain changes initiated by the water have taken place, and these require time for their completion. The following average data are useful to remember in connexion with the steeping process:—

Amount of water in steep-ripe barley (about) 60%.
Matter removed from barley during steeping (about) 1·5 %.
Increase in volume of barley due to water absorption (about) 18–20 %.

There has been much discussion as to the influence of saline matters in water on the steeping process. The late Professor Lintner stated that common salt in water tended to extract the nitrogenous constituents of the grain, but impeded its germination. Mills and Pettigrew found that waters containing calcium salts extracted a minimum of nitrogenous compounds from the barley; they also came to the conclusion that the esteem in which the Lichfield water is held for steeping purposes is due to the presence of nitrates which, they assert, have a stimulating effect on the subsequent germination of the grain. The writer has added lime-water to the extent of one-third of the total volume of water at the first change, believing it to promote regularity of germination. Bearing in mind, however, the observations of Adrian J. Brown, that the barleycorn is enclosed in a membrane permeable to water but impermeable to most salts, it is difficult to see how the saline constituents of water can have any effect except in removing matter from the external portions of the grain and on those corns which are broken. The apparent beneficial effect of lime-water in the steep is probably entirely due to the removal of matters from the husks or paleae.

Malting floors may be constructed of cement, tiles or slate, the two former being preferable to the latter. Ford, in 1849, recommended 200 sq. ft. per quarter of barley steeped as the area of the working floors, and he was quite convinced of the necessity of allowing ample floor room, so that the grain could be worked on the slow, cool system. Subsequently, however, maltsters reduced their floor area, and put the grain rapidly through the malting, thus producing what is termed "forced" malt. This kind of malt was, however, condemned by practical brewers, and a chemical test whereby forcing could be detected having been devised by E. R. Moritz and G. H. Morris, maltsters have been compelled again to increase the area of their working floors. At the present time the approved area may be placed at 175–200 sq. ft. per quarter of barley steeped. The area is, however, largely ruled by the kind of barley to be malted.

After the barley has been thrown out of the cistern it is made up in a rectangular heap 16–20 in. deep, called the "couch"; the object of this is to enable it to gather heat and so start germinating. It usually remains in couch for 12–24 hours, until in fact the interior portion of the heap registers a temperature of about 60° F. During the days of the malt tax the exciseman gauged the quantity of the barley while it was in the couch. After couching the barley is spread thinly and evenly on the floor, forming what is known as the young floor or No. 1 piece. The first visible sign of germination is the sprouting of the rootlet, termed "chitting," and this occurs either while the grain is on the couch or on the young floor. As already mentioned, it may be quickened by aerating the grain in the cistern. From the time the barley is first cast out of the cistern up to the stage of the young floor, or No. 1 piece, it has a pleasant ethereal odour resembling apples. Drs Thomson, Hope and Coventry stated in the earlier part of the 19th century that they distilled "spirits" from germinating barley at this stage. In the light of our present knowledge it would not be surprising if alcoholic fermentation were proved to occur within the grain at this stage, since intramolecular or anaerobic respiration in certain vegetables has been found to be due to alcoholic fermentation.

The thickness at which the young floor is spread depends upon the outside temperature and the nature of the barley. If the weather be warm, or if there be a tendency for the barley to heat, the piece must be spread all the thinner. At this stage the grain loses its external wet appearance. When spread too thickly the grain will begin to sweat, and the rootlets will be thrown out suddenly and unevenly. As a rule, under these circumstances, the rootlets will be long and thin, when they are said to be "wild." A piece which has been allowed to get into this condition must at once be spread thinner. If the sweating has not continued long, the harm done may be confined to increased loss by respiration. The young floor is usually turned with a plough twice during twelve hours, and it may be forked betweenwhiles, but no hard and fast rule can be laid down as to when this is necessary; it must be left to the maltster's judgment, as it depends entirely on what is going on within the grain. The object of turning is in the first place to aerate the grain and freshen it, secondly to check excessive rise of temperature, and thirdly to promote evenness of growth. Too frequent turning is not to be advised. After remaining four days on the young floor three or four rootlets should have appeared, and the acrospire should have begun to grow up the back of the corn. The apple-like odour of the piece then gives place to one resembling that of the common rush, and this should continue the whole time that the malt remains on the floor. On the fifth day the piece is next moved to No. 2 position, a stage nearer the kiln. It is here that sprinkling is resorted to when necessary. The amount of sprinkling and the time it is given cannot be exactly prescribed. The amount may vary from two to five gallons per quarter, and it should only be given when the rootlets, which ought to be short and curly, and five or more in number, show signs of losing their freshness. If an excessive amount of sprinkling be given forced growth ensues. It is preferable not to add the whole of the water at one time, but to divide it over two lots; and immediately after the piece has been sprinkled it should be thoroughly and carefully mixed, otherwise some of the grain will receive an undue proportion of water. When all the sprinkling water has been given to the piece, which as a rule should not be done later than at the sixth or seventh day of flooring, the temperature should be kept down to about 55° F. by turning. Too frequent turning may, however, detach the rootlet, and it may cause the grain to lose its vitality prematurely, so that growth of the acrospire stops.

By about the eighth day of flooring the acrospire should be about three-quarters up the corn. After this the germinating corn is moved forward to No. 3 piece, which is at first spread as thinly on the floors as in the previous pieces. Here it gradually dries and incipient withering of the rootlets sets in. The only treatment which is now given to the grain is to heap it up thicker and thicker by degrees until it is ready for loading on the kiln. This increase in thickness of the piece (now called the old piece) should not be too sudden, especially if the grain be fresh in appearance and contain a large quantity of water. When the piece is thickened up to say 10 in. in depth, while it is in a very moist condition, heating and sweating take place, with additional growth of acrospire and rootlet. Under such forcing conditions a large production of sugar and degradation of the proteins will take place. When, however, the moisture has been gradually reduced before thickening up, the rootlet dies off; and although increase of temperature may occur, this is accompanied by little or no further growth of the acrospire, action being confined to the mellowing of the grain by the enzymes. When the malt is ready for loading on the kiln it should be possible to break down the contents of each corn between the thumb and finger. Opinions differ as to what the final temperature on the withering floor should be. If the moisture content of the malt be about 50 %, the piece must be kept thin to avoid sweating. But under these conditions mellowing does not occur, hence the necessity of reducing the moisture content gradually after the last sprinkling water has been given. When the process has been conducted properly the temperature of the old piece may be allowed to rise as high as 70° F. during the six hours previous to loading. The moisture content of the green malt when loaded should not be much above 40 %.

The endosperm of green malt which is ready for the kiln should be soft and mealy, and should not exude moisture when pressed between the thumb-nails, but should crumble and disintegrate to a chalky mass having little or no adhesiveness.

The foregoing observations are not to be regarded as hard and fast rules, but they are simply intended to give some indications of the malting process when it proceeds on normal lines; it may be that on account of the presence of damaged corns the piece begins to develop mould by about the tenth day, and it then has to be kept thin and sometimes even loaded on kiln prematurely.

The malt made for grain distillers, in which a high diastatic activity is required, is manufactured on quite different lines from those above indicated. It is often sprinkled late, and loaded on kiln often in a sodden condition. In some cases sprinkling on kiln is resorted to, but it is doubtful if this leads to the desired object. Other things being equal, the smaller the corns—*i.e.* the greater number of embryos in a given weight—the higher the diastatic activity of the malt. In selecting a barley for the production of highly diastatic malt, the diastatic power of the original raw grain is a factor of great importance.

Kilning.—When loaded on kiln, malt intended for brewing ale and stout is, if properly withered, in a moribund condition; nevertheless, during the first stages of the kilning process a certain amount of vital activity is manifested, and the malt undergoes mellowing by the action of enzymes on the contents of the endosperm. If the malt be loaded while the rootlets appear fresh on account of the presence of too much moisture, rapid growth of the acrospire ensues, giving rise to overshot corns, known in Germany as "hussars." To check this the moisture must be rapidly removed by the passage of large volumes of air through the malt. But under such circumstances mellowing does not occur. The ideal conditions of kilning are when the malt has been properly withered on the floors before loading, and, assuming that drying and curing occupy four days, that 25–30 % of the moisture be removed very gradually, this occupying the first three days, at the end of which the malt is said to be hand-dry. The thickness at which the malt is spread on the kiln should not exceed 7–8 in., and until hand-dry (that is to say, reduced to a moisture content of 12–15%) it should not be turned; if moved at all (and that only is necessary when reek occurs), it should only be lightly forked. The rate at which the temperature is raised depends largely on the kind of malt to be made and the construction of the kiln. If high flavour and colour are required, these are produced by keeping the malt for several hours near a temperature of 160° F. while it still contains 12–15% of moisture. If more than this amount of moisture be present when the temperature reaches the limit just mentioned, the conditions known as stewing would obtain, with the result that "forced" malt would be produced. A certain amount of colour is produced at the final temperature to which the malt is raised; but when such means are relied upon for the production of the greater part of the colour, reduction of extract and deficiency of flavour follow, the colour being then almost exclusively the result of caramelization of the carbohydrates.

The so-called curing stage constitutes the last part of the kilning process, and the malt must then be turned frequently to ensure uniformity of action. Mechanical turners are exceedingly useful for this purpose. Curing in a drum, as in the so-called pneumatic malting process (see below), also effects satisfactory curing.

The following table will give an idea of the kilning temperatures usually employed for the three kinds of malt mentioned, but it must be remembered that these temperatures are largely regulated by the construction of the kiln and the amount of draught available. In this connexion it may be mentioned that the final curing temperature is not necessarily a criterion of the tint of the malt. A malt may have been finished off at a very high temperature and still be a pale malt, provided the moisture percentage has been sufficiently reduced in the initial stages of kilning.

	Pale Malt.	Running Ale Malt.	Amber Malt.
st day temp.	90–100° F.	90–100° F.	90–100° F.
nd „ „	100–120	100–120	100–130
rd „ „	120–130 (10 hrs.)	120–130 (6 hrs.)	130–150 (6 hrs.)
rd „ „	130–180 (8 „)	130–150 (12 „)	150–160 (12 „)
rd „ „	180–190 (6 „)	150–180 (6 „)	160–180 (6 „)
th „ „	drop to 170 (12 „)	180–190 (12 „)	180–200 (12 „)
th „ „		190–200 (6 „)	200–220 (6 „)
th „ „		drop to 180 (6 „)	drop to 190 (6 „)

The average laboratory values obtained from malts of the descriptions after about two months' storage should be as follows:—

	Pale Malt.	Running Ale Malt.	Amber Malt.
Extract per standard quarter of 336 lb	95–98 lb	94–96 lb	94–96 lb
Moisture	about 2·0 % in each case		
Diastatic activity (Lintner) . . .	30–35	20–30	8–10
Tint (Lovibond 52 series neutral).	3–5	6–8	20–25

Metabolic Changes.—All through the malting process metabolic changes are proceeding, in which both carbohydrates and proteins are concerned. In its resting stage the embryo of a barley-corn is generally free from starch; as soon as germination sets in, however, starch appears in the scutellum, while the amount of sucrose there present increases, these being apparently formed from maltose originating from the action of diastase on the starch of the endosperm. Sucrose also augments in the aleurone layer, but starch is never formed in the aleurone cells. These changes occur when the malt is first loaded on kiln· indeed, at no part of the malting process is there greater physiological activity.

Kilning has been specially studied by J. Grüss, who divides the process into four stages, the first being that at which the temperature limit is 113° F. It is characterized by a continuation of the living processes, especially growth of the acrospire, which, as already stated, proceeds too far if the malt be loaded too wet. In any case the rootlet dies away. The metabolism of the carbohydrates already mentioned is accompanied by that of the nitrogenous constituents, the reserve protein of the sub-aleurone layer being attacked by proteolytic enzymes and broken down into simpler compounds. This is a most important matter from the point of view of the brewing value of barley, for the degradation products of the proteins are necessary constituents of wort as yeast food. Moreover, unless proper modification of these protein bodies occurs it is impossible to produce tender malt. A barley which contains a high percentage of reserve protein is as a rule unfitted for malting purposes, and indeed, the higher the protein content the greater the difficulty the maltster experiences in dealing with it. Protein hydrolysis requires the presence of a certain amount of moisture, and if this be removed too rapidly by a forced draught at the early stages of kilning the proteolytic enzymes cannot perform their function. If, on the other hand, the grain be loaded in too moist a condition, and the temperature be raised too quickly, the proteolytic enzymes lose their activity and the proteins remain for the most part unattacked. When germination is allowed to proceed on the kiln too great degradation of the protein occurs, and the malt is liable to produce fretty beers, on account of the presence of an excessive amount of nitrogenous nutritive matter, which leads to the development of disease organisms.

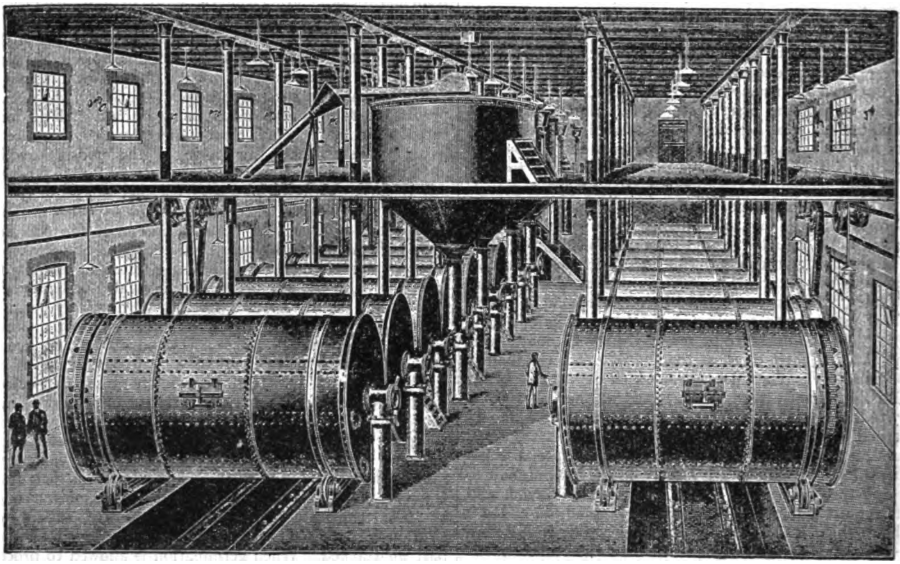
The second stage of the kilning process, according to Grüss, is that at which the temperatures range from 113° to 167° F. The life of the corn is now suspended, but enzymatic processes continue. The starch is further saccharified, and the dividing line of the aleurone layer at the furrow is attacked, as are also the cell walls of the endosperm, which are still intact, these being partially converted into gummy substances. This change, however, also requires the presence of a certain amount of moisture. If too much air be passed through the malt at this stage the above-named dividing partition of the cell walls is not attacked. The air may expand the grain to some extent and produce malt of a low bushel weight, which, however, is not properly modified and cannot give satisfactory results in practice.

During the third stage of kilning, an enzyme, which Grüss claims to have recognized, and which he denotes spermoxidase, is said to exert its activity.

Schönfeld has confirmed the discoveries of Grüss by practical experiments.

Fuel.—The fuel used for drying and curing malt is either anthracite or coke, and the greatest care is necessary in selecting it on account of its liability to contain arsenic, which is to a greater or less extent an invariable constituent of all coal. The fuel used for malting purposes should not contain more arsenic than [illegible]th grain per lb. Gas coke should on no account be used, unless it has been proved to be sufficiently free from arsenic; but the best oven coke frequently contains so little arsenic that it may be employed with perfect safety, especially if it be mixed with a proportion (*e.g.* 5%) of milk of lime, which retains the arsenic as calcium arsenate. In Germany malt is, as a rule, dried and cured with hot air, whilst in Great Britain the products of combustion are passed through the malt, as it is believed that they exert a beneficial influence on the flavour. The proportion of fuel used for drying and curing malt varies according to the quality of the fuel and the construction of the kiln, but on an average it may be placed at 50–80 ℔ per quarter.

Storing.—After the malt has passed through the curing stage it is generally heaped up for a few hours. This is believed to increase its flavour. The malt is then stripped from the kiln, and the rootlets, technically known as the coombs, are removed. Formerly this was effected by workmen treading the malt, who wore heavy boots for the purpose. At the present time, however, the rootlets are usually removed by machinery, special forms of which have been devised for this as well as for dressing and polishing the malt. It is the custom of some maltsters to store malt with the rootlets still attached; but this is an objectionable practice, since malt coombs attract moisture, and the presence of more than 3% of moisture in malt produces the condition known as "slackness." When the malt is packed in bin it is often covered with a layer of coombs, which then prevent access of atmospheric moisture. Malt, to preserve its good qualities intact, should be stored in bins made as nearly as possible air-tight, and it should never be placed in bin until it is quite cool. It is probably wrong to store malt in bins adjacent to the kilns, where it is kept at a higher temperature than that of the surrounding atmosphere. During storage of the malt a kind of mellowing occurs, the mechanism of which is not understood. It is, however, known by practical brewers that the best results cannot be obtained when new malt is used.



[From Sykes & Ling, *Principles and Practice of Brewing* (1907), Charles Griffin & Co., Ltd.]

FIG. 9.—Diagrammatic view of pneumatic malting, showing pneumatic washing and steeping cisterns.

Premature Malting.—Several years ago Galland suggested germinating barley in a drum, his idea being to do away with handling of the grain, and also to be independent of changes of atmospheric temperature. The latest development of this system, the so-called Galland-Henning process of pneumatic malting, has been improved by Mr R. Blair Robertson, and a diagrammatic view of the interior of one of these maltings, showing the drums and conical steeping cisterns, is shown in fig. 9.

The drums are provided with a perforated channel for the passage of air through the malt, which is packed in the annular space between this channel and outside wall of the drum. Each drum is capable of revolving on its axis, and there are arrangements for passing either moist, saturated or dry air through the malt. The system as now improved is capable of producing some of the best malt, especially if, after germination has been completed in the drums, the green malt is loaded on an ordinary kiln and the initial stages of kilning (see above) conducted in the usual way; the curing, however, may be carried out successfully in a special form of drum.

Yield and Weight.—The malting process is attended with a certain amount of loss of dry substance of the barley, as follows:—

In the steep	1·5 to 2·0%
By respiration on floors and on kilns	3·0 „ 5·0%
Coombs	3·0 „ 4·0%
Total	7·5 „ 11·0%

In addition to this, barley, as already mentioned, contains from 15 to 20% of moisture, whereas finished malt contains 1 to 2%. The total loss in weight which barley undergoes in the malting process may be put down at from 17 to 28%. Since, however, malt is lighter than barley (and the quantity of both was in former years measured exclusively by volume), it frequently happens that a given number of quarters of barley yields a larger number of quarters of finished malt. When this happens it is usual to speak of an increase having been obtained. At the present time weight replaces measure for both barley and malt, and although it is usual to speak of the quantity of grain in terms of quarters, what is meant is not the measured quarter, but so many weighed standard quarters. The standard quarter for English malting barley is 448 ℔ and for malt 336 ℔. From this it will be seen that when a given number of weighed quarters of barley yields the same number of quarters of finished malt, the actual yield is 75%, and there is then said to be neither increase nor decrease. As a rule, in practical working the yield of malt varies from a 4% decrease to a 10% increase, corresponding to an actual yield on the original barley of 72 to 82·5%.

J. Baverstock, an old writer, says that finished malt should weigh one-fifth less than the barley from which it is produced. This corresponds to a malting increase of about 7%, which is a high yield. As a rule, foreign barley will give a greater malting increase than English barley, because, on the one hand, the former usually contains less moisture than the latter, and, further, because there is less loss on the floors by respiration and rootlet growth.

The yield of malt from barley may be determined in the laboratory in an extremely simple manner. Since every grain of barley must yield a grain of malt, if we know the respective weights of a definite number of barley and malt grains, provided that this number is large enough to represent the average, then obviously this gives the data requisite for calculating the yield of malt from barley. The number of corns the weight of which is determined for this purpose is usually 1000, and if the weight of this number be determined on several different 1000 corns, the average will closely approximate to the truth. Instead of counting the corns by hand, an instrument may be used for this purpose.

If 1000 corns of a barley were found to weigh 42 grammes, and 1000 corns of a finished malt from the same barley 32 grammes, then the yield of malt is $\frac{32 \times 100}{42} = 76 \cdot 1$, this corresponding to a 1% increase. Assuming that the moisture content of the barley was 15% and that of the finished malt 2%, 100 grammes of malt will contain 2 grammes of moisture, and 76·1 grammes will contain $\frac{76 \cdot 1 \times 2}{100} = 1 \cdot 5$ grammes moisture; therefore 76·1 grammes of malt contain $76 \cdot 1 - 1 \cdot 5 = 74 \cdot 6$ grammes of dry matter. This was obtained from $100 - 15 = 85$ grammes of barley dry substance. Hence 100 parts of barley dry substance will yield $\frac{74 \cdot 6 \times 100}{85} = 87 \cdot 7$ corresponding with a loss of dry substance equal to 12·5% of the dry substance of the barley, or with a loss of 10·7% on the barley containing 15% of moisture.

The results obtained by this method of laboratory control when it is accurately carried out agree very closely with those deduced from the practical results of weighing the barley, malt and coombs in the malting.

Special Malts.—In addition to the kinds of malt considered in what precedes, there are others mostly used for imparting specific flavours and colour to beers and stout. These are crystal malt, imperial malt, brown or blown malt, and black or roasted malt. Crystal malt is grown for a shortened period on the floors, and then placed in a wire cylinder, which is rotated over a fire so that it is dried at a very high temperature. The weight per quarter is from 250 to 280 lb. Imperial malt is dried off on an ordinary kiln at a final temperature of 240–270° F., but it is not allowed the usual length of time on the withering floor. It is placed on the drying kiln in a layer not exceeding one inch and a half in thickness. A moderate heat from burnt wood is first applied until the bulk of the moisture has been driven off, when the temperature is suddenly raised so that the grains swell some 25% and the malt takes up a strong empyreumatic flavour from the products of combustion. This kind of malt weighs 270–300 lb per quarter. Black or roasted malt is prepared by roasting malt in a cylinder. Ford states that perfectly malted corn gives a colour of less intensity and permanence than does partially malted corn, and this has been confirmed by other observers. A certain quantity of the so-called black malt is actually made from raw barley, but this gives a product of inferior flavour. The weight per quarter of black malt varies as much as from 215 to 290 lb.

Valuation.—For the valuation of malt the following determinations are usually carried out: Extract per standard quarter, moisture, diastatic activity by the Lintner process, tint, and matters soluble in cold water. The physical examination of malt is also a matter of importance, inasmuch as direct evidence is obtained thereby of the modification of the malt. Among the methods adopted for this purpose may be mentioned counting the percentage of corns in which the acrospire has grown up to one-half, two-thirds and three-fourths the entire length of the corn. In properly made malt the modification of the endosperm should proceed *pari passu* with the growth of the acrospire. The sinker test is also useful when carried out in an intelligent manner. Those corns which sink in water and lie flat are improperly modified. Normal malt has a specific gravity less than water and the corns have equal density throughout; consequently they float horizontally in water. In forced samples the proximal ends are frequently lighter than the distal ends, and the corns float horizontally in water, with the germ directed upwards. The latter, however, may in some cases fill with water, and the corns lie flat or sink. This is a characteristic of over-modified malt. It will be seen from these remarks that it is essential to carry out the sinker test under standard conditions. The modification of the malt may also be determined by means of the diaphanoscope already referred to under Barley.

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MALTA, the largest of the Maltese Islands, situated between Europe and Africa, in the central channel which connects the eastern and western basins of the Mediterranean Sea. The group belongs to the British Empire. It extends over 29 m., and consists of Malta, 91 sq. m., Gozo (*q.v.*) 20 sq. m., Comino (set apart as a quarantine station) 1 sq. m., and the uninhabited rocks called Cominotto and Filfla. Malta (lat. of Valletta Observatory 35° 53′ 55″ N., long. 14° 30′ 45″ W.) is about 60 m. from the nearest point of Sicily, 140 m. from the mainland of Europe and 180 from Africa; it has a magnificent natural harbour. From the dawn of maritime trade its possession has been important to the strongest nations on the sea for the time being.

Malta is about 17½ m. long by 8¼ broad; Gozo is 8¾ by 4½ m. This chain of islands stretches from N.E. to S.E. On the S.W. the declivities towards the sea are steep, and in places rise abruptly some 400 ft. from deep water. The general slope of these ridges is towards the N.W., facing Sicily and snow-capped Etna, the source of cool evening breezes. The Bingemma range, rising 726 ft., is nearly at right angles to the axis of the main island. The geological "Great Fault" stretches from sea to sea at the foot of these hills. There are good anchorages in the channels between Gozo and Comino, and between Comino and Malta. In addition to the harbours of Valletta, there are in Malta, facing N.W., the bays called Mellicha and St Paul's, the inlets of the Salina, of Madalena, of St Julian and St Thomas; on the S.E. there is the large bay of Marsa Scirocco. There are landing places on the S.W. at Fomh-il-rih and Miggiarro. Mount Sceberras (on which Valletta is built) is a precipitous promontory about 1 m. long, pointing N.E. It rises out of deep water; well-sheltered creeks indent the opposite shores on both sides. The waters on the S.E. form the "Grand Harbour," having a narrow entrance between Ricasoli Point and Fort St Elmo. The series of bays to the N.W., approached between the points of Tigne and St Elmo, is known as the Marsamuscetto (or Quarantine) Harbour.

Mighty fortifications and harbour works have assisted to make this ideal situation an emporium of Mediterranean trade. During the Napoleonic wars and the Crimean campaign the Grand Harbour was frequently overcrowded with shipping. The gradual supplanting of sail by steamships has made Malta a coaling station of primary importance. But the tendency to great length and size in modern vessels caused those responsible for the civil administration towards the end of the 19th century to realize that the harbour accommodation was becoming inadequate for modern fleets and first-class liners. A breakwater was therefore planned on the Monarch shoal, to double the available anchorage area and increase the frontage of deep-water wharves available in all weathers.

Geology and Water Supply.

The Maltese Islands consist largely of Tertiary Limestone, with somewhat variable beds of Crystalline Sandstone, Greensand and Marl or Blue Clay. The series appears to be in line with similar formations at Tripoli in Africa, Cagliari in Sardinia, and to the east of Marseilles. To the south-east of the Great Fault (already mentioned) the beds are more regular, comprising, in descending order, (*a*) Upper Coralline Limestone; (*b*) Yellow, Black or Greensand; (*c*) Marl or Blue Clay; (*d*) White, Grey and Pale Yellow Sandstone; (*e*) Chocolate-coloured nodules with shells, &c.; (*f*) Yellow Sandstone; (*g*) Lower Crystalline Limestone. The Lower Limestone probably belongs to the Tongarian stage of the Oligocene series, and the Upper Coralline Limestone to the Tortonian stage of the Miocene. The beds are not folded. The general dip of the strata is from W.S.W. to E.N.E. North of the Great Fault and at Comino the level of the beds is about 400 ft. lower, bringing (*c*), the Marl, in juxtaposition with (*g*), the semi-crystalline Limestone. There is a system of lesser faults, parallel to the Great Fault, dividing the area into a number of blocks, some of which have fallen more than others. There are also indications of another series of faults roughly parallel to the south-east coast, which point to the islands being fragments of a former extensive plateau. The mammalian remains found in Pleistocene deposits are of exceptional interest. Among the more remarkable forms are a species of hippopotamus, the elephant (including a pigmy variety), and a gigantic dormouse

In the Coralline Limestone the following fossils have been noted:—*Spondylus*, *Ostrea*, *Pecten*, *Cytherea*, *Arca*, *Terebratula*, *Orthis*, *Clavagella*, *Echinus*, *Cidaris*, *Nucleolites*. *Brissus*, *Spatangus*; in the Marl the *Nautilus zigzag*; in the Yellow, Black and Greensand shells of *Lenticulites complanatus*, teeth and vertebrae of *Squalidae* and *Cetacea*; in the Sandstone *Vaginula depressa*. *Crystallaria*, *Nodosaria*, *Brissus*, *Nucleolites*, *Pecten burdigallensis*, *Scalaria*, *Scutella subrotunda*, *Spatangus*, *Nautilus*, *Ostrea navicularis* and *Pecten cristatus* (see Captain Spratt's work and papers by Lord Ducie and Dr Adams).

The Blue Clay forms, at the higher levels, a stratum impervious to water, and holds up the rainfall, which soaks through the spongy mass of the superimposed coralline formations. Hence arise the springs which run perennially, several of which have been collected into the gravitation water supplies of the Vignacourt and Fawara aqueducts. The larger part of the water supply, however, is now derived by pumping from strata at about sea-level. These strata are generally impregnated with salt water, and are practically impenetrable to the rain-water of less weight. The honeycomb of rock, and capillary action, retard the lighter fresh-water from sinking to the sea; the soakage from rain has therefore to move horizontally, over the strata about sea-level, seeking outlets. At this stage the rain-water is intercepted by wells, and by galleries hewn for miles in the water-bearing rock. Large reservoirs assist to store this water after it is raised, and to equalize its distribution.

Climate and Hygiene.

The climate is, for the greater part of the year, temperate and healthy; the thermometer records an annual mean of 67° F. Between June and September the temperature ranges from 75° to 90°; the mean for December, January and February is 56°; March, May and November are mild. Pleasant north-east winds blow for an average of 150 days a year, cool northerly winds for 31 days, east winds 70 days, west for 34 days. The north-west "Gregale" (Euroclydon of Acts xxvii. 14) blows about the equinox, and occasionally, in the winter months, with almost hurricane force for three days together; it is recorded to have caused the drowning of 600 persons in the harbour in 1555. This wind has been a constant menace to shipping at anchor; the new breakwater on the Monarch Shoal was designed to resist its ravages. The regular tides are hardly perceptible, but, under the influence of barometric pressure and wind, the sea-level occasionally varies as much as 2 ft. The average rainfall is 21 in.; it is, however, uncertain; periods of drought have extended over three years. Snow is seen once or twice in a generation; violent hailstorms occur. On the 19th of October 1898, exceptionally large hailstones fell—one, over 4 in. in length, being brought to the governor, Sir Arthur Fremantle, for inspection. Mediterranean (sometimes called "Malta") fever has been traced by Colonel David Bruce to a *Micrococcus melitensis*. The supply of water under pressure is widely distributed and excellent. There is a modern system of drainage for the towns, and all sewerage has been intercepted from the Grand Harbour. There are efficient hospitals and asylums, a system of sanitary inspection, and modernized quarantine stations.

Flora.

It is hardly possible to differentiate between imported and indigenous plants. Among the marine flora may be mentioned *Porphyra laciniata*, the edible laver; *Codium tomentosum*, a coarse species; *Padina pavonia*, common in shallow water; *Ulva latissima*; *Haliseris polypodioides*; *Sargassum bacciferum*; the well-known gulf weed, probably transported from the Atlantic; *Zostera marina*, forming dense beds in muddy bays; the roots are cast up by storms and are valuable to dress the fields. Among the land plants may be noted the blue anemone; the ranunculus along the road-sides, with a strong perfume of violets; the Malta heath, which flowers at all seasons; *Cynomorium coccineum*, the curious "Malta fungus," formerly so valued for medicinal purposes that a guard was set for its preservation under the rule of the Knights; the pheasant's-eye; three species of mallow and geranium; *Oxalis cernua*, a very troublesome imported weed; *Lotus edulis*; *Scorpiurus subvillosa*, wild and cultivated as forage; two species of the horseshoe-vetch; the opium poppy; the yellow and claret-coloured poppy; wild rose; *Crataegus azarolus*, of which the fruit is delicious preserved; the ice-plant; squirting cucumber; many species of *Umbelliferae*; *Labiatae*, to which the spicy flavour of the honey (equal to that of Mt Hymettus) is ascribed; snapdragons; broom-rape; glass-wort; *Salsola soda*, which produces when burnt a considerable amount of alkali; there are fifteen species of orchids; the *gladiolus* and *iris* are also found; *Urginia scilla*, the medicinal squill, abounds with its large bulbous roots near the sea; seventeen species of sedges and seventy-seven grasses have been recorded.

Fauna.

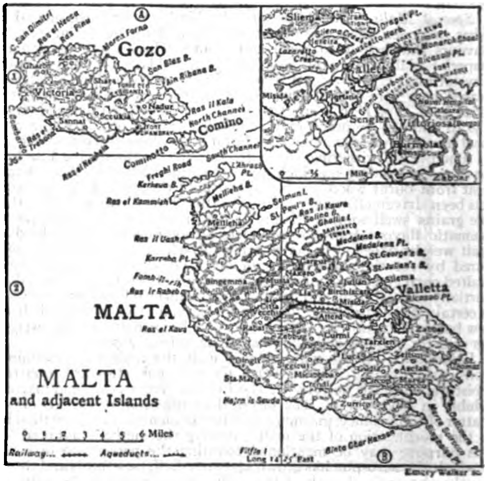
There are four species of lizard and three snakes, none of which is venomous; a land tortoise, a turtle and a frog. Of birds very few are indigenous; the jackdaw, blue solitary thrush, spectacled warbler, the robin, kestrel and the herring-gull. A bird known locally as *Hangi*, not met elsewhere in Europe, nests at Filfla. Flights of quail and turtle doves, as well as teal and ducks, stay long enough to afford sport. Of migratory birds over two hundred species have been enumerated. The only wild mammalia in the island are the hedgehogs, two species of weasel, the Norway rat, and the domestic mouse. The Maltese dog was never wild and has ceased to exist as a breed.

Malta has several species of zoophytes, sponges, mollusca and crustacea. Insect life is represented by plant-bugs, locusts, crickets, grasshoppers, cockroaches, dragon-flies, butterflies, numerous varieties of moths, bees and mosquitoes.

Among the fish may be mentioned the tunny, dolphin, mackerel, sardine, sea-bream, dentice and pagnell; wrasse, of exquisite rainbow hue and good for food; members of the herring family, sardines, anchovies, flying-fish, sea-pike; a few representatives of the cod family, and some flat fish; soles (very rare); *Cernus* which grows to large size; several species of grey and red mullet; eleven species of *Triglidae*, including the beautiful flying gurnard whose colours rival the angel-fish of the West Indies; and eighteen species of mackerel, all migratory.

Population and Language.

The real population of Malta, viz. of the country districts, is to be differentiated from the cosmopolitan fringe of the cities. There is continuous historical evidence that Malta remains to-day what Diodorus Siculus described it in the 1st century, "a colony of the Phoenicians"; this branch of the Caucasian race came down the great rivers to the Persian Gulf and thence to Palestine. It carried the art of navigation through the Mediterranean, along the Atlantic seaboard as far as Great Britain, leaving colonies along its path. In prehistoric times one of these colonies displaced previous inhabitants of Libyan origin. The similarity of the megalithic temples of Malta and of Stonehenge connect along the shores of western Europe the earliest evidence of Phoenician civilization. Philology proves that, though called "Canaanites" from having sojourned in that land, the Phoenicians have no racial connexion with the African descendants of Ham. No subsequent invader of Malta attempted to displace the Phoenician race in the country districts. The Carthaginians governed settlements of kindred races with a light hand; the Romans took over the Maltese as "dedititii," not as a conquered race. Their conversion by St Paul added difference of religion to the causes which prevented mixture of race. The Arabs from Sicily came to eject the Byzantine garrison; they treated the Maltese as friends, and were not sufficiently numerous to colonize. The Normans came as fellow-Christians and deliverers; they found very few Arabs in Malta. The fallacy that Maltese is a dialect of Arabia has been luminously disproved by A. E. Caruana; *Sull' origine della lingua Maltese*.



Emery Walker sc.

The upper classes have Norman, Spanish and Italian origin. The knights of St John of Jerusalem, commonly called "of Malta," were drawn from the nobility of Catholic Europe. They took vows of celibacy, but they frequently gave refuge in Malta to relatives driven to seek asylum from feudal wars and disturbances in their own lands. At the British occupation there were about two dozen families bearing titles of nobility granted, or recognized, by the Grand Masters, and descending by primogeniture. These "privileges" were guaranteed, together with the rights and religion of the islanders, when they became British subjects, but no government has ever recognized papal titles in Malta. High and low, all speak among themselves the Phoenician Maltese, altogether different from the Italian language; Italian was only spoken by 13·24 % in 1901. Such Italian as is spoken by the lingering minority has marked divergences of pronunciation and inflexion from the language of Rome and Florence. In 1901, in addition to visitors and the naval and military forces, 18,922 Maltese spoke English, and the number has been rapidly increasing.

In appearance the Maltese are a handsome, well-formed race, about the middle height, and well set up; they have escaped the negroid contamination noticeable in Sicily, and their features are less dark than the southern Italians. The women are generally smaller than the men, with black eyes, fine hair and graceful carriage. They are a thrifty and industrious people, prolific and devoted to their offspring, good-humoured, quick-tempered and impressionable. The food of the working classes is principally bread, with oil, olives, cheese and fruit, sometimes fish, but seldom meat; common wine is largely imported from southern Europe. The Maltese are strict adherents to the Roman Catholic religion, and enthusiastic observers of festivals, fasts and ceremonials.

In 1906 the birth-rate was 40·68 per thousand, and the excess of births over deaths 2637. In April 1907 the estimated population was 206,690 of whom 21,911 were in Gozo. This phenomenal congestion of population gives interest to records of its growth; in the 10th century there were 16,767 inhabitants in Malta and 4514 in Gozo; the total population in 1514 was 22,000. Estimates made at the arrival of the knights (1530) varied from 15,000 to 25,000: it was then necessary to import annually 10,000 quarters of grain from Sicily. The population in 1551 was, Malta 24,000, Gozo 7000. In 1582, 20,000 quarters of imported grain were required to avert famine. A census of 1590 makes the population 30,500; in that year 3000 died of want. The numbers rose in 1601 to 33,000; in 1614 to 41,084; in 1632 to 50,113; in 1667 to 55,155; in 1667 11,000 are said to have died of plague out of the total population. At the end of the rule of the knights (1798) the population was estimated at 100,000; sickness, famine and emigration during the blockade of the French in Valletta probably reduced the inhabitants to 80,000. In 1829 the population was 114,236; in 1836, 119,878 (inclusive of the garrison); in 1873, 145,605; at the census in 1901 the civil population was 184,742. Sanitation decreases the death-rate, religion keeps up the birth-rate. Nothing is done to promote emigration or to introduce manufactures.

Towns and Villages.—The capital is named after its founder, the Grand Master de la Valette, but from its foundation it has been called Valletta (pop. 1901, 24,685); it contains the palace of the Grand Masters, the magnificent Auberges of the several "Langues" of the Order, the unique cathedral of St John with the tombs of the Knights and magnificent tapestries and marble work; a fine opera house and hospital are conspicuous. Between the inner fortifications of Valletta and the outer works, across the neck of the peninsula, is the suburb of Floriana (pop. 7278). To the south-east of Valletta, at the other side of the Grand Harbour, are the cities of Senglea (pop. 8093), Vittoriosa (pop. 8993); and Cospicua (pop. 12,184); this group is often spoken of as "The Three Cities." The old capital, near the centre of the island is variously called Notabile, Città Vecchia (*q.v.*), and Medina, with its suburb Rabat, its population in 1901 was 7515; here are the catacombs and the ancient cathedral of Malta. Across the Marsamuscetto Harbour of Valletta is a considerable modern town called Sliema. The villages of Malta are Mellicha, St Paul's Bay, Musta, Birchircara, Lia, Atterd, Balzan, Naxaro, Gargur, Misida, S. Julian's, S. Giuseppe, Dingli, Zebbug, Siggieui, Curmi, Luca, Tarxein, Zurrico, Crendi, Micabbiba, Circop, Zabbar, Asciak, Zeitun, Gudia and Marsa Scirocco. The chief town of Gozo is called Victoria, and there are several small villages.

Industry and Trade.—The area under cultivation in 1906 was 41,534 acres. As a rule the tillers of the soil live away from their lands, in some neighbouring village. The fields are small and composed of terraces by which the soil has been walled up along the contours of the hills, with enormous labour, to save it from being washed away. Viewed from the sea, the top of one wall just appearing above the next produces a barren effect; but the aspect of the land from a hill in early spring is a beautiful contrast of luxuriant verdure. It is estimated that there are about 10,000 small holdings averaging about four acres and intensely cultivated. The grain crops are maize, wheat and barley; the two latter are frequently sown together. In 1906, 13,000 acres produced 17,975 quarters of wheat and 12,000 quarters of barley. The principal fodder crops are green barley and a tall clover called "sulla" (*Hedysarum coronarum*), having a beautiful purple blossom. Vegetables of all sorts are easily grown, and a rotation of these is raised on land irrigated from wells and springs. Potatoes and onions are grown for exportation at seasons when they are scarce in northern Europe. The rent of average land is about £2 an acre, of very good land over £3; favoured spots, irrigated from running springs, are worth up to £12 an acre. Two, and often three, crops are raised in the year; on irrigated land more than twice as many croppings are possible. The presence of phosphates accounts for the fertility of a shallow soil. There is a considerable area under vines, but it is generally more profitable to sell the fruit as grapes than to convert it into wine. Some of the best oranges in the world are grown, and exported; but sufficient care is not taken to keep down insect pests, and to replace old trees. Figs, apricots, nectarines and peaches grow to perfection. Some cotton is raised as a rotation crop, but no care is taken to improve the quality. The caroub tree and the prickly pear are extensively cultivated. There are exceptionally fine breeds of cattle, asses and goats; cows of a large and very powerful build are used for ploughing. The supply of butchers' meat has to be kept up by constant importations. More than two-thirds of the wheat comes from abroad; fish, vegetables and fruit are also imported from Sicily in considerable quantities. Excellent honey is produced in Malta; at certain seasons tunny-fish and young dolphin (lampuca) are abundant; other varieties of fish are caught all the year round.

About 5000 women and children are engaged in producing Maltese lace. The weaving of cotton by hand-looms survives as a languishing industry. Pottery is manufactured on a small scale; ornamental carvings are made in Maltese stone and exported to a limited extent. The principal resources of Malta are derived from its being an important military station and the headquarters of the Mediterranean fleet. There are great naval docks, refitting yards, magazines and stores on the south-east side of the Grand Harbour; small vessels of war have also been built here. Steamers of several lines call regularly, and there is a daily mail to Syracuse. The shipping cleared in 1905–1906 was 3524 vessels of 3,718,168 tons. Internal communications include a railway about eight miles long from Valletta to Notabile; there are electric tramways and motor omnibus services in several directions. The currency is English. Local weights and measures include the cantar, 175 lb; salm, one imperial quarter; cafiso, 4½ gallons; canna, 6 ft. 10½ in.; the tumolo (256 sq. ca.), about a third of an acre.

The principal exports of local produce are potatoes, cumin seed, vegetables, oranges, goats and sheep, cotton goods and stone.

To keep alive, in a fair standard of comfort, the population of 206,690, food supplies have to be imported for nine and a half months in the year. The annual value of exports would be set off against imported food for about one month and a half. The Maltese have to pay for food imports by imperial wages, earned in connexion with naval and military services, by commercial services to passing steamers and visitors, by earnings which emigrants send home from northern Africa and elsewhere, and by interest on investments of Maltese capital abroad. A long absence of the Mediterranean fleet, and withdrawals of imperial forces, produce immediate distress.

Finance.—The financial position in 1906–1907 is indicated by the following: Public revenue £513,594 (including £51,039 carried to revenue from capital); expenditure £446,849; imports (actual), £1,219,819; imports in transit, £5,876,981; exports (actual), £123,510; exports in transit £6,127,277; imports from the United Kingdom (actual), £218,461. In March 1907 there were 8159 depositors in the government savings bank, with £569,731 to their credit.

Government.—Malta is a crown colony, within the jurisdiction of a high commissioner and a commander-in-chief, to whom important questions of policy are reserved; in other matters the administration is under a military governor (£3000), assisted by a civil lieutenant-governor or chief secretary. There is an executive council, now comprising eleven members with the governor as president. The legislative council, under letters patent of the 3rd of June 1903, is composed of the governor (president), ten official members, and eight elected members. There are eight electoral districts with a total of about 10,000 electors. A voter is qualified on an income from property of £6, or by paying rent to the same amount, or having the qualifications required to serve as a common juror. There are no municipal institutions. Letters patent, orders in council, and local ordinances have the force of law. The laws of Justinian are still the basis of the common law, the Code of Rohan is not altogether abrogated, and considerable weight is still given to the Roman Canon Law. The principal provisions of the Napoleonic Code and some English enactments have been copied in a series of ordinances forming the Statute Law. Latin was the language of the courts till 1784, and was not completely supplanted by Italian till 1815. The partial use of English (with illogical limitations to the detriment of the Maltese-born British subjects who speak English) was introduced by local ordinances and orders in council at the end of the 19th century. The Maltese, of whom 86% cannot understand Italian, are still liable to be tried, even for their lives, in Italian, to them a foreign language. The endeavour to restrict juries to those who understand Italian reveals glaring incongruities.

Education.—There were, in 1906, 98 elementary day schools, and 33 night schools. The attendance on the 1st of September 1905 was 16,530, the percentage on those enrolled 84·6; the total enrolment was 18,719. The average cost per pupil in these schools was 35s. 11d. a year on daily attendance. There is a secondary school for girls in Valletta, and one for boys in Gozo. A lyceum in Malta had an average attendance of 464. The number of students at the university was about 150. The average cost per student in the lyceum was £8, 0s. 11d.; in the university £26, 10s. 1d. The fees in these institutions are almost nominal, the middle-classes are thus educated at the expense of the masses. In the 18th century the government of the Knights and of the Inquisition did not favour the education of the people, after 1800 British governors were slow to make any substantial change. About the middle of the 19th century it began to be recognized that the education of the people was more conducive to the safety of the fortress than to leave in ignorance congested masses of southern race liable to be swayed spasmodically by prejudice. At first an attempt was made to make Maltese a literary language by adapting the Arabic characters to record it in print. This failed for several reasons, the foremost being that the language was not Arabic but Phoenician, and because professors and teachers, whose personal ascendancy was based on the official prominence of Italian, did not realize that educational institutions existed for the rising generation rather than to provide salaries for alien teachers and men behind the times. Various educational schemes were proposed, but they were easier to propose than to carry into effect: no one, except Mr Savona, had the ability to urge English as the basis of instruction, and he agitated and was installed as director of education and made a member of the Executive. The obstruction which he encountered alarmed him, and he compromised by adopting a mixed system of both English and Italian, *pari passu*, as the basis of Maltese education; he resigned after a brief effort. Mr Savona's attempt to teach the Maltese children simultaneously two foreign languages (of which they were quite ignorant, and their teachers only partially conversant) without first teaching how to read and write the native Maltese systematically was continued for some years under an eminent archaeologist, Dr A. A. Caruana, who became Director of Education. He began to give some preference to English indirectly. On his resignation Sir G. Strickland established a new system of education based on the principle of beginning from the bottom, by teaching to read and write in Maltese as the medium for assimilating, at a further stage, either English or Italian, one at a time, and aiming at imparting general knowledge in colloquial English. A series of school books, in the Maltese language printed in Roman characters, with translations in English interlined in different type, was produced at the government printing office and sold at cost price. The parents and guardians were called upon to select whether each child should learn English or Italian next after learning reading, writing and arithmetic in Maltese. About 89% recorded their preference in favour of English at the outset; then, as a result of violent political agitation, this percentage was considerably lowered, but soon crept up again. Teachers and professors who were weak in English, lawyers, newspaper men and others, combined to deprive these reforms of their legitimate consequence, viz. that after a number of years English should be the language of the courts as well as of education, and to protect those belonging to the old order of knowledge from the competition of young Maltese better educated than themselves, whose rapid rise everywhere would be assured by knowing English thoroughly. An order in council was enacted in 1899 providing that no Maltese (except students of theology) should thenceforth suffer any detriment through inability to pass examinations in Italian, in either the schools or university, but the fraction of the Maltese who claim to speak Italian (13·24%) still command sufficient influence to hamper the full enjoyment of this emancipation by the majority. In the university most of the textbooks used are English, nevertheless many of the lectures are still delivered in Italian—for the convenience of some professors or to please the politicians, rather than for the benefit of the students. The number of students who enter the university without passing any examination in Italian is rapidly increasing; the longer the period of transition, the greater the detriment to the rising generation.

History and Antiquities.—The earliest inhabitants of Malta (Melita) and Gozo (Gaulos) belonged to a culture-circle which included the whole of the western Mediterranean, and to a race which perhaps originated from North Africa; and it is they, and not the Phoenicians, who were the builders of the remarkable megalithic monuments, which these islands contain, the Gigantia in Gozo, Hagiar Kim and Mnaidra near Crendi, the rock-cut hypogeum of Halsaflieni,[1] and the megalithic buildings on the hill of Corradino in Malta, being the most noteworthy. The contemporaneity of these structures has been demonstrated by the identity of the pottery and other objects discovered in them, including some remarkable steatopygic figures in stone, and it is clear that they belong to the neolithic period, numerous flints, but no metal, having been found. Those that have been mentioned seem to have been sanctuaries (some of them in part dwelling-places), but Halsaflieni was an enormous ossuary, of which others may have existed in other parts of the island; for the numerous rock-cut tombs which are everywhere to be seen belong to the Phoenician and Roman periods. In these buildings there is a great preference for apsidal terminations to the internal chambers, and the façades are as a rule slightly curved. The numerous niches, generally containing sacrificial (?) tables,[2] are often approached by window-like openings hewn out of one of the flat slabs by which they are enclosed. The surface of the stones in the interior is often pitted, as a form of ornamentation. Even the barren islet of Comino, between Malta and Gozo, was inhabited in prehistoric times.

To the Phoenician period, besides the tombs already mentioned, belong some remains of houses and cisterns, and (probably) a few round towers which are scattered about the island, while the important Roman house at Cittavecchia is the finest monument of this period in the islands.

The Carthaginians came to Malta in the 6th century B.C., not as conquerors, but as friends of a sister Phoenician colony (Freeman, *Hist. Sicily*, i. 255): Carthage in her struggle with Rome was at last driven to levy oppressive tribute, whereupon the Maltese gave up the Punic garrison to Titus Sempronius, under circumstances described by Livy (xxi. 51). The Romans did not treat the Maltese as conquered enemies, and at once gave them the privileges of a *municipium*; Cicero (*in Verrem*) refers to the Maltese as "Socii." Nothing was to be gained by displacing the Phoenician inhabitants in a country from which any race less thrifty would find life impossible by agriculture. On the strength of a monument bearing his name, it has been surmised that Hannibal was born in Malta, while his father was governor-general of Sicily; he certainly did not die in Malta. There is evidence from Cicero (*in Verrem*) that a very high stage of manufacturing and commercial prosperity, attained in

[1] See T. Zammit, *The Halsaflieni prehistoric hypogeum at Casal Paula, Malta* (Malta, 1910).

[2] Sometimes the pillar which represents the *baetylus*, which seems to have been the object of worship (see A. J. Evans in *Journal of Hellenic Studies*, xxi., 1901) stands free sometimes it serves as support to the table stone which covers the niche, and sometimes again monolithic tables occur. Conical stones (possibly themselves *baetyli*) are also found.

Carthaginian times, continued in Malta under the Romans. The Phoenician temple of Juno, which stood on the site of Fort St Angelo, is also mentioned by Valerius Maximus. An inscription records the restoration of the temple of Proserpine by Cheriston, a freed-man of Augustus and procurator of Malta. Diodorus Siculus (L. V., c. 4) speaks of the importance and ornamentation of Maltese dwellings, and to this day remains of palaces and dwellings of the Roman period indicate a high degree of civilization and wealth. When forced to select a place of exile, Cicero was at first (*ad Att.* III. 4, X. i. 8, 9) attracted to Malta, over which he had ruled as quaestor 75 B.C. Among his Maltese friends were Aulus Licinius and Diodorus. Lucius Castricius is mentioned as a Roman governor under Augustus. Publius was "chief of the island" when St Paul was shipwrecked (Acts xxvii. 7); and is said to have become the first Christian bishop of Malta. The site where the cathedral at Notabile now stands is reputed to have been the residence of Publius and to have been converted by him into the first Christian place of worship, which was rebuilt in 1090 by Count Roger, the Norman conqueror of Malta. The Maltese catacombs are strikingly similar to those of Rome, and were likewise used as places of burial and of refuge in time of persecution. They contain clear indication of the interment of martyrs. St Paul's Bay was the site of shipwreck of the apostle in A.D. 58; the "topon diathalasson" referred to in Acts is the strait between Malta and the islet of Selmun. The claim that St Paul was shipwrecked at Meleda off the Dalmatian coast, and not at Malta, has been clearly set at rest, on nautical grounds, by Mr Smith of Jordanhill (*Voyage and Shipwreck of St Paul*, London, 1848). According to tradition and to St Chrysostom (*Hom.* 54) the stay of the apostle resulted in the conversion of the Maltese to Christianity. The description of the islanders in Acts as "barbaroi" confirms the testimony of Diodorus Siculus that they were Phoenicians, neither hellenized nor romanized. The bishopric of Malta is referred to by Rocco Pirro (*Sicilia sacra*), and by Gregory the Great (*Epist.* 2, 44; 9, 63; 10, 1). It appears that Malta was not materially affected by the Greek schism, and remained subject to Rome.

On the final division of the Roman dominions in A.D. 395 Malta was assigned to the empire of Constantinople. On the third Arab invasion, A.D. 870, the Maltese joined forces against the Byzantine garrison, and 3000 Greeks were massacred. Unable to garrison the island with a large force, the Arabs cleared a zone between the central stronghold, Medina, and the suburb called Rabat, to restrict the fortified area. Many Arab coins, some Kufic inscriptions and several burial-places were left by the Arabs; but they did not establish their religion or leave a permanent impression on the Phoenician inhabitants, or deprive the Maltese language of the characteristics which differentiate it from Arabic. There is no historical evidence that the domination of the Goths and Vandals in the Mediterranean ever extended to Malta: there are fine Gothic arches in two old palaces at Notabile, but these were built after the Norman conquest of Malta. In 1090 Count Roger the Norman (son of Tancred de Hauteville), then master of Sicily, came to Malta with a small retinue; the Arab garrison was unable to offer effective opposition, and the Maltese were willing and able to welcome the Normans as deliverers and to hold the island after the immediate withdrawal of Count Roger. A bishop of Malta was witness to a document in 1090. The Phoenician population had continued Christian during the mild Arab rule. Under the Normans the power of the Roman Church quickly augmented, tithes were granted, and ecclesiastical buildings erected and endowed. The Normans, like the Arabs, were not numerically strong; the rule of both, in Sicily as well as Malta, was based on a recognition of municipal institutions under local officials; the Normans, however, exterminated the Mahommedans. Gradually feudal customs asserted themselves. In 1193 Margarito Brundusio received Malta as a fief with the title of count; he was Grand Admiral of Sicily. Constance, wife of the emperor Henry IV. of Germany became, in 1194, heiress of Sicily and Malta; she was the last of the Norman dynasty. The Grand Admiral of Sicily in 1223 was Henry, count of Malta. He had led 300 Maltese at the capture of two forts in Tripoli by the Genoese. In 1265 Pope Alexander IV. conferred the crown of Sicily on Charles of Anjou to the detriment of Manfred, from whom the French won the kingdom at the battle of Benevento. Under the will of Corradino a representative of the blood of Roger the Norman, Peter of Aragon claimed the succession, and it came to him by the revolution known as "the Sicilian Vespers" when 28,000 French were exterminated in Sicily. Charles held Malta for two years longer, when the Aragonese fleet met the French off Malta, and finally crushed them in the Grand Harbour. In 1427 the Turks raided Malta and Gozo, they carried many of the inhabitants into captivity, but gained no foothold. The Maltese joined the Spaniards in a disastrous raid against Gerbi on the African coast in 1432. In 1492 the Aragonese expelled the Jews. Dissatisfaction arose under Aragonese rule from the periodical grants of Malta, as a marquisate or countship, to great officers of state or illegitimate descendants of the sovereign. Exemption was obtained from these incidences of feudalism by large payments to the Crown in return for charters covenanting that Malta should for ever be administered under the royal exchequer without the intervention of intermediary feudal lords. This compact was twice broken, and in 1428 the Maltese paid King Alfonso 30,000 florins for a confirmation of privileges, with a proviso that entitled them to resist by force of arms any intermediate lord that his successors might attempt to impose. Under the Aragonese, Malta, as regards local affairs, was administered by a *Università* or municipal commonwealth with wide and indefinite powers, including the election of its officers, Capitan di Verga, Jurats, &c. The minutes of the "Consiglio Popolare" of this period are preserved, showing it had no legislative power; this was vested in the king, and was exercised despotically in the interests of the Crown. The knights of St John having been driven from Rhodes by the Turks, obtained the grant of Malta, Gozo and Tripoli in 1530 from the emperor Charles V., subject to a reversion in favour of the emperor's successor in the kingdom of Aragon should the knights leave Malta, and to the annual tribute of a falcon in acknowledgment that Malta was under the suzerainty of Spain. The Maltese, at first, challenged the grant as a breach of the charter of King Alfonso, but eventually welcomed the knights. The Grand Master de l'Isle Adam, on entering the ancient capital of Notabile, swore for himself and his successors to maintain the rights and liberties of the Maltese. The Order of St John took up its abode on the promontory guarded by the castle of St Angelo on the southern shore of the Grand Harbour, and, in expectation of attacks from the Turks, commenced to fortify the neighbouring town called the Borgo. The knights lived apart from the Maltese, and derived their principal revenues from estates of the Order in the richest countries of Europe. They accumulated wealth by war, or by privateering against the Turks and their allies. The African Arabs under Selim Pasha in 1551 ravaged Gozo, after an unsuccessful attempt on Malta, repulsed by cavalry under Upton, an English knight. The Order of St John and the Christian Maltese now realized that an attempt to exterminate them would soon be made by Soliman II., and careful preparations were made to meet the attack.

The great siege of Malta which made the island and its knights famous, and checked the advance of Mahommedan power in southern and western Europe, began in May 1565. The fighting men of the defenders are variously recorded between 6100 and 9121; the roll comprises one English knight, Oliver Starkey. The Mahommedan forces were estimated from 29,000 to 38,500. Jehan Parisot de la Valette had participated in the defence of Rhodes, and in many naval engagements. He had been taken prisoner by Dragut, who made him row for a year as a galley slave till ransomed. This Grand Master had gained the confidence of Philip of Spain, the friendship of the viceroy of Sicily, of the pope and of the Genoese admiral, Doria. The Sultan placed his troops under the veteran Mustapha, and his galleys under his youthful relative Piali, he hesitated to make either supreme and ordered them to await the arrival of Dragut with his Algerian allies, before deciding on their final plans. Meanwhile, against Mustapha's better judgment, Piali induced the council of war to attack St Elmo, in order to open the way for his fleet to an anchorage, safe in all weathers, in Marsamuscetto harbour. This strategical blunder was turned to the best advantage by La Valette, who so prolonged the most heroic defence of St Elmo that the Turks lost 7000 killed and as many wounded before exterminating the 1200 defenders, who fell at their post. In the interval Dragut was mortally wounded, the attack on Notabile was neglected, valuable time lost, and the main objective (the Borgo) and St Angelo left intact. The subsequent siege of St Angelo, and its supporting fortifications, was marked by the greatest bravery on both sides. The knights and their Maltese troops fought for death or victory, without asking or giving quarter. The Grand Master proved as wise a leader as he was brave. By September food and ammunition were getting scarce, a large relieving force was expected from Sicily, and Piali became restive, on the approach of the equinox, for the safety of his galleys. At last the viceroy of Sicily, who had the Spanish and allied fleets at his disposal, was spurred to action by his council. He timidly landed about 6000 or 8000 troops at the north-west of Malta and withdrew. The Turks began a hurried embarcation and allowed the Christians to join forces at Notabile; then, hearing less alarming particulars of the relieving force, Mustapha relanded his reluctant troops, faced his enemies in the open, and was driven in confusion to his ships on the 8th of September.

The Order thus reached the highest pinnacle of its fame, and new knights flocked to be enrolled therein from the flower of the nobility of Europe; La Valette refused a cardinal's hat, determined not to impair his independence. He made his name immortal by founding on Mt Sceberras "a city built by gentlemen for gentlemen" and making Valletta a magnificent example of fortification, unrivalled in the world. The pope and other sovereigns donated vast sums for this new bulwark of Christianity, but, as its ramparts grew in strength, the knights were slow to seek the enemy in his own waters, and became false to their traditional strategy as a naval power. Nevertheless, they harassed Turkish commerce and made booty in minor engagements throughout the 16th and 18th centuries, and they took part as an allied Christian power in the great victory of Lepanto. With the growth of wealth and security the martial spirit of the Order began to wane, and so also did its friendly relations with the Maltese. The field for recruiting its members, as well as its landed estates, became restricted by the Reformation in England and Germany, and the French knights gradually gained a preponderance which upset the international equilibrium of the Order. The election of elderly Grand Masters became prevalent, the turmoil and chances of frequent elections being acceptable to younger members. The civil government became neglected and disorganized, licentiousness increased, and riots began to be threatening. Expenditure on costly buildings was almost ceaseless, and kept the people alive. In 1614 the Vignacourt aqueduct was constructed. The Jesuits established a university, but they were expelled and their property confiscated in 1768. British ships of war visited Malta in 1675, and in 1688 a fleet under the duke of Grafton came to Valletta. The fortifications of the "Three Cities" were greatly strengthened under the Grand Master Cotoner.

In 1722 the Turkish prisoners and slaves, then very numerous, formed a conspiracy to rise and seize the island. Premature discovery was followed by prompt suppression. Castle St Angelo and the fort of St James were, in 1775, surprised by rebels, clamouring against bad government; this rising is known as the Rebellion of the Priests, from its leader, Mannarino. The last but one of the Grand Masters who reigned in Malta, de Rohan, restored good government, abated abuses and promulgated a code of laws; but the ascendancy acquired by the Inquisition over the Order, the confiscation of the property of the knights in France on the outbreak of the Revolution, and the intrigues of the French made the task of regenerating the Order evidently hopeless in the changed conditions of Christendom. On the death of Rohan the French knights disagreed as to the selection of his successor, and a minority were able to elect, in 1797, a German of weak character, Ferdinand Hompesch, as the last Grand Master to rule in Malta. Bonaparte had arranged to obtain Malta by treachery, and he took possession without resistance in June 1798; after a stay of six days he proceeded with the bulk of his forces to Egypt, leaving General Vaubois with 6000 troops to hold Valletta. The exiled knights made an attempt to reconstruct themselves under the emperor Paul of Russia, but finally the Catholic parent stem of the Order settled in Rome and continues there under papal auspices. It still comprises members who take vows of celibacy and prove the requisite number of quarterings.

Towards the close of the rule of the knights in Malta feudal institutions had been shaken to their foundations, but the transition to republican rule was too sudden and extreme for the people to accept it. The French plundered the churches, abolished monks, nuns and nobles, and set up forthwith the ways and doings of the French Revolution. Among other laws Bonaparte enacted that French should at once be the official language, that 30 young men should every year be sent to France for their education; that all foreign monks be expelled, that no new priests be ordained before employment could be found for those existing; that ecclesiastical jurisdiction should cease; that neither the bishop nor the priests could charge fees for sacramental ministrations, &c. Stoppage of trade, absence of work (in a population of which more than half had been living on foreign revenues of the knights), and famine, followed the defeat of Bonaparte at the Nile, and the failure of his plans to make Malta a centre of French trade. An attempt to seize church valuables at Notabile was forcibly resisted by the Maltese, and general discontent broke out into open rebellion on the 2nd of September 1798. The French soon discovered to their dismay that, from behind the rubble walls of every field, the agile Maltese were unassailable. The prospect of an English blockade of Malta encouraged the revolt, of which Canon Caruana became the leader. Nelson was appealed to, and with the aid of Portuguese allies he established a blockade and deputed Captain Ball, R.N. (afterwards the first governor) to assume, on the 9th of February 1799, the provisional administration of Malta and to superintend operations on land. Nelson recognized the movement in Malta as a successful revolution against the French, and upheld the contention that the king of Sicily (as successor to Charles V. in that part of the former kingdom of Aragon) was the legitimate sovereign of Malta. British troops were landed to assist in the siege; few lives were lost in actual combat, nevertheless famine and sickness killed thousands of the inhabitants, and finally forced the French to surrender to the allies. Canon Caruana and other leaders of the Maltese aspired to obtain for Malta the freedom of the Roman Catholic religion guaranteed by England in Canada and other dependencies, and promoted a petition in order that Malta should come under the strong power of England rather than revert to the kingdom of the two Sicilies.

The Treaty of Amiens (1802) provided for the restoration of the island to the Order of St John; against this the Maltese strongly protested, realizing that it would be followed by the re-establishment of French influence. The English flag was flown side by side with the Neapolitan, and England actually renewed war with France sooner than give up Malta. The Treaty of Paris (1814), with the acclamations of the Maltese, confirmed Great Britain in the aggregation of Malta to the empire.

A period elapsed before the government of Malta again became self-supporting, during which over £600,000 was contributed by the British exchequer in aid of revenue, and for the importation of food-stuffs. The restoration of Church property, the re-establishment of law and administration on lines to which the people were accustomed before the French invasion, and the claiming for the Crown of the vast landed property of the knights, were the first cares of British civil rule. As successor to the Order, the Crown claimed and eventually established (by the negotiations in Rome of Sir Frederick Hankey, Sir Gerald Strickland and

Sir Lintorn Simmons) with regard to the presentation of the bishopric (worth about £4000 a year) the right to veto the appointment of distasteful candidates. This right was exercised to secure the nomination of Canon Caruana and later of Monsignor Pace. When the pledge, given by the Treaty of Amiens, to restore the Order of St John with a national Maltese "langue," could not be fulfilled, political leaders began demanding instead the re-establishment of the "Consiglio Popolare" of Norman times (without reflecting that it never had legislative power); but by degrees popular aspirations developed in favour of a free constitution on English lines. The British authorities steadily maintained that, at least until the mass of the people became educated, representative institutions would merely screen irresponsible oligarchies. After the Treaty of Paris stability of government developed, and many important reforms were introduced under the strong government of the masterful Sir Thomas Maitland; he acted promptly, without seeking popularity or fearing the reverse, and he ultimately gained more real respect than any other governor, not excepting the marquess of Hastings, who was a brilliant and sympathetic administrator. Trial by jury for criminal cases was established in 1829. A council of government, of which the members were nominated, was constituted by letters patent in 1835, but this measure only increased the agitation for a representative legislature. Freedom of the press and many salutary innovations were brought about on a report of John Austin and G. C. Lewis, royal commissioners, appointed in 1836. The basis of taxation was widened, sinecures abolished, schools opened in the country districts, legal procedure simplified, and Police established on an English footing. Queen Adelaide vistied Malta in 1838 and founded the Anglican collegiate church of St Paul. Sir F. Hankey as chief secretary was for many years the principal official of the civil administration. In 1847 Mr R. Moore O'Ferrall was appointed civil governor. In June 1849 the constitution of the council was altered to comprise ten nominated and eight elected members.

The revolutions in Italy caused about this time many, including Crispi and some of the most intellectual Italians, to take refuge in Malta. These foreigners introduced new life into politics and the press, and made it fashionable for educated Maltese to delude themselves with the idea that the Maltese were Italians, because a few of them could speak the language of the peninsula. A clerical reaction followed against new progressive ideas and English methods of development. After much unreasoning vituperation the Irish Catholic civil governor, who had arrived amidst the acclamations of all, left his post in disgust. His successor as civil governor was Sir W. Reid, who had formerly held military command. His determined attempts to promote education met with intense opposition and little success. At this period the Crimean War brought great wealth and commercial prosperity to Malta. Under Sir G. Le Marchant, in 1858, the nominal rule of military governors was re-established, but the civil administration was largely confided to Sir Victor Houlton as chief secretary, whilst the real power began to be concentrated in the hands of Sir A. Dingli, the Crown advocate, who was the interpreter of the law, and largely its maker, as well as the principal depository of local knowledge, able to prevent the preferment of rivals, and to countenance the barrier which difference of language created between governors and governed. The civil service gravitated into the hands of a clique. At this period much money was spent on the Marsa extension of the Grand Harbour, but the rapid increase in the size of steamships made the scheme inadequate, and limited its value prematurely. The military defences were entirely remodelled under Sir G. Le Marchant, and considerable municipal improvements and embellishments were completed. But this governor was obstructed and misrepresented by local politicians as vehemently as his predecessors and his successors. Ministers at home have often appeared to be inclined to the policy of pleasing by avoiding the reforming of what might be left as it was found. Sir A. Dingli adapted a considerable portion of the Napoleonic Code in a series of Malta Ordinances, but stopped short at points likely to cause agitation. Sir P. Julyan was appointed royal commissioner on the civil establishments, and Sir P. Keenan on education; their work revived the reform movement in 1881. Mr Savona led an agitation for a more sincere system of education on English lines. Fierce opposition ensued, and the *pari passu* compromise was adopted to which reference is made in the section on *Education* above; Mr Savona was an able organizer, and began the real emancipation of the Maltese masses from educational ignorance; but he succumbed to agitation before accomplishing substantial results.

An executive council was established in 1881, and the franchise was extended in 1883. A quarter of a century of Sir Victor Houlton's policy of *laissez-faire* was changed in 1883 by the appointment of Sir Walter Hely-Hutchinson as chief secretary. An attempt was made to utilize fully the abilities of this eminent administrator by creating him civil lieutenant-governor, in whom to concentrate both the real and the nominal power of detailed administration; but the military authorities objected to his corresponding directly with the Colonial Office; and a political deadlock began to develop. Sir A. Dingli was transferred from an administrative office to that of chief justice. With the continuance of military power over details, the public could not understand where responsibility really rested. The elected members under the leadership of Dr Mizzi clamoured for more power, opposed reforms and protested against the carrying of government measures by the casting vote of a military governor as president of the council. To force a crisis, abstention of elected members from the council was resorted to, together with the election of notoriously unfit candidates. Under these circumstances a constitution of a more severe type was recommended by those responsible for the government of Malta and was about to be adopted, as the only alternative to a deadlock, by the imperial authorities.

A regulation excluding Maltese from the navy (because of their speaking on board a language that their officers did not understand) provoked from Trinity College, Cambridge, the Strickland correspondence in *The Times* on the constitutional rights of the Maltese, and a leading article induced the Colonial Office to try an experiment known as the Strickland-Mizzi Constitution of 1887. This constitution (abolished in 1903) ended a period of government by presidential casting votes and official ascendancy. For the first time the elected members were placed in a majority; they were given three seats in the executive council; in local questions the government had to make every effort to carry the majority by persuasion. When persuasion failed and imperial interests, or the rights of unrepresented minorities, were involved the power of the Crown to legislate by order in council could be (and was) freely used. This system had the merit of counteracting any abuse of power by the bureaucracy. It brought to bear on officials effective criticism, which made them alert and hard-working. Governor Simmons eventually gave his support to the new constitution, which was received with acclamation. Strickland, who had been elected while an undergraduate on the cry of equality of rights for Maltese and English, and Mizzi, the leader of the anti-English agitation, were, as soon as elected, given seats in the executive council to co-operate with the government; but their aims were irreconcilable. Mizzi wanted to undo the educational forms of Mr Savona, to ensure the predominance of the Italian language and to work the council as a caucus. Strickland desired to replace bureaucratic government by a system more in touch with the independent gentlemen of the country, and to introduce English ideas and precedents. Friction soon arose. Mizzi cared little for a constitution that did not make him complete master of the situation, and resigned his post in the government.

Sir Walter Hely-Hutchinson left Malta in March 1889, and was succeeded by Sir Gerald Strickland (Count Della Catena), who lost no time in pushing, and carrying with a rapidity that was considered hasty, reforms that had been retarded for years. The majorities behind the government began to dwindle and agitation to grow. Meanwhile the Royal Malta Militia was established as a link between the Maltese and the garrison. The police were reorganized with proper pay, criminal laws were rigorously enforced. A naval officer was placed over the police to diminish difficulties with the naval authorities and sailors. A marine force was raised to stop smuggling; and the subtraction of coal during coaling operations was stopped by drastic legislation. The civil service was reorganized so as to reward merit and work by promotion. Tenders were strictly enforced in letting government property and contracts; a largely increased revenue was applied on water supply, drainage and other works. Lepers were segregated by law.

The Malta marriage question evoked widespread agitation; Sir A. Dingli had refrained from making any provision in his code as to marrying. The Maltese relied on the Roman Canon Law, the English on the common law of England, Scots or Irish had nothing but the English law to fall back upon. Maltese authorities were ignorant of the disabilities of British Nonconformists at common law, and they had not perceived that persons with a British domicile could not evade their own laws by marrying in Malta, *e.g.* that an English girl up to the age of 21 required the father's or guardian's consent from which a Maltese was legally exempt at 18. Sir G. Strickland preferred legislation to the covering up of difficulties by governors' licences and appeals to incongruous precedents. Sir Lintorn Simmons was appointed envoy to the Holy See, to ascertain how far legislation might be pushed in the direction of civil marriage without justifying clerical agitation and obstruction in the council. He succeeded in coming to an agreement with Rome. Nevertheless Sir A. Dingli and ecclesiastics of all denominations, for conflicting reasons, swelled the opposition against the liberal concessions obtained from Leo XIII. The legal necessity for legislation in accordance with the agreement was, nevertheless, on a special reference, submitted to the privy council, whose decision affirmed the advisibility of legislation and the need for validating retrospectively marriages not supported by either Maltese or English common law. Agitation in the imperial parliament stopped government action, but the publicity of the finding of the privy council warned all concerned against the risk of neglecting the common law of the empire whenever they were not prepared to follow the *lex loci contractus*.

Since the British occupation it was disputed whether the military authorities had the right to alienate for the benefit of the imperial exchequer fortress sites no longer required for defence. The reversion of such property was claimed for the local civil government, and the principles governing these rights were ultimately laid down by an order in council, which also determined military rights to restrict buildings within the range of forts. The co-operation of naval and military authorities was obtained for the construction, at imperial expense, of the breakwater designed to save Malta from being abandoned by long and deep draft modern vessels. British-born subjects were given the right to be tried in English. The new system of education (already described) was set up, and many new schools were built with funds provided by order in council against the wishes of the elected majority.

An order in council (1899) making English the language of the courts after fifteen years (by which the Maltese would have obtained the right to be tried in English) was promulgated at a time when the system of taxation was also being revised; henceforth agitation in favour of Italian and against taxation attained proportions unpleasant for those who preferred popularity to reform and progress. The elected members demanded the recall of Sir G. Strickland on his refusing to change his policy. The military governor gave way, as regards making English the language of the courts on a fixed date, but educational reforms and the imposition of new taxes (those in Malta being 27s. 6d. per head, against 93s. in England) were enacted by an order in council notwithstanding the agitation. Mr Mereweather was appointed chief secretary and civil lieutenant-governor in 1902, and Sir Gerald Strickland became governor and commander-in-chief of the Leeward Islands. Governor Sir F. Grenfell was created a peer. Strenuous efforts were made to placate the Italian party in the administration of the educational reforms; but, as these were not repealed, elected members refused supply, and kept away from the council. Persistence in this course led to the repeal by letters-patent of 1903 of the Strickland-Mizzi Constitution of 1887. In place of occasional orders in council for important matters in urgent cases, bureaucratic government with an official majority was again, with its drawbacks, fully re-established for all local affairs great and small. The representatives of the people were repeatedly re-elected, only to resign again and again as a protest against a restricted constitution.

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For the language question, see Mr Chamberlain's speech in the House of Commons, on the 28th of January 1902 Also parliamentary papers for Grievances of the Maltese Nobility, and Constitutional Changes.

MALTA (or MEDITERRANEAN) FEVER, a disease long prevalent of Malta and formerly at Gibraltar, as well as other Mediterranean centres, characterized by prolonged high temperature, with anaemia, pain and swelling in the joints, and neuritis, lasting on an average four months but extending even to two or three years. Its pathology was long obscure, but owing to conclusive research on the part of Colonel (afterwards Sir) David Bruce, to which contributions were made by various officers of the R.A.M.C. and others, this problem had now been solved. A specific microorganism, the *Micrococcus melitensis*, was discovered in 1887, and it was traced to the milk of the Maltese goats. A commission was sent out to Malta in 1904 to investigate the question, and after three years' work its conclusions were embodied in a report by Colonel Bruce in 1907. It was shown that the disappearance of the disease from Gibraltar had synchronized with the non-importation of goats from Malta; and preventive measures adopted in Malta in 1906, by banishing goats' milk from the military and naval dietary, put a stop to the occurrence of cases. In the treatment of Malta fever a vaccine has been used with considerable success.

MALTE-BRUN, CONRAD (1755–1826), French geographer, was born on the 12th of August 1755 at Thisted in Denmark, and died at Paris on the 14th of December 1826. His original name was Malte Conrad Bruun. While a student at Copenhagen he made himself famous partly by his verses, but more by the violence of his political pamphleteering; and at length, in 1800, the legal actions which the government authorities had from time to time instituted against him culminated in a sentence of banishment. The principles which he had advocated were those of the French Revolution, and after first seeking asylum in Sweden he found his way to Paris. There he looked forward to a political career; but, when Napoleon's personal ambition began to unfold itself, Malte-Brun was bold enough to protest, and to turn elsewhere for employment and advancement. He was associated with Edme Mentelle (1730–1815) in the compilation of the *Géographie mathématique . . . de toutes les parties du monde* (Paris, 1803–1807, 16 vols.), and he became recognized as one of the best geographers of France. He is remembered, not only as the author of six volumes of the learned *Précis de la géographie universelle* (Paris, 1810–1829), continued by other hands after his death, but also as the originator of the *Annales des voyages* (1808), and one of the founders of the Geographical Society of Paris. His second son, Victor Adolphe Malte-Brun (1816–1889), followed his father's career of geographer, and was a voluminous author.

MALTHUS, THOMAS ROBERT (1766–1834), English economist, was born in 1766 at the Rookery, near Guildford, Surrey, a small estate owned by his father, Daniel Malthus, a gentleman of good family and independent fortune, of considerable culture, the friend and correspondent of Rousseau and one of his executors. Young Malthus was never sent to a public school, but received his education from private tutors. In 1784 he was sent to Cambridge, where he was ninth wrangler, and became fellow of his college (Jesus) in 1797. The same year he received orders, and undertook the charge of a small parish in Surrey. In the following year he published the first edition of his great work, *An Essay on the Principle of Population as it affects the Future Improvement of Society, with Remarks on the Speculations of Mr Godwin, M. Condorcet, and other Writers.* The work excited a good deal of surprise as well as attention; and with characteristic thoroughness and love of truth the author went abroad to collect materials for the verification and more exhaustive treatment of his views. As Britain was then at war with France, only the northern countries of Europe were quite open to his research at that time; but during the brief Peace of Amiens Malthus continued his investigations in France and Switzerland. The result of these labours appeared in the greatly enlarged and more mature edition of his work published in 1803. In 1805 Malthus married happily, and not long after was appointed professor of modern history and political economy in the East India Company's College at Haileybury. This post he retained till his death suddenly from heart disease on the 23rd of December 1834. Malthus was one of the most amiable, candid and cultured of men. In all his private relations he was not only without reproach, but distinguished for the beauty of his character. He bore popular abuse and misrepresentation without the slightest murmur or sourness of temper. The aim of his inquiries was to promote the happiness of mankind, which could be better accomplished by pointing out the real possibilities of progress than by indulging in vague dreams of perfectibility apart from the actual facts which condition human life.

Malthus's *Essay on Population* grew out of some discussions which he had with his father respecting the perfectibility of society. His father shared the theories on that subject of Condorcet and Godwin, and his son combated them on the ground that the realization of a happy society will always be hindered by the miseries consequent on the tendency of population to increase faster than the means of subsistence. His father was struck by the weight and originality of his views, asked him to put them in writing, and then recommended the publication of the manuscript. It was in this way the *Essay* saw the light. Thus it will be seen that both historically and philosophically the doctrine of Malthus was a corrective reaction against the superficial optimism diffused by the school of Rousseau. It was the same optimism, with its easy methods of regenerating society and its fatal blindness to the real conditions that circumscribe human life, that was responsible for the wild theories of the French Revolution and many of its consequent excesses.

The project of a formal and detailed treatise on population was an afterthought of Malthus. The essay in which he had studied a hypothetic future led him to examine the effects of the principle he had put forward on the past and present state of society; and he undertook an historical examination of these effects, and sought to draw such inferences in relation to the actual state of things as experience seemed to warrant. In its original form he had spoken of no checks to population but those which came under the head either of vice or of misery. In the 1803 edition he introduced the new element of the preventive check supplied by what he calls "moral restraint," and is thus enabled to "soften some of the harshest conclusions" at which he had before arrived. The treatise passed through six editions in his lifetime, and in all of them he introduced various additions and corrections. That of 1816 is the last he revised, and supplies the final text from which it has since been reprinted.

Notwithstanding the great development which he gave to his work and the almost unprecedented amount of discussion to which it gave rise, it remains a matter of some difficulty to discover what solid contribution he has made to our knowledge, nor is it easy to ascertain precisely what practical precepts, not already familiar, he founded on his theoretic principles. This twofold vagueness is well brought out in his celebrated correspondence with Nassau Senior, in the course of which it seems to be made apparent that his doctrine is new not so much in its essence as in the phraseology in which it is couched. He himself tells us that when, after the publication of the original essay, the main argument of which he had deduced from David Hume, Robert Wallace, Adam Smith and Richard Price, he began to inquire more closely into the subject, he found that "much more had been done" upon it "than he had been aware of." It had "been treated in such a manner by some of the French economists, occasionally by Montesquieu, and, among English writers, by Dr Franklin, Sir James Steuart, Arthur Young and Rev. J. Townsend, as to create a natural surprise that it had not excited more of the public attention." "Much, however," he thought, "remained yet to be done. The comparison between the increase of population and food had not, perhaps, been stated with sufficient force and precision," and "few inquiries had been made into the various modes by which the level" between population and the means of subsistence "is effected." The first desideratum here mentioned—the want, namely, of an accurate statement of the relation between the increase of population and food—Malthus doubtless supposed to have been supplied by the celebrated proposition that "population increases in a geometrical, food in an arithmetical ratio." This proposition, however, has been conclusively shown to be erroneous, there being no such difference of law between the increase of man and that of the organic beings which form his food. When the formula cited is not used, other somewhat nebulous expressions are sometimes employed, as, for example, that "population has a tendency to increase faster than food," a sentence in which both are treated as if they were spontaneous growths, and which, on account of the ambiguity of the word "tendency," is admittedly consistent with the fact asserted by Senior, that food tends to increase faster than population. It must always have been perfectly well known that population will probably (though not necessarily) increase with every augmentation of the supply of subsistence, and may, in some instances, inconveniently press upon, or even for a certain time exceed, the number properly corresponding to that supply. Nor could it ever have been doubted that war, disease, poverty—

the last two often the consequences of vice—are causes which keep population down. In fact, the way in which abundance, increase of numbers, want, increase of deaths, succeed each other in the natural economy, when reason does not intervene, had been fully explained by Joseph Townsend in his *Dissertation on the Poor Laws* (1786) which was known to Malthus. Again, it is surely plain enough that the apprehension by individuals of the evils of poverty, or a sense of duty to their possible offspring, may retard the increase of population, and has in all civilized communities operated to a certain extent in that way. It is only when such obvious truths are clothed in the technical terminology of "positive" and "preventive checks" that they appear novel and profound; and yet they appear to contain the whole message of Malthus to mankind. The laborious apparatus of historical and statistical facts respecting the several countries of the globe, adduced in the altered form of the essay, though it contains a good deal that is curious and interesting, establishes no general result which was not previously well known.

It would seem, then, that what has been ambitiously called Malthus's theory of population, instead of being a great discovery as some have represented it, or a poisonous novelty, as others have considered it, is no more than a formal enunciation of obvious, though sometimes neglected, facts. The pretentious language often applied to it by economists is objectionable, as being apt to make us forget that the whole subject with which it deals is as yet very imperfectly understood—the causes which modify the force of the sexual instinct, and those which lead to variations in fecundity, still awaiting a complete investigation.

It is the law of diminishing returns from land, involving as it does—though only hypothetically—the prospect of a continuously increasing difficulty in obtaining the necessary sustenance for all the members of a society, that gives the principal importance to population as an economic factor. It is, in fact, the confluence of the Malthusian ideas with the theories of Ricardo, especially with the corollaries which the latter deduced from the doctrine of rent (though these were not accepted by Malthus), that has led to the introduction of population as an element in the discussion of so many economic questions in modern times.

Malthus had undoubtedly the great merit of having called public attention in a striking and impressive way to a subject which had neither theoretically nor practically been sufficiently considered. But he and his followers appear to have greatly exaggerated both the magnitude and the urgency of the dangers to which they pointed.[1] In their conceptions a single social imperfection assumed such portentous dimensions that it seemed to overcloud the whole heaven and threaten the world with ruin. This doubtless arose from his having at first omitted altogether from his view of the question the great counteracting agency of moral restraint. Because a force exists, capable, if unchecked, of producing certain results, it does not follow that those results are imminent or even possible in the sphere of experience. A body thrown from the hand would, under the single impulse of projection, move for ever in a straight line; but it would not be reasonable to take special action for the prevention of this result, ignoring the fact that it will be sufficiently counteracted by the other forces which will come into play. And such other forces exist in the case we are considering. If the inherent energy of the principle of population (supposed everywhere the same) is measured by the rate at which numbers increase under the most favourable circumstances, surely the force of less favourable circumstances, acting through prudential or altruistic motives, is measured by the great difference between this maximum rate and those which are observed to prevail in most European countries. Under a rational system of institutions, the adaptation of numbers to the means available for their support is effected by the felt or anticipated pressure of circumstances and the fear of social degradation, within a tolerable degree of approximation to what is desirable. To bring the result nearer to the just standard, a higher measure of popular enlightenment and more serious habits of moral reflection ought indeed to be encouraged. But it is the duty of the individual to his possible offspring, and not any vague notions as to the pressure of the national population on subsistence, that will be adequate to influence conduct.

It can scarcely be doubted that the favour which was at once accorded to the views of Malthus in certain circles was due in part to an impression, very welcome to the higher ranks of society, that they tended to relieve the rich and powerful of responsibility for the condition of the working classes, by showing that the latter had chiefly themselves to blame, and not either the negligence of their superiors or the institutions of the country. The application of his doctrines, too, made by some of his successors had the effect of discouraging all active effort for social improvement. Thus Chalmers "reviews *seriatim* and gravely sets aside all the schemes usually proposed for the amelioration of the economic condition of the people" on the ground that an increase of comfort will lead to an increase of numbers, and so the last state of things will be worse than the first.

Malthus has in more modern times derived a certain degree of reflected lustre from the rise and wide acceptance of the Darwinian hypothesis. Its author himself, in tracing its filiation, points to the phrase "struggle for existence" used by Malthus in relation to the social competition. Darwin believed that man advanced to his present high condition through such a struggle, consequent on his rapid multiplication. He regarded, it is true, the agency of this cause for the improvement of the race as largely superseded by moral influences in the more advanced social stages. Yet he considered it, even in these stages, of so much importance towards that end that, notwithstanding the individual suffering arising from the struggle for life, he deprecated any great reduction in the natural, by which he seems to mean the ordinary, rate of increase.

Besides his great work, Malthus wrote *Observations on the Effect of the Corn Laws*; *An Inquiry into the Nature and Progress of Rent*; *Principles of Political Economy*; and *Definitions in Political Economy*. His views on rent were of real importance.

For his life see *Memoir* by his friend Dr Otter, bishop of Chichester (prefixed to 2nd ed., 1836, of the *Principles of Political Economy*), and *Malthus and his Work*, by J. Bonar (London, 1885). Practically every treatise on economics deals with Malthus and his essay, but the following special works may be referred to: Soetbeer, *Die Stellung der Sozialisten zur Malthusschen Bevölkerungslehre* (Berlin, 1886); G. de Molinari, *Malthus, essai sur le principe de population* (Paris, 1889); Cossa, *Il Principio di popolazione di T R. Malthus* (Milan, 1895); and Ricardo, *Letters to Malthus*, ed. J. Bonar (1887).

MALTON, a market town in the Thirsk and Malton parliamentary division of Yorkshire, England, 21 m. N.E. of York by a branch of the North Eastern railway. The town comprises Old Malton and New Malton in the North Riding, and Norton on the opposite side of the river Derwent, in the East Riding. Pop. of urban district of Malton (1901), 4758; of urban district of Norton 3842. The situation, on the wooded hills rising from the narrow valley, is very picturesque. The church of St Michael is a fine late Norman building with perpendicular tower; the church of St Leonard, of mixed architecture, with square tower and spire, has three Norman arches and a Norman font. The church of St Mary at Old Malton was attached to a Gilbertine priory founded in 1150; it is transitional Norman and Early English, with later insertions. Remains of the priory are scanty, but include a crypt under a modern house. In the neighbourhood of Malton are the slight but beautiful fragments of Kirkham Abbey, an Early English Augustinian foundation of Walter l'Espec (1131); and the fine mansion of Castle Howard, a massive building by Vanbrugh, the seat of the earls of Carlisle, containing a noteworthy collection of pictures. Malton possesses a town-hall, a corn exchange, a museum, and a grammar-school founded in 1547. There are iron and brass foundries, agricultural implement works, corn mills, tanneries and breweries. In the neighbourhood are lime and whinstone quarries.

Traces of a Romano-British village exist on the east side of the town, but there appears to be no history of Malton before the Norman Conquest. The greater part of Malton belonged to the crown in 1086 and was evidently retained until Henry I.

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[1] Malthus himself said, "It is probable that, having found the bow bent too much one way, I was induced to bend it too much the other in order to make it straight."

gave the castle and its appurtenances to Eustace son of John, whose descendants took the name of Vescy. Eustace meditated the deliverance of Malton Castle to King David of Scotland in 1138, but his plans were altered owing to the battle of the Standard. The "burgh" of Malton is mentioned in 1187, and in 1295 the town returned two members to parliament. It was not represented again, however, until 1640, when an act was passed to restore its ancient privileges. In 1867 the number of members was reduced to one, and in 1885 the town was disfranchised. Until the 17th century the burgesses had all the privileges of a borough by prescriptive right, and were governed by two bailiffs and two under-bailiffs, but these liberties were taken from them in 1684 and have never been revived. From that time a bailiff and two constables were appointed at the court leet of the lord of the manor until a local board was formed in 1854. In the 13th century Agnes de Vescy, then lady of the manor, held a market in Malton by prescription, and Camden writing about 1586 says that the lord of the manor then held two weekly markets, on Tuesday and Saturday, the last being the best cattle market in the county. The markets are now held on Saturdays and alternate Tuesdays, and still belong to the lord of the manor.

MALTZAN, HEINRICH VON, BARON ZU WARTENBURG UND PENZLIN (1826–1874), German traveller, was born on the 6th of September 1826 near Dresden. He studied law at Heidelberg, but on account of ill health spent much of his time from 1850 in travel. Succeeding to his father's property in 1852, he extended the range of his journeys to Morocco and other parts of Barbary, and before his return home in 1854 had also visited Egypt, Palestine and other countries of the Levant. In 1856–1857 he was again in Algeria; in 1858 he reached the city of Morocco; and in 1860 he succeeded in performing the pilgrimage to Mecca, which he afterwards described in *Meine Wallfahrt nach Mecca* (Leipzig, 1865), but had to flee for his life to Jidda without visiting Medina. He then visited Aden and Bombay, and after some two years of study in Europe again began to wander through the coasts and islands of the Mediterranean, repeatedly visiting Algeria. His first book of travel, *Drei Jahre im Nordwesten von Afrika* (Leipzig), appeared in 1863, and was followed by a variety of works and essays, popular and scientific. Maltzan's last book, *Reise nach Südarabien* (Brunswick, 1873), is chiefly valuable as a digest of much information about little-known parts of south Arabia collected from natives during a residence at Aden in 1870–1871. Among his other services to science must be noticed his collection of Punic inscriptions (*Reise in Tunis und Tripolis*, Leipzig, 1870), and the editing of Adolph von Wrede's remarkable journey in Hadramut (*Reise in Hadramaut*, &c., Brunswick, 1870). After long suffering from neuralgia, Maltzan died by his own hand at Pisa on the 23rd of February 1874.

MALUS, ÉTIENNE LOUIS (1775–1812), French physicist, was born at Paris on the 23rd of June 1775. He entered the military engineering school at Mezières; but, being regarded as a suspected person, he was dismissed without receiving a commission, and obliged to enter the army as a private soldier. Being employed upon the fortifications of Dunkirk, he attracted the notice of the director of the works, and was selected as a member of the École polytechnique then to be established under G. Monge. After three years at the École he was admitted into the corps of engineers, and served in the army of the Sambre and Meuse; he was present at the passage of the Rhine in 1797, and at the affairs of Ukratz and Altenkirch. In 1798 he joined the Egyptian expedition and remained in the East till 1801. On his return he held official posts successively at Antwerp, Strassburg and Paris, and devoted himself to optical research. A paper published in 1809 ("Sur une propriété de la lumière réfléchie par les corps diaphanes") contained the discovery of the polarization of light by reflection, which is specially associated with his name, and in the following year he won a prize from the Institute with his memoir, "Théorie de la double refraction de la lumière dans les substances cristallines." He died of phthisis in Paris on the 23rd of February 1812.

MALVACEAE, in botany, an order of Dicotyledons belonging to the series Columniferae, to which belong also the orders Tiliaceae (containing *Tilia*, the lime-tree), Bombaceae (containing *Adansonia*, the baobab), Sterculiaceae (containing *Theobroma*, cocoa, and *Cola*, cola-nut). It contains 39 genera with about 300 species, and occurs in all regions except the coldest, the number of species increasing as we approach the tropics. It is represented in Britain by three genera: *Malva*, mallow; *Althaea*, marsh-mallow; and *Lavatera*, tree-mallow. The plants are herbs, as in the British mallows, or, in the warmer parts of the earth, shrubs or trees. The leaves are alternate and often palmately lobed or divided; the stipules generally fall early. The leaves and young shoots often bear stellate hairs and the tissues contain mucilage-sacs. The regular, hermaphrodite, often showy flowers are borne in the leaf-axils, solitary or in fasicles, or form more or less complicated cymose arrangements. An epicalyx (see MALLOW, figs. 3, 4), formed by a whorl of three or more bracteoles is generally present just beneath the calyx; sometimes, as in *Abutilon*, it is absent. The parts of the flowers are typically in fives (fig. 1); the five sepals, which have a valvate aestivation, are succeeded by five often large showy petals which are twisted in the bud; they are free to the base, where they are attached to the staminal tube and fall with it when the flower withers. The very numerous stamens are regarded as arising from the branching of a whorl of five opposite the petals; they are united into a tube at the base, and bear kidney-shaped one-celled anthers which open by a slit across the top (fig. 2). The large spherical pollen-grains are covered with spines. The carpels are one to numerous; when five in number, as in *Abutilon*, they are opposite the petals, or, as in *Hibiscus*, opposite the sepals. In the British genera and many others they are numerous, forming a whorl round the top of the axis in the centre of the flower, the united styles rising from the centre and bearing a corresponding number of stigmatic branches. In *Malope* the numerous carpels are arranged one above the other in vertical rows. One or more anatropous ovules are attached to the inner angle of each carpel; they are generally ascending but sometimes pendulous or horizontal; the position may vary, as in *Abutilon*, in one and the same carpel.

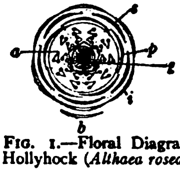


FIG. 1.—Floral Diagram of Hollyhock (*Althaea rosea*).

a, Stamens. *b*, Bract.
g, Pistil of carpels.
i, Epicalyx, formed from an involucre of bracteoles.
p, Petals. *s*, Sepals.

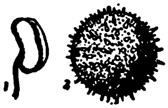


FIG. 2.

1, Anther.
2, Pollen grain of Hollyhock (*Althaea rosea*) enlarged. The pollen grain bears numerous spines, the dark spots indicate thin places in the extine.

The flowers are proterandrous; when the flower opens the unripe stigmas are hidden in the staminal tube and the anthers occupy the centre of the flower; as the anthers dehisce the filaments bend backwards and finally the ripe stigmas spread in the centre. Pollination is effected by insects which visit the flower for the honey, which is secreted in pits one between the base of each petal and is protected from rain by hairs on the lower margin of the petals. In small pale-flowered forms, like *Malva rotundifolia*, which attract few insects, self-pollination has been observed, the style-arms twisting to bring the stigmatic surfaces into contact with the anthers.

Except in *Malvaviscus* which has a berry, the fruits are dry. In *Malva* (see MALLOW) and allied genera they form one-seeded schizocarps separating from the persistent central column and from each other. In *Hibiscus* and *Gossypium* (cotton-plant, *q.v.*), the fruit is a capsule splitting loculicidally. Distribution of the seeds is sometimes aided by hooked outgrowths on the wall of the schizocarp, or by a hairy covering on the seed, an extreme case of which is the cotton-plant where the seed is buried in a mass of long tangled hairs—the cotton. The embryo is generally large with much-folded cotyledons and a small amount of endosperm.

The largest genus, *Hibiscus*, contains 150 species, which are widely distributed chiefly in the tropics; *H. rosasinensis* is a well-known greenhouse plant. *Abutilon* (*q.v.*) contains 80 species, mainly tropical; *Lavatera*, with 20 species, is chiefly Mediterranean; *Althaea* has about 15 species in temperate and warm regions, *A. rosea* being the hollyhock (*q.v.*); *Malva* has about 30 species in the north-temperate zone. Several genera are largely or exclusively American.

MALVASIA (Gr. *Monemvasia*, *i.e.* the "city of the single approach or entrance"; Ital. *Napoli di Malvasia;* Turk. *Mengeshe* or *Beneshe*), one of the principal fortresses and commercial centres of the Levant during the middle ages, still represented by a considerable mass of ruins and a town of about 550 inhabitants. It stood on the east coast of the Morea, contiguous to the site of the ancient Epidaurus Limera, of which it took the place. So extensive was its trade in wine that the name of the place became familiar throughout Europe as the distinctive appellation of a special kind—Ital. *Malvasia;* Span. *Malvagia;* Fr. *Malvoisie;* Eng. *Malvesie* or *Malmsey*. The wine was not of local growth, but came for the most part from Tenos and others of the Cyclades.

As a fortress Malvasia played an important part in the struggles between Byzantium, Venice and Turkey. The Byzantine emperors considered it one of their most valuable posts in the Morea, and rewarded its inhabitants for their fidelity by unusual privileges. Phrantzes (Lib. IV. cap. xvi.) tells how the emperor Maurice made the city (previously dependent in ecclesiastical matters on Corinth) a metropolis or archbishop's see, and how Alexius Comnenus, and more especially Andronicus II. (Palaeologus) gave the Monembasiotes freedom from all sorts of exactions throughout the empire. It was captured after a three years' siege by Guillaume de Villehardouin in 1248, but the citizens retained their liberties and privileges, and the town was restored to the Byzantine emperors in 1262. After many changes, it placed itself under Venice from 1463 to 1540, when it was ceded to the Turks. In 1689 it was the only town of the Morea which held out against Morosini, and Cornaro his successor only succeeded in reducing it by famine. In 1715 it capitulated to the Turks, and on the failure of the insurrection of 1770 the leading families were scattered abroad. As the first fortress which fell into the hands of the Greeks in 1821, it became in the following year the seat of the first national assembly.

See Curtius, *Peloponnesos*, ii. 293 and 328; Castellan, *Lettres sur la Morée* (1808), for a plan; Valiero, *Hist. della guerra di Candia* (Venice, 1679), for details as to the fortress; W. Miller in *Journal of Hellenic Studies* (1907).

MALVERN, an inland watering-place in the Bewdley parliamentary division of Worcestershire, England, 128 m. W.N.W. from London by the Great Western railway, served also by a branch of the Midland railway from Ashchurch on the Bristol-Birmingham line. Pop. of urban district (1901), 16,449. It is beautifully situated on the eastern slopes of the Malvern Hills, which rise abruptly from the flat valley of the Severn to a height of 1395 ft. in the Worcestershire Beacon. The district still bears the name of Malvern Chase, originally a Crown-land and forest, though it was granted to the earldom of Gloucester by Edward I. A ditch along the summit of the hills determined the ancient boundary. Becoming a notorious haunt of criminals, the tract was disafforested by Charles I., with the exception of a portion known as the King's Chase, part of which is included in the present common-land formed under the Malvern Hills Act of 1884.

Malvern was in early times an important ecclesiastical settlement, but its modern fame rests on its fine situation, pure air, and chalybeate and bituminous springs. The open-air cure for consumptive patients is here extensively practised.

The name Malvern is collectively applied to a line of small towns and villages, extending along the foot of the hills for 5 m. The principal is GREAT MALVERN, lying beneath the Worcestershire Beacon. It has a joint station of the Great Western and Midland railways. Here was the Benedictine priory which arose in 1083 out of a hermitage endowed by Edward the Confessor. The priory church of SS. Mary and Michael is a fine cruciform Perpendicular building, with an ornate central tower, embodying the original Norman nave, and containing much early glass and carved choir-stalls. The abbey gate and the refectory also remain. There are here several hydropathic establishments, and beautiful pleasure gardens. Malvern College, founded in 1862, is an important English public school. A museum is attached to it. Mineral waters are manufactured. At MALVERN WELLS, 2½ m. S., are the principal medicinal springs, also the celebrated Holy Well, the water of which is of perfect purity. There are extensive fishponds and hatcheries; and golf-links. The Great Western railway has a station, and the Midland one at Hanley Road. LITTLE MALVERN lies at the foot of the Herefordshire Beacon, which is crowned by a British camp, 1½ m. S. of Malvern Wells. There was a Benedictine priory here, of which traces remain in the church. MALVERN LINK, 1 m. N.E. of Great Malvern, of which it forms a suburb, has a station on the Great Western railway. WEST MALVERN and NORTH MALVERN, named from their position relative to Great Malvern, are pleasant residential quarters on the higher slopes of the hills.

MALWA, an historic province of India, which has given its name to one of the political agencies into which Central India is divided. Strictly, the name is confined to the hilly table-land, bounded S. by the Vindhyan range, which drains N. into the river Chambal; but it has been extended to include the Nerbudda valley farther south. Its derivation is from the ancient tribe of Malavas about whom very little is known, except that they founded the Vikrama Samvat, an era dating from 57 B.C., which is popularly associated with a mythical king Vikramaditya. The earliest name of the tract seems to have been Avanti, from its capital the modern Ujjain. The position of the Malwa or Moholo mentioned by Hsuan Tsang (7th century) is plausibly assigned to Gujarat. The first records of a local dynasty are those of the Paramaras, a famous Rajput clan, who ruled for about four centuries (800–1200), with their capital at Ujjain and afterwards at Dhar. The Mahommedans invaded Malwa in 1235; and in 1401 Dilawar Khan Ghori founded an independent kingdom, which lasted till 1531. The greatest ruler of this dynasty was Hoshang Shah (1405–1435), who made Mandu (*q.v.*) his capital and embellished it with magnificent buildings. In 1562 Malwa was annexed to the Mogul empire by Akbar. On the break-up of that empire, Malwa was one of the first provinces to be conquered by the Mahrattas. About 1743 the Mahratta peshwa obtained from Delhi the title of governor, and deputed his authority to three of his generals—Sindhia of Gwalior, Holkar of Indore, and the Ponwar of Dhar who claims descent from the ancient Paramaras. At the end of the 18th century Malwa became a cockpit for fighting between the rival Mahratta powers, and the headquarters of the Pindaris or irregular plunderers. The Pindaris were extirpated by the campaign of Lord Hastings in 1817, and the country was reduced to order by the energetic rule of Sir John Malcolm. Malwa is traditionally the land of plenty, in which sufferers from famine in the neighbouring tracts always take refuge. But in 1899-1900 it was itself visited by a severe drought, which seriously diminished the population, and has since been followed by plague. The most valuable product is opium.

The Malwa agency has an area of 8919 sq. m. with a population (1901) of 1,054,753. It comprises the states of Dewas (senior and junior branch), Jaora, Ratlam, Sitamau and Sailana, together with a large portion of Gwalior, parts of Indore and Tonk, and about 35 petty estates and holdings. The headquarters of the political agent are at Nimach.

Malwa is also the name of a large tract in the Punjab, south of the river Sutlej, which is one of the two chief homes of the Sikhs, the other being known as Manjha. It includes the British districts of Ferozpore and Ludhiana, together with the native states of Patiala, Jind, Nabha and Maler Kotla.

See J. Malcolm, *Central India* (1823); C. E. Luard, *Bibliography of Central India* (1908), and *The Paramars of Dhar and Malwa* (1908).

MAMARONECK, a township of Westchester county, New York, U.S.A., on Long Island Sound, about 20 m. N.E. of New York City and a short distance N.E. of New Rochelle. Pop. (1890), 2385; (1900) 3849; (1905) 5655; (1910)

5602. Mamaroneck is served by the New York, New Haven & Hartford railway. The township includes the village of Larchmont (pop. in 1910, 1958), incorporated in 1891, and part of the village of Mamaroneck (pop. in 1910, including the part in Rye township, 5699), incorporated in 1895. Larchmont is the headquarters of the Larchmont Yacht Club. The site of Mamaroneck township was bought in 1660 from the Indians by John Richbell, an Englishman, who obtained an English patent to the tract in 1668. The first settlement was made by relatives of his on the site of Mamaroneck village in 1676, and the township was erected in 1788. On the 28th of August 1776, near Mamaroneck, a force of American militiamen under Capt. John Flood attacked a body of Loyalist recruits under William Lounsbury, killing the latter and taking several prisoners. Soon afterwards Mamaroneck was occupied by the Queen's Rangers under Colonel Robert Rogers. On the night of the 21st of October an attempt of a force of Americans under Colonel John Haslet to surprise the Rangers failed, and the Americans, after a hand-to-hand fight, withdrew with 36 prisoners. Mamaroneck was the home of John Peter DeLancey (1753–1828), a Loyalist soldier in the War of Independence, and was the birthplace of his son William Heathcote DeLancey (1797–1865), a well-known Protestant Episcopal clergyman, provost of the University of Pennsylvania in 1827–1832 and bishop of western New York from 1839 until his death. James Fenimore Cooper, the novelist, married (1811) a daughter of John Peter DeLancey; lived in Mamaroneck for several years, and here wrote his first novel, *Precaution*, and planned *The Spy*.

MAMELI, GOFFREDO (1827–1849), Italian poet and patriot, was born at Genoa of a noble Sardinian family. He received a sound classical education at the Scolopi College, and later studied law and philosophy at the university of Genoa. When nineteen years old he corresponded with Mazzini, to whom he became whole-heartedly devoted; among other patriotic poems he wrote a hymn to the Bandiera brothers, and in the autumn of 1847 a song called "Fratelli d'Italia," which as Carducci wrote, "resounded through every district and on every battlefield of the peninsula in 1848 and 1849." Mameli served in the National Guard at Genoa, and then joined the volunteers in the Lombard campaign of 1848, but after the collapse of the movement in Lombardy he went to Rome, where the republic was proclaimed and whence he sent the famous despatch to Mazzini: "Roma! Repubblica! Venite! " At first he wrote political articles in the newspapers, but when the French army approached the city with hostile intentions he joined the fighting ranks and soon won Garibaldi's esteem by his bravery. Although wounded in the engagement of the 30th of April, he at once resumed his place in the ranks, but on the 3rd of June he was again wounded much more severely, and died in the Pellegrini hospital on the 6th of July 1849. Besides the poems mentioned above, he wrote hymns to Dante, to the Apostles, "Dio e popolo," &c. The chief merit of his work lies in the spontaneity and enthusiasm for the Italian cause which rendered it famous, in spite of certain technical imperfections, and he well deserved the epithet of "The Tyrtaeus of the Italian revolution."

See A. G. Barrili, "G. Mameli nella vita e nell' arte," in *Nuova Antologia* (June 1, 1902); the same writer's edition of the *Scritti editi ed inediti di G. Mameli* (Genoa, 1902); Countess Martinengo Cesaresco, *Italian Characters* (London, 1901); A. Luzio, *Profili Biografici* (Milan, 1905); G. Trevelyan, *Garibaldi's Defence of the Roman Republic* (London, 1907).

MAMELUKE (anglicized through the French, from the Arabic *mamlūk*, a slave), the name given to a series of Egyptian sultans, originating (1250) in the usurpation of supreme power by the bodyguard of Turkish slaves first formed in Egypt under the successors of Saladin. See EGYPT: *History* (Moslem period).

MAMERTINI, or "children of Mars," the name taken by a band of Campanian (or Samnite) freebooters who about 289 B.C. seized the Greek colony of Messana at the north-east corner of Sicily, after having been hired by Agathocles to defend it (Polyb. I. 7. 2). The adventure is explained by tradition (*e.g.* Festus 158, Müller) as the outcome of a *ver sacrum*; the members of the expedition are said to have been the male children born in a particular spring of which the produce had been vowed to Apollo (cf. SAMNITES), and to have settled first in Sicily near Tauromenium. An inscription survives (R. S. Conway, *Italic Dialects*, 1) which shows that they took with them the Oscan language as it was spoken in Capua or Nola at that date, and the constitution usual in Italic towns of a free community (*touta*=) governed by two annual magistrates (*meddices*). The inscription dedicated some large building (possibly a fortification) to Apollo, which so far confirms the tradition just noticed. Though in the Oscan language, the inscription is written in the Greek alphabet common to south Italy from the 4th century B.C. onwards, viz. the Tarentine Ionic, and so are the legends of two coins of much the same date as the inscription (Conway, ib. 4). From 282 onwards (B. V. Head, *Historia numorum*, 136) the legend itself is Graecized (MAMEPTINΩN, instead of MAAMEPTINOTM) which shows how quickly here, as everywhere, "Graecia capta ferum victorem cepit." On the Roman conquest of Sicily the town secured an independence under treaty (Cicero, *Verr.* 3. 6. 13). The inhabitants were still called Mamertines in the time of Strabo (vi. 2. 3).

See further Mommsen, *C.I.L.* x. sub loc., and the references already given. (R. S. C.)

MAMERTINUS, CLAUDIUS (4th century A.D.), one of the Latin panegyrists. After the death of Julian, by whom he was evidently regarded with special favour, he was praefect of Italy (365) under Valens and Valentinian, but was subsequently (368) deprived of his office for embezzlement. He was the author of an extant speech of thanks to Julian for raising him to the consulship, delivered on the 1st of January 362 at Constantinople. Two panegyrical addresses (also extant) to Maximian (emperor A.D. 286–305) are attributed to an older *magister* Mamertinus, but it is probable that the corrupt MS. superscription contains the word *memoriae*, and that they are by an unknown *magister memoriae* (an official whose duty consisted in communicating imperial rescripts and decisions to the public). The first of these was delivered on the birthday of Rome (April 21, 289), probably at Maximian's palace at Augusta Trevirorum (Trèves), the second in 290 or 291, on the birthday of the emperor. By some they are attributed to Eumenius (*q.v.*) who was a *magister memoriae* and the author of at least one (if not more) panegyrics.

The three speeches will be found in E. Bährens, *Panegyrici latini* (1874); see also Teuffel-Schwabe, *Hist. of Roman Literature* (Eng trans.), § 417, 7.

MAMIANI DELLA ROVERE, TERENZIO, COUNT (1802–1885), Italian writer and statesman, was born at Pesaro in 1799. Taking part in the outbreaks at Bologna arising out of the accession of Pope Gregory XVI., he was elected deputy for Pesaro to the assembly, and subsequently appointed minister of the interior; but on the collapse of the revolutionary movement he was exiled. He returned to Italy after the amnesty of 1846, and in 1848 he was entrusted with the task of forming a ministry. He remained prime minister, however, only for a few months, his political views being anything but in harmony with those of the pope. He subsequently retired to Genoa where he worked for Italian unity, was elected deputy in 1856, and in 1860 became minister of education under Cavour. In 1863 he was made minister to Greece, and in 1865 to Switzerland, and later senator and councillor of state. Meanwhile, he had founded at Genoa in 1849 the Academy of Philosophy, and in 1855 had been appointed professor of the history of philosophy at Turin; and he published several volumes, not only on philosophical and social subjects, but of poetry, among them *Rinnovamento della filosofia antica italiana* (1836), *Teoria della Religione e dello stato* (1869), *Kant e l'ontologia* (1879), *Religione dell' avenire* (1880), *Di un nuovo diritto europeo* (1843, 1857). He died at Rome on the 21st of May, 1885.

See *Indice delle opere di Terenzio Mamiani* (Pesaro, 1887); Gaspare, *Vita di Terenzio Mamiani* (Ancona, 1887); Barzellotti, *Studii e ritratti* (Bologna, 1893).

MAMMALIA (from Lat. *mamma*, a teat or breast), the name proposed by the Swedish naturalist Linnaeus for one of the classes, or primary divisions, of vertebrated animals, the members of which are collectively characterized by the presence in the females of special glands secreting milk for the nourishment of the young. With the exception of the lowest group, such glands always communicate with the exterior by means of the teats, nipples or mammae, from which the class derives its name. The class-name (modified by the French into *Mammifères*, and replaced in German by the practically equivalent term *Säugethiere*) has been anglicized into "Mammals" (mammal, in the singular). Of recent years, and more especially in America, it has become a custom to designate the study of mammals by the term "mammalogy." Etymologically, however, that designation cannot be justified; for it is of hybrid (Latin and Greek) origin, and is equivalent to "mastology," the science which deals with the mammary gland (Gr. μαστός, woman's breast), a totally different signification. As regards existing forms of life, the limitations of the class are perfectly well defined and easy of recognition; for although certain groups (not, by the way, whales, which, although excluded in popular estimation from the class, are in all essential respects typical mammals) are exceedingly aberrant, and present structural features connecting them with the lower vertebrate classes, yet they are by common consent retained in the class to which they are obviously most nearly affiliated by their preponderating characteristics. There is thus at the present day a great interval, unbridged by any connecting links, between mammals and the other classes of vertebrates.

Not so, however, when the extinct forms of vertebrate life are taken into consideration, for there is a group of reptiles from the early part of the Secondary, or Mesozoic period, some of whose members must have been so intimately related to mammals that, were the whole group fully known, it would clearly be impossible to draw a distinction between Mammalia on the one hand and Reptilia on the other. Indeed, as it is, we are already partially acquainted with one of these early intermediate creatures (*Tritylodon*), which forms a kind of zoological shuttlecock, being, so to speak, hit from one group to another, and back again, by the various zoologists by whom its scanty remains have been studied. Considered collectively, mammals, which did not make their appearance on the earth for some time after reptiles had existed, are certainly the highest group of the whole vertebrate sub-kingdom. This expression must not, however, be considered in too restricted a sense. In mammals, as in other classes, there are low as well as high forms; but by any tests that can be applied, especially those based on the state of development of the central nervous system, it will be seen that the average exceeds that of any other class, that many species of this class far excel those of any other in perfection of structure, and that it contains one form which is unquestionably the culminating point amongst organized beings.

Mammals, then, are vertebrated animals, possessing the normal characteristics of the members of that primary division of the animal kingdom. They are separated from fishes and batrachians (Pisces and Batrachians) on the one hand, and agree with reptiles, and birds (Reptilia and Aves) on the other, in the possession during intra-uterine life of the membranous vascular structures respectively known as the amnion and the allantois, and likewise in the absence at this or any other period of external gills. A four-chambered heart, with a complete double circulation, and warm blood (less markedly so in the lowest group than in the rest of the class), distinguish mammals from existing reptiles, although not from birds. From both birds and reptiles the class is distinguished, so far at any rate as existing forms are concerned, by the following features: the absence of a nucleus in the red corpuscles of the blood, which are nearly always circular in outline; the free suspension of the lungs in a thoracic cavity, separated from the abdominal cavity by a muscular partition, or diaphragm, which is the chief agent in inflating the lungs in respiration; the aorta, or main artery, forming but a single arch after leaving the heart, which curves over the left terminal division of the windpipe, or bronchus; the presence of more or fewer hairs on the skin and the absence of feathers; the greater development of the bridge, or commissure, connecting the two halves of the brain, which usually forms a complete corpus callosum, or displays an unusually large size of its anterior portion; the presence of a fully developed larynx at the upper end of the trachea or windpipe, accompanied by the absence of a syrinx, or expansion, near the lower end of the same; the circumstance that each half of the lower jaw (except perhaps at a very early stage of development) consists of a single piece articulating posteriorly with the squamosal element of the skull without the intervention of a separate quadrate bone; the absence of prefrontal bones in the skull; the presence of a pair of lateral knobs, or condyles (in place of a single median one), on the occipital aspect of the skull for articulation with the first vertebra; and, lastly, the very obvious character of the female being provided with milk-glands, by the secretion of which the young (produced, except in the very lowest group, alive and not by means of externally hatched eggs) are nourished for some time after birth.

In the majority of mammals both pairs of limbs are well developed and adapted for walking or running. The fore-limbs may, however, be modified, as in moles, for burrowing, or, as in bats, for flight, or finally, as in whales and dolphins, for swimming, with the assumption in this latter instance of a flipper-like form and the complete disappearance of the hind-limbs. Special adaptations for climbing are exhibited by both pairs of limbs in opossums, and for hanging to boughs in sloths. In no instance are the fore-limbs wanting.

In the great majority of mammals the hind extremity of the axis of the body is prolonged into a tail. Very generally the tail has distinctly the appearance of an appendage, but in some of the lower mammals, such as the thylacine among marsupials, and the aard-vark or ant-bear among the edentates, it is much thickened at the root, and passes insensibly into the body, after the fashion common among reptiles. As regards function, the tail may be a mere pendent appendage, or may be adapted to grasp boughs in climbing, or even to collect food or materials for a nest or sleeping place, as in the spider-monkeys, opossums and rat-kangaroos. Among jumping animals it may serve as a balance, as in the case of jerboas and kangaroos, while in the latter it is also used as a support when resting; among many hoofed mammals it is used as a fly-whisk; and in whales and dolphins, as well as in the African *Potamogale* and the North American musquash, it plays an important part in swimming. Its supposed use as a trowel by the beaver is, however, not supported by the actual facts of the case.

As already indicated, the limbs of different mammals are specially modified for various modes of life; and in many cases analogous modifications occur, in greater or less degree, throughout the entire body. Those modifications most noticeable in the case of cursorial types may be briefly mentioned as examples. In this case, as might be expected, the greatest modifications occur in the limbs, but correlated with this is also an elongation of the head and neck in long-legged types. Adaptation for speed is further exhibited in the moulding of the shape of the body so as to present the minimum amount of resistance to the air, as well as in increase in heart and lung capacity to meet the extra expenditure of energy. Finally, in the jumping forms we meet with an increase in the length and weight of the tail, which has to act as a counterpoise. As regards the feet, a reduction in the number of digits from the typical five is a frequent feature, more especially among the hoofed mammals, where the culmination in this respect is attained by the existing members of the horse tribe and certain representatives of the extinct South American *Proterotheriidae*, both of which are monodactyle. Brief reference may also be made to the morphological importance of extraordinary length or shortness in the skulls of mammals—dolichocephalism and brachycephalism; both these features being apparently characteristic of specialized types, the former condition being (as in the horse) often, although not invariably, connected with length of limb and neck, and adaptation to speed, while brachycephalism may be correlated with short limbs and an abbreviated neck. Exceptions to this rule, as exemplified by the cats, are due to special adaptive causes. In point of bodily size mammals present a greater range of variation than is exhibited by any other living terrestrial animals, the extremes in this respect being displayed by the African elephant on the one hand and certain species of shrew-mice (whose head and body scarcely exceed an inch and a half in length) on the other. When the aquatic members of the class are taken into consideration, the maximum dimensions are vastly greater, Sibbald's rorqual attaining a length of fully 80 ft., and being probably the bulkiest and heaviest animal that has ever existed. Within the limits of individual groups, it may be accepted as a general rule that increase in bulk or stature implies increased specialization; and, further, that the largest representatives of any particular group are also approximately the latest. The latter dictum must not, however, be pushed to an extreme, since the African elephant, which is the largest living land mammal, attaining in exceptional cases a height approaching 12 ft., was largely exceeded in this respect by an extinct Indian species, whose height has been estimated at between 15 and 16 ft.

In regard to sense-organs, ophthalmoscopic observations on the eyes of living mammals (other than man) have revealed the existence of great variation in the arrangement of the bloodvessels, as well as in the colour of the retina; blue and violet seem to be unknown, while red, yellow and green form the predominating shades. In the main, the various types of minute ocular structure correspond very closely to the different groups into which mammals are divided, this correspondence affording important testimony in the favour of the general correctness of the classification. Among the exceptions are the South American squirrel-monkeys, whose eyes approximate in structure to those of the lemurs. Man and monkeys alone possess parallel and convergent vision of the two eyes, while a divergent, and consequently a very widely extended, vision is a prerogative of the lower mammals; squirrels, for instance, and probably also hares and rabbits, being able to see an object approaching them directly from behind without turning their heads.

An osteological question which has been much discussed is the fate of the reptilian quadrate bone in the mammalian skull. In the opinion of F. W. Thyng, who has carefully reviewed all the other theories, the balance of evidence tends to show that the quadrate has been taken up into the inner ear, where it is represented among the auditory ossicles by the incus.

Although the present article does not discuss mammalian osteology in general (for which see VERTEBRATA), it is interesting to notice in this connexion that the primitive condition of the mammalian tympanum apparently consisted merely of a small and incomplete bony ring, with, at most, an imperfect ventral wall to the tympanic cavity, and that a close approximation to this original condition still persists in the monotremes, especially *Ornithorhynchus*. The tympano-hyal is the characteristic mammalian element in this region; but the entotympanic likewise appears to be peculiar to the class, and to be unrepresented among the lower vertebrates. The tympanum itself has been regarded as representing one of the elements—probably the supra-angular—of the compound reptilian lower jaw. The presence of only seven vertebrae in the neck is a very constant feature among mammals; the exceptions being very few.

Two other points in connexion with mammalian osteology may be noticed. A large number of mammals possess a perforation, or foramen, on the inner side of the lower end of the humerus, and also a projection on the shaft of the femur known as the third trochanter. From its occurrence in so many of the lower vertebrates, the entepicondylar foramen of the humerus, as it is called, is regarded by Dr E. Stromer as a primitive structure, of which the original object was to protect certain nerves and bloodvessels. It is remarkable that it should persist in the spectacled bear of the Andes, although it has disappeared in all other living members of the group. The third trochanter of the femur, on the other hand, can scarcely be regarded as primitive, seeing that it is absent in several of the lower groups of mammals. Neither can its presence be attributed, as Professor A. Gaudry suggests, to the reduction in the number of the toes, as otherwise it should not be found in the rhinoceros. Its general absence in man forbids the idea of its having any connexion with the upright posture.

Hair.—In the greater number of mammals the skin is more or less densely clothed with a peculiarly modified form of epidermis known as hair. This consists of hard, elongated, slender, cylindrical or tapering, thread-like masses of epidermic tissue, each of which grows, without branching, from a short prominence, or papilla, sunk at the bottom of a pit, or follicle, in the true skin, or dermis. Such hairs, either upon different parts of the skin of the same species, or in different species, assume very diverse forms and are of various sizes and degrees of rigidity—as seen in the fur of the mole, the bristles of the pig, and the spines of the hedgehog and porcupine, which are all modifications of the same structures. These differences arise mainly from the different arrangement of the constituent elements into which the epidermal cells are modified. Each hair is composed usually of a cellular pithy internal portion, containing much air, and a denser or more horny external or cortical part. In some mammals, as deer, the substance of the hair is almost entirely composed of the central medullary or cellular substance, and is consequently very easily broken; in others the horny part prevails almost exclusively, as in the bristles of the wild boar. In the three-toed sloth (*Bradypus*) the hairs have a central horny axis and a pithy exterior. Though generally nearly smooth, or but slightly scaly, the surface of some hairs is imbricated; that is to say, shows projecting scale-like processes, as in some bats, while in the two-toed sloth (*Choloepus*) they are longitudinally grooved or fluted. Though usually more or less cylindrical or circular in section, hairs are often elliptical or flattened, as in the curly-haired races of men, the terminal portion of the hair of moles and shrews, and conspicuously in the spines of the spiny squirrels of the genus *Xerus* and those of the mouse-like *Platacanthomys*. Hair having a property of mutual cohesion or "felting," which depends upon a roughened scaly surface and a tendency to curl, as in domestic sheep, is called "wool."

It has been shown by J. C. H. de Meijere that the insertion of the individual hairs in the skin displays a definite arrangement, constant for each species, but varying in different groups. In jerboas, for example, a bunch of twelve or thirteen hairs springs from the same point, while in the polar bear a single stout hair and several slender ones arise together, and in the marmosets three equal-sized hairs form regular groups. These tufts or groups likewise display an orderly and definite grouping in different mammals, which suggests the origin of such groups from the existence in primitive mammals of a scaly coat comparable to that of reptiles, and indeed directly inherited therefrom.

In a large proportion of mammals there exist hairs of two distinct types: the one long, stiff, and alone appearing on the surface, and the other shorter, finer and softer, constituting the under-fur, which may be compared to the down of birds. A well-known example is furnished by the fur-bearing seals, in which the outer fur is removed in the manufacture of commercial "seal-skin," leaving only the soft and fine under-fur.

Remarkable differences in the direction or slope of the hair are noticeable on different parts of the body and limbs of many mammals, especially in certain apes, where the hair of the fore-limbs is inclined towards the elbow from above and from below. More remarkable still is the fact that the direction of the slope often differs in closely allied groups, as, for instance, in African and Asiatic buffaloes, in which the hair of the middle line of the back has opposite directions. Whorls of hair, as on the face of the horse and the South American deer known as brockets, occur where the different hair-slopes meet. In this connexion reference may be made to patches or lines of long and generally white hairs situated on the back of certain ruminants, which are capable of erection during periods of excitement, and serve, apparently, as "flags" to guide the members of a herd in flight. Such are the white chrysanthemum-like patches on the rump of the Japanese deer and of the American prong-buck (*Antilocapra*), and the line of hairs situated in a groove on the loins of the African spring-buck. The white under-side of the tail of the rabbit and the yellow rump-patch of many deer are analogous.

The eye-lashes, or *ciliae*, are familiar examples of a special local development of hair. Special tufts of stout stiff hairs, sometimes termed *vibrissae*, and connected with nerves, and in certain cases with glands, occur in various regions. They are most common on the head, while they constitute the "whiskers," or "feelers," of the cats and many rodents. In other instances, notably in the lemurs, but also in certain carnivora, rodents and marsupials, they occupy a position on the fore-arm near the wrist, in connexion with glands, and receive sensory powers from the radial nerve. In some mammals the hairy covering is partial and limited to particular regions; in others, as the hippopotamus and the sea-cows, or Sirenia, though scattered over the whole surface, it is extremely short and scanty;

but in none is it reduced to so great an extent as in the Cetacea, in which it is limited to a few small bristles confined to the neighbourhood of the lips and nostrils, and often present only in the young, or even the foetal condition.

Some kinds of hairs, as those of the mane and tail of the horse, persist throughout life, but more generally, as in the case of the body-hair of the same animal, they are shed and renewed periodically, generally annually. Many mammals have a longer hairy coat in winter, which is shed as summer comes on; and some few, which inhabit countries covered in winter with snow, as the Arctic fox, variable hare and ermine, undergo a complete change of colour in the two seasons, being white in winter and grey or brown in summer. There has been much discussion as to whether this winter whitening is due to a change in the colour of the individual hairs or to a change of coat. It has, however, been demonstrated that the senile whitening of human hair is due to the presence of phagocytes, which devour the pigment-bodies; and from microscopic observations recently made by the French naturalist Dr E. Trouessart, it appears that much the same kind of action takes place in the hairs of mammals that turn white in winter. Cold, by some means or other, causes the pigment-bodies to shift from the normal positions, and to transfer themselves to other layers of the hair, where they are attacked and devoured by phagocytes. The winter whitening of mammals is, therefore, precisely similar to the senile bleaching of human hair, no shift of the coat taking place. Under the influence of exposure to intense cold a small mammal has been observed to turn white in a single night, just as the human hair has been known to blanch suddenly under the influence of intense emotion, and in both cases extreme activity of the phagocytes is apparently the inducing cause. The African golden-moles (*Chrysochloris*), the desmans or water-moles (*Myogale*), and the West African *Potamogale velox*, are remarkable as being the only mammals whose hair reflects those iridescent tints so common in the feathers of tropical birds.

The principal and most obvious purpose of the hairy covering is to protect the skin. Its function in the hairless Cetacea is discharged by the specially modified and thickened layer of fatty tissue beneath the skin known as "blubber."

Scales, &c.—True scales, or flat imbricated plates of horny material, covering the greater part of the body, are found in one family only of mammals, the pangolins or *Manidae*; but these are also associated with hairs growing from the intervals between the scales or on the parts of the skin not covered by them. Similarly imbricated epidermic productions form the covering of the under-surface of the tail of the African flying rodents of the family *Anomaluridae*; and flat scutes, with the edges in apposition, and not overlaid, clothe both surfaces of the tail of the beaver, rats and certain other members of the rodent order, and also of some insectivora and marsupials. Armadillos alone possess an external bony skeleton, composed of plates of bony tissue, developed in the skin and covered with scutes of horny epidermis. Other epidermic appendages are the horns of ruminants and rhinoceroses—the former being elongated, tapering, hollow caps of hardened epidermis of fibrous structure, fitting on and growing from conical projections of the frontal bones and always arranged in pairs, while the latter are of similar structure, but without any internal bony support, and situated in the middle line. Callosities, or bare patches covered with hardened and thickened epidermis, are found on the buttocks of many apes, the breast of camels, the inner side of the limbs of *Equidae*, the grasping under-surface of the tail of prehensile-tailed monkeys, opossums, &c. The greater part of the skin of the one-horned Asiatic rhinoceros is immensely thickened and stiffened by an increase of the tissue of both the skin and epidermis, constituting the well-known jointed "armour-plated" hide of those animals.

Nails, Claws and Hoofs.—With few exceptions, the terminal extremities of the digits of both limbs of mammals are more or less protected or armed by epidermic plates or sheaths, constituting the various forms of nails, claws or hoofs. These are absent in the Cetacea alone. A perforated spur, with a special secreting gland in connexion with it, is found attached to each hind-leg of the males of the existing species of Monotremata.

Scent-glands, &c.—Besides the universally distributed sweat-glands connected with the hair-system, most mammals have special glands in modified portions of the skin, often involuted to form a shallow recess or a deep sac with a narrow opening, situated in various parts of the surface of the body, and secreting odorous substances, by the aid of which individuals recognize one another. These probably afford the principal means by which wild animals are able to become aware of the presence of other members of the species, even at great distances.

To this group of structures belong the suborbital face-gland, "larmier," or "crumen," of antelopes and deer, the frontal gland of the muntjak and of bats of the genus *Phyllorhina*, the chin-gland of the chevrotains and of *Taphozous* and certain other bats, the glandular patch behind the ear of the chamois and the reed-buck, the glands on the lower parts of the legs of most deer and a few antelopes (the position of which is indicated by tufts of long and often specially coloured hair), the interdigital foot-glands of goats, sheep, and many other ruminants, the temporal gland of elephants, the lateral glands of the musk-shrew, the gland on the back of the hyrax and the peccary (from the presence of which the latter animal takes the name *Dicotyles*), the gland on the tails of the members of the dog-tribe, the preputial glands of the musk-deer and beaver (both well known for the use made of their powerfully odorous secretion in perfumery), and also of the swine and hare, the anal glands of Carnivora, the perineal gland of the civet (also of commercial value), the caudal glands of the fox and goat, the gland on the wing-membrane of bats of the genus *Saccopteryx*, the post-digital gland of the rhinoceros, &c. Very generally these glands are common to both sexes, and it is in such cases that their function as a means of mutual recognition is most evident. It has been suggested that the above-mentioned callosities or "chestnuts" on the limbs of horses are vestigial scent-glands; and it is noteworthy that scrapings or shavings from their surface have a powerful attraction for other horses, and are also used by poachers and burglars to keep dogs silent. The position of such glands on the lower portions of the limbs is plainly favourable to a recognition-taint being left in the tracks of terrestrial animals; and antelopes have been observed deliberately to rub the secretion from their face-glands on tree-trunks. When glands are confined to the male, their function is no doubt sexual; the secretion forming part of the attraction, or stimulus, to the other sex.

Dentition.—In the great majority of mammals the teeth form a definite series, of which the hinder elements are of a more or less complex type, while those in front are simpler. With the exception of the marsupials, a set of deciduous, or milk, teeth is developed in most mammals with a complicated type of dentition; these milk-teeth being shed at a comparatively early period (occasionally even *in utero*), when they are succeeded by the larger permanent series, which is the only other ever developed. This double series of teeth thus forms a very characteristic feature of mammals generally. Both the milk and the permanent dentition display the aforesaid complexity of the hinder teeth as compared with those in front, and since the number of milk-teeth is always considerably less than that of the permanent set, it follows that the hinder milk-teeth are usually more complex than the teeth of which they are the predecessors in the permanent series, and represent functionally, not their immediate successors, but those more posterior permanent teeth which have no direct predecessors. This character is clearly seen in those animals in which the various members of the lateral or cheek series are well differentiated from each other in form, as the Carnivora, and also in man.

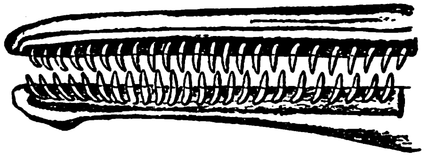


FIG. 1.—Upper and Lower Teeth of one side of the Mouth of a Dolphin (*Lagenorhynchus*), as an example of the homoeodont type of dentition. The bone covering the outer side of the roots of the teeth has been removed to show their simple character.

In mammals with two sets of teeth the number of those of the permanent series preceded by milk-teeth varies greatly, being sometimes, as in marsupials and some rodents, as few as one on each side of each jaw, and in other cases including the larger portion of the series. As a rule, the teeth of the two sides of the jaws are alike in number and character, except in cases of accidental or abnormal variation, and in the tusks of the narwhal, in which the left is of immense size, and the right rudimentary. In mammals, such as dolphins and some armadillos, which have a large series of similar teeth, not always constant in number in different individuals, there may indeed be differences in the two sides; but, apart from these in describing the dentition of any mammal, it is generally sufficient to give the number and characters of the teeth of one side only. As the teeth of the upper and the lower jaws work against each other in masticating, there is a general correspondence or harmony between them, the projections of one series, when the mouth is closed, fitting into corresponding depressions of the other. There is also a general resemblance in the number, characters and mode of succession of both series; so that, although individual teeth of the upper and lower jaws may not be in the strict sense of the term homologous parts, there is a great convenience in applying the same descriptive terms to the one which are used for the other.

The simplest dentition is that of many species of dolphin (fig. 1), in which the crowns are single-pointed, slightly curved cones, and the roots also single and tapering; so that all the teeth are alike in form from the anterior to the posterior end of the series, though it may be with some slight difference in size, those at the two extremities being rather smaller than the others. Such a dentition is called "homoeodont" (Gr. ὅμοιος, like, ὀδούς, tooth), and in the case cited, as the teeth are never changed, it is also monophyodont (Gr. μόνος, alone, single, φύειν, to generate, ὀδούς, tooth). Such teeth are adapted only for catching slippery living prey, like fish.

In a very large number of mammals the teeth of different parts of the series are more or less differentiated in character; and, accordingly, have different functions to perform. The front teeth are simple and one-rooted, and are adapted for cutting and seizing. They are called "incisors." The back, lateral or cheek teeth, on the other hand, have broader and more complex crowns, tuberculated or ridged, and supported on two or more roots. They crush or grind the food, and are hence called "molars." Many mammals have, between these two sets, a tooth at each corner of the mouth, longer and more pointed than the others, adapted for tearing or stabbing, or for fixing struggling prey. From the conspicuous development of such teeth in the Carnivora, especially the dogs, they have received the name of "canines." A dentition with its component parts so differently formed that these distinctive terms are applicable to them is called heterodont (Gr. *ἕτερος*, different). In most cases, though by no means invariably, mammals with a heterodont dentition are also diphyodont (Gr. *διφυής*, of double form).

This general arrangement is obvious in a considerable number of mammals; and examination shows that, under great modifications in detail, there is a remarkable uniformity of essential characters in the dentition of a large number of members of the class belonging to different orders and not otherwise closely allied, so much that it is possible to formulate a common plan of dentition from which the others have been derived by the alteration of some and the suppression of other members of the series, and occasionally, but very rarely, by addition. In this generalized form of mammalian dentition the total number of teeth present is 44, or 11 above and 11 below on each side. Those of each jaw are placed in continuous series without intervals between them; and, although the anterior teeth are simple and single-rooted, and the posterior teeth complex and with several roots, the transition between the two kinds is gradual.

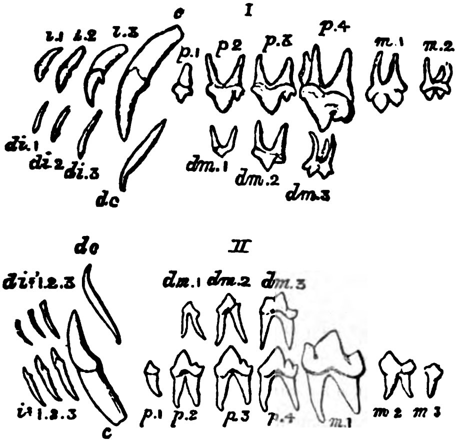


FIG. 2.—Milk and Permanent Dentitions of Upper (I.) and Lower (II.) Jaws of the Dog (*Canis*), with the symbols by which the different teeth are designated. The third upper molar (*m* 3) is the only tooth wanting to complete the typical heterodont mammalian dentition.

In dividing and grouping such teeth for the purpose of description and comparison more definite characters are required than those derived merely from form or function. The first step towards a classification rests on the fact that the upper jaw is composed of two bones, the premaxilla and the maxilla, and that the division or suture between these bones separates the three front teeth from the rest. These three teeth, which are implanted in the premaxilla, form a distinct group, to which the name of "incisor" is applied. This distinction is, however, not so important as it appears at first sight, for their connexion with the bone is only of a secondary nature, and, although it happens conveniently that in the great majority of cases the division between the bones coincides with the interspace between the third and fourth tooth of the series, still, when it does not, as in the mole, too much weight must not be given to this fact, if it contravenes other reasons for determining the homologies of the teeth. The eight remaining teeth of the upper jaw offer a natural division, inasmuch as the three hindmost never have milk-predecessors; and, although some of the anterior teeth may be in the same case, the particular one preceding these three always has such a predecessor. These three, then, are grouped as the "molars." Of the five teeth between the incisors and molars the most anterior, or the one usually situated close behind the premaxillary suture, very generally assumes a lengthened and pointed form, and constitutes the "canine" of the Carnivora, the tusk of the boar, &c. It is customary, therefore, to call this tooth, whatever its size or form, the "canine." The remaining four are the "premolars." This system has been objected to as artificial, and in many cases not descriptive, the distinction between premolars and canine especially being sometimes not obvious; but the terms are now in such general use, and also so convenient, that it is not likely they will be superseded. It is frequently convenient to refer to all the teeth behind the canine as the "cheek-teeth."

With regard to the lower teeth the difficulties are greater, owing to the absence of any suture corresponding to that which defines the incisors above; but since the number of the teeth is the same, since the corresponding teeth are preceded by milk-teeth, and since in the large majority of cases it is the fourth tooth of the series which is modified in the same way as the canine (or fourth tooth) of the upper jaw, it is reasonable to adopt the same divisions as with the upper series, and to call the first three, which are implanted in the part of the mandible opposite to the premaxilla, the incisors, the next the canine, the next four the premolars, and the last three the molars.

It may be observed that when the mouth is closed, especially when the opposed surfaces of the teeth present an irregular outline, the corresponding upper and lower teeth are not exactly opposite, otherwise the two series could not fit into one another, but as a rule the points of the lower teeth shut into the interspaces in front of the corresponding teeth of the upper jaw. This is very distinct in the canine teeth of the Carnivora, and is a useful guide in determining the homologies of the teeth of the two jaws.

For the sake of brevity the complete dentition is described by the following formula, the numbers above the line representing the teeth of the upper, those below the line those of the lower jaw: incisors $\frac{3-3}{3-3}$, canines $\frac{1-1}{1-1}$, premolars $\frac{4-4}{4-4}$, molars, $\frac{3-3}{3-3}=\frac{11-11}{11-11}$; total 44. As, however, initial letters may be substituted for the names of each group, and it is unnecessary to give more than the numbers of the teeth on one side of the mouth, the formula may be abbreviated into:

$$i\,\tfrac{3}{3},\ c\,\tfrac{1}{1},\ p\,\tfrac{4}{4},\ m\,\tfrac{3}{3};\ \text{total } 44.$$

The individual teeth of each group are enumerated from before backwards, and by such a formula as the following:—

$$\frac{i\,1,\ i\,2,\ i\,3,\ c,\ p\,1,\ p\,2,\ p\,3,\ p\,4,\ m\,1,\ m\,2,\ m\,3}{i\,1,\ i\,2,\ i\,3,\ c,\ p\,1,\ p\,2,\ p\,3,\ p\,4,\ m\,1,\ m\,2,\ m\,3}$$

a special numerical designation is given by which each one can be indicated. In mentioning any single tooth, such a sign as $\underline{m1}$ will mean the first upper molar, $\overline{m1}$ the first lower molar, and so on.

When, as is the case among nearly all existing mammals with the exception of the members of the genera *Sus* (pigs), *Gymnura* (rat-shrew), *Talpa* (moles) and *Myogale* (desmans) the number of teeth is reduced below the typical forty-four, it appears to be an almost universal rule that if one of the incisors is missing it is the second, or middle one, while the premolars commence to disappear from the front end of the series and the molars from the hinder end.

The milk-dentition is expressed by a similar formula, *d* for deciduous, being added before the letter expressive of the nature of the tooth. As the three molars and (almost invariably) the first premolar of the permanent series have no predecessors, the typical milk-dentition would be expressed as follows: $di\,\tfrac{3}{3},\ dc\,\tfrac{1}{1},\ dm\,\tfrac{3}{3}=28$. The teeth which precede the premolars of the permanent series are called either milk-molar or milk-premolar. When there is a marked difference between the premolars and molars of the permanent dentition, the first milk-molar resembles a premolar, while the last has the characters of the posterior molar. It is sometimes convenient to refer to all the seven cheek-teeth as members of a single continuous series (which they undoubtedly are), and for this purpose the following nomenclature has been proposed:—

	Upper Jaw.	Lower Jaw.
Cheek-tooth 1	Protus.	Protid.
" 2	Deuterus.	Deuterid.
" 3	Tritus.	Tritid.
" 4	Tetartus.	Tetartid.
" 5	Pemptus.	Pemptid.
" 6	Hectus.	Hectid.
" 7	Hebdomus.	Hebdomid.

With the exception of the Cetacea, most of the Edentata, and the Sirenia, in which the teeth, when present, have been specialized in a retrograde or aberrant manner, the placental mammals as a whole have a dentition conforming more or less closely to the foregoing type.

With the marsupials the case is, however, somewhat different; the whole number not being limited to 44, owing largely to the fact that the number of upper incisors may exceed three pairs, reaching indeed in some instances to as many as five. Moreover, with the exception of the wombats, the number of pairs of incisors in the upper always exceeds those in the lower. When fully developed, the number of cheek-teeth is, however, seven; and it is probable that, as in placentals, the first four of these are premolars and the remaining three molars, although it was long held that these numbers should be transposed. The most remarkable feature about the marsupial dentition is that, at most, only a single pair of teeth is replaced in each jaw; this pair, on the assumption that there are four premolars, representing the third of that series. With the exception of this replacing pair of teeth in each jaw, it is considered by many authorities that the marsupial dentition corresponds to the deciduous, or milk, dentition of placentals. If this be really the case, the rudiments of an earlier set of teeth which have been detected in the jaws of some members of the order, represent, not the milk-series, but a prelacteal dentition. On the assumption that these functional teeth correspond to the milk-series of placentals, marsupials in this respect agree exactly with modern elephants, in which the same peculiarity exists.

In very few mammals are teeth entirely absent. Even in the whalebone whales their germs are formed in the same manner and at the same period of life as in other mammals, and even become partially calcified, although they never rise above the gums, and completely disappear before birth. In the American anteaters and the pangolins among the Edentata no traces of teeth have been found at any age. Adult monotremes are in like case, although the duck-billed platypus (*Ornithorhynchus*) has teeth when young on the sides of the jaws. The northern sea-cow (*Rhytina*), now extinct, appears to have been toothless throughout life.

In different groups of mammals the dentition is variously specialized in accordance with the nature of the food on which the members of these groups subsist. From this point of view the various adaptive modifications of mammalian dentition may be roughly grouped under the headings of piscivorous, carnivorous, insectivorous, omnivorous and herbivorous.

The fish-eating, or piscivorous, type of dentition is exemplified under two phases in the dolphins and in the seals (being in the latter instance a kind of retrograde modification from the carnivorous type). In the dolphins, and in a somewhat less marked degree among the seals, this type of dentition consists of an extensive series of conical, nearly equal-sized, sharp-pointed teeth, implanted in an elongated and rather narrow mouth (fig. 1), and adapted to seize slippery prey without either tearing or masticating. In the dolphins the teeth form simple cones, but in the seals they are often trident-like; while in the otters the dentition differs but little from the ordinary carnivorous type.

This carnivorous adaptation, in which the function is to hold and kill struggling animals, often of large size, attains its highest development in the cats (*Felidae*). The canines are in consequence greatly developed, of a cutting and piercing type, and from their wide separation in the mouth give a firm hold; the jaws being as short as is consistent with the free action of the canines, or tusks, so that no power is lost. The incisors are small, so as not to interfere with the penetrating action of the tusks; and the crowns of some of the teeth of the cheek-series are modified into scissor-like blades, in order to rasp off the flesh from the bones, or to crack the bones themselves, while the later teeth of this series tend to disappear.

In the insectivorous type, as exemplified in moles and shrew-mice, the middle pair of incisors in each jaw are long and pointed so as to have a forceps-like action for seizing insects, the hard coats of which are broken up by the numerous sharp cusps surmounting the cheek-teeth.

In the omnivorous type, as exemplified in man and monkeys, and to a less specialized degree in swine, the incisors are of moderate and nearly equal size; the canines, if enlarged, serve for other purposes than holding prey, and such enlargement is usually confined to those of the males; while the cheek-teeth have broad flattened crowns surmounted by rounded bosses, or tubercles.

In the herbivorous modification, as seen in three distinct phases in the horse, the kangaroo, and in ruminants, the incisors are generally well developed in one or both jaws, and have a nipping action, either against one another or against a toothless hard pad in the upper jaw; while the canines are usually small or absent, at least in the upper jaw, but in the lower jaw may be approximated and assimilated to the incisors. The cheek-teeth are large, with broad flattened crowns surmounted either by simple transverse ridges, or complicated by elevations and infoldings. In the specialized forms the premolars tend to become more or less completely like the molars; and, contrary to what obtains among the Carnivora, the whole series of cheek-teeth (with the occasional exception of the first) is very strongly developed.

Opinions differ as to the mode in which the more complicated cheek-teeth of mammals have been evolved from a simpler type of tooth. According to one theory, this has been brought about by the fusion of two or more teeth of a simple conical type to form a compound tooth. A more generally accepted view—especially among palaeontologists—is the tritubercular theory, according to which the most generalized type of tooth consists of three cusps arranged in a triangle, with the apex pointing inwards in the teeth of the upper jaw. Additions of extra cusps form teeth of a more complicated type. Each cusp of the primitive triangle has received a separate name, both in the teeth of the upper and of the lower jaw, while names have also been assigned to super-added cusps. Molar teeth of the simple tritubercular type persist in the golden moles (*Chrysochloris*) among the Insectivora and also in the marsupial mole (*Notoryctes*) among the marsupials. The type is, moreover, common among the mammals of the early Eocene, and still more so in those of the Jurassic epoch; this forming one of the strongest arguments in favour of the tritubercular theory. (See Professor H. F. Osborn, "Palaeontological Evidence for the Original Tritubercular Theory," in vol. xvii. (new series) of the *American Journal of Science*, 1904.)

Digestive System.—As already mentioned, mammals are specially characterized by the division of the body-cavity into two main chambers, by means of the horizontal muscular partition known as the diaphragm, which is perforated by the great blood-vessels and the alimentary tube. The mouth of the great majority of mammals is peculiar for being guarded by thick fleshy lips, which are, however, absent in the Cetacea; their principal function being to seize the food, for which purpose they are endowed, as a rule, with more or less strongly marked prehensile power. The roof of the mouth is formed by the palate, terminating behind by a muscular, contractile arch, having in man and a few other species a median projection called the uvula, beneath which the mouth communicates with the pharynx. The anterior part of the palate is composed of mucous membrane tightly stretched over the flat or slightly concave bony layer which separates the mouth from the nasal passages, and is generally raised into a series of transverse ridges, which sometimes, as in ruminants, attain a considerable development. In the floor of the mouth, between the two branches of the lower jaw, and supported behind by the hyoid apparatus, lies the tongue, an organ the free surface of which, especially in its posterior part, is devoted to the sense of taste, but which by reason of its great mobility (being composed almost entirely of muscular fibres) performs important mechanical functions connected with masticating and procuring food. Its modifications of form in different mammals are numerous. Between the long, extensile, worm-like tongue of the anteaters, essential to the peculiar mode of feeding of those animals, and the short, immovable and almost functionless tongue of the porpoise, every intermediate condition is found. Whatever the form, the upper surface is, however, covered with numerous fine papillae, in which the terminal filaments of the taste-nerve are distributed. In some mammals, notably lemurs, occurs a hard structure known as the sublingua, which may terminate in a free horny tip. If, as has been suggested, this organ represents the tongue of reptiles, the mammalian tongue will obviously be a superadded organ distinctive of the class.

Salivary glands, of which the most constant are the parotid and the submaxillary, are always present in terrestrial mammals. Next in constancy are the "sublingual," closely associated with the last-named, at all events in the locality in which the secretion is poured out; and the "zygomatic," found only in some mammals in the cheek, just under cover of the anterior part of the zygomatic arch, the duct entering the mouth-cavity near that of the parotid.

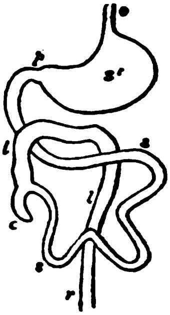


Fig. 3.—Diagrammatic Plan of the general arrangement of the Alimentary Canal in a typical Mammal.

o, oesophagus;
st, stomach;
p, pylorus;
ss, small intestine (abbreviated);
c, caecum;
ll, large intestine or colon, ending in
r, the rectum.

The alimentary, or intestinal, canal varies greatly in relative length and capacity in different mammals, and also offers manifold peculiarities of form, being sometimes a simple cylindrical tube of nearly uniform calibre throughout, but more often subject to alterations of form and capacity in different portions of its course—the most characteristic and constant being the division into an upper and narrower and a lower and wider portion, called respectively the small and the large intestine; the former being arbitrarily divided into duodenum, jejunum and ileum, and the latter into colon and rectum. One of the most striking peculiarities of this part of the canal is the frequent presence of a blind pouch, "caecum," situated at the junction of the large and the small intestine. Their structure presents an immense variety of development, from the smallest bulging of a portion of the side-wall of the tube to a huge and complex sac, greatly exceeding in capacity the remainder of the alimentary canal. It is only in herbivorous mammals that the caecum is developed to this great extent, and among these there is a complementary relationship between the size and complexity of the organ and that of the stomach. Where the latter is simple the caecum is generally the largest, and vice versa. In vol. xvii. (1905) of the *Transactions* of the Zoological Society of London, Dr P. Chalmers Mitchell has identified the paired caeca, or blind appendages, of the intestine of birds with the usually single caecum of mammals. These caeca occur in birds (as in mammals) at the junction of the small with the large intestine; and while in ordinary perching-birds they are reduced to small nipple-like buds of no functional importance, in many other birds—owls for instance—they form quite long receptacles. Among mammals, the horse and the dog may be cited as instances where the single caecum is of large size, this being especially the case of the former, where it is of enormous dimensions; in human beings, on the other hand, the caecum is rudimentary, and best known in connexion with "appendicitis." The existence of paired caeca was previously known in a few armadillos and anteaters, but Dr Mitchell has shown that they are common in these groups, while he has also recorded their occurrence in the hyrax and the manati. With the aid of these instances of paired caeca, coupled with the frequent existence of a rudiment of its missing fellow when only one is functional, the author has been enabled to demonstrate conclusively that these double organs in birds correspond in relations with their normally single representative in mammals.

In mammals both caecum and colon are often sacculated, a disposition caused by the arrangement of the longitudinal bands of muscular tissue in their walls; but the small intestine is always smooth and simple-walled externally, though its lining membrane often exhibits contrivances for increasing the absorbing surface without adding to the general bulk of the organ, such as the numerous small tags, or "villi," by which it is everywhere beset, and the more obvious transverse, longitudinal, or reticulating folds projecting into the interior, met with in many animals, of which the "valvulae conniventes" of man form well-known examples. Besides the crypts of Lieberkühn found throughout the intestinal canal, and the glands of Brunner confined to the duodenum, there are other structures in the mucous membrane, about the nature of which there is still much uncertainty, called "solitary" and "agminated" glands, the latter more commonly known by the name of "Peyer's patches." Of the liver little need be said, except that in all living mammals it has been divided into a number of distinct lobes, which have received separate names. It has, indeed, been suggested that in the earlier mammals the liver was a simple undivided organ. This, however, is denied by G. Ruge (vol. xxix. of Gegenbaur's *Morphologisches Jahrbuch*).

Origin of Mammals.—That mammals have become differentiated from a lower type of vertebrates at least as early as the commencement of the Jurassic period is abundantly testified by the occurrence of the remains of small species in strata of that epoch, some of which are mentioned in the articles MARSUPIALIA and MONOTREMATA (*q.v.*). Possibly mammalian remains also occur in the antecedent Triassic epoch, some palaeontologists regarding the South African *Tritylodon* as a mammal, while others consider that it was probably a reptile. Whatever may be the true state of the case with regard to that animal probably also holds good in the case of the approximately contemporaneous European *Microlestes*. Of the European Jurassic (or Oolitic) mammals our knowledge is unfortunately very imperfect; and from the scarcity of their remains it is quite probable that they are merely stragglers from the region (possibly Africa) where the class was first differentiated. It is not till the early Eocene that mammals become a dominant type in the northern hemisphere.

It is now practically certain that mammals are descended from reptiles. Dr H. Gadow, in a paper on the origin of mammals contributed to the *Zeitschrift für Morphologie*, sums up as follows: "Mammals are descendants of reptiles as surely as they [the latter] have been evolved from Amphibia. This does not mean that any of the living groups of reptiles can claim their honour of ancestry, but it means that the mammals have branched where the principal reptilian groups meet, and that is a long way back. The Theromorpha, especially small Theriodontia, alone show us what these creatures were like." It may be explained that the Theromorpha, or Anomodontia, are those extinct reptiles so common in the early Secondary (Triassic) deposits of South Africa, some of which present a remarkable resemblance in their dentition and skeleton to mammals, while others come equally near amphibians. A difficulty naturally arises with regard to the fact that in reptiles the occipital condyle by which the skull articulates with the vertebral column is single, although composed of three elements, whereas in amphibians and mammals the articulation is formed by a pair of condyles. Nevertheless, according to Professor H. F. Osborn, the tripartite reptilian condyle, by the loss of its median element, has given rise to the paired mammalian condyles; so that this difficulty disappears. The fate of the reptilian quadrate bone (which is reduced to very small dimensions in the Anomodontia) has been referred to in an earlier section of the present article, where some mention has also been made of the disappearance in mammals of the hinder elements of the reptilian lower jaw, so as to leave the single bone (dentary) of each half of this part of the skeleton in mammals.

Most of the earliest known mammals appear to be related to the Marsupialia and Insectivora. Others however (inclusive of *Tritylodon* and *Microlestes*, if they be really mammals), seem nearer to the Monotremata; and the question has yet to be decided whether placentals and marsupials on the one hand, and monotremes on the other are not independently derived from reptilian ancestors.

With regard to the evolution of marsupials and placentals, it has been pointed out that the majority of modern marsupials exhibit in the structure of their feet traces of the former opposability of the thumb and great toe to the other digits; and it has accordingly been argued that all marsupials are descended from arboreal ancestors. This doctrine is now receiving widespread acceptation among anatomical naturalists; and in the *American Naturalist* for 1904, Dr W. D. Matthew, an American palaeontologist, considers himself provisionally justified in so extending it as to include all mammals. That is to say, he believes that, with the exception of the duckbill and the echidna, the mammalian class as a whole can lay claim to descent from small arboreal forms. This view is, of course, almost entirely based upon palaeontological considerations; and these, in the author's opinion, admit of the conclusion that all modern placental and marsupial mammals are descended from a common ancestral stock, of which the members were small in bodily size. These ancestral mammals, in addition to their small size, were characterized by the presence of five toes to each foot, of which the first was more or less completely opposable to the other four. The evidence in favour of this primitive opposability is considerable. In all the groups which are at present arboreal, the palaeontological evidence goes to show that their ancestors were likewise so; while since, in the case of modern terrestrial forms, the structure of the wrist and ankle joints tends to approximate to the arboreal type, as we recede in time, the available evidence, so far as it goes, is in favour of Dr Matthew's contention.

The same author also discusses the proposition from another standpoint, namely, the condition of the earth's surface in Cretaceous times. His theory is that in the early Cretaceous epoch the animals of the world were mostly aerial, amphibious, aquatic or arboreal; the flora of the land being undeveloped as compared with its present state. On the other hand, towards the close of the Cretaceous epoch (when the Chalk was in course of deposition), the spread of a great upland flora vastly extended the territory available for mammalian life. Accordingly, it was at this epoch that the small ancestral insectivorous mammals first forsook their arboreal habitat to try a life on the open plains, where their descendants developed on the one hand into the carnivorous and other groups, in which the toes are armed with nails or claws, and on the other into the hoofed group, inclusive of such monsters as the elephant and the giraffe. The hypothesis is not free from certain difficulties, one of which will be noticed later.

Classification.—Existing mammals may be primarily divided into three main groups, or subclasses, of which the second and third are much more closely related to one another than is either of them to the first. These three classes are the Monotremata (or Prototheria), the Marsupialia (Didelphia, or Metatheria), and the Placentalia (Monodelphia, or Eutheria); the distinctive characters of each being given in separate articles (see MONOTREMATA, MARSUPIALIA and MONODELPHIA.)

The existing monotremes and marsupials are each represented only by a single order; but the placentals are divided into the following ordinal and subordinal groups, those which are extinct being marked with an asterisk (*):—

1. Insectivora (Moles, Hedgehogs, &c.).
2. Chiroptera (Bats).
3. Dermoptera (Colugo, or Flying Lemur).
4. Edentata:—
    a. Xenarthra (Anteaters, Sloths and Armadillos).
    b. Pholidota (Pangolins).
    c. Tubulidentata (Ant-bears, or Aard-varks).

5. Rodentia (Gnawing Mammals):—
    a. Duplicidentata (Hares and Picas).
    b. Simplicidentata (Rats, Beavers, &c.).
6. *Tillodontia (*Tillotherium*).
7. Carnivora:—
    a. Fissipedia (Cats, Dogs, Bears, &c.).
    b. Pinnipedia (Seals and Walruses).
    c. *Creodonta (*Hyaenodon*, &c.).
8. Cetacea (Whales and Dolphins):—
    a. *Archaeoceti (*Zeuglodon*, &c.).
    b. Odontoceti (Spermwhales and Dolphins).
    c. Mystacoceti (Whalebone Whales).
9. Sirenia (Dugongs and Manatis).
10. Ungulata (Hoofed Mammals):—
    a. Proboscidea (Elephants and Mastodons).
    b. Hyracoidea (Hyraxes).
    c. *Barypoda (*Arsinöitherium*).
    d. *Toxodontia (*Toxodon*, &c.).
    e. *Amblypoda (*Uintatherium*, &c.).
    f. *Litopterna (*Macrauchenia*, &c.).
    g. *Ancylopoda (*Chalicotherium*, &c.).
    h. *Condylarthra (*Phenacodus*, &c.).
    i. Perissodactyla (Tapirs, Horses, &c.).
    j. Artiodactyla (Ruminants, Swine, &c.).
11. Primates:—
    a. Prosimiae (Lemurs and Galagos).
    b. Anthropoidea (Monkeys, Apes and Man).

Separate articles are devoted to each of these orders, where references will be found to other articles dealing with some of the minor groups and a number of the more representative species.

Relationships of the Groups.—As we recede in time we find the extinct representatives of many of these orders approximating more and more closely to a common generalized type, so that in a large number of early Eocene forms it is often difficult to decide to which group they should be assigned.

The Insectivora are certainly the lowest group of existing placental mammals, and exhibit many signs of affinity with marsupials; they may even be a more generalized group than the latter. From the Insectivora the bats, or Chiroptera, are evidently a specialized lateral offshoot; while the Dermoptera may be another branch from the same stock. As to the Edentata, it is still a matter of uncertainty whether the pangolins (Pholidota) and the ant-bears (Tubulidentata) are rightly referred to an order typically represented by the sloths, anteaters, and armadillos of South and Central America, or whether the two first-named groups have any close relationship with one another. Much uncertainty prevails with regard to the ancestry of the group as a whole, although some of the earlier South American forms have a comparatively full series of teeth, which are also of a less degenerate type than those of their modern representatives.

An almost equal degree of doubt obtains with regard to the ancestry of that very compact and well-defined group the Rodentia. If, however, the so-called Proglires of the lower Eocene are really ancestral rodents, the order is brought into comparatively close connexion with the early generalized types of clawed, or unguiculate mammals. Whether the extinct Tillodontia are most nearly allied to the Rodentia, the Carnivora or the Ungulata, and whether they are really entitled to constitute an ordinal group by themselves, must remain for the present open questions.

The Carnivora, as represented by the (mainly) Eocene Creodonta, are evidently an ancient and generalized type. As regards the number and form of their permanent teeth, at any rate, creodonts present such a marked similarity to carnivorous marsupials, that it is difficult to believe the two groups are not allied, although the nature of the relationship is not yet understood, and the minute internal structure of the teeth is unlike that of marsupials and similar to that of modern Carnivora. There is the further possibility that creodonts may be directly descended from the carnivorous reptiles; a descent which if proved might introduce some difficulty with regard to the above-mentioned theory as to the arboreal ancestry of mammals generally. Be this as it may, there can be little doubt that the creodonts are related to the Insectivora, which, as stated above, show decided signs of kinship with the marsupials.

A much more interesting relationship of the creodont carnivora has, however, been established on the evidence of recent discoveries in Egypt. From remains of Eocene age in that country Dr E. Fraas, of Stuttgart, has demonstrated the derivation of the whale-like *Zeuglodon* from the creodonts. Dr C. E. Andrews has, moreover, not only brought forward additional evidence in favour of this most remarkable line of descent, but is confident—which Professor Fraas was not—that *Zeuglodon* itself is an ancestral cetacean, and consequently that whales are the highly modified descendants of creodonts. It must be admitted, however, that the links between *Zeuglodon* and typical cetaceans are at present unknown; but it may be hoped that these will be eventually brought to light from the deposits of the Mokattam Range, near Cairo. Whales and dolphins being thus demonstrated to be nothing more than highly modified Carnivora, might almost be included in the same ordinal group.

An analogous statement may be made with regard to the sea-cows, or Sirenia, which appear to be derivates from the great herbivorous order of Ungulata, and might consequently be included in that group, as indeed has been already done in Dr Max Weber's classification. It is with the proboscidean suborder of the Ungulata to which the Sirenia are most nearly related; the nature of this relationship being described by Dr Andrews as follows:—

"In the first place, the occurrence of the most primitive Sirenians with which we are acquainted in the same region as the most generalized proboscidean, *Moeritherium*, is in favour of such a view, and this is further supported by the similarity of the brain-structure and, to some extent, of the pelvis in the earliest-known members of the two groups. Moreover, in the anatomy of the soft-parts of the recent forms there are a number of remarkable points of resemblance. Among the common characters may be noted the possession of: (1) pectoral mammae; (2) abdominal testes, (3) a bifid apex of the heart; (4) bilophodont molars with a tendency to the formation of an additional lobe from the posterior part of the cingulum. The peculiar mode of displacement of the teeth from behind forwards in some members of both groups may perhaps indicate a relationship, although in the case of the Sirenia the replacement takes place by means of a succession of similar molars, while in the Proboscidea the molars remain the same numerically, but increase greatly in size and number of transverse ridges."

These and certain other facts referred to by the same author point to the conclusion that not only are the Sirenia and the Proboscidea derived from a single ancestral stock, but that the Hyracoidea—and so *Arsinöitherium*—are also derivatives from the same stock, which must necessarily have been Ethiopian.

Of the other suborders of ungulates, the Toxodontia and Litopterna are exclusively South American, and while the former may possibly be related to the Hyracoidea and Barypoda, the latter is perhaps more nearly akin to the Perissodactyla. The Amblypoda, on the other hand, are perhaps not far removed from the ancestral Proboscidea, which depart comparatively little from the generalized ungulate type. The latter is represented by the Eocene Condylarthra, which undoubtedly gave rise to the Perissodactyla and Artiodactyla, and probably to most, if not all, of the other groups. The Condylarthra, in their turn, approximate closely to the ancestral Carnivora, as they also do in some degree to the ancestral Primates. As regards the latter order, although we are at present unacquainted with all the connecting links between the lemurs and the monkeys, there is little doubt that the ancestors of the former represent the stock from which the latter have originated. C. D. Earle, in the *American Naturalist* for 1897, observes that "so far as the palaeontological evidence goes it is decidedly in favour of the view that apes and lemurs are closely related. Beginning with the earliest known lemur, *Anaptomorphus*, this genus shows tendencies towards the anthropoids, and, when we pass up into the Oligocene of the Old World, *Adapis* is a decidedly mixed type, and probably not far from the common stem-form which gave origin to both suborders of the Primates. In regard to *Tarsius*, it is evidently a type nearly between the lemurs and apes, but with many essential characters belonging to the former group."

Distribution.—For an account of the "realms" and "regions" into which the surface of the globe has been divided by those who have made a special study of the geographical distribution of animals, see ZOOLOGICAL DISTRIBUTION. For the purposes of such zoo-geographical divisions, mammals are much better adapted than birds, owing to their much more limited powers of dispersal; most of them (exclusive of the purely aquatic forms, such as seals, whales, dolphins and sea-cows) being unable to cross anything more than a very narrow arm of the sea. Consequently, the presence of nearly allied groups of mammals in areas now separated by considerable stretches of sea proves that at no very distant date such tracts must have had a land-connexion. In the case of the southern continents the difficulty is, however, to determine whether allied groups of mammals (and other animals) have reached their present isolated habitats by dispersal from the north along widely sundered longitudinal lines, or whether such a distribution implies the former existence of equatorial land-connexions. It may be added that even bats are unable to cross large tracts of sea; and the fact that fruit-bats of the genus *Pteropus* are found in Madagascar and the Seychelles, as well as in India, while they are absent from Africa, is held to be an important link in the chain of evidence demonstrating a former land-connexion between Madagascar and India.

There is another point of view from which mammals are of especial importance in regard to geographical distribution, namely their comparatively late rise and dispersal, or "radiation," as compared with reptiles.

As regards terrestrial mammals (with which alone we are at present concerned), one of the most striking features in their distribution is their practical absence from oceanic islands; the only species found in such localities being either small forms which might have been carried on floating timber, or such as have been introduced by human agency. This absence of mammalian life in oceanic islands extends even to New Zealand, where the indigenous mammals comprise only two peculiar species of bats, the so-called Maori rat having been introduced by man.

One of the leading features in mammalian distribution is the fact that the Monotremata, or egg-laying mammals, are exclusively confined to Australia and Papua, with the adjacent islands. The marsupials also attain their maximum development in Australia ("Notogaea" of the distributionists), extending, however, as far west as Celebes and the Moluccas, although in these islands they form an insignificant minority among an extensive placental fauna, being represented only by the cuscuses (*Phalanger*), a group unknown in either Papua or Australia. Very different, on the other hand, is the condition of things in Australia and Papua, where marsupials (and monotremes) are the dominant forms of mammalian life, the placentals being represented (apart from bats, which are mainly of an Asiatic type) only by a number of more or less aberrant rodents belonging to the mouse-tribe, and in Australia by the dingo, or native dog, and in New Guinea by a wild pig. The dingo was, however, almost certainly brought from Asia by the ancestors of the modern natives; while the Papuan pig is also in all probability a human introduction, very likely of much later date. The origin of the Australasian fauna is a question pertaining to the article ZOOLOGICAL DISTRIBUTION. The remaining marsupials (namely the families *Didelphyidae* and *Epanorthidae*) are American, and mainly South and Central American at the present day; although during the early part of the Tertiary period representatives of the first-named family ranged all over the northern hemisphere.

The Insectivora (except a few shrews which have entered from the north) are absent from South America, and appear to have been mainly an Old World group, the only forms which have entered North America being the shrew-mice (*Soricidae*) and moles (*Talpidae*). The occurrence of one aberrant group (*Solenodon*) in the West Indies is, however, noteworthy. The family with the widest distribution is the *Soricidae*, the *Talpidae* being unknown in Africa. The tree-shrews (*Tupaiidae*) are exclusively Asiatic, whereas the jumping-shrews (*Macroscelididae*) are equally characteristic of the African continent. Madagascar is the sole habitat of the tenrecs (*Centetidae*), as is Southern Africa of the golden moles (*Chrysochloridae*). It is, however, important to mention that an extinct South American insectivore, *Necrolestes*, has been referred to the family last mentioned; and even if this reference should not be confirmed in the future, the occurrence of a representative of the order in Patagonia is a fact of considerable importance in distribution.

The Rodentia have a wider geographical range than any other order of terrestrial mammals, being, as already mentioned, represented by numerous members of the mouse-tribe (*Muridae*) even in Australasia. With the remarkable exception of Madagascar, where it is represented by the *Nesomyidae*, that family has thus a cosmopolitan distribution. Very noteworthy is the fact that, with the exception of Madagascar (and of course Australia) the squirrel family (*Sciuridae*) is also found in all parts of the world. Precisely the same may be said of the hares, which, however, become scarce in South America. On the other hand, the scaly-tailed squirrels (*Anomaluridae*), the jumping-hares (*Pedetidae*), and the strand-moles (*Bathyergidae*) are exclusively African; while the sewellels (*Haplodontidae*) and the pocket-gophers (*Geomyidae*) are as characteristically North American, although a few members of the latter have reached Central America. The beavers (*Castoridae*) are restricted to the northern hemisphere, whereas the dormice (*Gliridae*) and the mole-rats (*Spalacidae*) are exclusively Old World forms, the latter only entering the north of Africa, in which continent the former are largely developed. The jerboa group (*Dipodidae*, or *Jaculidae*) is also mainly an Old World type, although its aberrant representatives the jumping-mice (*Zapus*) have effected an entrance into Arctic North America. Porcupines enjoy a very wide range, being represented throughout the warmer parts of the Old World, with the exception of Madagascar (and of course Australasia), by the *Hystricidae*, and in the New World by the *Erethizontidae*. Of the remaining families of the Simplicidentata, all are southern, the cavies (*Caviidae*), chinchillas (*Chinchillidae*), and degus (*Octodontidae*) being Central and South American, while the *Capromyidae* are common to southern America and Africa, and the *Ctenodactylidae* are exclusively African. The near alliance of all these southern families, and the absence of so many Old World families from Madagascar form two of the most striking features in the distribution of the order. Lastly, among the Duplicidentata, the picas (*Ochotonidae* or *Lagomyidae*) form a group confined to the colder or mountainous regions of the northern hemisphere.

Among the existing land Carnivora (of which no representatives except the introduced dingo are found in Australasia) the cat-tribe (*Felidae*) has now an almost cosmopolitan range, although it only reached South America at a comparatively recent date. Its original home was probably in the northern hemisphere; and it has no representatives in Madagascar. The civet-tribe (*Viverridae*), on the other hand, which is exclusively an Old World group, is abundant in Madagascar, where it is represented by peculiar and aberrant types. The hyenas (*Hyaenidae*), at any rate at the present day, to which consideration is mainly limited, are likewise Old World. The dog-tribe (*Canidae*), on the other hand, are, with the exception of Madagascar, an almost cosmopolitan group. Their place of origin was, however, almost entirely in the northern hemisphere, and not improbably in some part of the Old World, where they gave rise to the bears (*Ursidae*). The latter are abundant throughout the northern hemisphere, and have even succeeded in penetrating into South America, but, with the exception of the Mediterranean zone, have never succeeded in entering Africa, and are therefore of course unknown in Madagascar. The raccoon group (*Procyonidae*) is mainly American, being represented in the Old World only by the pandas (*Aelurus* and *Aeluropus*), of which the latter apparently exhibits some affinity to the bears. The birthplace of the group was evidently in the northern hemisphere—possibly in east Central Asia. The weasel-tribe (*Mustelidae*) is clearly a northern group, which has, however, succeeded in penetrating into South America and Africa, although it has never reached Madagascar.

The extinct creodonts, especially if they be the direct descendants of the anomodont reptiles, may have originated in Africa, although they are at present known in that continent only from the Fayum district. Elsewhere they occur in South America and throughout a large part of the northern hemisphere, where they appear to have survived in India to the later Oligocene or Miocene.

In the case of the great order, or assemblage, of Ungulata it is necessary to pay somewhat more attention to fossil forms, since a considerable number of groups are either altogether extinct or largely on the wane.

So far as is at present known, the earliest and most primitive group, the Condylarthra, is a northern one, but whether first developed in the eastern or the western hemisphere there is no sufficient evidence. The more or less specialized Litopterna and Toxodontia, as severally typified by the macrauchenia and the toxodon, are, on the other hand, exclusively South American. With the primitive five-toed Amblypoda, as represented by the coryphodon, we again reach a northern group, common to the two hemispheres; but there is not improbably some connexion between this group and the much more specialized Barypoda, as represented by *Arsinöitherium*, of Africa. The Ancylopoda, again, typified by *Chalicotherium*, and characterized by the claw-like character of the digits, are probably another northern group, common to the eastern and western hemispheres.

Recent discoveries have demonstrated the African origin of the elephants (Proboscidea) and hyraxes (Hyracoidea), the latter group being still indeed mainly African, and in past times also limited to Africa and the Mediterranean countries. As regards the elephants, (now restricted to Africa and tropical Asia), there appears to be evidence that the ancestral mastodons, after having developed from African forms probably not very far removed from the Amblypoda, migrated into Asia, where they gave rise to the true elephants. Thence both elephants and mastodons reached North America by the Bering Sea route; while the former, which arrived earlier than the latter, eventually penetrated into South America.

The now waning group of Perissodactyla would appear to have originally been a northern one, as all the three existing families, rhinoceroses (*Rhinocerotidae*), tapirs (*Tapiridae*), and horses (*Equidae*), are well represented in the Tertiaries of both halves of the northern hemisphere. If eastern Central Asia were tentatively given as the centre of radiation of the group, this might perhaps best accord with the nature of the case. Rhinoceroses disappeared comparatively early from the New World, and never reached South America. In Siberia and northern Europe species of an African type survived till a comparatively late epoch, so that the present relegation of the group to tropical Asia and Africa may be regarded as a modern feature in distribution. Horses, now unknown in a wild state in the New World, although still widely spread in the Old, attained a more extensive range in past times, having successfully invaded South America. On the other hand, in common with the rest of the Perissodactyla, they never reached Madagascar. In addition to the occurrence of their fossil remains almost throughout the world, the former wide range of the tapirs is attested by the fact of their living representatives being confined to such widely sundered areas as Malaysia and tropical America.

The Artiodactyla are the only group of ungulates known to have been represented in Madagascar; but since both these Malagasy forms—namely two hippopotamuses (now extinct) and a river-hog—are capable of swimming, it is most probable that they reached the island by crossing the Mozambique Channel. As regards the deer-family (*Cervidae*), which is unknown in Africa south of the Sahara, it is quite evident that it originated in the northern half of the Old World, whence it reached North America by the Bering Sea route, and eventually travelled into South America. More light is required with regard to the past history of the giraffe-family (*Giraffidae*), which includes the African okapi and the extinct Indian *Sivatherium*, and is unknown in the New World. Possibly, however, its birthplace may prove to be Africa; if so, we shall have a case analogous to that of the African elephant, namely that while giraffes flourished during the Pliocene in Asia (where they may have originated), they survive only in Africa. An African origin has also been suggested for the hollow-horned ruminants (*Bovidae*); and if this were substantiated it would explain the abundance of that family in Africa and the absence from the heart of that continent of the deer-tribe. Some confirmation of this theory is afforded by the fact that whereas we can recognize ancestral deer in the Tertiaries of Europe we cannot point with certainty to the forerunners of the *Bovidae*. Whether its birthplace was in Africa or to the north, it is, however, clear that the hollow-horned ruminants are essentially an Old World group, which only effected an entrance into North America at a comparatively recent date, and never succeeded in reaching South America. So far as it goes, this fact is also in favour of the African ancestry of the group.

The *Antilocapridae* (prongbuck), whose relationships appear to be rather with the *Cervidae* than with the *Bovidae*, are on the other hand apparently a North American group. The chevrotains (*Tragulidae*), now surviving only in West and Central Africa and tropical Asia, are conversely a purely Old World group.

The camels (*Tylopoda*) certainly originated in the northern hemisphere, but although their birthplace has been confidently claimed for North America, an equal, if not stronger, claim may be made on the part of Central Asia. From the latter area, where wild camels still exist, the group may be assumed to have made its way at an early period into North America; whence, at a much later date, it finally penetrated into South America. In the Old World it seems to have reached the fringe of the African continent, where its wanderings in a wild state were stayed.

The pigs (*Suidae*) and the hippopotamuses (*Hippopotamidae*) are essentially Old World groups, the former of which has alone succeeded in reaching America, where it is represented by the collateral branch of the peccaries (*Dicotylinae*). An African origin would well explain the present distribution of both groups, but further evidence on this point is required before anything decisive can be affirmed, although it is noteworthy that the earliest known pig (*Geniohyus*) is African. The *Suinae* are at present spread all over the Old World, although the African forms (other than the one from the north) are markedly distinct from those inhabiting Europe and Asia. Hippopotamuses, on the contrary, are now exclusively African, although they were represented in tropical Asia during the Pliocene and over the greater part of Europe at a later epoch.

A brief notice with regard to the distribution of the Primates must suffice, as their past history is too imperfectly known to admit of generalizations being drawn. The main facts at the present day are, firstly, the restriction of the Prosimiae, or lemurs, to the warmer parts of the Old World, and their special abundance in Madagascar (where other Primates are wanting); and, secondly, the wide structural distinction between the monkeys of tropical America (Platyrrhina), and the Old World monkeys and apes, or Catarrhina. It is, however, noteworthy that extinct lemurs occur in the Tertiary deposits of both halves of the northern hemisphere—a fact which has induced Dr J. L. Wortman to suggest a polar origin for the entire group—a view we are not yet prepared to endorse. For the distribution of the various families and genera the reader may be referred to the article PRIMATES; and it will suffice to mention here that while chimpanzees and baboons are now restricted to Africa and (in the case of the latter group) Arabia, they formerly occurred in India.

As regards aquatic mammals, the greater number of the Cetacea, or whales and dolphins, have, as might be expected, a very wide distribution in the ocean. A few, on the other hand, have a very restricted range, the Greenland right whale (*Balaena mysticetus*) being, for instance, limited to the zone of the northern circumpolar ice, while no corresponding species occurs in the southern hemisphere. In this case, not only temperature, but also the peculiar mode of feeding, may be the cause. The narwhal and the beluga have a very similar distribution, though the latter occasionally ranges farther south. The bottle-noses (*Hyperöodon*) are restricted to the North Atlantic, never entering, so far as known, the tropical seas. Other species are exclusively tropical or austral in their range. The pigmy whale (*Neobalaena marginata*), for instance, has only been met with in the seas round Australia, New Zealand and South America, while a beaked whale (*Berardius arnouxi*) appears to be confined to the New Zealand seas.

The Cetacea, however, are by no means limited to the ocean, or even to salt water, some entering large rivers for considerable distances, and others being exclusively fluviatile. The susu (*Platanista*) is, for instance, extensively distributed throughout nearly the whole of the river systems of the Ganges, Brahmaputra and Indus, ascending as high as there is water enough to swim in, but apparently never passing out to sea. The individuals inhabiting the Indus and the Ganges must therefore have been for long ages isolated without developing any distinctive anatomical characters, those by which *P. indi* was separated from *P. gangetica* having been shown to be of no constant value. *Orcella fluminalis*, again, appears to be limited to the Irrawaddy; and at least two distinct species of dolphin, belonging to different genera, are found in the Amazon. It is remarkable that none of the great lakes or inland seas of the world is inhabited by cetaceans.

The great difference in the manner of life of the sea-cows, or Sirenia, as compared with that of the Cetacea, causes a corresponding difference in their geographical distribution. Slow in their movements, and feeding on vegetable substances, they are confined to the neighbourhood of rivers, estuaries or coasts, although there is a possibility of accidental transport by currents across considerable distances. Of the three genera existing within historic times, one (*Manatus*) is exclusively confined to the shores of the tropical Atlantic and the rivers entering into it, individuals scarcely specifically distinguishable being found both on the American and the African. The dugong (*Halicore*) is distributed in different colonies, at present isolated, throughout the Indian Ocean from Arabia to North Australia; while the *Rhytina* or northern sea-cow was, for some time before its extinction, limited to a single island in the extreme north of the Pacific Ocean.

The seals (*Pinnipedia*) although capable of traversing long reaches of ocean, are less truly aquatic than the last two groups, always resorting to the land or to ice-floes for breeding. The geographical range of each species is generally more or less restricted, usually according to climate, as they are mostly inhabitants either of the Arctic or Antarctic seas and adjacent temperate regions, few being found within the tropics. For this reason the northern and the southern species are for the most part quite distinct. In fact, the only known exception is the case of a colony of elephant-seals (*Macrorhinus leoninus*), whose general range is in the southern hemisphere, inhabiting the coast of California. In this case a different specific name has been given to the northern form, but the characters by which it is distinguished are of little importance, and probably, except for the abnormal geographical distribution, would never have been discovered. The most remarkable circumstance connected with the distribution of seals is the presence of members of the order in the three isolated great lakes or inland seas of Central Asia—the Caspian, Aral and Baikal—which, notwithstanding their long isolation, have varied but slightly from species now inhabiting the Polar Ocean.

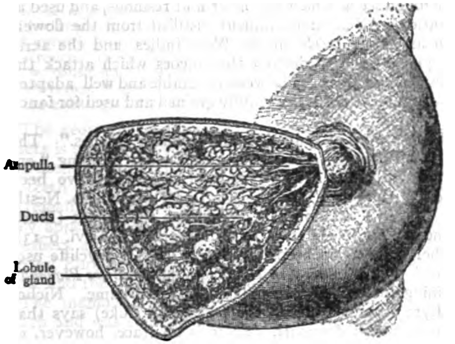
AUTHORITIES.—The above article is partly based on that of Sir W. H. Flower in the 9th edition of this work. The literature connected with mammals is so extensive that all that can be attempted here is to refer the reader to a few textbooks, with the aid of which, combined with that of the annual volumes of the *Zoological Record*, he may obtain such information on the subject as he may require: F. E. Beddard, "Mammals," *The Cambridge Natural History*, vol. x. (1902); W. H. Flower and R. Lydekker, *The Study of Mammals* (London, 1891); Max Weber, *Die Säugethiere* (Jena, 1904); W. T. Blanford, *The Fauna of British India—Mammalia* (1888–1891); D. G. Elliot, *Synopsis of the Mammals of North America* (Chicago, 1901) and *The Mammals of Middle America and the West Indies* (Chicago, 1904); W. L. Sclater, *The Fauna of South Africa—Mammals* (Cape Town, 1901–1902); W. K. Parker, *Mammalian Descent* (London, 1885); E. Trouessart, *Catalogus mammalium, tam viventium quam fossilium* (Paris, 1898–1899); and supplement, 1904–1905; T. S. Palmer, *Index generum mammalium* (Washington, 1904); W. L. and P. L. Sclater, *The Geography of Mammals* (London, 1899); R. Lydekker, *A Geographical History of Mammals* (Cambridge, 1896). (W. H. F.; R. L.)

MAMMARY GLAND (Lat. *mamma*), or female breast, the organ by means of which the young are suckled, and the possession of which, in some region of the trunk, entitles the animal bearing it to a place in the order of Mammalia.

Anatomy.—In the human female the gland extends vertically from the second to the sixth rib, and transversely from the edge of the sternum to the mid axillary line; it is embedded in the fat superficial to the pectoralis major muscle, and a process which extends toward the armpit is sometimes called the axillary tail. A little below the centre of the glandular swelling is the *nipple*, surrounding which is a pigmented circular patch called the areola; this is studded with slight nodules, which are the openings of areolar glands secreting an oily fluid to protect the skin during suckling. During the second or third month of pregnancy the areola becomes more or less deeply pigmented, but this to a large extent passes off after lactation ceases. In structure the gland consists of some fifteen to twenty lobules, each of which has a *lactiferous duct* opening at the summit of the nipple, and branching in the substance of the gland to form secondary lobules, the walls of which are lined by cubical epithelium in which the milk is secreted. These secondary lobules project into the surrounding fat, so that it is difficult to dissect out the gland cleanly. Before opening at the nipple each lactiferous duct has a fusiform dilatation called the *ampulla*.

After the child-bearing period of life the breasts atrophy and tend to become pendulous, while in some African races they are pendulous throughout life. Variations in the mammary glands are common; often the left breast is larger than the right, and in those rare cases in which one breast is suppressed it is usually the right, though suppression of the breast does not necessarily include absence of the nipple.

Supernumerary nipples and glands are not uncommon, and, when they occur, are usually situated in the mammary line which extends from the anterior axillary fold to the spine of the pubis; hence, when an extra nipple appears above the normal one, it is external to it, but, when below, it is nearer the middle line. The condition of extra breasts is known as *polymasty*, that of extra nipples as *polythely*, and it is interesting to notice that the latter is commoner in males than in females. O. Ammon (quoted by Wiedersheim) records the case of a German soldier who had four nipples on each side. These nipples in the human subject are seldom found below the costal margin. In normal males the breast structure is present, but rudimentary, though it is not very rare to find instances of boys about puberty in whom a small amount of milk is secreted, and one case at least is recorded of a man who suckled a child. A functional condition of the mammary glands in men is known as *gynaekomasty*. (For further details see *The Structure of Man*, by R. Wiedersheim, translated by H. and M. Bernard, and edited by G. B. Howes, London, 1895.)



(From A. F. Dixon, Cunningham's *Text Book of Anatomy*.)

FIG. 1.—Dissection of the Mammary Gland.

Embryology.—There is every probability that the mammary glands are modified and hypertrophied sebaceous glands, and transitional stages are seen in the areolar glands, which sometimes secrete milk. At an early stage of foetal life a raised patch of ectoderm is seen, which later on becomes a saucer-like depression; from the bottom of this fifteen or twenty solid processes of cells, each presumably representing a sebaceous gland, grow into the mesoderm which forms the connective-tissue stroma of the mamma. Later on these processes branch. The last stage is that the centre of the *mammary pit* or saucer-like depression once more grows up to form the nipple, and at birth the processes become tubular, thus forming lactiferous ducts. The glands grow little until the age of puberty, but their full development is not reached until the birth of the first child.

Comparative Anatomy.—In the lower Mammals the mammary line, already mentioned, appears in the embryo as a ridge, and in those which have many young at a birth patches of this develop in the thoracic and abdominal regions to form the mammae, while the intervening parts of the ridge disappear. The number of mammae is not constant in animals of the same species; as an instance of this it will be found that in the dog the number of nipples varies from seven to ten, though animals with many nipples are more liable to variation than those with few. When only a few young are produced at a time the mammae are few, and it seems to depend on the convenience of suckling in which part of the mammary line the glands are developed. In the pouched Mammals (Monotremes and Marsupials) inguinal mammae are found, and so they are in most Ungulates as well as in the Cetacea. In the elephants, Sirenia, Chiroptera and most of the Primates, on the other hand, they are confined to the pectoral region, and this is also the case in some Rodents, *e.g.* the jumping hare (*Pedetes caffer*). In the monotremes the mammary pit remains throughout life, and the milk is conducted along the hairs to the young, but in other Mammals nipples are formed in one of two ways. One is that already described in Man, which is common to the Marsupials and Primates, while in the other the margin or *vallum* of the mammary pit grows up, and so forms a nipple with a very deep pit, into the bottom of which the lactiferous ducts open. The latter is regarded as the primary arrangement. In the monotremes the mammae are looked upon, not as modified sebaceous glands, as in other Mammals, but as altered sweat glands. It is further of interest to notice that in these primitive Mammals the glands are equally developed in both sexes, and it is thought that among the bats the male often assists in suckling the young (see G. Dobson, *Brit. Museum Cat. of the Chiroptera*, London, 1878). These facts, together with the occasional occurrence of gynaekomasty in man, make it probable that the ancestral Mammal was an animal in which both sexes helped in the process of lactation.

For further details and literature up to 1906 see *Comparative Anatomy of Vertebrates*, by R. Wiedersheim, adapted by W. N. Parker (1907), and Bronn's *Classen und Ordnungen des Thierreichs*.

(F. G. P.)

Diseases of the Mammary Gland.—Inflammation of the breast (*mastitis*) is apt to occur in a woman who is suckling, and is due to the presence of septic micro-organisms, which, as a rule, have found their way into the milk-ducts, the lymphatics or the veins, through a crack, or other wound, in a nipple which has been made sore by the infant's vigorous attempts to obtain food. Especially is this septic inflammation apt to occur if the nipple is depressed, or so badly formed that the infant has difficulty in feeding from it. The inflamed breast is enlarged, tender and painful, and the skin over it is hot, and perhaps too reddened. The woman feels ill and feverish, and she may shiver, or have a definite rigor—which suggests that the inflammation is running on to the formation of an abscess. The abscess may be superficial to, or beneath, the breast, but it is usually within the breast itself. The infant should at once be weaned, the milk-tension being relieved by the breast-pump. Fomentations should be applied under waterproof jaconette, and the breast should be evenly supported by a bandage or by the corsets. Belladonna and glycerine should be smeared over the breast, with the view of checking the secretion of milk, as well as of easing pain. But before this is done six or eight leeches may be applied. On the first indication that matter is collecting, an incision should be made, for if the matter is allowed to remain locked up in the breast tissue the abscess will rapidly increase in size, and the whole of the breast may become infected and destroyed. Supposing that, in making the incision, no pus is discovered, the relief to the vascular tension thus afforded will be nevertheless highly beneficial. The operation had better be done under a general anaesthetic, so that the surgeon can introduce a probe, or his finger, into the wound, breaking down the partitions which are likely to exist between separate abscesses, and thus enable them to be drained through the one opening. As the discharge begins to cease, the tenderness subsides, and gentle massage, or firm strapping of the breast, will prove useful. The general treatment will consist in the administration of an aperient, and, the tongue being clean, in prescribing such drugs as quinine, strychnia and iron. The diet should be liberal, but not carried to such excess that the power of digestion and absorption is overtaxed. During the early acute stage of the disease small doses of morphia may be necessary. When the tongue has cleaned, a little wine may be given with advantage.

Chronic Eczema around the nipple of a woman late in life, with, perhaps, localized ulceration, is known as *Paget's Disease*. The importance of it is that cancerous infiltration is apt to pass from it along the milk-ducts and to involve the breast in malignant disease. Hence, when eczema about the nipple refuses to clear up under the influence of soothing treatment, it is well to insist on the removal of the entire breast. Sometimes this eczema is malignant from the beginning, being associated with the active prolifization of the epithelial cells of the milk-ducts, and with their escape into the surrounding tissues. The nipple is retracted in most of these cases, which, however, are not often met with.

Chronic Mastitis is of frequent occurrence in women who are past middle age. The part of the breast involved is enlarged, hard, and more or less tender and painful. It is sometimes impossible clinically to distinguish this disease from cancer. True, the tumour is not so definite or so hard as a cancer, nor is it attached to the skin, nor to the muscles of the chest wall, and if there are any glands secondarily enlarged in the arm-pit they are not so hard as they may be in cancer. But all these are questions of degree. It is, of course, highly inadvisable to leave it to time to clear up the diagnosis, for a chronic mastitis, innocent at first, may eventually become cancerous. If in any case the difficulty of distinguishing a chronic mastitis from a malignant tumour of the breast is insuperable, the safest course is to remove the breast and have it examined by the microscope. The suggestion, sometimes made, as to the preliminary removal of a small piece of the tumour for examination is not to be recommended.

A simple glandular tumour, *fibro-adenoma*, is apt to be found in the breasts of youngish women, who may possibly give an account of some blow or other injury; there may, however, be no history of injury. The tumour is smooth, rounded or oval, and lies loose in the midst of the breast; as a rule it is not tender. It is not associated with enlarged glands in the arm-pit. The tumour had best be removed, though there is no urgency about the operation, as the growth is absolutely innocent. There is, however, no telling as to what course an innocent tumour of the breast may take as middle age comes on.

Cysts of the Breast.—A *galactocele* is a tumour due to the locking up of milk in a greatly dilated duct. Other forms of cystic disease may be due to serous or hydatid fluid, or to thin pus, being surrounded by fibrous walls. Such cysts are best treated by free incision, and by passing a gauze dressing into their depths. If the tissue is occupied by many cysts, the whole breast had better be removed.

Cancer of the Breast may be met with in men as well as in women; in men, however, it is very rare. It is commonest in women between the ages of forty and fifty. It is sometimes met with in women of twenty; and the younger the individual the more malignant is the disease. Married life seems to have no effect as regards the incidence of the disease, but it often happens that a breast which gave trouble during the period of suckling becomes later the subject of cancer; in other cases there is a clear history of the attack having followed an injury. It is, thus, as if inflammatory changes in the breast were the direct cause of a later cancerous invasion. Though it is impossible to affirm that heredity has a great influence in the incidence of cancer, it is, nevertheless, remarkable that the members of certain families are unusually prone to the disease.

The chief feature of a cancerous tumour of the breast is its great hardness. The technical name for the growth is *scirrhus* (Gr. *σκιρος*, or *σκιρρος*, any hard coat or covering, *stucco*), from its stony hardness. The tumour consists of a dense framework of fibrous tissue, with groups of cancer-cells in the spaces. The malignancy of the disease depends upon the cells, not upon the fibrous tissue. In young subjects the cells predominate, but in old ones the contraction of the fibrous tissue throughout the breast compresses and destroys the cells, and this sometimes to such an extent that there is at last nothing left at the site but contracted fibrous tissue, all trace of malignancy having disappeared. This variety of the disease is found in old people, and is called *atrophic cancer*.

The cells of a cancerous breast are apt to be carried by the lymphatics to the lymphatic glands in the arm-pit, and by the blood-stream to the spinal column and to other parts of the skeleton, and sometimes to the liver, which thus becomes large and hard, or to the other breast.

As the fibrous tissue around the tumour becomes invaded by the new growth it undergoes contraction (much as a string becomes shorter when it is wetted), and as this shortening of the fibrous bands increases the nipple may be retracted, and the breast may be closely bound down to the chest-wall; and, further, the skin overlying the tumour may be drawn in towards the tumour so as to form a conspicuous dimple. Later, the nutrition of this patch of skin may be so interfered with that it mortifies or breaks down, and thus a cancerous ulcer is produced. This ulcer slowly spreads, and its floor is covered with a discharge in which septic micro-organisms undergo cultivation; in this way the ulcer becomes highly offensive. By the use of antiseptic lotions and a frequent change of dressings, however, all unpleasant smell can be checked or prevented. As the ulcer extends it is apt to implicate large blood-vessels, so that serious, and sometimes alarming, haemorrhages take place. And if the breast had previously been in pain, the bleeding is likely to give great relief. But repeated haemorrhages bring on increasing exhaustion, and thus materially hasten the end.

There is at present only one trustworthy treatment for cancer, and that is its free removal by operation. The entire breast and the nipple must be sacrificed. At the present day the operation itself is not a "dreadful" one. To be successful it must be very thorough, and it must be done *early*. The patient, being under an anaesthetic, feels nothing, and the subsequent dressings of the wound are attended with scarcely any pain. There need be but a couple of days of confinement to bed, and when the wound has soundly healed the patient may be encouraged to use her arm. Should there be recurrence of cancerous nodules in or about the wound, their removal should be promptly and widely effected. The writer has records of one case in which between the first operation and the last report there was a space of over twenty-nine years, and another of fifteen years. Each of these patients had one extensive operation, and four or five smaller operations for dealing with recurrences. Each of them, however, might be considered unlikely subjects for further return.

For a *superficial cancer* the X-rays may be of service, but many applications of the rays are likely to be needed, and the case may possibly refuse to yield to their influence, and, after loss of valuable time, the disease may have eventually to be removed by the knife. The great advantage which the treatment by the knife offers over every other method is that the growth can be cleanly, efficiently and promptly removed, and, with it, all the affected lymph-spaces, and the lymphatic glands which are secondarily implicated.

As regards the value of radium in the treatment of cancer of the breast, the high expectations which were somewhat widely associated with this newly-found element early in 1909 must be said to have been unjustified by any precise results. Injections of radium salts have been made into the substance of a cancer, and tubes of aluminium containing the salt have been introduced into the growth, but no deep cancer has thereby been cured. Radium has also been exposed again and again on the surface of the affected breast, but similarly with no great result. Unfortunately, whilst one is experimenting in the treatment of an operable cancer, the epithelial cells of the growth may be making their way towards distant parts, where no rays or emanations could possibly reach them. Whatever may be the future of radium as a therapeutic agent in the treatment of cancer of the breast, it is certain that, on the facts as known at the beginning of 1910, the only safe course is to remove the breast by direct operation, together with the associated lymph-spaces and lymphatic glands. And if this is done promptly and thoroughly cancer of the breast will come more and more into the class of curable diseases. (E. O.*)

MAMMEE APPLE, South American or St Domingo Apricot, the fruit of *Mammea americana* (natural order Clusiaceae), a large tree with opposite leathery gland-dotted leaves, white, sweet-scented, short-stalked, solitary or clustered axillary flowers and yellow fruit 3 to 6 in. in diameter. The bitter rind encloses a sweet aromatic flesh, which is eaten raw or steeped in wine or with sugar, and is also used for preserves. There are one to four large rough seeds, which are bitter and resinous, and used as anthelmintics. An aromatic liqueur distilled from the flowers is known as *eau de créole* in the West Indies, and the acrid resinous gum is used to destroy the chigoes which attack the naked feet of the negroes. The wood is durable and well adapted for building purposes; it is beautifully grained and used for fancy work.

MAMMON, a word of Aramaic origin meaning "riches." The etymology is doubtful; connexions with a word meaning "entrusted," or with the Hebrew *matmon*, treasure, have been suggested. "Mammon," Gr. *μαμωνᾶs* (see Professor Eb. Nestle in *Ency. Bib. s.v.*), occurs in the Sermon on the Mount (Matt. vi. 24) and the parable of the Unjust Steward (Luke xvi. 9–13). The Authorized Version keeps the Syriac word. Wycliffe uses "richessis." The *New English Dictionary* quotes *Piers Plowman* as containing the earliest personification of the name. Nicholaus de Lyra (commenting on the passage in Luke) says that *Mammon est nomen daemonis*. There is no trace, however, of any Syriac god of such a name, and the common identification of the name with a god of covetousness or avarice is chiefly due to Milton (*Paradise Lost*, i. 678).

MAMMOTH (O. Russ. *mammot*, mod. *mamant*; the Tatar word *mama*, earth, from which it is supposed to be derived, is not known to exist), a name given to an extinct elephant, *Elephas primigenius* of Blumenbach. Probably no extinct animal has left such abundant evidence of its former existence; immense numbers of bones, teeth, and more or less entire carcases, or "mummies," as they may be called, having been discovered, with the flesh, skin and hair *in situ*, in the frozen soil of the tundra of northern Siberia.

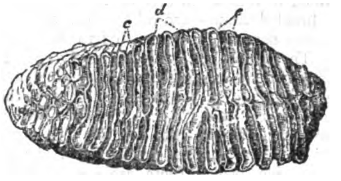
The general characteristics of the order Proboscidea, to which the mammoth belongs, are given under that heading. The mammoth pertains to the most highly specialized section of the group of elephants, which also contains the modern Asiatic species. Of the whole group it is in many respects, as in the size and form of the tusks and the characters of the molar teeth, the farthest removed from the mastodon type, while its nearest surviving relative, the Asiatic elephant (*E. maximus*), has retained the slightly more generalized characters of the mammoth's contemporaries of more southern climes, *E. columbi* of America and *E. armeniacus* of the Old World. The tusks, or upper incisor teeth, which were probably smaller in the female, in the adult males attained the length of from 9 to 10 ft. measured along the outer curve. Upon leaving the head they were directed at first downwards, and outwards, then upwards and finally inwards at the tips, and generally with a tendency to a spiral form not seen in other elephants.

It is chiefly by the characters of the molar teeth that the various extinct modifications of the elephant type are distinguished. Those of the mammoth (fig. 2) differ from the corresponding organs of allied species in great breadth of the crown as compared with the length, the narrowness and crowding or close approximation of the ridges, the thinness of the enamel, and its straightness, parallelism and absence of "crimping," as seen on the worn surface or in a horizontal section of the tooth. The molars, as in other elephants, are six in number on each side above and below, succeeding each other from before backwards. Of these Dr Falconer gave the prevailing "ridge-formula" (or number of complete ridges in each tooth) as 4, 8, 12, 12, 16, 24, as in *E. maximus*. Dr Leith-Adams, working from more abundant materials, has shown that the number of ridges of each tooth, especially those at the posterior end of the series, is subject to individual variation, ranging in each tooth of the series within the following limits: 3 to 4, 6 to 9, 9 to 12, 9 to 15, 14 to 16, 18 to 27—excluding the small plates, called "talons," at each end. Besides these variations in the number of ridges or plates of which each tooth is composed, the thickness of the enamel varies so much as to have given rise to a distinction between a "thick-plated" and a "thin-plated" variety—the latter being most prevalent among specimens from the Arctic regions. From the specimens with thick enamel plates the transition to the other species mentioned above, including *E. maximus*, is almost imperceptible.

The bones of the skeleton generally more resemble those of the Indian elephant than of any other species, but the skull differs in the narrower summit, narrower temporal fossae, and more prolonged incisive sheaths, supporting the roots of the enormous tusks. Among the external characters by which the mammoth was distinguished from either of the existing species of elephant was the dense clothing, not only of long, coarse outer hair, but also of close under woolly hair of a reddish-brown colour, evidently in adaptation to the cold climate it inhabited. This character is represented in rude but graphic drawings of prehistoric age found in caverns in the south of France. It should be added that young Asiatic elephants often show considerable traces of the woolly coat of the mammoth. The average height does not appear to have exceeded that of either of the existing species of elephant.

The geographical range of the mammoth was very extensive. There is scarcely a county in England in which its remains have not been found in alluvial gravel or in caverns, and numbers of its teeth are dredged in the North Sea. In Scotland and Ireland its remains are less abundant, and in Scandinavia and Finland they appear to be unknown; but they have been found in vast numbers at various localities throughout the greater part of central Europe (as far south as Santander and Rome), northern Asia, and the northern part of the American continent.

The mammoth belongs to the post-Tertiary or Pleistocene epoch and was contemporaneous with man. There is evidence to show that it existed in Britain before, during and after the glacial period. It is in northern Siberia that its remains have been found in the greatest abundance and in exceptional preservation. For a long period there has been from that region an export of mammoth-ivory, fit for commercial purposes, to China and to Europe. In the middle of the 10th century trade was carried on at Khiva in fossil ivory. Middendorff estimated the number of tusks which have yearly come into the market during the last two centuries at at least a hundred pairs, but Nordenskiöld considers this estimate too low. Tusks are found along the whole shore-line between the mouth of the Obi and Bering Strait, and the farther north the more numerous they become, the islands of New Siberia being one of the favourite collecting localities. The remains are found not only round the mouths of the great rivers, but embedded in the frozen soil in such circumstances as to indicate that the animals lived not far from the localities in which they are found; and they are exposed either by the melting of the ice in warm summers or the washing away of the sea-cliffs or river-banks. In this way the bodies of more or less nearly perfect animals, often standing in the erect position, with the soft parts and hairy covering entire, have been brought to light.

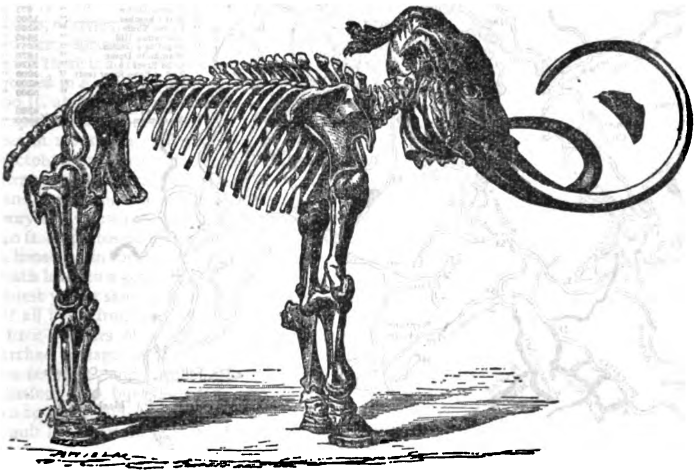


(From Owen.)

FIG. 2.—Grinding surface of Upper Molar Tooth of the Mammoth (*Elephas primigenius*). *c*, cement; *d*, dentine; *e*, enamel.

For geographical distribution and anatomical characters see Falconer's *Palaeontological Memoirs*, vol. ii. (1868); B. Dawkins, "*Elephas Primigenius*, its Range in Space and Time," *Quart. Journ. Geol. Soc.*, xxxv. 138 (1879); and A. Leith Adams, "Monograph of British Fossil Elephants," part ii., *Palaeontographical Society* (1879). (W. H. F.; R. L.*)

MAMMOTH CAVE, a cave in Edmondson county, Kentucky, U.S.A., 37° 14′ N. lat. and 86° 12′ W. long., by rail 85 m. S.S.W. of Louisville. Steamboats run from the mouth of the Green river, near Evansville, Indiana, to the Mammoth Cave landing. The cave is usually said to have been discovered, in 1809, by a hunter named Hutchins; but the county records, as early as 1797, fixed its entrance as the landmark for a piece of real estate. Its mouth is in a forest ravine, 194 ft. above Green river and 600 ft. above the sea. This aperture is not the original mouth, the latter being a chasm a quarter of a mile north of it, and leading into what is known as Dixon's cave. The two portions are not now connected, though persons in one can make themselves heard by those in the other.



(From Tilesius.)

FIG. 1.—Skeleton of Mammoth (*Elephas primigenius*), with portions of the skin.

The cavernous limestone of Kentucky covers an area of 8000 sq. m., is massive and homogeneous, and belongs to the Subcarboniferous period. It shows few traces of dynamic disturbance, but has been carved, mainly by erosion since the Miocene epoch, into many caverns, of which the Mammoth Cave is the largest.

The natural arch that admits one to Mammoth Cave has a span of 70 ft., and from a ledge above it a cascade leaps 59 ft. to the rocks below, where it disappears. A flight of stone steps leads the way down to a narrow passage, through which the air rushes with violence, outward in summer and inward in winter. The temperature of the cave is uniformly 54° F. throughout the year, and the atmosphere is both chemically and optically of singular purity. While the lower levels are moist from the large pools and rivers that have secret connexion with Green river, the upper galleries are extremely dry. These conditions led at one time to the erection of thirteen cottages at a point about 1 m. underground, for the use of invalids, especially consumptives. The experiment failed, and only two cottages now remain as curiosities.

The Main Cave, from 40 to 300 ft. wide and from 35 to 125 ft. high, has several vast rooms, *e.g.* the Rotunda, where are the ruins of the old saltpetre works; the Star Chamber, where the protrusion of white crystals through a coating of the black oxide of manganese creates an optical illusion of great beauty; the Chief City, where an area of 2 acres is covered by a vault 125 ft. high, and the floor is strewn with rocky fragments, among which are found numerous half-burnt torches made of canes, and other signs of prehistoric occupancy. Two skeletons were exhumed near the

Rotunda; but few other bones of any description have been found. The so-called Mammoth Cave ' mummies" (*i.e.* bodies kept by being inhumed in nitrous earth), with accompanying utensils, ornaments, braided sandals and other relics, were found in Short and Salt Caves near by, and removed to Mammoth Cave for exhibition. The Main Cave, which abruptly ends 4 m. from the entrance, is joined by winding passages, with spacious galleries on different levels; and, although the diameter of the area of the whole cavern is less than 10 m., the conbined length of all accessible avenues is supposed to be about 150 m.

The chief points of interest are arranged along two lines of exploration, besides which there are certain side excursions. The "short route" requires about four hours, and the "long route" nine. Audubon's Avenue, the one nearest the entrance, is occupied in winter by myriads of bats, that hang from the walls in clusters like swarms of bees. The Gothic Avenue contains numerous large stalactites and stalagmites, and an interesting place called the Chapel, and ends in a double dome and cascade. Among the most surprising features of cave scenery are the vertical shafts that pierce through all levels, from the uppermost galleries, or even from the sink-holes, down to the lowest floor. These are styled pits or domes, according to the position occupied by the observer. A crevice behind a block of stone, 40 ft. long by 20 ft. wide, called the Giant's Coffin, admits the explorer to a place where six pits, varying in depth from 65 ft. to 200 ft., exist in an area of 600 yds. This includes Gorin's Dome, which is viewed from a point midway in its side, and also from its top, and was formerly regarded as the finest room in the cavern. Others admire more the Mammoth Dome, at the termination of Spark's Avenue, where a cataract falls from a height of 150 ft. amid walls wonderfully draped with stalactitic tapestry. The Egyptian Temple, which is a continuation of the Mammoth Dome, contains six massive columns, two of them quite perfect and 80 ft. high and 25 ft. in diameter. The combined length of these contiguous chambers is 400 ft. By a crevice above they are connected with an arm of Audubon's Avenue. Lucy's Dome, one of the group of Jessup Domes, is supposed to be the loftiest of all these vertical shafts. A pit called the "Maelstrom," in Croghan's Hall, is the spot most remote from the mouth of the cave. There are some fine stalactites near this pit, and others in the Fairy Grotto and in Pensico Avenue; but, considering the magnitude of Mammoth Cave, its poverty of stalactitic ornamentation is remarkable. The wealth of crystals is, however, surprising, and these are of endless variety and fantastic beauty.

Cleveland's Cabinet and Marion's Avenue, each a mile long, are adorned by myriads of gypsum rosettes and curiously twisted crystals, called "oulopholites." These cave flowers are unfolded by pressure, as if a sheaf were forced through a tight binding, or the crystal fibres curl outward from the centre of the group. Thus spotless arches of 50 ft. span are embellished by floral clusters and garlands, hiding nearly every foot of the grey limestone. The botryoidal formations hanging by thousands in Mary's Vineyard resemble mimic clusters of grapes,

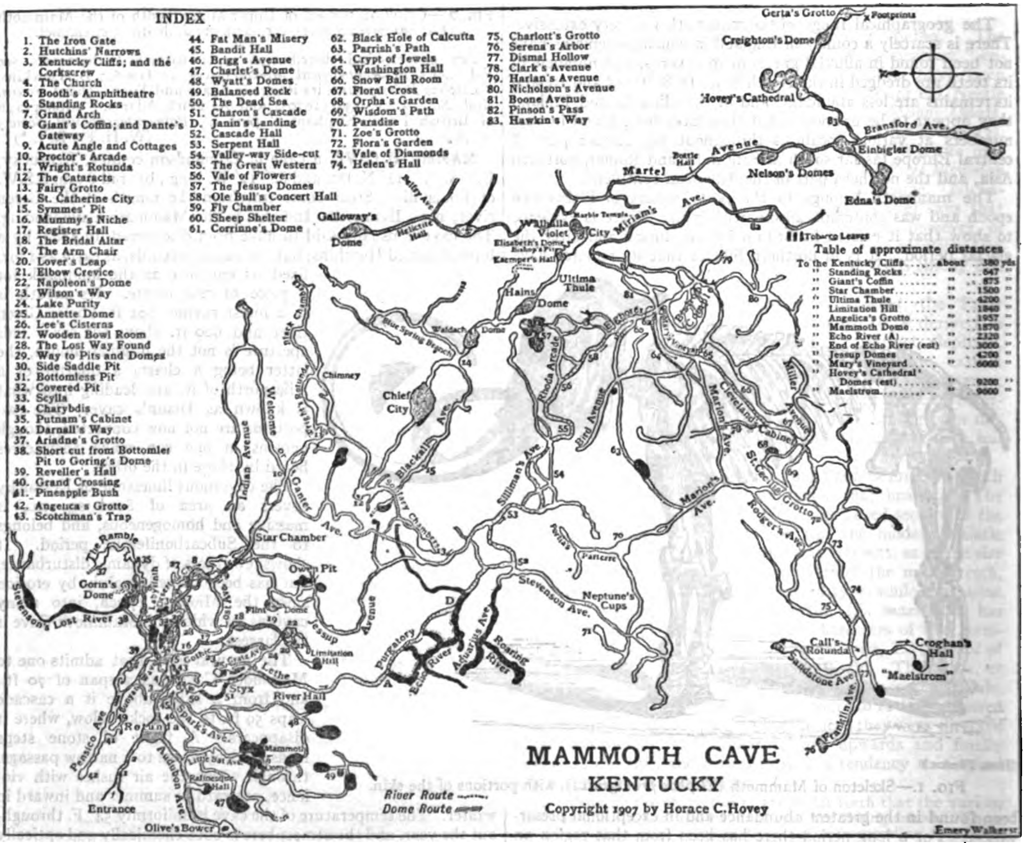


Table of approximate distances

To the Kentucky Cliffs	about	380	yds.
" Standing Rocks	"	647	"
" Giant's Coffin	"	875	"
" Star Chamber	"	1500	"
" Ultima Thule	"	4200	"
" Limitation Hill	"	1840	"
" Angelica's Grotto	"	1957	"
" Mammoth Dome	"	1870	"
" Echo River (A)	"	2320	"
" End of Echo River (est)	"	3000	"
" Jessup Domes	"	4700	"
" Mary's Vineyard	"	6000	"
" Hovey's Cathedral' Domes (est)	"	9200	"
" Maelstrom	"	9000	"

as the oulopholites resemble roses. Again, there are chambers with drifts of snowy crystals of the sulphate of magnesia, the ceilings so thickly covered with their efflorescence that a loud concussion will cause them to fall like flakes of snow.

Many small rooms and tortuous paths, where nothing of special interest can be found, are avoided as much as possible on the regular routes; but certain disagreeable experiences are inevitable. There is peril also in the vicinity of the deep pits. The one known as the Bottomless Pit was for many years a barrier to all further exploration, but it is now crossed by a wooden bridge. Long before the shaft had been cut as deep as now the water flowed away by a channel gradually contracting to a serpentine way, so extremely narrow as to be called the Fat Man's Misery. The walls, only 18 in. apart, change direction eight times in 105 yds., while the distance from the sandy path to the ledge overhead is but 5 ft. The rocky sides are finely marked with waves and ripples, as if running water had suddenly been petrified. This winding way conducts one to River Hall, beyond which lie the crystalline gardens that have been described. It used to be said that, if this narrow passage were blocked up, escape would be impossible; but an intricate web of fissures, called the Corkscrew, has been discovered, by means of which a good climber, ascending only a few hundred feet, lands 1000 yds. from the mouth of the cave, and cuts off one or two miles.

The waters, entering through numerous domes and pits, and falling, during the rainy season, in cascades of great volume, are finally collected in River Hall, where they form several extensive lakes, or rivers, whose connexion with Green River is known to be in deep springs appearing under arches on its margin. Whenever there is a freshet in Green River the streams in the cave are joined in a continuous body of water, the rise sometimes being 60 ft. above the low-water mark. The subsidence within is less rapid than the rise; and the streams are impassable for about seven months in each year. They are navigable from May to October, and furnish interesting features of cave scenery. The first approach is called the Dead Sea, embraced by cliffs 60 ft. high and 100 ft. long, above which a path has been made, whence a stairway leads down to the banks of the river Styx, a body of water 40 ft. long, crossed by a natural bridge. Lake Lethe comes next—a broad basin enclosed by walls 90 ft. high, below which a narrow path leads to a pontoon at the neck of the lake. A beach of the finest yellow sand extends for 500 yds. to Echo River, the largest of all being from 20 to 200 ft. wide, 10 to 40 ft. deep and about three-quarters of a mile long. It is crossed by boats. The arched passage-way is very symmetrical, varying in height from 19 to 35 ft., and famous for its musical reverberations—not a distinct echo, but an harmonious prolongation of sound for from 10 to 30 seconds after the original tone is produced. The long vault has a certain keynote of its own, which, when firmly struck, excites harmonics, including tones of incredible depth and sweetness.

There are several other streams here besides those in River Hall. On one of them F. J. Stevenson of London is said to have floated for seven hours without finding its end. A glance at the accompanying map will show that there is a labyrinth of avenues and chasms seldom visited and never fully explored. New discoveries are frequently made. An exploring party in 1904 found a curious complex of upper and lower galleries accessible from the most eastern portion of the cave; beyond which another party, in 1905, discovered several large domes previously unknown. H. C. Hovey, in 1907, was led by expert guides into still wilder recesses, where a series of five domes were found, that opened into each other by tall gateways; each dome being 60 ft. in diameter and 175 ft. high. This magnificent group has since been named "Hovey's Cathedral Domes." No instrumental survey of the Mammoth Cave has ever been allowed by the management. The best map possible is therefore only the result of estimates and partial measurements. The depths of the most noted pits have easily been ascertained by line and plummet and the height of several large domes has been found by the use of small balloons. While making a survey exclusively for the cave-owners in 1908, Max Kaemper of Berlin, Germany, forced an opening from the main cave into a remarkable region to which the general name of "Violet City" was given, in honour of Mrs Violet Blair Janin, who owned a third of the Mammoth Cave estate. Special features are Kaemper Hall, Blair Castle, the Marble Temple and Walhalla. There are eleven enormous pits, many large fine stalactites and stalagmites and surprisingly beautiful mural decorations. Dr Hovey made and published (1909) a new handbook embodying all known discoveries of importance, with four sketch-maps of the routes of usual exhibition.

The fauna of Mammoth Cave has been classified by F. W. Putnam, A. S. Packard and E. D. Cope, who have catalogued twenty-eight species truly subterraneous, besides those that may be regarded as stragglers from the surface. They are distributed thus: *Vertebrata*, 8 species; *Insecta*, 17; *Arachnida*, 12; *Myriapoda*, 2; *Crustacea*, 5; *Vermes*, 3; *Mollusca*, 1. Ehrenberg adds a list of 8 Polygastric *Infusoria*, 1 fossil infusorian, 5 *Phytolitharia* and several microscopic fungi. A bed of *Agaricus* was found by the writer near the river Styx; and upon this hint an attempt has been made to propagate edible fungi in this locality. All the known forms of plant-life are either fungi or allied to them, and many are only microscopic. The most interesting inhabitants of Mammoth Cave are the blind, wingless grasshoppers, with extremely long antennae; blind, colourless crayfish (*Cambarus pellucidus*, Telk.); and the blind fish, *Amblyopsis spelaeus*, colourless and viviparous, from 1 in. to 6 in. long. The *Cambarus* and *Amblyopsis* have wide distribution, being found in many other caves, and also in deep wells, in Kentucky and Indiana. Fish not blind are occasionally caught, which are apparently identical with species existing in streams outside. The true subterranean fauna may be regarded as chiefly of Pleistocene origin; yet certain forms are possibly remnants of Tertiary life.

BIBLIOGRAPHY.—*Plan and Description of the Great and Wonderful Cave in Kentucky*, by Dr Nahum Ward (1816); *Notes on the Mammoth Cave, with a Map*, by Edmund F. Lee, C.E. (1835); *Rambles in the Mammoth Cave in 1844*, by Alexander Bullitt, with map by Stephen Bishop; guide-books by Wright (1858), Binkerd (1869), Forwood (1875), Proctor (1878), Hovey (1882), &c., and Hovey and Call (1897); Hovey's *Celebrated American Caverns* (1882, &c.); and *The Mammoth Cave and its Inhabitants*, by Packard and F. W. Putnam (1879). (H. C. H.)

MAMORÉ, a large river of Bolivia which unites with the Beni in 10° 20′ S. to form the Madeira, one of the largest tributaries of the Amazon. It rises on the northern slope of the Sierra de Cochabamba east of the city of Cochabamba, and is known as the Chimoré down to its junction with the Chapare, or Chapari. Its larger tributaries are the Chapare, Sécure, Apere and Yacuma from the west, and the Ichila, Guapay or Grande, Ivari and Guaporé from the east. Taking into account its length only, the Guapay should be considered the upper part of the Mamoré; but it is shallow and obstructed, and carries a much smaller volume of water. The Guaporé, or Itenez, also rivals the Mamoré in length and volume, having its source in the Serra dos Parecis, Matto Grosso, Brazil, a few miles from streams flowing northward to the Tapajos and Amazon, and southward to the Paraguay and Paraná. The Mamoré is interrupted by rapids a few miles above its junction with the Beni, but a railway 180 m. long has been undertaken from below the rapids of the Madeira. Above the rapids the river is navigable to Chimoré, at the foot of the *sierra*, and most of its tributaries are navigable for long distances. Franz Keller (in *The Amazon and Madeira Rivers*; New York, 1874) gives the outflow of the Mamoré at mean water level, and not including the Guaporé, as 2530 cub. in. per second, and the area of its drainage basin, also not including the Guaporé, as 9382 sq. m.

See Edward D. Mathews, *Up the Amazon and Madeira Rivers* (London, 1879).

MAMUN (*c.* 786–833), originally ABDALLAH, surnamed AL-MA'MŪN ("in whom men trust"), the seventh of the Abbasid caliphs of Bagdad, was born about A.D. 786, and was the second son of Harun al-Rashid. By Harun's will he was successor-designate to his brother Amin, during whose reign he was to be governor of the eastern part of the empire. On Harun's death (809) Amin succeeded and Mamun acquiesced. Irritated, however, by the treatment he received from Amin, and supported by a portion of the army, Mamun speedily rebelled. A five years' struggle between the two brothers ended in the death of Amin and the proclamation of Mamun as caliph at Bagdad (Sept. 813). Various factions and revolts, which disturbed the first years of his reign, were readily quelled by his prudent and energetic measures. But a much more serious rebellion, stirred up by his countenancing the heretical sect of Ali and adopting their colours, soon after threatened his throne. His crown was actually on the head of his uncle Ibrahim b. Mahdi (surnamed Mobarek) for a short time (Barbier de Meynard, in *Journal Asiatique*, March–April 1869). This inaugurated a period of tranquillity, which Mamun employed in fostering literature and science. He had already, while governor of Khorasan, founded a college there, and attracted to it the most eminent men of the day, and Bagdad became the seat of academical instruction. At his own expense he caused to be translated into Arabic many valuable books from the Greek, Persian, Chaldean and Coptic languages; and he was himself an ardent student of mathematics and astronomy. The first Arabic translation of Euclid was dedicated to him in 813. Mamun founded observatories at Bagdad and Kassiun (near Damascus), and succeeded in determining the inclination of the ecliptic. He also caused a degree of the meridian to be measured on the plain of Shinar; and he constructed astronomical tables, which are said to be wonderfully accurate.

In 827 he was converted to the heterodox faith of the Moʻtazilites, who asserted the free-will of man and denied the eternity of the Koran. The later years (829–830) of his reign were distracted by hostilities with the Greek emperor Theophilus, while a series of revolts in different parts of the Arabian empire betokened the decline of the military glory of the caliphs. Spain and part of Africa had already asserted their independence, and Egypt and Syria were now inclined to follow. In 833, after quelling Egypt, at least nominally, Mamun marched into Cilicia to prosecute the war with the Greeks, but died near Tarsus, leaving his crown to a younger brother, Motasim. The death of Mamun ended an important epoch in the history of science and letters and the period of Arabian prosperity which his father's reign had begun.

See further under CALIPHATE, sect. C., §§ 5, 6, 7.

MAMUND, a Pathan tribe and valley on the Peshawar border of the North-West Frontier Province of India. The Mamunds live partly in Bajour and partly in Afghan territory, due north of the Mohmands, a much larger tribe, with whom they must not be confounded. They are one of the clans of the Tarkanis (*q.v.*), and number 6000 fighting men; they gave much trouble during the Chitral Campaign in 1895, and again during the Mohmand Expedition in 1897 they inflicted severe losses upon General Jeffrey's brigade. (See MOHMAND.)

MAN, the word common to Teutonic languages for a single person of the human race, of either sex, the Lat. *homo*, and Gr. ἄνθρωπος; also for the human race collectively, and for a full-grown adult male human being. Teutonic languages, other than English, have usually adopted a derivative in the first sense, *e.g.* German *Mensch*. Philologists are not in agreement as to whether the Sanskrit *manu* is the direct source, or whether both are to be traced to a common root. Doubt also is thrown on the theory that the word is to be referred to the Indo-Germanic root, *men*, meaning "to think," seen in "mind," man being essentially the thinking or intelligent animal. (See ANTHROPOLOGY.)

MAN, ISLE OF (anc. *Mona*), a dominion of the crown of England, in the Irish Sea. (For map, see ENGLAND, section I.) It is about 33 m. long by about 12 broad in the broadest part. Its general form resembles that of an heraldic lozenge, though its outline is very irregular, being indented with numerous bays and narrow creeks. Its chief physical characteristic is the close juxtaposition of mountain, glen and sea, which has produced a variety and beauty of scenery unsurpassed in any area of equal size elsewhere.

The greater part of its surface is hilly. The hills, which reach their culminating point in Snaefell (2034 ft.), have a definite tendency to trend in the direction of the longer axis, but throw out many radiating spurs, which frequently extend to the coast-line. They are, for the most part, smooth and rounded in outline, the rocks being such as do not favour the formation of crags, though, owing to the rapidity of their descent, streams have frequently rent steep-walled craggy gulleys in their sides. The strength of the prevalent westerly winds has caused them to be treeless, except in some of the lower slopes, but they are clad with verdure to their summits. Rising almost directly from the sea, they appear higher than they really are, and therefore present a much more imposing appearance than many hills of greater altitude. On the south-west, where they descend precipitously into the sea, they unite with the cliffs to the north and south of them to produce the most striking part of the coast scenery for which the isle is remarkable. But, indeed, the whole coast from Peel round by the Calf, past Castletown and Douglas to Maughold Head, near Ramsey, is distinguished by rugged grandeur. From Ramsey round by the Point of Ayre to within a few miles of Peel extend low sandy cliffs, bordered by flat sandy shores, which surround the northern plain. This plain is relieved only by a low range of hills, the highest of which attains an elevation of 270 ft. The drainage of the island radiates from the neighbourhood of Snaefell, from which mountain and its spurs streams have on all sides found their way to the sea. The most important of these are the Sulby, falling into the sea at Ramsey; the *Awin-glass* (bright river) and the *Awin-dhoo* (dark river), which unite their waters near Douglas; the *Neb*, at the mouth of which Peel is situated; and the *Awin-argid* (silver river, now called the Silverburn), which joins the sea at Castletown. There are no lakes. The narrow, winding glens thus formed, which are studded with clumps of fir, sycamore and mountain ash, interspersed with patches of gorse, heather and fern, afford a striking and beautiful contrast to the bare mountain tops. Traces of an older system of drainage than that which now exists are noticeable in many places, the most remarkable being the central depression between Douglas and Peel. The chief bays are, on the east coast, Ramsey, with an excellent anchorage, Laxey, Douglas, Derbyhaven, Castletown and Port St Mary; and, on the west coast, Port Erin and Peel.

Geology.—The predominant feature in the stratigraphy of the Isle of Man is, in the words of G. W. Lamplough,[1] "the central ridge of slate and greywacke, which seems to have constituted an insulated tract at as early a date as the beginning of the Carboniferous period. This prototype of the present island appears afterwards to have been enfolded and obliterated by the sediments of later times; but with the progress of denudation the old ridge has once more emerged from beneath this mantle." This mass of ancient rocks, the Manx Slate Series, has been divided locally into the Barrule slates, the Agneesh and other grit beds; and the Lonan and Niarbyl Flags. The whole series strikes N.E.–S.W., while structurally the strata form part of a synclinorium, the higher beds being on the N.W. and S.E. sides of the islands, the lower beds in the interior; although the subordinate dips appear to indicate an anticlinal structure. These rocks have been greatly crumpled; and in places, notably in Sully Glen, thrusting has developed a well-marked crush-breccia. So much has this folding and compression toughened the soft argillaceous rocks that the Barrule Slate, for example, is almost everywhere found occupying the highest points, while the hard but more joined grits and flags occupy the lower ground on the mountain flanks. The Manx Series is penetrated and altered by large masses of granite at Dhoon, Foxdale and one or two other spots; and dykes, more or less directly associated with these masses, are numerous. No satisfactory fossils have yet been obtained from these rocks, but they are regarded, provisionally, as of Upper Cambrian age. Carboniferous rocks, including a basal conglomerate, white limestone with abundant fossils, and the black "Posidonomya Beds" (some of which are polished as a black marble) occur about Castletown, Poolvash Bay and Langness; and the basement beds appear again on the west coast at Peel. The cliffs and foreshore at Scarlet Point exhibit contemporaneous Carboniferous tuffs, agglomerates and basalts, as well as later dolerite dykes, in a most striking manner. Here too may be seen some curious effects of thrusting in the limestones. At the northern end of the island the Manx Slates end abruptly in an ancient sea-cliff which crosses between Ramsey and Ballaugh. The low-lying country beyond is formed of a thick mass of glacial sands, gravels and boulder clay. In the Bride Hills are to be seen glacial mounds rising 150 ft. above the level of the plain. The depressions known as the Curragh, now drained but still peaty in places, probably represent the sites of late glacial lakes. Glacial deposits are found also in all parts of the island. Beneath the thick drift of the plain, Carboniferous, Permian and Trassic rocks have been proved to lie at some depth below the present sea-level. On the coast near the Point of Ayr is a raised beach. Silver-bearing lead ore, zinc and copper are the principal minerals found in the Isle of Man; the most important mining centres being at Foxdale and Laxey.

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[1] G. W. Lamplough, *The Geology of the Isle of Man*, Mem. Geol. Survey (1903).

Climate.—The island is liable to heavy gales from the south-west. Of this the trend of the branches of the trees to the north-east is a striking testimony. But it is equally subject to the influence of the warm drift from the Atlantic, so that its winters are mild, and, influenced by the less changeable temperature of the sea, its summers cool. The mean annual temperature is 49°·0 F., the temperature of the coldest month (January) being 41°·5, and the warmest (August) 58°·5, giving an extreme annual range of temperature of 17°·1 only, while the average temperature in spring is 46°·0, in summer 57°·2, in autumn 50°·9 and in winter 42°·0. Further evidence of the mildness of the climate is afforded by the fact that fuchsias, hydrangeas, myrtles and escallonias grow luxuriantly in the open air. Its rainfall, placed as it is between mountain districts in England, Ireland, Scotland and Wales, is naturally rather wet than dry. Statistics, however, reveal remarkable divergencies in the amounts of rain in the different parts of the island, varying from 61 in. at Snaefell to 25 in. at the Calf of Man. In the more populous districts it varies from 46 in. at Ramsey, and 45 in. at Douglas, to 38 in. at Peel and 34 in. at Castletown. Of sunshine the Isle of Man has a larger share than any portion of the United Kingdom except the south and south-east coasts and the Channel Islands. Briefly, then, the climate of the island may be pronounced to be equable and sunny, and, though humid, decidedly invigorating; its rainfall, though it varies greatly, is excessive in the populous districts; and its winds are strong and frequent, and usually mild and damp.

Fauna.—Like Ireland, the Isle of Man is exempt from snakes and toads, a circumstance traditionally attributed to the agency of St Patrick, the patron saint of both islands. Frogs, however, have been introduced from Ireland, and both the sand lizard and the common lizard are found. Badgers, moles, squirrels and voles are absent and foxes are extinct. Fossil bones of the Irish elk are frequently found, and a complete skeleton of this animal is to be seen at Castle Rushen. The red deer, which is referred to in the ancient laws and pictured on the runic crosses, became extinct by the beginning of the 18th century. Hares are less plentiful than formerly, and rabbits are not very numerous. Snipe are fairly common, and there are a few partridges and grouse. The latter, which had become extinct, were reintroduced in 1880. Woodcock, wild geese, wild ducks, plover, widgeon, teal, heron, bittern, kingfishers and the Manx shearwater (*Puffinus anglorum*) visit the island, but do not breed there. The puffin (*Fratercula artica*) is still numerous on the Calf islet in the summer time. The peregrine falcon, which breeds on the rocky coast, and the chough have become very scarce. The legal protection of sea-birds (local act of 1867) has led to an enormous increase in the number of gulls. A variety of the domestic cat, remarkable for the absence or stunted condition of the tail, is peculiar to the island.

Flora.—Like the fauna, the flora is chiefly remarkable for its meagreness. It contains at most 450 species as compared with 690 in Jersey. Alpine forms are absent. But what it lacks in variety it makes up in beauty and quantity. For the profusion of the gorse-bloom and the abundance of spring flowers, especially of primroses, and of ferns, the Isle of Man is probably unrivalled.

People.—The Manx people of the present day are mainly of Scandio-Celtic origin, with some slight traces of earlier races. They have large and broad heads, usually broader than those of their brother Celts (*Goidels*) in Ireland and Scotland, with very broad, but not specially prominent cheek-bones. Their faces are usually either scutiform, like those of the Northmen, or oval, which is the usual Celtic type, and their noses are almost always of good length, and straighter than is general among Celtic races. Light eyes and fair complexion, with rather dark hair, are the more usual combinations. They are usually rather tall and heavily built, their average height (males) being 5 ft. 7½ in., and average weight (naked) 155 lb. The tendency of the population to increase is balanced by emigration. It reached its maximum in 1891. Since then it has slightly declined. A noticeable feature is its greater proportionate growth in the towns, especially in Douglas, than in the country. The country population reached its maximum in 1851. Since then it has been shrinking rapidly, especially in the northern district.

Sheadings, Parishes and Towns.		1726.	1821.	1871.	1901.
Rushen.	Malew (P.)	890	2,649	2,466	2,113
	Castletown (T.)	785	2,036	2,318	1,963
	Arbory (P.)	661	1,455	1,350	802
	Rushen (P.)	813	2,568	3,665	3,277
Middle.	Santon (P.)	376	800	628	468
	Braddan (P.)	780	1,754	2,215	2,177
	Douglas (T.)	810	6,054	13,846	19,149
	Onchan (P.)	370	1,457	1,620	3,942
Glenfalea.	Marown (P.)	499	1,201	1,121	973
	German (P.)	510	1,849	1,762	1,230
	Peel (T.)	475	1,909	3,496	3,306
	Patrick (P.)	745	2,031	2,888	1,925
Garff.	Lonan (P.)	547	1,846	3,741	2,513
	Maughold (P.)	529	1,514	1,433	887
	Ramsey (T.)	460	1,523	3,861	4,672
Ayre.	Lezayre (P.)	1,309	2,209	1,620	1,389
	Bride (P.)	612	1,001	880	539
	Andreas (P.)	967	2,229	1,757	1,144
Michael.	Jurby (P.)	483	1,108	788	504
	Ballaugh (P.)	806	1,467	1,077	712
	Michael (P.)	643	1,427	1,231	928
Total		14,070	40,087	53,763	54,613

Chief Political Divisions and Towns.—The island is divided into six sheadings (so named from the Scandinavian *skeða-þing*, or ship-district), called Glenfaba, Middle, Rushen, Garff, Ayre and Michael, each of which has its officer, the coroner, whose functions are similar to those of a sheriff; and there are seventeen parishes. For the towns see CASTLETOWN, DOUGLAS, PEEL and RAMSEY. The principal villages are Ballasalla, Ballaugh, Foxdale, Laxey, Michael, Onchan, Port Erin and Port St Mary.

Communications.—There is communication by steamer with Liverpool, Glasgow, Greenock, Belfast, Silloth, Whitehaven, Belfast and Dublin throughout the year and, during the summer season, there are also steamers plying to Androssan, Heysham, Fleetwood and Blackpool. A daily mail was established in 1879. The internal communications are excellent. The roads are under the management of a board appointed by the Tynwald Court, a surveyor-general, and parochial surveyors. They are maintained by a system of licences on public-houses, carriages, carts and dogs, and a rate on real property. There are railways between Douglas, Ramsey, Peel, Castletown, Port Erin and Port St Mary, the line between Douglas and Ramsey being via St John's and Michael. Electric tramways run from Douglas to Ramsey via Laxey, from Douglas to Port Soderick, and from Laxey to the summit of Snaefell.

Industries. (*a*) *Agriculture.*—The position of the Manx farmers, though they generally pay higher rents than their compeers in those countries do, is, except in the remote parts of the island, more favourable than that of the English or Scottish farmers. The best land is in the north and south. The farms are principally held on lease and small holdings have almost entirely disappeared. The cultivated area is about 93,000 acres, or 65% of the whole. The commons and uncultivated lands on the mountains are also utilized for pasturage. Oats occupy about three-fourths of the area under corn crops, barley about one-sixth. The amount of wheat and other corn crops is very trifling. Neither Manx wheat nor barley is as good on an average as English; but oats is, on the whole, fully equal to what is grown on the mainland. Turnips, which are an excellent crop, are largely exported, and the dry and sandy soil of the north of the island is very favourable for the growth of potatoes. The white and red clover and the common grasses grow luxuriantly, and the pasturage is, generally speaking, good. Some of the low-lying land, especially in the north, is much in need of systematic drainage. The livestock, largely in consequence of the premiums given by the insular government and the local agricultural society to bulls, heavy and light stallions and cart mares, now approximates very closely in quality to the stock in the north of England. Dairying, owing to the large number of summer visitors, is the most profitable department of agricultural industry. Apples, pears and wall fruit do not succeed very well, but the soil is favourable for the cultivation of strawberries, raspberries, gooseberries, currants and vegetables. Both agricultural and market-garden produce are quite insufficient to supply the demand in the summer.

(*b*) *Fishing.*—The important place which the fishing industry anciently held in the social organization of the Isle of Man is quaintly reflected in the wording of the oath formerly taken by the deemsters, who promised to execute the laws between the sovereign and his subjects, and "betwixt party and party, as indifferently as the herring backbone doth lie in the midst of the fish." The statutes and records abound in evidence of the great extent to which both the people and their rulers were dependent on the produce of the sea. The most numerous fish are herrings, cod, mackerel, ling, haddock, plaice, sole, fluke, turbot and brett. The industry is, however, in a decaying condition, especially the herring fishery, which, for reasons which have not been satisfactorily ascertained, fails periodically. The amount of fish caught, except herrings, is not sufficient to supply the local demand in the summer, though some of the fish named are exported during the rest of the year. About 250 vessels, aggregating 4260 tons, with crews numbering 4250, are employed in this industry. A fish hatchery has been established at Port Erin by the insular government.

(*c*) *Mining.*—There is no doubt that, in proportion to its area, the metalliferous wealth of the Isle of Man has been very considerable. Two of its mines, Laxey and Foxdale, have stood for a long series of years in the first rank in the British Islands for productiveness of zinc and silver lead respectively. These metals have constituted its principal riches, but copper pyrites and hematite iron have also been raised in marketable quantities, while only very small amounts of the ores of nickel and antimony have been found. The mines are rented from the Crown as lord of the manor. The value of the ore produced is about £40,000 annually. Other economic products are clay, granite, limestone, sandstone, slate (of an inferior quality) and salt, which has been discovered near the Point of Ayre.

(*d*) *Textiles, &c.*—Since labour has become scarcer and dearer textile industries have been declining, being unable to compete with larger and more completely organized manufactories elsewhere. The principal manufactured articles are woollen cloths and blankets, hemp ropes and cotton, and herring nets. A few fishing vessels are built, and brewing is a prosperous industry. But, apart from agriculture, the most important industry (for so it may be called) is that of the provision for summer visitors, nearly half a million of whom come to the island annually.

Commerce.—The chief exports are lead, zinc, turnips, ropes, cotton nets and salt. The imports consist chiefly of timber, provisions, live-stock, poultry, flour, fruit, vegetables and eggs. In 1906 the tonnage of vessels (other than fishing or wind-bound vessels) cleared for traffic was 720,790. The number of vessels (other than fishing vessels) registered as belonging to the island in 1906 was 79.

Government.—The government of the island is vested in a lieutenant-governor, appointed by the Crown; in a Council, which is the upper branch of the legislature; in the House of Keys, which is the lower branch; and in the Tynwald Court. The Council and Keys sit separately as legislative bodies, but they sit in the Tynwald Court as distinct bodies with co-ordinate powers to transact executive business and to sign Bills. The Tynwald Court controls the surplus revenue, after the payment of the cost of government and of a fixed contribution of £10,000 to the imperial exchequer, subject to the supervision of the Treasury and the veto of the lieutenant-governor, and it appoints boards to manage the harbours, highways, education, local government, and lunatic and poor asylums. The Imperial government, after intimating its intention to Tynwald, fixes the rates of the customs duties, but Tynwald can by resolution "impose, abolish or vary" the customs duties subject to the approval of parliament or the Treasury, such change to take effect immediately and to continue for six months, and, if parliament be then sitting, to the end of the session, provided that the same be not in the meantime annulled by the passing of an act of parliament, or a Treasury minute. The approval of the sovereign of the United Kingdom in Council is essential to every legislative enactment. Acts of the imperial parliament do not affect the island except it be specially named in them. The lieutenant-governor, who is the representative of the sovereign, presides in the Council, in the Tynwald Court, in the High Court of Justice (Staff of Government division) and in the Court of General Gaol Delivery. He is the supreme executive authority, and he shares the control of the legislative and administrative functions, including the management of the revenue and the control of its surplus, with the Tynwald Court; he has also the power of veto as regards the disposal of surplus revenue and the nature of proposed harbour works, and his signature is necessary to the validity of all acts. It has been the practice for him to act as chancellor of the exchequer and to initiate all questions concerning the raising or expenditure of public funds. The Council consists of the lieutenant-governor, the lord-bishop of the diocese, the clerk of the rolls, the two deemsters, the attorney-general, the archdeacon (all of whom are appointed by the Crown) and the vicar-general, who is appointed by the bishop. No act of the governor and Council is valid unless it is the act of the governor and at least two members of the Council. The House of Keys (for origin of the name see KEY) is one of the most ancient legislative assemblies in the world. It consists of twenty-four members, elected by male and female owners or occupiers of property. Each of the six sheadings elects three members; the towns of Castletown, Peel and Ramsey one each, and Douglas five. There is no property qualification required of the members, and the house sits for five years unless previously dissolved by the lieutenant-governor.

Law.—The High Court of Justice, of which the lieutenant-governor is president, contains three divisions: viz. the Chancery Division, in which the clerk of the rolls sits as judge, the Common Law Division, of which the deemsters are the judges, the Staff of Government Division, in which the governor and three judges sit together. The jurisdiction of the Chancery and Common Law Division is in the main similar to that of the corresponding divisions in the English Courts. The Staff of Government exercises appellate jurisdiction, similar to that of the Appeal Courts in England. The Common Law Courts for the southern division of the island are held at Douglas and Castletown alternately and those for the northern division at Ramsey, once in three months. Actions in these courts are heard by a deemster and a special or common jury. The Chancery Court sits once a fortnight at Douglas. The deemsters also have summary jurisdiction in matters of debt, actions for liquidated damages under £50, suits for possession of real or personal property, petitions for probate, &c. These courts, called Deemsters' Courts, are held weekly, alternately at Douglas and Castletown, by the deemster for the southern division of the island, and at Ramsey and Peel by the deemster for the northern division. Criminal cases are heard by the magistrates or a high-bailiff and are (with the exception of minor cases which may be dealt with summarily) sent on by them for trial by a deemster and a jury of six, who hear the evidence and determine whether there is sufficient ground for sending the case for trial before the Court of General Gaol Delivery, thus discharging the functions of the Grand Jury in England. The Court of General Gaol Delivery is the Supreme Criminal Court and is presided over by the lieutenant-governor, who is assisted by the clerk of the rolls and the two deemsters. The high-bailiffs hold weekly courts in the four towns for the recovery of debts under forty shillings and for the trial of cases usually brought before a stipendiary magistrate in England. The magistrates (J.P.'s) also hold regular courts in the towns for the trial of breaches of the peace and minor offences. There is a coroner in each of the six sheadings. These officers are appointed annually by the lieutenant-governor and perform duties similar to those of a sheriff's officer in England. Inquests of death are held by a high-bailiff and jury. The Manx Bar is distinct from that of England. Its members, called "Advocates," combine the functions of barrister and solicitor. The laws relating to real property still retain much of their ancient peculiarity, but other branches of law have of late years by various acts of Tynwald been made practically identical with English law.

As regards real property the general tenure is a customary freehold devolving from each possessor to his next heir-at-law. The descent of land follows the same rules as the descent of the crown of England. The right of primogeniture extends to females in default of males in the direct line. The interest of a widow or widower, being the first wife or husband of a person deceased, is a life estate in one-half of the lands which have descended hereditarily, and is forfeited by a second marriage; a second husband or second wife is only entitled to a life interest in one-fourth, if there be issue of the first marriage. Of the land purchased by the husband the wife surviving him is entitled to a life interest in one moiety. By a statute of the year 1777 proprietors of land are empowered to grant leases for any term not exceeding twenty-one years in possession without the consent of the wife.

Church.—It is not known by whom Christianity was introduced into Man, but from the large proportion of names of Irish ecclesiastics surviving in the appellations of the old Manx *keeills*, or cells, which are of similar type to the Irish oratories of the 6th and 7th centuries, and in the dedications of the parish churches, which are usually on ancient sites, it may be reasonably conjectured that Manxmen were, for the most part, Christianized by Irish missionaries. During the incursions of the pagan Vikings Christianity was almost certainly extirpated and it was probably not reintroduced before the beginning of the 11th century. The two most important events in the history of the medieval Manx Church were the formation of the diocese of *Sodor* (*q.v.*) and the foundation of the abbey of Rushen, a branch of the Cistercian abbey of Furness, in 1134. This latter event was important because the Cistercians were exempted from all episcopal visitation and control, by charter granted by the pope, and were, therefore, only subject to his rule and that of the abbots of their own order. From this time till the Reformation we find that there was an almost continuous struggle between the laity and the spiritual barons and monks, who had obtained great power and much property in the island. In 1458 the diocese was placed under York. The dissolution of the religious houses in Man was not brought about by the English Act of 1539, which did not apply to the island, but by the arbitrary action of Henry VIII. From such evidence as is available it would seem that the Reformation was a very slow process. When Isaac Barrow (uncle of his well-known namesake) became bishop in 1663 the condition of the Church was deplorable, but under him and his able and saintly successors, Thomas

Wilson (1698–1755) and Mark Hildesley (1755–1773), it attained to a very much higher level than the English Church during the same period. After Hildesley's time it was again neglected, and successful missions by John Wesley and others resulted in the establishment and rapid increase of Nonconformity. It was not till the second decade of the 19th century that the condition of the Church began to improve again, and this improvement has steadily continued. In 1878 a Sodor and Man theological school was established for the training of candidates for holy orders. This school has been affiliated to Durham University. In 1880 four rural deaneries were established, and commissioners were constituted as trustees of endowments for Church purposes. In 1895 a cathedral chapter, with four canons, was constituted under the name of the "Dean and Chapter of Man," the bishop being the dean of the cathedral church. A Church Sustentation Fund was established by Bishop Straton in 1894, with a view to supplementing the incomes of the clergy, which had been greatly reduced on account of the low price of corn. There have been several acts giving Nonconformists equal rights with Churchmen. Among these are the Burials Acts of 1881 and 1895, which permit burials to take place in churchyards without the rites of the Church of England, and allow any burial service, provided it be Christian, in mortuary chapels. At the present day Nonconformists, chiefly Wesleyan Methodists, probably outnumber Churchmen, and there is a small number of Roman Catholics and Presbyterians. The bishop, who has a seat, but not a vote, in the House of Lords, is assisted by an archdeacon, a vicar-general, a registrar and a sumner-general. The jurisdiction of the only remaining ecclesiastical court, which is presided over by the vicar-general, as representing the bishop, is mainly in connexion with affiliation questions, the swearing-in of churchwardens and the granting of faculties. The power of the Manx Convocation to make canons, though not exercised since 1704, has never been abrogated, and so far affords a token that the Manx Church is a separate national Church governed by its own laws, which, however, must be approved by the insular Legislature.

Education.—It was not till 1872, when the insular Legislature passed the Public Elementary Education Act, that the Manx State undertook any direct responsibility for education. This act differed from the English Act of 1870 in three important particulars: (1) it at once constituted every town and parish a school district under a school board; (2) the attendance of children was made compulsory; and (3) every elementary school, those in connexion with the Church of Rome excepted, was obliged to provide for non-sectarian instruction in religious subjects, and for the reading of the Bible accompanied by suitable explanation. Since the date of this act education has made extraordinary strides. It became free in 1892, and a higher-grade school was established in Douglas in 1894. The public elementary schools, which are nearly all managed by School Boards, are subject to the control of a local "Council of Education" appointed by the Tynwald Court; but, as the Manx Act of 1872 requires that, in order to obtain a government grant, the schools shall fulfil the conditions contained in the minutes of the education department at Whitehall, they are examined by English inspectors and compelled to attain the same standard of efficiency as the English and Welsh schools. In 1907 an act establishing a system of secondary education was passed by the Legislature. The total number of public elementary schools in 1906 was 47, 42 being board and 5 denominational. Besides King William's College, opened in 1833, which provided a similar education to that obtainable at the English public schools, there are grammar schools in Douglas, Ramsey and Castletown.

The Manx language (see CELT: *Language*) still lingers, the census of 1901 showing that there were about 4400 people who understood something of it. There is now no one who does not speak English.

Economics.—Municipal government was established in 1860, and in 1876 vaccination was made compulsory, as also was the registration of births, marriages and deaths in 1878. It was not till 1884 that the sanitation of the towns was seriously taken in hand; but ten years more elapsed before the sanitary condition of the island was dealt with by the passing of an act which constituted parish and village districts, with commissioners elected by the people, who had, in conjunction with a board elected by the Tynwald Court and an inspector appointed by it, to attend to all questions relating to sanitation and infectious diseases. As a result of these measures the death-rate has been greatly reduced. In 1888 a permissive poor law was established; it has been adopted by all the towns except Peel and by seven of the seventeen country parishes. Before this date the poor had been dependent on voluntary relief, which broke down owing to the growth of a temporarily employed class occupied in administering to the wants of the summer visitors. The total number of persons in receipt of poor relief averages about 920, and that of lunatics about 212. The average number of births during the five years 1902–1906 was 21·6, of marriages 6·1, and of deaths 17·6 per thousand. The rateable annual value of the parishes, towns and villages is about £400,000. The revenue for the year ending the 31st of March 1907 was £86,365, and the expenditure £75,728. The largest revenue raised was £91,193 in 1901, and the debt reached its maximum amount, £219,531, in 1894.

History.—The history of the Isle of Man falls naturally into three periods. In the first of these the island was inhabited by a Celtic people. The next is marked by the Viking invasions and the establishment of Scandinavian rule. The third period is that of the English dominion. The secular history of the Isle of Man during the Celtic period is an absolute blank, there being no trustworthy record of any event whatever before the incursions of the Northmen, since the exploits attributed to Baetan MacCairill, king of Ulster, at the end of the 6th century, which were formally supposed to have been performed in the Isle of Man, really occurred in the country between the Firths of Clyde and Forth. And it is clear that, even if the supposed conquest of the Menavian islands—Man and Anglesey—by Edwin of Northumbria, in 616, did take place, it could not have led to any permanent results; for, when the English were driven from the coasts of Cumberland and Lancashire soon afterwards, they could not well have retained their hold on the island to the west of these coasts. It is, however, possible that in 684, when Ecfrid laid Ireland waste from Dublin to Drogheda, he temporarily occupied Man. During the period of Scandinavian domination there are two main epochs—one before the conquest of Man by Godred Crovan in 1079, and the other after it. The earlier epoch is characterized by warfare and unsettled rule, the later is comparatively peaceful. Between about A.D. 800 and 815 the Vikings came to Man chiefly for plunder; between about 850 and 990, when they settled in it, the island fell under the rule of the Scandinavian kings of Dublin; and between 990 and 1079, it was subject to the powerful earls of Orkney. The conqueror Godred Crovan was evidently a remarkable man, though little information about him is attainable. According to the *Chronicon Manniae* he "subdued Dublin, and a great part of Leinster, and held the Scots in such subjection that no one who built a vessel dared to insert more than three bolts." The memory of such a ruler would be likely to survive in tradition, and it seems probable therefore that he is the person commemorated in Manx legend under the name of King Gorse or Orry. The islands which were under his rule were called the *Suðr-eyjar* (Sudreys or the south isles, in contradistinction to the *norðr-eyjar*, or the north isles, *i.e.* the Orkneys and Shetlands, and they consisted of the Hebrides, and of all the smaller western islands of Scotland, with Man. At a later date his successors took the title of *Rex Manniae et Insularum*. Olaf, Godred's son, was a powerful monarch, who, according to the Chronicle, maintained "such close alliance with the kings of Ireland and Scotland that no one ventured to disturb the Isles during his time" (1113–1152). His son, Godred, who for a short period ruled over Dublin also, as a result of a quarrel with Somerled, the ruler of Argyll, in 1156, lost the smaller islands off the coast of Argyll. An independent sovereignty was thus interposed between the two divisions of his kingdom. Early in the 13th century, when Reginald of Man did homage to King John, we hear for the first time of English intervention in the affairs of Man. But it was into the hands of Scotland that the islands were ultimately to fall. During the whole of the Scandinavian period the isles were nominally under the suzerainty of the kings of Norway, but they only occasionally asserted it with any vigour. The first to do so was Harold Haarfager about 885, then came Magnus Barfod about 1100, both of whom conquered the isles. From the middle of the 12th century till 1217 the suzerainty, owing to the fact that Norway was a prey to civil dissensions, had been of a very shadowy character. But after that date it became a reality and Norway consequently came into collision with the growing power of Scotland. Finally, in 1261, Alexander III. of Scotland sent envoys to Norway to negotiate for the cession of the isles, but their efforts led to no result. He therefore initiated hostilities which terminated in the complete defeat of the Norwegian fleet at Largs in 1263. Magnus, king of Man and the Isles, who had fought on the Norwegian side, was compelled to surrender all the islands over which he had ruled, except Man, for which he did homage. Two years later Magnus died and in 1266 the king of Norway, in consideration of the sum of 4000 marks, ceded the islands, including Man, to Scotland. But Scotland's rule over Man was not firmly established till 1275, when the Manx were defeated in a decisive battle at Ronaldsway, near Castletown. In 1290 we find Edward I. of England in possession of Man, and it remained in English hands till 1313, when it was taken by Robert Bruce after besieging Castle Rushen for five weeks. Then, till 1346, when the battle of Neville's Cross decided the long struggle between England and Scotland in England's favour, there followed a confused period when Man was sometimes under English and sometimes under Scottish rule. About 1333 it had been granted by King Edward III. to William de Montacute, 1st earl of Salisbury, as his absolute possession, without reserving any service to be rendered to him. In 1392 his son sold the island "with the crowne" to Sir William Le Scroope. In 1399 Henry IV. caused Le Scroope, who had taken Richard's side, to be beheaded. The island then came into the possession of the crown and was granted to Henry de Percy, earl of Northumberland, but, he having been attainted, Henry IV., in 1406, made a grant of it, with the patronage of the bishopric, to Sir John Stanley, his heirs and assigns, on the service of rendering two falcons on paying homage and two falcons to all future kings of England on their coronation.

With the accession of the Stanleys to the throne there begins a better epoch in Manx history. Though the island's new rulers rarely visited its shores, they placed it under responsible governors, who, in the main, seem to have treated it with justice. Of the thirteen members of the family who ruled in Man, the second Sir John Stanley (1414–1432), James, the 7th earl (1627–1651), and the 10th earl of the same name (1702–1736) had the most important influence on it. The first curbed the power of the spiritual barons, introduced trial by jury, instead of trial by battle, and ordered the laws to be written. The second, known as the Great Stanley, and his wife, Charlotte de la Tremoille (or Tremouille), are probably the most striking figures in Manx history. In 1643 Charles I. ordered him to go to Man, where the people, who were no doubt influenced by what was taking place in England, threatened to revolt. But his arrival, with English soldiers, soon put a stop to anything of this kind. He conciliated the people by his affability, brought in Englishmen to teach various handicrafts and tried to help the farmers by improving the breed of Manx horses, and, at the same time, he restricted the exactions of the Church. But the Manx people never had less liberty than under his rule. They were heavily taxed; troops were quartered upon them; and they also had the more lasting grievance of being compelled to accept leases for three lives instead of holding their land by the "straw" tenure which they considered to be equivalent to a customary inheritance. Six months after the death of the king Stanley received a summons from General Ireton to surrender the island, which he haughtily declined. In August 1651 he went to England with some of his troops, among whom were 300 Manxmen, to join King Charles II., and he and they shared in the decisive defeat of the Royalists at Worcester. He was captured and confined in Chester Castle, and, after being tried by court martial, was executed at Wigan. Soon after his death the Manx Militia, under the command of William Christian, rose against the Countess and captured all the insular forts except Rushen and Peel. They were then joined by a parliamentary force under Colonel Duckenfield, to whom the Countess surrendered after a brief resistance. Fairfax had been appointed "Lord of Man and the Isles" in September, so that Man continued under a monarchical government and remained in the same relation to England as before. The restoration of Stanley government in 1660 therefore caused as little friction and alteration as its temporary cessation had. One of the first acts of the new lord, Charles (the 8th earl), was to order Christian to be tried. He was found guilty and executed. Of the other persons implicated in the rebellion only three were excepted from the general amnesty. But by order in Council they were pardoned, and the judges responsible for the sentence on Christian were punished. His next act was to dispute the permanency of the tenants' holdings, which they had not at first regarded as being affected by the acceptance of leases, a proceeding which led to an almost open rebellion against his authority and to the neglect of agriculture. In lieu of it the people devoted themselves to the fisheries and to contraband trade. The agrarian question was not settled till 1704, when James, Charles's brother and successor, largely through the influence of Bishop Wilson, entered into a compact with his tenants, which was embodied in an act, called the "Act of Settlement." Their compact secured the tenants in the possession of their estates in perpetuity on condition of a fixed rent, and a small fine on succession or alienation. From the great importance of this act to the Manx people it has been called their *Magna Carta*. As time went on, and the value of the estates increased, the rent payable to the lord became so small in proportion as to be almost nominal. James died in 1736 and the sovereignty of the isle passed to James Murray, 2nd duke of Atholl. In 1764 he was succeeded by his only surviving child Charlotte, Baroness Strange, and her husband, John Murray, who, in right of his wife, became Lord of Man. About 1720 the contraband trade greatly increased. In 1726 it was, for a time, somewhat checked by the interposition of parliament, but during the last ten years of the Atholl régime (1756–1765) it assumed such proportions that, in the interests of the imperial revenue, it became necessary to suppress it. With a view to so doing an Act of Parliament, called the "Revesting Act," was passed in 1765, under which the sovereign rights of the Atholls and the customs revenues of the island were purchased for the sum of £70,000, and an annuity of £2000 was granted to the duke and duchess. The Atholls still retained their manorial rights, the patronage of the See, and certain other perquisites, which were finally purchased for the excessive sum of £417,144 in 1828. Up to the time of the Revestment the Tynwald Court passed laws concerning the government of the island in all respects and had control over its finances, subject to the approval of the lord. After the Revestment, or rather after the passage of the "Mischief Act" in the same year, Imperial Parliament legislated with respect to customs, harbours and merchant shipping, and, in measures of a general character, it occasionally inserted clauses by which penalties in contravention of the acts of which they formed part might be enforced in the island. It also assumed the control of the insular customs duties. Such were the changes which, rather than the transference of the sovereignty from the lord to the king of Great Britain and Ireland, modified the Constitution of the Isle of Man. Its ancient laws and tenures were not interfered with, but in many ways the Revestment adversely affected it. The hereditary lords were far from being model rulers, but most of them had taken some personal share in its government, and had interested themselves in the well-being of its inhabitants. But now the whole direction of its affairs was handed over to officials, who regarded the island as a pestilent nest of smugglers, from which it was their duty to extract as much revenue as possible. Some alleviation of this state of things was experienced between 1793 and 1826 when the 4th duke of Atholl was appointed governor, since, though he quarrelled with the Keys and was unduly solicitous for his pecuniary interests, he did occasionally exert himself to promote the welfare of the island. After his departure the English officials resumed their sway. But they were more considerate than before. Moreover, since smuggling, which had only been checked, not suppressed, by the Revesting Act, had by that time almost disappeared, and the Manx revenue was producing a large and increasing surplus, the Isle of Man came to be regarded more favourably, and, thanks to this fact and to the representations of the Manx people to English ministers in 1837, 1844 and 1853, it obtained a somewhat less stringent customs tariff and an occasional dole towards erecting its much neglected public works. Since 1866, when the Isle of Man obtained a measure of at least nominal "Home Rule," the Manx people have made remarkable progress, and at the present day form a prosperous community.

Monuments.—The prehistoric monuments in Man are numerous. There are earth entrenchments, seemingly of the earliest period; fragments of stone circles and alignments; burial cairns with stone cists of several successive periods; urn mounds and *cranneges* or lake dwellings. The monuments belonging to the historic period begin with the round tower on Peel islet, the humble Celtic *keeills* and the sculptured crosses in which the island is especially rich. Of these crosses about one-fourth have inscriptions in the old Norse language. The origin and history of the early buildings remaining on the island are obscure. The castles of Rushen and Peel are the only important buildings of a military character which survive, but the remains of ecclesiastical buildings are numerous and interesting, though, with the exception of St German's Cathedral on Peel islet, now in ruins, they are only small and simple structures.

Arms.—There has been much controversy about the origin of the arms of the island—the "three-legs" found on a beautiful pillar cross near Maughhold churchyard belonging to the latter part of the 14th century. It was probably originally a sun symbol and was brought from Sicily by the Vikings. The motto *quocunque jeceris stabit* is of comparatively recent origin.

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Hall Caine's novels, *The Deemster*, *The Manxman*, &c., have no doubt tended to popularize the island. The most truthful description of the social life of the people is to be found in a novel entitled *The Captain of the Parish*, by John Quine. *Bibliotheca Monensis* (*Manx Society*, vol. xxiv.) contains a good list of MSS. and books relating to the island up to 1876, and A. W. Moore's *History of the Isle of Man* has a list of the most important MSS. and books up to 1900.

(A. W. M.)

MANAAR, GULF OF, a portion of the Indian Ocean lying between the coast of Madras and Ceylon. Its northern limit is the line of rocks and islands called Adam's Bridge. Its extreme width from Cape Comorin to Point de Galle is about 200 miles.

MANACOR, a town of Spain in the island of Majorca, 40 m. by rail E. of Palma. Pop. (1900), 12,408. Manacor has a small trade in grain, fruit, wine, oil and live stock. In the neighbourhood are the cave of Drach, containing several underground lakes, and the caves of Artá, one of the largest and finest groups of stalactite caverns in western Europe.

MANAGE, to control, direct, or be in a position or have the capacity to do anything (from Ital. *maneggiare*, to train horses, literally to handle; Lat. *manus*, hand). The word was first used of the "management" of a horse. Its meanings have been much influenced by the French *ménager*, to direct a household or *ménage* (from late Lat. *mansio*, house); hence to economize, to husband resources, &c. The French *menage*, act of guiding or leading, from *mener*, to lead, seems also to have influenced the meaning.

MANAGUA, the capital of Nicaragua, and of the department of Managua; on the southern shore of Lake Managua, and on the railway from Diriamba to El Viejo, 65 m. by rail S.E. of the Pacific port of Corinto. Pop. (1905), about 30,000. Managua is a modern city, with many flourishing industries and a rapidly growing population. Its chief buildings are those erected after 1855, when it was chosen as the capital to put an end to the rivalry between the then more important cities of Leon and Granada. They include the Palacio Nacional or government buildings, Corinthian in style, the national library and museum, an ornate Renaissance structure, the barracks and the general post office. Owing to its position on the lake, and its excellent communications by rail and steamer, Managua obtained after 1855 an important export trade in coffee, sugar, cocoa and cotton, although in 1876 it was temporarily ruined by a great inundation.

MANAKIN, from the Dutch word *Manneken*, applied to certain small birds, a name apparently introduced into English by G. Edwards (*Nat. Hist. Birds*, i. 21) in or about 1743, since which time it has been accepted generally, and is now used for those which form the family *Pipridae*. The manakins are peculiar to the Neotropical Region and have many of the habits of the titmouse family (*Paridae*), living in deep forests, associating in small bands, and keeping continually in motion, but feeding almost wholly on the large soft berries of the different kinds of *Melastoma*. The *Pipridae*, however, have no close affinity with the *Paridae*,[1] but belong to another great division of the order *Passeres*, the *Clamatores* group of the *Anisomyodae*. The manakins are nearly all birds of gay appearance, generally exhibiting rich tints of blue, crimson, scarlet, orange or yellow in combination with chestnut, deep black, black and white, or olive green; and among their most obvious characteristics are their short bill and feeble feet, of which the outer toe is united to the middle toe for a good part of its length. The tail, in most species very short, has in others the middle feathers much elongated, and in one of the outer rectrices are attenuated and produced into threads. They have been divided (Brit. Mus. *Cat. Birds*, vol. xiv.) into nineteen genera with about seventy species, of which eighteen are included under *Pipra* itself. *P. leucilla*, one of the best known, has a wide distribution from the isthmus of Panama to Guiana and the valley of the Amazon; but it is one of the most plainly coloured of the family, being black with a white head. The genus *Machaeropterus*, consisting of four species, is very remarkable for the extraordinary form of some of the secondary wing-feathers in the males, in which the shaft is thickened and the webs changed in shape, as described and illustrated by P. L. Sclater (*Proc. Zool. Society*, 1860, p. 90; *Ibis*, 1862, p. 175[2]) in the case of the beautiful *M. deliciosus*, and it has been observed that the wing-bones of these birds are also much thickened, no doubt in correlation with this abnormal structure. A like deviation from the ordinary character is found in the allied genus *Chiromachaeris*, comprehending seven species, and Sclater is of the opinion that it enables them to make the singular noise for which they have long been noted, described by O. Salvin (*Ibis*, 1860, p. 37) in the case of one of them, *M. candaei*, as beginning "with a sharp note not unlike the crack of a whip," which is "followed by a rattling sound not unlike the call of a landrail"; and it is a similar habit that has obtained for another species, *M. edwardsi*, the name in Cayenne, according to Buffon (*Hist. Nat. Oiseaux*, iv. 413), of *Cassenoisette*.

(A. N.)

MANAOAG, a town in the north central part of the province of Pangasinán, Luzon, Philippine Islands, on the Angalacan river, 21 m. N.E. of Lingayen. Pop. (1903), 16,793. The inhabitants devote themselves especially to rice-culture, though tobacco, Indian corn, sugar-cane, fruit and vegetables are also raised. A statue of the Virgin Mary here is visited annually (especially during May) by thousands from Pangasinán and adjoining provinces. The inhabitants are mostly Ilocanos. Manaoag includes the town proper and eighteen barrios.

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[1] Though Edwards called the species he figured (*ut supra*) a titmouse, he properly remarked that there was no genus of European birds to which he could liken it.

[2] The figures are repeated by Darwin (*Descent of Man*, &c., ii. 66).

MANÁOS, a city and port of Brazil and capital of the state of Amazonas, on the left bank of the Rio Negro 12 m. above its junction with the Solimões, or Amazon, and 908 m. (Wappäus) above the mouth of the latter, in lat. 3° 8′ 4″ S., long. 60° W. Pop. (1908), about 40,000, including a large percentage of Indians, negroes and mixed-bloods; the city is growing rapidly. Manáos stands on a slight eminence overlooking the river, 106 ft. above sea-level, traversed by several "igarapés" (canoe paths) or side channels, and beautified by the luxuriant vegetation of the Amazon valley. The climate is agreeable and healthful, the average temperature for the year (1902) being 84°, the number of rainy days 130, and the total rainfall 66·4 in. Up to the beginning of the 20th century the only noteworthy public edifices were the church of N.S. da Concciçåo, the St Sebastião asylum and, possibly, a Misericordia hospital; but a government building, a custom-house, a municipal hall, courts of justice, a market-place and a handsome theatre were subsequently erected, and a modern water-supply system, electric light and electric tramways were provided. The "igarapés" are spanned by a number of bridges. Higher education is provided by a lyceum or high school, besides which there is a noteworthy school (bearing the name of Benjamin Constant) for poor orphan girls. Manáos has a famous botanical garden, an interesting museum, a public library, and a meteorological observatory. The port of Manáos, which is the commercial centre of the whole upper Amazon region, was nothing but a river anchorage before 1902. In that year a foreign corporation began improvements, which include a stone river-wall or quay, storehouses for merchandise, and floating wharves or landing stages connected with the quay by floating bridges or roadways. The floating wharves and bridges are made necessary by the rise and fall of the river, the difference between the maximum and minimum levels being about 33 ft.

The principal exports are rubber, nuts, cacao, dried fish, hides and piassava fibre. The markets of Manáos receive their supplies of beef from the national stock ranges on the Rio Branco, and it is from this region that hides and horns are received for export. The shipping movement of the port has become large and important, the total arrivals in 1907, including small trading boats, being 1589, of which 133 were ocean-going steamers from Europe and the United States, 75 from south Brazilian ports, and 227 river steamers from Pará. This rapid growth in its direct trade is due to a provincial law of 1878 which authorized an abatement of 3% in the export duties on direct shipments, and a state law of 1900 which made it compulsory to land and ship all products of the state from the Manáos custom-house.

The first European settlement on the site of Manáos was made in 1660, when a small fort was built here by Francisco da Motta Falcão, and was named São José de Rio Negro. The mission and village which followed was called Villa de Barra, or Barra do Rio Negro (the name "Barra" being derived from the "bar" in the current of the river, occasioned by the set-back caused by its encounter with the Amazon). It succeeded Barcellos as the capital of the old *capitania* of Rio Negro in 1809, and became the capital of Amazonas when that province was created in 1850, its name being then changed to Manáos, the name of the principal tribe of Indians living on the Rio Negro at the time of its discovery. In 1892 Manáos became the see of the new bishopric of Amazonas.

MANASSAS, a district of Prince William county, Virginia, and a town of the district, about 30 m. W.S.W. of Washington, D.C. Pop. (1910) of the district, 3381; of the town, 1217. The village of Manassas (in the town), known also as Manassas Junction, is served by the Chesapeake & Ohio and the Southern railways. North of the junction is Bull Run, a small stream which empties into the Occoquan, an arm of the Potomac. In this neighbourhood two important battles of the American Civil War, the first and second battles of Bull Run, were fought on the 21st of July 1861 and on the 29th-30th of August 1862 respectively; by Southern historians these battles are called the battles of Manassas. At Manassas is the Manassas Industrial School for Coloured Youth (non-sectarian; privately supported), which was founded in 1892 and opened in 1894; in 1908–1909 it had nine teachers (all negroes) and 121 pupils, all in elementary grades.

MANASSEH (7th cent. B.C.), son of Hezekiah, and king of Judah (2 Kings xxi. 1–18). His reign of fifty-five years was marked by a reaction against the reforming policy of his father, and his persistent idolatry and bloodshed were subsequently regarded as the cause of the destruction of Jerusalem and of the dispersion of the people (2 Kings xxiii. 26 seq.; Jer. xv. 4). As a vassal of Assyria he was contemporary with Sennacherib, Esar-haddon (681–668 B.C.) and Assur-bani-pal (668–626 B.C.), and his name (*Me-na-si-e*) appears among the tributaries of the two latter. Little is known of his history. The chronicler, however, relates that the Assyrian army took him in chains to Babylon, and that after his repentance he returned, and distinguished himself by his piety, by building operations in Jerusalem and by military organization (2 Chron, xxxiii. 10 sqq.). The story of his penitence referred to in xxxiii. 22, is untrustworthy, but the historical foundation may have been some share in the revolt of the Babylonian Samas-sum-ukin (648 B.C.), on which occasion he may have been summoned before Assur-bani-pal with other rebels and subsequently reinstated. See further Driver, in Hogarth, *Authority and Archaeology*, pp. 114 sqq. Manasseh was succeeded by his son Amon, who after a brief reign of two years perished in a conspiracy, his place being taken by Amon's son (or brother) Josiah (*q.v.*). A lament formerly ascribed to Manasseh (cf. 2 Chron. xxxiii. 18) is preserved in the Apocrypha (see MANASSES, PRAYER OF; and APOCRYPHAL LITERATURE). On Judg. xviii. 30 (marg.), see JONATHAN.

MANASSEH (apparently Hebrew for "he who causes to forget," but see H. W. Hogg, *Encyc. Bib.*, *s.v.*); in the Bible, a tribe of Israel, the elder but less important of the "sons" of Joseph. Its seat lay to the north of Ephraim, but its boundaries can scarcely be defined. It merged itself with its "brother" in the south and with Issachar, Zebulun and other tribes in the north (Josh. xvii. 7 sqq.). From the latter it was separated for a time by a line of Canaanite cities extending from Dor to Bethshean, which apparently were not all subdued till the days of David or Solomon (Judg. i. 27; 1 Sam. xxxi. 10; 1 Kings ix. 15). Besides its western settlement in the fertile glades of northern Samaria, running out into the great plain, there were territories east of the Jordan reckoned to Manasseh. Gilead and Bashan were said to have been taken by Machir, and a number of places of uncertain identification were occupied by Nobah and Jair (Num. xxxii. 41; Judg. x. 3–5). It seems most natural to suppose that these districts were held before the Israelites crossed over to the west (cf. the tradition Num. xxi., Deut. iii.). On the other hand, in Judg. v. 14, Machir may conceivably belong to the west, and it is possible that, according to another tradition, these movements were the result of the complaint of the Joseph tribes that their original territory was too restricted.[1] In the genealogical lists, Machir, perhaps originally an independent branch, is the eldest son of Manasseh (Josh. xvii. 1 *b*, 2); but according to later schemes he is Manasseh's only son (Num. xxvi. 28–34). Intermixture with Aramaeans is indicated in the view that he was the son of Manasseh and an Aramean concubine (1 Chron. vii. 14), and this is supported by the statement that the Arameans of Geshur and Maacah (cf. 2 Sam. x. 6; Gen. xxii. 24) dwelt among the Israelites of eastern Jordan (Josh. xiii. 13). Subsequently, at an unknown period of history, sixty cities were lost (1 Chron. ii. 23). The story of the daughters of the Manassite Zelophehad is of interest for the Hebrew law of inheritance (Num. xxvii. 1–11, xxxvi.).

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[1] So Budde (*Richter u. Samuel*), who recovers certain old fragments and arranges Josh. xvii. 14–18 (*v.* 18 read "hill-country of Gilead"); Num. xxxii. 39, 41 seq.; Josh. xiii. 13.

Some details of the history of this twofold branch of the Israelites are contained in the stories of Gideon (W. Manasseh) and Jephthah (E. Manasseh). The relations between Saul and Jabesh-Gilead point to the close bond uniting the two districts, but the details have been variously interpreted: Winckler, for example, suggesting that Saul himself was originally from E. Manasseh and that he followed in the steps of Jephthah (*Keilinschr. u. d. alte Test.*, pp. 216 seq. 227). Generally speaking, its position in the west made it share the fortunes of Ephraim, whilst on the east the proximity of Ammonites and Moabites controlled its history; see also the articles on its southern neighbours, Gad and Reuben, and the articles Genealogy (Biblical); and Jews: *History*. (S. A. C.)

MANASSES, CONSTANTINE, Byzantine chronicler, flourished in the 12th century during the reign of Manuel I. (Comnenus) (1143–1180). He was the author of a *Chronicle* or historical synopsis of events from the creation of the world to the end of the reign of Nicephorus Botaniates (1081), written by direction of Irene, the emperor's sister-in-law. It consists of about 7000 lines in the so-called "political" metre.[1] There is little to be said of it, except that it is rather more poetical than the iambic chronicle of Ephraim (about 150 years later). It obtained great popularity and appeared in a free prose translation; it was also translated into Slavonic. The poetical romance of the *Loves of Aristander and Callithea;* also in "political" verse, is only known from the fragments preserved in the *'Ροδωνια* (rose-garden) of Macarius Chrysocephalus (14th century). Manasses also wrote a short biography of Oppian, and some descriptive pieces (all except one unpublished) on artistic and other subjects.

Editions.—*Chronicle* in Bonn, *Corpus scriptorum hist. Byz.*, 1st ed. Bekker (1837) and in J. P. Migne, *Patrologia graeca*, cxxvii.; *Aristander and Callithea* in R. Hercher's *Scriptores erotici graeci*, ii. (1859); "Life of Oppian" in A. Westermann, *Vitarum scriptores graeci minores* (1845). A long didactic poem in "political" verse (edited by E. Miller in *Annuaire de l'assoc. pour l'encouragement dès études grecques en France*, ix. 1875) is attributed to Manasses or one of his imitators. See also F. Hirsch, *Byzantinische Studien* (1876); C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897).

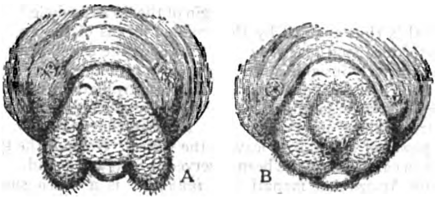
MANASSES, PRAYER OF, an apocryphal book of the Old Testament: This writing, which since the Council of Trent has been relegated by the Church of Rome to the position of an appendix to the Vulgate, was placed by Luther and the translators of the English Bible among the apocryphal books. In some MSS. of the Septuagint it is the eighth among the canticles appended to the Psalter, though in many Greek psalters, which include the canticles, it is not found at all. In Swete's Old Testament in Greek, iii. 802 sqq., A is printed with the variants of T (*Psalterium turicense*).[2] From the statements in 2 Chron. xxxiii. 12, 13, 18, 19, it follows that the Old Testament chronicler found a prayer attributed to Manasseh in his Hebrew sources, *The History of the Kings of Israel* and *The History of the Seers*. Naturally the question arose, had the existing Prayer of Manasses any direct connexion with the prayer referred to by the chronicler? Ewald was of opinion that the Greek was an actual translation of the lost Hebrew; but Ball more wisely takes it as a free rendering of a lost Haggadic narrative founded on the older document from which the chronicler drew his information. This view he supports by showing that there was once a considerable literature in circulation regarding Manasseh's later history. On the other hand most scholars take the Prayer to have been written in Greek, *e.g.* Fritzsche, Schürer and Ryssel (Kautzsch, *Apok. u. Pseud.* i. 165–168).

This fine penitential prayer seems to have been modelled after the penitential psalms. It exhibits considerable unity of thought, and the style is, in the main, dignified and simple.

As regards the date, Fritzsche, Ball and Ryssel agree in assigning this psalm to the Maccabean period. Its eschatology and doctrine of "divine forgiveness" may point to an earlier date.

The best short account of the book is given by Ball (*Speaker's Apocrypha*, ii. 361–371); see also Porter in Hastings's *Dict. Bible*, iii. 232–233. (R. H. C.)

MANATI (often anglicized as "manatee"), the name, adapted from the Carib *manattoui*, given by the Spanish colonists of the West Indies to the American representative of a small group of herbivorous aquatic mammals, constituting, with their allies the dugong and the now extinct *Rhytina*, the order Sirenia. The name, though possibly of Mandingo origin (see Mandingo), was latinized as *manatus*, furnished with hands, thus referring the etymology to the somewhat hand-like form, or hand-like use, of the fore-flippers, which alone serve these creatures for limbs. Manatis, as shown in the illustration in the article Sirenia, are somewhat whale-like in shape, having a similar horizontally expanded tail-fin; but here the resemblance to the Cetacea ceases, the whole organization of these animals being constructed on entirely different lines. The American manati, *Manatus* (or, as some would have it, *Trichechus latirostris*), inhabits the rivers of Florida, Mexico, Central America and the West Indies, and measures from 9 to 13 feet in length. The body is somewhat fish-like, but depressed and ending posteriorly in a broad, flat, shovel-like horizontal tail, with rounded edges. The head is of moderate size, oblong, with a blunt, truncated muzzle, and divided from the body by a slight constriction or neck. The fore limbs are flattened oval paddles, placed rather low on the sides of the body, and showing externally no signs of division into fingers, but with three diminutive flat nails near their extremities. No traces of hind limbs are discernible either externally or internally; and there is no dorsal fin. The mouth is peculiar, the tumid upper lip being cleft in the middle line into two lobes, each of which is separately movable. The nostrils are two semilunar valve-like slits at the apex of the muzzle. The eyes are very minute, placed at the sides of the head, and with a nearly circular aperture with wrinkled margins; and external ears are wanting. The skin generally is of a dark greyish colour, not smooth or glistening like that of whale or dolphin, but finely wrinkled. At a little distance it appears naked, but close inspection, at all events in young animals, shows a scanty covering of delicate hairs, and both upper and under lips are supplied with short, stiff bristles.



(From Murie.)

Front view of head of American Manati, showing the eyes, nostrils, and mouth. A, with the lobes of the upper lip divaricated; B, with the lip contracted.

Manatis have a number—as many as 20 pairs in each jaw—of two-ridged teeth, of which, however, but comparatively few are in use at once. They lack the large tusks of the male dugong, and the fore part of the skull is not so much bent down as in that animal. In life the palate has a horny plate, with a similar one in the lower jaw. The skeleton is described under Sirenia.

Manatis pass their life in the water, inhabiting bays, lagoons, estuaries and large rivers, but the open sea is unsuited to their peculiar mode of life. As a rule they prefer shallow water, in which, when not feeding, they lie near the bottom. In deeper water they often float, with the body much arched, the rounded back close to the surface, and the head, limbs and tail hanging downwards. The air in the lungs assists them to maintain this position. Their food consists exclusively of aquatic plants, on which they feed beneath the water. They are slow in their movements, and perfectly harmless, but are subject to persecution for the sake of their oil, skin and flesh. Frequent attempts have been made to keep specimens alive in captivity, and sometimes with considerable success, one having lived in the Brighton Aquarium for upwards of sixteen months. From such captive specimens certain observations on the mode of life of these animals have been made. We learn, for instance, that from the shoulder-joint the flippers can be moved in all directions, and the elbow and wrist permit of free extension and flexion. In feeding, manatis push the food towards their mouths by means of one of the hands, or both used simultaneously, and any one who has seen these members thus employed can believe the stories of their carrying their young under their arms. Still more interesting is the action of the peculiar lateral pads formed by the divided upper lip, thus described by Professor A. Garrod: "These pads have the power of transversely approaching towards and receding from one another simultaneously (see fig.). When the animal is on the point of seizing (say) a leaf of lettuce, the pads are diverged transversely in such a way as to make a median gap of considerable breadth. Directly the leaf is within grasp the lip-pads are approximated, the leaf is firmly seized between their contiguous bristly surfaces, and then drawn inwards by a backward movement of the lower margin of the lip as a whole." The animal is thus enabled by the unaided means of the upper lip to introduce food placed before it without the assistance of the comparatively insignificant lower lip, the action recalling that of the mouth of the silkworm and other caterpillars in which the mandibles diverge and converge laterally during mastication. All trustworthy observations indicate that the manati has not the power of voluntarily leaving the water. None of the specimens in confinement has been observed to emit any sound.

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[1] "Political" verse or metre is the name given to a kind of verse found as early as the 6th century in proverbs, and characteristic of Byzantine and modern Greek poetry. It takes no account of the quantity of syllables; the scansion depends on accent, and there is always an accent on the last syllable but one. It is specially used of an iambic verse with fifteen syllables, *i.e.* seven feet and an unaccented syllable over. Byron compares ("A captain bold of Halifax who lived in country quarters." Such facile metres are called "political," in the sense of "commonplace," "of the city." Cf. Gibbon's *Decline and Fall* (ed. Bury, 1898), vi. 108; Du Cange, *Gloss. med. et infin. lat.* (vi. 395), who has an interesting quotation from Leo Allatius. Leo explains "political" as implying that the verses are "scorta et meretrices, quod omnibus sunt obsequiosae et peculiares, et servitutem publicam serviunt."

[2] Nestle (*Septuaginta Studien III.*) contends that the text of A and T is derived from the *Apost. Const.* ii. 22, or from its original, and not from a MS. of the Septuagint.

The Amazonian manati (*M. inunguis*) is a much smaller species, not exceeding 7 or 8 ft. in length, and without nails to the flippers. It ascends most of the tributaries of the Amazon until stopped by rapids. From a specimen which lived a short time in London it appears that the lip-pads are less developed than in the northern species. The third species is the West African *M. senegalensis*, which extends a distance of about ten degrees south and sixteen north of the equator, and ranges into the heart of the continent as far as Lake Tchad. From 8 to 10 ft. appears to be the normal length; the weight of a specimen was 590 lb. The colour is bluish black, with a tinge of olive-green above and yellow below. (R. L.*)

MANBHUM, a district of British India, in the Chota Nagpur division of Bengal. The administrative headquarters are at Purulia. Area, 4147 sq. m.; pop. (1901), 1,301,364, showing an increase of 9·1% since 1891. Manbhum district forms the first step of a gradual descent from the table-land of Chota Nagpur to the delta of lower Bengal. In the northern and eastern portions the country is open, and consists of a series of rolling downs dotted here and there with isolated conical hills. In the western and southern tracts the country is more broken and the scenery much more picturesque. The principal hills are Dalma (3407 ft.), the crowning peak of a range of the same name; Gangabari or Gajboro (2220 ft.), the highest peak of the Baghmundi range, about 20 m. south-west of Purulia; and Panchkot or Panchet (1600 ft.), on which stands the old fort of the rajas of Panchet. The hills are covered with dense jungle. The chief river is the Kasai, which flows through the district from north-west to south-east into Midnapore, and on which a considerable floating trade in *sal* timber is carried on. The most numerous aboriginal tribe are the Sontals; but the Bhumij Kols are the characteristic race. In Manbhum they inhabit the country lying on both sides of the Subanrekha. They are pure Mundas, but their compatriots to the east have dropped the title of Munda and the use of their distinctive language, have adopted Hindu customs, and are fast becoming Hindus in religion. The Bhumij Kols of the Jungle Mahals were once the terror of the surrounding districts; they are now more peaceful.

Three principal crops of rice are grown, one sown broadcast early in May on table-lands and the tops of ridges, an autumn crop, and a winter crop, the last forming the chief harvest of the district. Other crops are wheat, barley, Indian corn, pulses, oilseeds, linseeds, jute, hemp, sugar-cane, indigo, pan and tobacco. Owing to the completeness of the natural drainage, floods are unknown, but the country is liable to droughts caused by deficient rainfall. The principal articles of export are oilseeds, pulses, *ghi*, lac, indigo, tussur silk (manufactured near Raghunathpur), timber, resin, coal, and (in good seasons) rice. The chief imports are salt, piece goods, brass utensils and unwrought iron. Cotton hand-loom weaving is carried on all over the district. Manbhum contains the Jherria coalfield, in the Damodar valley, where a large number of mines have been opened since 1894. The United Free Church of Scotland has a mission at Pakheria, with a printing press that issues a monthly journal in Sonthali; and a German Lutheran mission has been established since 1864. The district is traversed by the Bengal–Nagpur railway, while two branches of the East Indian railway serve the coalfield.

MANCHA, LA (Arabic, *Al Monsha*, "the dry land" or "wilderness"), a name which when employed in its widest sense denotes the bare and monotonous elevated plateau of central Spain that stretches between the mountains of Toledo and the western spurs of the hills of Cuenca, being bounded on the S. by the Sierra Morena and on the N. by the Alcarria region. It thus comprises portions of the modern provinces of Toledo, Albacete and Cuenca, and the greater part of Ciudad Real. Down to the 16th century the eastern portion was known as La Mancha de Montearagon or de Aragon, and the western simply as La Mancha; afterwards the north-eastern and south-western sections respectively were distinguished by the epithets *Alta* and *Baja* (upper and lower). La Mancha is famous as the scene of Cervantes' novel *Don Quixote*; in appearance, with its multitude of windmills and vast tracts of arid land, it remains almost exactly as Cervantes described it. Many villages, such as El Toboso and Argamasilla de Alba, both near Alcázar de San Juan, are connected by tradition with episodes in *Don Quixote*.

MANCHE, a department of north-western France, made up chiefly of the Cotentin and the Avranchin districts of Normandy, and bounded W., N. and N.E. by the English Channel (Fr. *La Manche*), from which it derives its name, E. by the department of Calvados, S.E. by Orne, S. by Mayenne and Ille-et-Vilaine. Pop. (1906), 487,443. Area, 2475 sq. m.

The department is traversed from south to north by a range of hills, in many parts picturesque, and connected in the south with those of Maine and Brittany. In the country round Mortain, which has been called the Switzerland of Normandy, they rise to a height of 1200 ft. The coast-line, running northward along the bay of the Seine from the rocks of Grand Camp to Cape Barfleur, thence westward to Cape la Hague, and finally southward to the Bay of Mont St Michel, has a length of 200 miles. The Vire and the Taute (which near the small port of Carentan receives the Ouve as a tributary on the left) fall into the sea at the Calvados border, and are united by a canal some miles above their mouths. From the mouth of the Taute a low beach runs to the port of St Vaast-la-Hougue, where the coast becomes rocky, with sandbanks. Off St Vaast lies the fortified island of Tatihow, with the laboratory of marine zoology of the Natural History Museum of Paris. Between Cape Barfleur and Cape la Hague lie the roads of Cherbourg, protected by the famous breakwater. The whole western coast is inhospitable; its small havens, lying behind formidable barriers and reefs, are almost dry at low tide. Great cliffs, such as the points of Jobourg (420 ft. high) and Flamanville, alternate with long strands, such as that which extends for 30 m. from Cape Carteret to Granville. Between this coast and the Channel Islands the tide, pent up between numerous sandbanks, flows with a terrific force that has given these passages such ill-omened names as *Passage de la Déroute* and the like. The only important harbours are Granville and the haven of refuge of Diélette between Granville and Cherbourg. Carteret carries on a passenger traffic with the Channel Islands. The chief stream is the Sienne, with its tributary the Soulle flowing by Coutances. South of Granville the sands of St Pair are the commencement of the great bay of Mont Saint Michel, whose area of 60,000 acres was covered with forest till the terrible tide of the year 709. The equinoctial tides reach a vertical height of nearly 50 ft. In the bay the picturesque walls of the abbey rise from the summit of a rock 400 ft. high. The Sée, which waters Avranches, and the Couesnon (separating Manche from Ille-et-Vilaine) disembogue in the bay.

The climate of Manche is mild and humid, from its propinquity to the sea. Frosts are never severe; myrtles and fuchsias flourish in the open air. Excessive heat is also unusual; the predominant winds are south-west.

The characteristic industry of the department is the rearing of horses and cattle, carried on especially in the rich meadow of the eastern Cotentin; sheep are raised in the western arrondissement of Coutances. Wheat, buckwheat, barley and oats are the chief cereals cultivated. Manche is one of the foremost departments for the production of cider-apples and pears; plums and figs are also largely grown. Butter is an important source of profit, as also are poultry and eggs. Flourishing market-gardens are found in the west. The department contains valuable granite quarries in the Cherbourg arrondissement and the Chausey islands; building and other stone is quarried.

Villedieu manufactures copper-ware and Sourdeval iron and other metal-ware; and there are wool-spinning mills, paper-works and leather-works, but the department as a whole is industrially unimportant. There are oyster-beds on the coast (St Vaast, &c.), and the maritime population, besides fishing for herring, mackerel, lobsters or sole, collect seaweed for agricultural use. Coutances is the seat of a bishopric of the province of Rouen. The department forms part of the region of the X. army corps and of the circumscriptions of the académie (educational division) and appeal-court of Caen. Cherbourg (*q.v.*), with its important port, arsenal and shipbuilding yards, is the chief centre of population. St Lô (*q.v.*) is the capital; there are six arrondissements (St Lô, Avranches, Cherbourg, Coutances, Mortain, Valognes), with 48 cantons and 647 communes. Avranches, Mortain, Coutances, Granville and Mont Saint Michel receive separate treatment. At Lessay and St Sauveur-le-Vicomte there are the remains of ancient Benedictine abbeys, and Torigni-sur-Vire and Tourlaville (close to Cherbourg) have interesting châteaux of the 16th century. Valognes, which in the 17th and 18th centuries posed as a provincial centre of culture, has a church (15th, 16th and 17th centuries) remarkable for its dome, the only one of Gothic architecture in France.

MANCHESTER, EARLS AND DUKES OF. The Manchester title, in the English peerage, belongs to a branch of the family of Montagu (*q.v.*). The first earl was SIR HENRY MONTAGU (*c.* 1563–1642), grandson of Sir Edward Montagu, chief justice of the king's bench 1539–1545, who was named by King Henry VIII. one of the executors of his will, and governor to his son, Edward VI. Sir Henry Montagu, who was born at Boughton, Northamptonshire, about 1563, was educated at Christ's College, Cambridge, and, having been called to the bar, was elected recorder of London in 1603, and in 1616 was made chief justice of the king's bench, in which office it fell to him to pass sentence on Sir Walter Raleigh in October 1618. In 1620 he was appointed lord high treasurer, being raised to the peerage as Baron Montagu of Kimbolton, Huntingdonshire, and Viscount Mandeville. He became president of the council in 1621, in which office he was continued by Charles I., who created him earl of Manchester[1] in 1626. In 1628 he became lord privy seal, and in 1635 a commissioner of the treasury. Although from the beginning of his public life in 1601, when he first entered parliament, Manchester had inclined to the popular side in politics, he managed to retain to the end the favour of the king. He was a judge of the Star Chamber, and one of the most trusted councillors of Charles I. His loyalty, ability and honesty were warmly praised by Clarendon. In conjunction with Coventry, the lord keeper, he pronounced an opinion in favour of the legality of ship-money in 1634. He died on the 7th of November 1642. Manchester was married three times. One of his sons by his third wife was father of Charles Montagu, created earl of Halifax in 1699.

EDWARD MONTAGU, 2nd earl of Manchester (1602–1671), eldest son of the 1st earl by his first wife, Catherine Spencer, granddaughter of Sir John Spencer of Althorpe, was born in 1602, and was educated at Sidney Sussex College, Cambridge. He was member of parliament for Huntingdonshire 1623–1626, and in the latter year was raised to the peerage in his father's lifetime as Baron Montagu of Kimbolton, but was known generally by his courtesy title of Viscount Mandeville. His first wife, who was related to the duke of Buckingham, having died in 1625 after two years of marriage, Mandeville married in 1626 Anne, daughter of the 2nd earl of Warwick. The influence of his father-in-law, who was afterwards admiral on the side of the parliament, drew Mandeville to the popular side in the questions in dispute with the crown, and at the beginning of the Long Parliament he was one of the recognized leaders of the popular party in the upper House, his name being joined with those of the five members of the House of Commons impeached by the king in 1642. At the outbreak of the Civil War, having succeeded his father in the earldom in November 1642, Manchester commanded a regiment in the army of the earl of Essex, and in August 1643 he was appointed major-general of the parliamentary forces in the eastern counties, with Cromwell as his second in command. Having become a member of the "committee of both kingdoms" in 1644, he was in supreme command at Marston Moor (July 1, 1644); but in the subsequent operations his lack of energy brought him into disagreement with Cromwell, and in November 1644 he strongly expressed his disapproval of continuing the war (see CROMWELL, OLIVER). Cromwell brought the shortcomings of Manchester before parliament in the autumn of 1644; and early in the following year, anticipating the self-denying ordinance, Manchester resigned his command. He took a leading part in the frequent negotiations for an arrangement with Charles, was custodian with Lenthall of the great seal 1646–1648, and frequently presided in the House of Lords. He opposed the trial of the king, and retired from public life during the Commonwealth; but after the Restoration, which he actively assisted, he was loaded with honours by Charles II. In 1667 he was made a general, and he died on the 5th of May 1671. Manchester was made a K.G. in 1661, and became F.R.S. in 1667. Men of such divergent sympathies as Baxter, Burnet and Clarendon agreed in describing Manchester as a lovable and virtuous man, who loved peace and moderation both in politics and religion. He was five times married, leaving children by two of his wives, and was succeeded in the title by his eldest son, Robert, 3rd earl of Manchester (1634–1683).

See Lord Clarendon, *History of the Rebellion and Civil Wars in England* (7 vols., Oxford, 1839) and *Life of Clarendon* (Oxford, 1827); S. R. Gardiner, *History of the Great Civil War, 1642–1649*. (4 vols., London, 1886–1891); *The Quarrel between Manchester and Cromwell*, Camden Soc., N.S. 12 (London, 1875); Sir Philip Warwick, *Memoirs of the Reign of Charles I.* (London, 1701).

CHARLES MONTAGU, 1st duke of Manchester (*c.* 1656–1722), son of Robert, 3rd earl of Manchester, was educated at Trinity College, Cambridge, and succeeded to his father's earldom in 1683. Warmly sympathizing with the Whig revolution of 1688, he attended William and Mary at their coronation, fought under William at the Boyne, became a privy councillor in 1698, and held various important diplomatic posts between that date and 1714, when he received an appointment in the household of George I., by whom on the 28th of April 1719 he was created duke of Manchester. He died on the 20th of January 1722, and was succeeded successively in the dukedom by his two sons, William 2nd duke of Manchester (1700–1739), and Robert 3rd duke (*c.* 1710–1762), who was vice-chamberlain to Queen Caroline, wife of George II.

GEORGE MONTAGU, 4th duke of Manchester (1737–1788), was the son of Robert, the 3rd duke. He was a supporter of Lord Rockingham, and an active opponent in the House of Lords of Lord North's American policy. In the Rockingham ministry of 1782 Manchester became lord chamberlain. He died in September 1788.

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[1] The title was derived, not from Manchester in Lancashire, but from Manchester (or Godmanchester) in Huntingdonshire, where the Montagu family estates were.

William Montagu, 5th duke of Manchester (1768–1843), second son of the preceding, was educated at Harrow, and having become a colonel in the army in 1794, was appointed governor of Jamaica in 1808. Here he remained, except for a visit to England (1811–1813) till 1827, administering the colony with ability in a period of considerable difficulty, and doing much to prepare the way for emancipation of the slaves. From 1827 to 1830 he was postmaster-general in the cabinet of the duke of Wellington, and died in Rome on the 18th of March 1843. His wife was Susan, daughter of the 4th duke of Gordon. He was succeeded by his son George, 6th duke (1799–1855), a captain in the navy; whose son William Drogo, 7th duke (1823–1890), married Louise, daughter of the Comte d'Alten of Hanover, who after his death married Spencer Cavendish, 8th duke of Devonshire. William was succeeded by his son George Victor Drogo, 8th duke of Manchester (1853–1892), on whose death the title devolved on his son, William Angus Drogo, 9th duke of Manchester (b.1877). (R. J. M.)

MANCHESTER, a township of Hartford county, Connecticut, U.S.A., about 9 m. E. of Hartford. Pop.(1890), 8222; (1900), 10,601, of whom 3771 were foreign-born; (1910 census) 13,641. Manchester is served by the New York, New Haven & Hartford railway and by electric line connecting with Hartford, Rockville and Stafford Springs. The township covers an area of about 28 sq. m., and includes the villages of Manchester, South Manchester, Buckland, Manchester Green and Highland Park. The Hockanum River provides a good water power, and Manchester has various manufactures. At South Manchester, an attractive industrial village, a silk mill was built in 1838; the silk mills of one firm (Cheney Brothers) here cover about 12 acres; the company has done much for its employees, whose homes are almost all detached cottages in attractive grounds. Manchester was originally a part of the township of Hartford, and later a part of the township of East Hartford. The first settlement within its present limits was made about 1672; the land was bought from the Indians in 1676; and the township was separated from East Hartford and incorporated in 1823.

See also Meakin's *Model Factories and Villages* (1905).

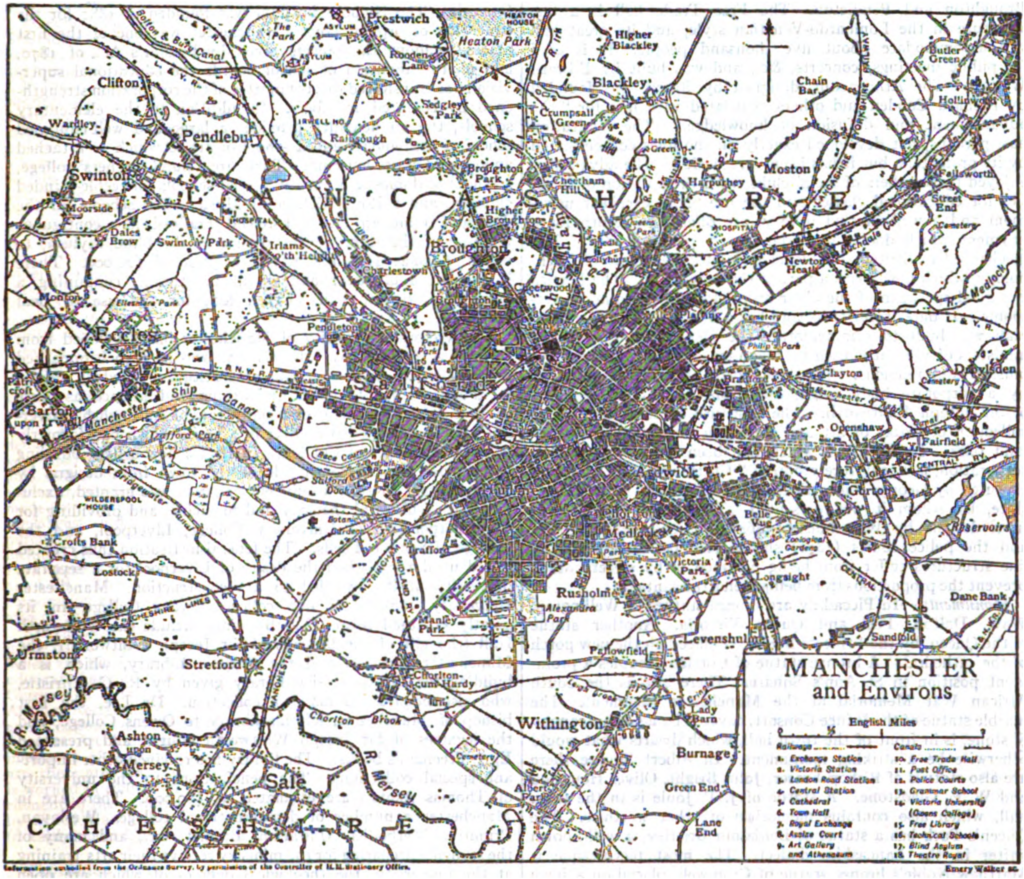
MANCHESTER, a city and county of a city, municipal, county and parliamentary borough of Lancashire, England, 189 m. N.W. by N. of London, and 31 m. E. by N. of Liverpool. It stands for the most part on a level plain, the rising ground being chiefly on the north side. The rivers are the Irwell, the Medlock, the Irk, and the Tib, the last entirely overarched and covered by streets and warehouses. The Irwell, which separates Manchester from Salford, is crossed by a series of bridges and discharges itself into the Mersey, which is about 10 m. distant. The chief part of the district, before it was covered with the superficial drift of sand, gravel and clay, consisted of upper New Red Sandstone with slight portions of lower New Red Sandstone, magnesian marls and upper red marls, hard sandstone and limestone rock, and cold clays and shales of contiguous coal-fields. The city, as its thousands of brick-built houses show, has been for the most part dug out of its own clay-fields. The parliamentary and municipal boroughs of Manchester are not conterminous. The city boundaries, which in 1841 enclosed 4293 acres, have been successively enlarged and now enclose 19,914 acres.

There are four large stations for the Lancashire & Yorkshire, London & North-Western, the Midland, Cheshire lines, Great Northern, and Great Central railways, and many subsidiary stations for local traffic. Tramways, as well as railways, run from Manchester to Oldham, Ashton, Eccles, Stockport, &c., with which places the city is connected by continuous lines of street. The length of the streets in the city of Manchester is 758 m. (exclusive of those in the district of Withington, which joined the city in 1905). The tramway lines within the city boundaries extend to 111 m., and in addition there are 58 m. leased to the corporation by adjacent local authorities. As a matter of fact, the whole of south-east Lancashire and some portions of Cheshire are linked to Manchester by railways and tramways so as to form one great urban area, and the traveller passes from one town to another by lines of street which, for the most part, are continuous. Facility of communication is essential to the commercial prosperity of Manchester, and its need was recognized by the duke of Bridgewater, whose canal, constructed in 1761, has now been absorbed by the Manchester Ship Canal (*q.v.*). The making of this early waterway was an event only less important than the opening of the Manchester & Liverpool railway in 1830.

The township of Manchester, which forms the nucleus of the city, is comparatively small, and outlying hamlets having been added, its size has increased without regularity of plan. Roughly speaking, the city forms a square, with Market Street as its central thoroughfare. The tendency of recent development is to reduce the irregularities so that the other main streets may either run parallel to or intersect Market Street. Deansgate, which formerly ended in a narrow tangle of buildings, is now a broad road with many handsome buildings, and the same process of widening, enlarging and rebuilding is going on, more or less, all over Manchester. Market Street, which has not been widened since 1820, has been termed, and with some reason, "the most congested street in Europe"; but relief is anticipated from some of the other street improvements. The centre of the city is occupied by business premises; the factories and workshops are mainly on the eastern side. The most important of the public buildings are in the centre and the south. The latter is also the most favoured residential district, and at its extremity is semi-rural in character. Large masses of the population live beyond the city boundary and come to their daily avocations by train and tram. Such a population is rarely homogeneous and Manchester attracts citizens from every part of the globe; there are considerable numbers of German, Armenian and Jewish residents. The houses are for the most part of brick, the public buildings of stone, which is speedily blackened by the smoky atmosphere. Many of the warehouses are of considerable architectural merit, and in recent years the use of terra-cotta has become more common. It is only in the suburbs that gardens are possible; the air is laden with black dust, and the rivers, in spite of all efforts, are in the central part of the city mere dirty ditches. It is impossible to describe Manchester in general terms, for within the city boundaries the conditions vary from the most squalid of slums to suburban and almost rural beauty.

Churches.—Manchester is the seat of an Anglican bishopric, and the chief ecclesiastical building is the cathedral, which, however, was built simply as a parish church, and, although a fine specimen of the Perpendicular period, is by no means what might be expected as the cathedral of an important and wealthy diocese. In the course of restoration a piece of Saxon sculpture came to light. This "Angel stone" represents a winged figure with a scroll inscribed *In manus tuas Domine* in characters of the 8th century. The bulk of the building belongs to the early part of the 15th century. The first warden was John Huntington, rector of Ashton, who built the choir. The building, which was noticed for its hard stone by Leland when he visited the town, did not stand time and weather well, and by 1845 some portions of it were rapidly decaying. This led to its restoration by James P. Holden. By 1868 the tower was almost completely renovated in a more durable stone. Further restoration was carried out by J. S. Crowther, and the addition of a porch and vestries was executed by Basil Champneys. The total length is 220 ft. and the breadth 112 ft. There are several stained-glass windows, including one to the memory of "Chinese Gordon." The recumbent statues of Bishop James Fraser and of Hugh Birley, M.P., should also be named. In the Ely chapel is the altar tomb of Bishop James Stanley. In the stalls there are some curious *miserere* carvings. The tower is 139 ft. high, and contains a peal of ten bells, chiefly from the foundry of the Rudhalls. There are two organs, one by Father Smith, and a modern one in an oak case designed by Sir G. Scott. The parish church was made collegiate in 1422, and when in 1847 the bishopric of

Manchester was created the warden and fellows became dean and canons and the parish church became the cathedral. The first bishop was James Prince Lee, who died in 1869; the second was James Fraser, who died in 1885; the third was James Moorhouse, who resigned in 1903 and was succeeded by Edmund Arbuthnott Knox. The church endowments are considerable and have been the subject of a special act of parliament, known as the Manchester Rectory Division Act of 1845, which provides £1500 per annum for the dean and £600 to each of the four canons, and divides the residue among the incumbents of the new churches formed out of the old parish.



Information embodied from the Ordnance Survey, by permission of the Controller of H.M. Stationery Office.

Of the Roman Catholic churches that of the Holy Name, which belongs to the Jesuits, is remarkable for its costly decoration. The Greek Church and most of the Nonconformist bodies have places of worship. There are twelve Jewish synagogues. The meeting-house of the Society of Friends is said to be the largest of the kind in the kingdom and will seat 1200 persons.

Public Buildings.—The Royal Infirmary, founded in 1752, having become inadequate for its purposes, a new building has been erected on the south side of the city near the university, from designs by Edwin T. Hall and John Brooke; it was opened in 1909 by king Edward VII. The central site in Piccadilly thus became available for other purposes, and the corporation gave instructions for plans to be made for a new library and art gallery. The art gallery already existing in 1909 was founded as the Royal Institution, but in 1882 passed under the control of the city council. The building was designed by Sir Charles Barry. The collection contains some fine paintings by Etty, Millais, Leighton and other artists. The sculpture includes casts of the Elgin marbles and a statue of Dr John Dalton by Chantrey. The most striking of the public buildings is the town hall, probably the largest municipal building in the country, but no longer entirely adequate to the increasing business of the city council. It was completed in 1877 from designs by Alfred Waterhouse, who selected as the style of architecture a form of Gothic, but treated it very freely as purposes of utility required. The edifice covers 8000 sq. yds., and includes more than two hundred and fifty rooms. The building consists of continuous lines of corridors surrounding a central courtyard and connected by bridges. The principal tower is 286 ft. high to the top of the ball, and affords a view which extends over a large part of south Lancashire and Cheshire and is bounded only by the hills of Derbyshire. The tower contains a remarkable peal of bells by Taylor of Loughborough, forming an almost perfect chromatic scale of twenty-one bells; each bell has on it a line from canto 105 of Tennyson's *In Memoriam*. The great hall is 100 ft. long and 50 ft. wide, and contains a magnificent organ built by Cavaillé-Coll of Paris. The twelve panels of this room are filled with paintings by Ford Madox Brown, illustrating the history and progress of the city. The royal exchange is a fine specimen of Italian architecture and was erected in 1869; the great meeting-hall is one of the largest rooms in England, the ceiling having a clear area, without supports, of 120 ft. in width. The exchange is seen at its best on market days (Tuesday and Friday). The assize courts were built in 1864 from designs by Waterhouse. The style is a mixture of Early English and Decorative, and a large amount of decorative art has been expended on the building. The branch Bank of England is a Doric building designed by C. R. Cockerell. There are separate town-halls for the townships of Ardwick, Chorlton, Hulme, Cheetham, Broughton and Pendleton. The Free Trade hall is a fine structure in the Lombardo-Venetian style, and its great hall will accommodate about five thousand people. It is used for public meetings, concerts, &c., and was built by Edward Walters. The Athenaeum, designed by Barry, was founded by Richard Cobden and others associated with him for "the advancement and diffusion of knowledge." The institution has, perhaps, not developed exactly on the lines contemplated by its promoters, but it has been very useful. The advantages enjoyed by members of social clubs, with the addition of facilities for educational classes and the use of an excellent news-room and a well-selected library, are offered in return for a payment which does not amount to a penny a day. The mechanics' institution has developed into the school of Technology, which now forms a part of the university. The Portico is a good specimen of the older proprietary libraries and news-rooms. It dates from 1806, and has a library. The Memorial Hall was built to commemorate the memory of the ejected ministers of 1662; it is used for meetings, scientific, educational, musical and religious. The Whitworth Institute is governed by a corporate body originating from the liberal bequests of Sir Joseph Whitworth. The Institute contains a valuable collection of works of art and stands in the centre of a woodland park. In the park, which has been transferred to the corporation, is a sculpture group of "Christ and the Children," executed by George Tinworth from the designs of R. D. Darbishire, by whom it was presented. The assize courts, built from designs by Waterhouse (1864), the post office (1887), and the police courts (1871) should also be named. Many fine structures suffer from being hemmed in by streets which prevent the proportions from being seen to advantage.

Monuments.—In Piccadilly are bronze statues of Wellington, Watt, Dalton, Peel and Queen Victoria. Another statue of the Queen, by the Princess Louise, is placed on the new porch of the cathedral. A bronze statue of Cobden occupies a prominent position in St Ann's Square. There also is the South African War Memorial of the Manchester Regiment. The marble statue of the Prince Consort, covered by a Gothic canopy of stone, is in front of the town hall, which dwarfs what would otherwise be a striking monument. In Albert Square there are also statues of Bishop Fraser, John Bright, Oliver Heywood and W. E. Gladstone. A statue of J. P. Joule is in the town hall, which also contains memorials of other worthies. The Queen's Park has a statue of Benjamin Brierley, a well-known writer in the Lancashire dialect. The most picturesque is Matthew Noble's bronze statue of Cromwell, placed on a huge block of rough granite as pedestal. It stands at the junction of Deansgate and Victoria Street, near the cathedral, and was presented to the town by Mrs E. S. Heywood.

Education.—There are many educational facilities. The oldest institution is the grammar school, which was founded in 1519 by Hugh Oldham, bishop of Exeter, a native of the town. The master and usher appointed by the bishop were to teach freely every child and scholar coming to the school, "without any money or reward taken"; and the bishop forbade the appointment of any member of the religious orders as head master. Some corn mills were devised for the maintenance of the school, which was further endowed at both the universities by Sarah, duchess of Somerset, in 1692. The school has now two hundred and fifty free scholars, whilst other pupils are received on payment of fees. Among those educated at the grammar school were Thomas De Quincey, Harrison Ainsworth and Samuel Bamford the Radical. After the grammar school the oldest educational foundation is that of Humphrey Chetham, whose bluecoat school, founded in 1653, is housed in the building formerly occupied by the college of clergy. This also contains the public library founded by Chetham, and is the most interesting relic of antiquity in the city. The educational charity of William Hulme (1631–1691) is administered under a scheme drawn up in 1881. Its income is nearly £10,000 a year, and it supports a grammar school and aids education in other ways. There are three high schools for girls. The Nicholls hospital was founded in 1881 for the education of orphan boys. Manchester was one of the first places to adopt the powers given by Forster's Act of 1870, and on the abolition of school boards the educational supervision was transferred to a committee of the corporation strengthened by co-opted members. In addition to the elementary schools, the municipality provides a large and well-equipped school of technology, and a school of art to which is attached an arts and crafts museum. There are a pupil teachers' college, a school of domestic economy, special schools for feeble-minded children, and a Royal College of Music. The schools for the deaf and dumb are situated at Old Trafford, in a contiguous building of the same Gothic design as the blind asylum, to which Thomas Henshaw left a bequest of £20,000. There is also an adult deaf and dumb institution, containing a news-room, lecture hall, chapel, &c., for the use of deaf mutes.

The Victoria University of Manchester has developed from the college founded by John Owens, who in 1846 bequeathed nearly £100,000 to trustees for an institution in which should be taught "such branches of learning and science as were then or might be hereafter usually taught in English universities." It was opened in 1851 in a house which had formerly been the residence of Cobden. In 1872 a new college building was erected on the south side of the town from designs by Waterhouse. In 1880 a university charter was granted, excluding the faculties of theology and medicine, and providing for the incorporation of University College, Liverpool, and the College of Science, Leeds. The federal institution thus created lasted until 1903, when the desire of Liverpool for a separate university of its own led to a reconstruction. Manchester University consists of one college—Owens College—in its greatly enlarged form. The buildings include the Whitworth Hall (the gift of the legatees of Sir Joseph Whitworth), the Manchester Museum and the Christie Library, which is a building for the university library given by R. C. Christie, who also bequeathed his own collection. Dr Lee, the first bishop of Manchester, left his library to Owens College, and the legatees of Sir Joseph Whitworth bought and presented E. A. Freeman's books. The library has received other important special collections. The benefactions to the university of Thomas Ashton are estimated at £80,000. There are in Manchester a number of denominational colleges, Wesleyan, Primitive Methodist, Unitarian, Baptist, &c., and many of the students preparing for the ministry receive their arts training at the university, the theological degrees of which are open to students irrespective of creed.

Libraries, Museums and Societies.—Manchester is well provided with libraries. The Chetham library, already named, contains some rare manuscripts, the gem of the collection being a copy of the historical compilation of Matthew Paris, with corrections in the author's handwriting. There is a large collection of matter relating to the history and archaeology of Lancashire and Cheshire, including the transcripts of Lancashire MSS. bequeathed by Canon F. R. Raines. The collections of broadsides formed by Mr J. O. Halliwell-Phillipps, and the library of John Byrom, rich in mystics and shorthand writers, should also be named. The Manchester Free Libraries were founded by Sir John Potter in 1852. There is now a reference library containing about 170,000 volumes, including an extensive series of English historical works, a remarkable collection of books of political economy and trade, and special collections relating to local history, Dr Thomas Fuller, shorthand and the gipsies. The

Henry Watson Music Library, and the Thomas Greenwood Library for librarians were presented to the reference library, and the Foreign Library was purchased. Affiliated to the reference library there are nineteen libraries, each of which includes a lending department and reading rooms. The municipal libraries contain in the aggregate over 366,000 vols. There are also libraries in connexion with the Athenaeum, the School of Technology, the Portico, and many other institutions. The most remarkable of the Manchester libraries is that founded by Mrs Enriqueta Rylands, and named the John Rylands Library in memory of her husband. The beautiful building was designed by Basil Champneys; the library includes the famous Althorp collection, which was bought from Earl Spencer. Mrs Rylands died in 1908, and by her will increased the endowment of the library so that it has an income of £13,000 yearly. She also bequeathed her own library.

Manchester possesses numerous literary and scientific associations. The oldest of these, the Literary and Philosophical Society, founded in 1781, has a high reputation, and has numbered among its working members John Dalton, Eaton Hodgkinson, William Fairbairn, J. P. Joule, H. E. Roscoe and many other famous men of science. It has published a series of memoirs and proceedings. The Manchester Statistical Society was the first society of the kind established in the kingdom, and has issued *Transactions* containing many important papers. The Field Naturalists' and Archaeologists' Society, the Microscopical Society, the Botanists' Association, and the Geological Society may also be named. Manchester is the headquarters of the Lancashire and Cheshire Antiquarian Society and of several printing clubs, the Chetham, the Record, the Lancashire Parish Registers societies. Seven daily papers are published, and various weekly and other periodicals. The journalism of Manchester takes high rank, the *Manchester Guardian* (Liberal) being one of the best newspapers in the country, while the *Manchester Courier* (Unionist) has an important local influence. The *Manchester Quarterly* is issued by the Manchester Literary Club, which was founded in 1862. The success of the Art Treasures Exhibition in 1857 was repeated in the Jubilee Exhibition of 1887. The Manchester Academy of Fine Arts is a society of artists, and holds an annual exhibition in the city art gallery.

Parks and Open Spaces.—There are fifty-three parks and open spaces. The Queen's Park, at Harpurhey, is pleasantly situated, though surrounded by cottages and manufactories. Philips Park is also attractive, in spite of its close proximity to some of the most densely populated portions of the town. The Alexandra Park has very good ornamental grounds and a fine cactus house with a remarkable collection presented by Charles Darrah. Some of the open spaces are small; Boggart Hole Clough, where great efforts have been made to preserve the natural features, is 76 acres in extent, and was the largest until 1902, when Heaton Park, containing 692 acres, was purchased. It was formerly the seat of the earls of Wilton, and includes Heaton House, one of Wyatt's structures. In the Queen's Park there is a museum, and periodical exhibitions of works of art are held. The total area of the city parks is 1146 acres. The corporation are also responsible for four cemeteries, having a total area of 228 acres.

Recreation.—There are nine theatres, mostly large, and eight music halls. The Theatre Royal was established as a patent theatre. When the bill for it was before the House of Lords in 1775 it was advocated as an antidote to Methodism. The Bellevue Zoological Gardens is a favourite holiday place for working people. The Ancoats Recreation Committee have since 1882 had Sunday lectures, and occasional exhibitions of pictures, window gardening, &c. The Ancoats Art Museum was founded to carry out the educational influences of art and culture generally. In addition to works of art, there are concerts, lectures, reading circles, &c. The museum is worked in connexion with a university settlement. The German element in the population has largely influenced the taste for music by which Manchester is distinguished, and the orchestral concerts (notably under Charles Hallé) are famous.

Population.—From a census taken in 1773 it appears that there were then in the township of Manchester and its out-townships 36,267 persons. The first decennial census, 1801, showed the population to be 75,275; in 1851 it was 303,382; in 1901, 606,824. It is not easy to make an exact comparison between different periods, because there have been successive enlargements of the boundaries. The population has overflowed into the surrounding districts, and if all that belongs to the urban area, of which it is the centre, were included, greater Manchester would probably rival London in the number of its inhabitants.

Manufactures and Commerce.—Manchester is the centre of the English cotton industry (for details see COTTON and COTTON MANUFACTURE), but owing to the enhanced value of land many mills and workshops have been removed to the outskirts and to neighbouring villages and towns, so that the centre of Manchester and an ever-widening circle around are now chiefly devoted not so much to production as to the various offices of distribution. It would be a mistake, however, to regard Manchester as solely dependent upon the industries connected with cotton. There are other important manufactures which in another community would be described as gigantic. Wool and silk are manufactured on a considerable scale, though the latter industry has for some years been on the decline. The miscellaneous articles grouped under the designation of small-wares occupy many hands. Machinery and tools are made in vast quantities; the chemical industries of the city are also on a large scale. In short, there are but few important manufactures that are wholly unrepresented. The proximity of Manchester to the rich coal-fields of Lancashire has had a marked influence upon its prosperity; but for this, indeed, the rapid expansion of its industries would have been impossible.

The Manchester Bankers' Clearing House returns show an almost unbroken yearly increase. The amount in 1872 was £72,805,510; in 1907 it was £320,296,332; by the severe depression of 1908 it was reduced to £288,555,307. Another test of prosperity is the increase in rateable value. In 1839 it was £669,994; in 1871, £1,703,627; in 1881, £2,301,225; in 1891, £2,798,005; in 1901, £3,394,879; in 1907, £4,191,039; in 1909, £4,234,129.

The commercial institutions of Manchester are too numerous for detailed description; its chamber of commerce has for more than sixty years exercised much influence on the trade of the district and of the nation. Manchester is the headquarters of the Co-operative Wholesale Society, and indeed of the co-operative movement generally.

The most important event in the modern history of the district is the creation of the Manchester Ship Canal (*q.v.*), by which Manchester and Salford have a direct communication with the sea at Eastham, near Liverpool. The canal was opened for traffic in January 1894. The official opening ceremony was on the 21st of May 1894, when Queen Victoria visited Manchester. The total expenditure on capital account has been £16,567,881. The original share capital of £8,000,000 and £1,812,000, raised by debentures, having been exhausted, the corporation of Manchester advanced on loan a further sum of £5,000,000.

Municipality.—Manchester received a municipal charter in 1838, received the title of city in 1853, and became a county borough in 1889. The city is divided into 30 wards, and the corporation consists of 31 aldermen and 93 councillors. The mayor received the title of lord mayor in 1893. Unlike some of the municipalities, that of Manchester makes no pecuniary allowance to its lord mayor, and the office is a costly one.

The water supply is controlled by the corporation. The works at Longdendale, begun in 1848, were completed, with extensions in 1884, at a cost of £3,147,893. The area supplied by Manchester waterworks was about 85 square miles, inhabited by a million people. The increase of trade and population led to the obtaining of a further supply from Lake Thirlmere, at the foot of Helvellyn and 96 miles from Manchester. The watershed is about 11,000 acres. The daily consumption is over 38 million gallons. Manchester supplies in bulk to many local authorities in the district between Thirlmere and the city. The corporation have also established works for the supply of hydraulic and electric power.

The gas lighting of Manchester has been in the hands of the corporation for many years, as also the supply of electricity both for lighting and energy. When the works are complete the electricity committee will supply an area of 45 sq. m.

Sanitary Condition.—Dr John Tatham constructed a Manchester life-table based on the vital statistics of the decennium 1881–1890, from which it appeared that, while in England and Wales of 1000 men aged 25 nearly 800 survived to be 45 and of 1000 aged 45, 569 survived to be 65, in Manchester the survivors were only 732 and 414 respectively. The expectation of life, at 25, was, for England and Wales 36·12 years, and for Manchester 30·69 years. But the death-rate has since rapidly decreased; in 1891 it was 26·0 per thousand living; in 1901 it was 21·6; in 1906 it was 19·0; in 1907 it was 17·9. The deaths of infants under one year old amounted to 169 per 1000.

The reports of the medical officer show that whilst the density of the population, the impurity of the atmosphere, and the pollution of the streams are difficult elements in the sanitary problem, great efforts have been made towards improving the health of the people. The birth-rate in 1907 was 28·4, but the population is augmented by immigration as well as by natural increase. The number of persons to the acre is 33.

Administration of Justice.—The city has a stipendiary magistrate who, in conjunction with lay magistrates, tries cases of summary jurisdiction in the police courts. There are also quarter sessions, presided over by a recorder. Separate sessions are held for the Salford hundred. Certain sittings of the Court of Chancery for the duchy of Lancaster are held in Manchester. In addition to the county court, there is an ancient civil court known as the Salford Hundred Court of Record. Assizes have been held since 1866.

Parliamentary Representation.—By the first Reform Bill Manchester received in 1832 two representatives. In 1868 this was increased to three, but each voter had only two votes. In 1885 the city was divided into six divisions, each returning one member. Owing to the extension of the city boundaries there are Manchester voters in the Stretford, Prestwich and Gorton parliamentary divisions.

History.—Very little is known with certainty of the early history of Manchester.[1] A Roman station of some importance existed at Castlefield, and a fragment of the wall still exists. Another, perhaps earlier, was at Hunt's Bank. In the 18th century considerable evidences of Roman occupation were still visible; and from time to time, in the course of excavation (especially during the making of the Bridgewater Canal), Roman remains have been found. The coins were chiefly those of Vespasian, Antoninus Pius, Trajan, Hadrian, Nero, Domitian, Vitellius and Constantine. Investigations by the Lancashire and Cheshire Antiquarian Society and the Classical Association have brought to light many relics, chiefly of pottery. The period succeeding the Roman occupation is for some time legendary. As late as the 17th century there was a tradition that Tarquin, an enemy of King Arthur, kept the castle of Manchester, and was killed by Lancelot of the Lake. The references to the town in authentic annals are very few. It was probably one of the scenes of the missionary preaching of Paulinus; and it is said (though by a chronicler of comparatively late date) to have been the residence of Ina, king of Wessex, and his queen Ethelberga, after he had defeated Ivor, somewhere about the year 689. Almost the only point of certainty in its history before the Conquest is that it suffered greatly from the devastations of the Danes, and that in 923 Edward, who was then at Thelwall, near Warrington, sent a number of his Mercian troops to repair and garrison it. In Domesday Book Manchester, Salford, Rochdale and Radcliffe are the only places named in south-east Lancashire, a district now covered by populous towns. Large portions of it were then forest, wood and waste lands. Twenty-one thanes held the manor or hundred of Salford among them. The church of St Mary and the church of St Michael in Manchester are both named in Domesday, and some difficulty has arisen as to their proper identification. Some antiquaries consider that the passage refers to the town only, whilst others think it relates to the parish, and that, while St Mary's is the present cathedral, St Michael's would be the present parish church of Ashton-under-Lyne. In 1301 Manchester received a charter of manorial liberties and privileges from its baron, Thomas Gresley, a descendant of one to whom the manor had been given by Roger of Poictou, who was created by William the Conqueror lord of all the land between the rivers Mersey and Ribble. The Gresleys were succeeded by the De la Warrs, the last of whom was educated for the priesthood, and became rector of the town. To avoid the evil of a non-resident clergy, he made considerable additions to the lands of the church, in order that it might be endowed as a collegiate institution. A college of clergy was thus formed, whose fellows were bound to perform the necessary services at the parish church, and to whom the old baronial hall was granted as a place of residence. The manorial rights passed to Sir Reginald West, a descendant of Joan Gresley, who was summoned to parliament as Baron de la Warre. The West family, in 1579, sold the manorial rights for £3000 to John Lacy, who, in 1596, resold them to Sir Nicholas Mosley, whose descendants enjoyed the emoluments derived from them until 1845, when they were purchased by the municipality of Manchester for a sum of £200,000. The lord of the manor had the right to tax and toll all articles brought for sale into the market of the town. But, though the inhabitants were thus to a large extent taxed for the benefit of one individual, they had a far greater amount of local self-government than might have been supposed, and the court leet, which was then the governing body of the town, had, though in a rudimentary form, nearly all the powers now possessed by municipal corporations. This court had not only control over the watching and warding of the town, the regulation of the water supply, and the cleaning of the streets, but also had power, which at times was used freely, of interfering with the private liberty of their fellow-citizens. Thus, no single woman was allowed to be a householder; no person might employ other than the town musicians; and the amount to be spent at wedding feasts and other festivities was carefully settled. Under the protection of the barons the town appears to have steadily increased in prosperity, and it early became an important seat of the textile manufactures. Fulling mills were at work in the district in the 13th century; and documentary evidence exists to show that woollen manufactures were carried on in Ancoats at that period. In 1538 Leland described it as "the fairest, best-builded, quickest, and most populous town in Lancashire." The right of sanctuary granted to the town in 1540 was found so detrimental to its industrial pursuits that after very brief experience the privilege was taken away. The college of Manchester was dissolved in 1547, but was refounded in Mary's reign. Under her successor the town became the headquarters of the commission for establishing the Reformed religion. In 1641 we hear of the Manchester people purchasing linen yarn from the Irish, weaving it, and returning it for sale in a finished state. They also brought cotton wool from Smyrna to work into fustians and dimities. An act passed in the reign of Edward VI. regulates the length of cottons called Manchester, Lancashire and Cheshire cottons. These, notwithstanding their name, were probably all woollen textures. It is thought that some of the Flemish weavers who were introduced into England by Queen Philippa of Hainault were settled at Manchester; and Fuller has given an exceedingly quaint and picturesque description of the manner in which these artisans were welcomed by the inhabitants of the country they were about to enrich with a new industry. The Flemish weavers were in all probability reinforced by religious refugees from the Low Countries.

In the civil wars, the town was besieged by the Royalists under Lord Strange (better known as earl of Derby—"the great Stanley"); but was successfully defended by the inhabitants under the command of a German soldier of fortune, Colonel Rosworm, who complained with some bitterness of their ingratitude to him. An earlier affray between the Puritans and some of Lord Strange's followers is said to have occasioned the shedding of the first blood in the struggle between the king and parliament. The year 1694 witnessed the trial of those concerned in the so-called Lancashire plot, which ended in the triumphant acquittal of the supposed Jacobites. That the district really contained many ardent sympathizers with the Stuarts was, however, shown in the rising of 1715, when the clergy ranged themselves to a large extent on the side of the Pretender; and was still more clearly shown in the rebellion of 1745, when the town was occupied by Prince Charles Edward Stuart, and a regiment, known afterwards as the Manchester regiment, was formed and placed under the command of Colonel Francis Townley. In the fatal retreat of the Stuart troops the Manchester contingent was left to garrison Carlisle, and surrendered to the duke of Cumberland. The officers were taken to London, where they were tried for high treason and beheaded on Kennington Common.

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[1] In the *Antonine Itinerary* the name Mancunium (*q.v.*) or Mamucium is given. This is the origin of the modern name, and has supplied the adjective "Mancunian" (cf. "Old Mancunians" applied to old boys of Manchester Grammar School).

The variations of political action in Manchester had been exceedingly marked. In the 16th century, although it produced both Roman Catholic and Protestant martyrs, it was earnestly in favour of the Reformed faith, and in the succeeding century it became indeed a stronghold of Puritanism. Yet the successors of the Roundheads who defeated the army of Charles I. were Jacobite in their sympathies, and by the latter half of the 18th century had become imbued with the aggressive form of patriotic sentiment known as anti-Jacobinism, which showed itself chiefly in dislike of reform and reformers of every description. A change, however, was imminent. The distress caused by war and taxation, towards the end of the 18th and the beginning of the 19th century, led to bitter discontent, and the anomalies existing in the parliamentary system of representation afforded only too fair an object of attack. While single individuals in some portions of the country had the power to return members of parliament for their pocket boroughs, great towns like Manchester were entirely without representation. The popular discontent was met by a policy of repression, culminating in the affair of Peterloo, which may be regarded as the starting-point of the modern reform agitation. This was in 1819, when an immense crowd assembled on St Peter's Fields (now covered by the Free Trade Hall and warehouses) to petition parliament for a redress of their grievances. The Riot Act was read by a clerical magistrate; but in such a manner as to be quite unheard by the mass of the people; and drunken yeomanry cavalry were then turned loose upon the unresisting mass of spectators. The yeomanry appear to have used their sabres freely; several people killed and many more injured; and, although the magistrates received the thanks of the prince regent and the ministry, their conduct excited the deepest indignation throughout the entire country. Those who had organized the meeting, including "Orator" Hunt with Samuel Bamford and other working men, were imprisoned.

Naturally enough, the Manchester politicians took an important part in the Reform agitation; when the Act of 1832 was passed, the town sent as its representatives the Right Hon. C. P. Thomson, vice-president of the board of trade, and Mark Philips. With one notable exception, this was the first time that Manchester had been represented in parliament since its barons had seats in the House of Peers in the earlier centuries. In 1654 Charles Worsley and R. Radcliffe were nominated to represent it in Cromwell's parliament. Worsley was a man of great ability, and has a place in history as the man who carried out the injunction of the Protector to "remove that bauble," the mace of the House of Commons. The agitation for the repeal of the corn laws had its headquarters at Manchester, and the success which attended it, not less than the active interest taken by its inhabitants in public questions, has made the city the home of other projects of reform. The "United Kingdom Alliance for the Suppression of the Liquor Traffic" was founded there in 1853, and during the continuance of the American War the adherents both of the North and of the South deemed it desirable to have organizations in Manchester to influence public opinion in favour of their respective causes. A charter of incorporation was granted in 1838; a bishop was appointed in 1847; and the town became a city in 1853. The Lancashire cotton famine, caused by the Civil War in America, produced much distress in the Manchester district, and led to a national movement to help the starving operatives. The more recent annals of Manchester are a record of industrial and commercial developments, and of increase in educational opportunities of all kinds. Politically Manchester was Liberal, of one or other shade, under the first Reform Act; a Conservative member was first elected in 1868, and in 1874 two. Under household suffrage in 1885 that party secured five out of six members; in 1886 and 1892, three out of six. In 1895 and 1900 five Unionists were elected, but in 1906 six Liberals were returned, one of whom (Mr Winston Churchill) was defeated at a by-election in 1908. In 1910 three Liberals, two Labour members and one Conservative were elected.

AUTHORITIES.—Although several excellent books have been written on subjects connected with the town, there is no adequate modern history. The *History of Manchester*, by the Rev. John Whitaker, appeared in 1771; it is a mere fragment, and, though containing much important matter, requires to be very discreetly used. The following may be recommended: John Reilly, *History of Manchester*, (1861); R. W. Procter, *Manchester in Holiday Dress* (1866), *Memorials of Manchester Streets* (1874), *Memorials of Byegone Manchester* (1880); Richard Buxton, *Botanical Guide to Manchester, &c.* (2nd ed., 1859); Leo Grindon, *Manchester Flora* (1859); Edward Baines, *History of Lancashire*, edited by Croston (1886–1893), 5 vols.; W. A. Shaw, *Manchester, Old and New* (1894); W. E. A. Axon, *Annals of Manchester* (1885), *Cobden as a Citizen* (1906); Harry Rawson, *Historical Record of some Recent Enterprises of the Corporation of Manchester* (1894); *Official Manual of Manchester and Salford* (1909); J. P. Earwaker, *Court Leet Records of Manchester, 1552–1686, 1731–1846* (1884–1890), 12 vols.; *Constable's Accounts, 1612–1647, 1743–1776* (1891–1892), 3 vols.; *Manchester Municipal Code* (1894–1899), 5 vols.; George Saintsbury, *Manchester* (1887); Thomas Swindells, *Manchester Streets and Manchester Men* (1906–1907), 3 vols.; James Tait, *Medieval Manchester* (1904); Charles Roeder, *Roman Manchester* (1900); Sir Bosdin Leech, *History of the Manchester Ship Canal* (1907), 2 vols. (W. E. A. A.)

MANCHESTER (popularly Manchester-by-the-Sea), a township of Essex county, Massachusetts, U.S.A., about 25 m. N.E. of Boston, on Massachusetts Bay. Pop. (1900), 2522; (1905, state census), 2618; (1910), 2673. Area, 7·64 sq. m. It is served by the Boston & Maine railroad, and is connected with neighbouring towns and cities by electric lines. The township, heavily wooded in parts, and with picturesque shores alternating between rocky headlands and sandy beaches, stretches for several miles along the coast between Beverly on the west and Gloucester on the east. It is one of the most beautiful watering-places in America, and is the favourite summer residence of many of the foreign diplomats at Washington. The "singing beach" is a stretch of white sand, which, when trodden upon, emits a curious musical sound. Manchester, originally a part of Salem, was settled about 1630 and was at first known as Jeffrey's Creek. It was incorporated separately under its present name in 1645.

See *Manchester Town Records* (2 vols., Salem, 1889–1891), and D. F. Lamson, *History of the Town of Manchester, 1645–1895* (Manchester, 1895).

MANCHESTER, the largest city of New Hampshire, U.S.A., and one of the county-seats of Hillsboro county, on the Merrimac river, at the mouth of the Piscataquog river, (by rail) 18 m. S. of Concord and 57 m. N.N.W. of Boston. Pop. (1890), 44,126; (1900), 56,987; (1910 U.S. census) 70,063. Of the total population in 1900, 24,257 were foreign-born, including 13,429 French-Canadians; and 37,530 were of foreign parentage (both parents foreign-born), including 18,839 of French-Canadian parentage. Manchester is served by the Southern, the Western, the White Mountains, and the Worcester Nashua & Portland divisions of the Boston & Maine railroad, and by inter-urban electric lines. It is situated on a plain about 90 ft. above the Merrimac river (which is spanned here by three bridges), commands extensive views of the beautiful Merrimac valley, and covers a land area of about 33 sq. m. On the east side of the city are two connected lakes known as Lake Massabesic (30 m. in circumference). Manchester is known for the attractive appearance of the residence districts in which the factory operatives live, detached homes and "corporation boarding-houses," instead of tenement houses, being the rule. The Institute of Arts and Sciences (incorporated in 1898) provides lecture courses and classes in science, art and music. Among the other public buildings and institutions are the United States Government building, the city-hall, the county-court-house, the city library (1854; the outgrowth of the Manchester Athenaeum, established in 1844), St Anselm's College (R.C.), a Roman Catholic cathedral, four Roman Catholic convents, the Elliot hospital, the Sacred Heart hospital and the hospital of Notre Dame de Lourdes, the State industrial school, the State house of correction, the Gale home for aged women, an old ladies' home (R.C.), St Martha's home for working girls, the Manchester children's home and four orphan asylums. In the largest of five public squares is a soldiers' monument, consisting of a granite column 50 ft. high, surmounted by a statue of Victory. The city has two parks, and in one of them, overlooking the Merrimac, is a monument to the memory of General John Stark, who was born and was buried here. The water-supply is obtained from Lake Massabesic. Amoskeag Falls in the Merrimac are 55 ft. in height, and by means of hydraulic canals Manchester is provided with a fine water-power. Steam power is also used, and the city is by far the most important manufacturing centre in the state. It is extensively engaged in the manufacture of cotton goods, boots and shoes, worsted goods, hosiery and other knit goods, and locomotives; among the other manufactures are linen goods, steam fire-engines, paper, edge tools, soap, leather, carriages and beer. The value of the city's factory products increased from $24,628,345 in 1900 to $30,696,926 in 1905, or 24·6%. In 1905 Manchester produced 24·8% of the total factory product of the state. Manchester ranks fifth among the cities of the United States in cotton manufacturing, and ninth among the cities of the country in the manufacture of boots and shoes.

On account of the abundance of fish in the river here, Amoskeag Falls and vicinity were a favourite resort of the Penacook Indians, and it is said that John Eliot, the "Apostle to the Indians," preached to them here in the summer of 1651. The first white settlement within the present limits of Manchester was made in 1722 by Scottish-Irish immigrants at Goffe's Falls, 5 m. below Amoskeag Falls. In 1723 a cabin was built by some of these immigrants at the greater falls, and gradually a small settlement grew up there. In 1735 Massachusetts granted to a body of men known as "Tyng's Snow-Shoe Scouts" and their descendants a tract of land 3 m. wide along the east bank of the Merrimac, designated as "Tyng's Township." The Scottish-Irish claimed this tract as part of their grant from New Hampshire, and there arose between the rival claimants a bitter controversy which lasted until May 1741, when the courts decided against the Massachusetts claimants. In 1751 the territory formerly known as "Tyng's Township," and sometimes called "Harrytown," with portions of Chester and Londonderry, was incorporated as a township under the name Derryfield; in 1810 the name was changed to Manchester, the change having been suggested by the town's manufacturing possibilities; and in 1846 Manchester was chartered as a city. The first sawmill was erected as early as 1736, and during the years from 1794 to 1807 a canal was constructed around the Amoskeag Falls through which to carry lumber. As late as 1830 the town had a population of only 877, but in 1831 the Amoskeag Manufacturing Company was incorporated, the construction of hydraulic canals and the erection of cotton mills followed, the villages of Piscataquog and Amoskeag were annexed in 1853, and the population increased to 3235 in 1840, to 8841 in 1860, and to 33,592 in 1880.

Consult M. D. Clarke, *Manchester, A Brief Record of its Past and a Picture of its Present* (Manchester, 1875).

MANCHESTER, a former city of Chesterfield county, Virginia, U.S.A., (on the S. side of the James river), since 1910 a part of Richmond. Pop. (1900), 9715, of whom 3338 were negroes; (1906 estimate), 9997. It is served by the Atlantic Coast Line, the Seaboard Air Line, and the Southern railways, by electric lines to Richmond and Petersburg, and by numerous river boats. It is finely situated in a bend of the river, with about 2 m. of water front; on the heights above is Forest Hill park, a pleasure resort, and adjacent to it Woodland Heights, a beautiful residential district. From the surrounding country come much agricultural produce, coal, lumber, bricks and granite. There is a good harbour and excellent water power. Among the manufactures are paper, flour, cotton goods, leather, brick, railway supplies, &c. The value of the city's factory products increased from $1,621,358 in 1900 to $3,226,268 in 1905, or 99%.

MANCHESTER SHIP CANAL. The advantage of a waterway for the conveyance of goods between eastern Lancashire and the sea is so obvious that so far back as the year 1721 Thomas Steers designed a plan for continuing to Manchester the barge navigation which then existed between Liverpool and Warrington. Parliamentary powers were then obtained to improve the rivers Mersey and Irwell from Warrington to Manchester by means of locks and weirs. This work was successfully carried out, and proved of great benefit to the trade of the district. The duke of Bridgewater, who had made a canal from his collieries at Worsley to Manchester, afterwards continued the canal to the Mersey at Runcorn; this extension was opened in 1722 and competed with the Mersey and Irwell navigation, both routes being navigated by barges carrying about fifty tons of cargo. The Liverpool & Manchester railway at a later date afforded further facilities for conveyance of goods, but the high rates of carriage, added to heavy charges at the Liverpool docks, prejudiced trade, and the question was mooted of a ship canal to bring cotton, timber, grain and other goods direct to Manchester without transshipment. The first plan was made by William Chapman in 1825, and was followed by one designed by Henry Palmer in 1840, but it was not until the year 1882 that the movement was originated that culminated in the opening of the Manchester Ship Canal by Queen Victoria on the 21st of May 1894.

In determining the plan of the canal the main point which arose was whether it should be made with locks or whether it should be on the sea-level throughout, and therefore tidal. The advantage of a still waterway in navigating large steamers, and the facilities afforded by one constant water-level for works on the banks and the quick discharge of goods at the terminal docks at Manchester, secured the adoption of the plans for a canal with locks as designed by Sir E. Leader Williams. The fresh-water portion of the canal extended between Manchester and Runcorn, while from the latter place to Garston it was proposed to improve the upper Mersey estuary by constructing training walls and dredging to form a deep central channel. Parliamentary powers to construct the canal were sought in the session of 1883, when the bill passed the committee of the House of Commons but was rejected by the committee of the House of Lords. Brought forward again the next year, it was passed by the Lords but thrown out by the Commons. The opposition from Liverpool and the railway companies was very strong; to meet to some extent that of the former, a continuation of the canal was proposed from Runcorn to Eastham along the Cheshire side of the Mersey, instead of a trained channel in the estuary, and in this form the bill was again introduced in the session of 1885, and, notwithstanding strong opposition, was passed by both houses of parliament. The cost of this contest to promoters and opponents exceeded £400,000, the various committees on the bill having sat over 175 days. Owing to difficulties in raising the capital the works were not begun until November 1887.

The total length of the canal is 35½ m. and it may be regarded as divided into three sections. From Eastham to Runcorn it is near or through the Mersey estuary for 12¾ m., and thence to Latchford near Warrington, 8¼ m., it is inland; both these sections have the same water-level, which is raised by high tides. At Latchford the locks stop tidal action, and the canal is fed by the waters of the rivers Mersey and Irwell from that point to Manchester, 14½ m. from Latchford. The canal begins on the Cheshire side of the Mersey at Eastham, about 6 m. above Liverpool. The entrance is well sheltered and adjoins a good low-water channel communicating with the Sloyne deep at Liverpool. Three entrance locks have been provided close to and parallel with each other, their length and width being 600 by 80, 350 by 50, and 150 by 30 ft. These locks maintain the water-level in the canal nearly to mean high-water level (14 ft. 2 in. above the Liverpool datum); when the tide rises above that height the lock gates are opened and the tide flows up to Latchford, giving on high spring tides an additional depth of water of about 7 ft. On the ebb tide this water is returned to the Mersey through large sluices at Randles Creek and at the junction of the river Weaver with the canal, the level of the canal thus being reduced to its normal height. The canal throughout to Manchester has a minimum depth of 28 ft.; the depth originally was 26 ft., but the lock sills were placed 2 ft. lower to allow of the channel being dredged to 28 ft. when necessary. The minimum width at bottom is 120 ft., allowing large vessels to pass each other at any point on the canal; this width is considerably increased at the locks and other parts. The slopes are generally about 1½ to 1, but are flatter through some portions; in rock-cutting the sides are nearly vertical. From Eastham to Runcorn the canal is alternately inland and on the foreshore of the estuary, on which embankments were constructed to act as dams and keep out the tide during the excavation of the canal, and afterwards to maintain the water-level at low water in the estuary; both sides are faced with heavy coursed stone. The material for the embankments was principally clay excavated from the cuttings. In some places, where the foundation was of a porous nature, sheeting piles of timber had to be used. At Ellesmere Port, where the embankment is 6200 ft. long on sand, 13,000 whole timber sheeting piles 35 ft. long were driven, to secure the base of the embankment on each side; water jets under pressure through 1¾ in. wrought-iron pipes were used at the foot of each pile to assist the sinking, which was found most difficult by ordinary means. At the river Weaver ten Stoney roller sluices are built, each 30 ft. span, with heavy stone and concrete piers and foundations; at Runcorn, where the river Mersey is narrow, a concrete sea-wall 4300 ft. long was substituted for the embankment. At various points under the canal cast-iron siphon pipes were laid to carry off any land drainage which was at a lower level than the canal; the largest of these siphons were constructed to allow the tidal and fresh water of the river Gowy to pass under the canal at Stanlow Point, between Eastham and Ellesmere Port. Two 12-ft. siphons are there placed close together, built of cast-iron segments; they are each 400 ft. long, and were laid on concrete 4 ft. below the bottom of the canal. From Runcorn to Latchford the canal is nearly straight, the depth of cutting varying from 35 to 70 ft., partly in rock, but generally in alluvial deposit. The whole length of the canal passes through the New Red Sandstone formation, with its overlying beds of gravel, clay, sand and silt, which gave much trouble during the progress of the work; retaining walls of stone and brickwork had to be built in these places to maintain the sides of the canal from slips and injury from the wash of steamers.

The canal from Latchford to Manchester is in heavy cutting through the valleys of the rivers Mersey and Irwell. As these rivers are circuitous in course, only very small portions could be utilized in forming the canal; a line as nearly straight as possible was therefore adopted, and involved many crossings of the river channels. During the whole progress of the work these had to be kept open for the discharge of floods and land water, and in some places temporary cuts of considerable length had to be made for the same object. In November 1890 and December 1891 high winter floods covered the whole of the river valleys, filling many miles of the unfinished canal and causing great damage to the slopes. Altogether 23 m. of canal had to be pumped out to enable the work to be completed. After the cuttings between the river channels were finished, the end dams were removed, and the rivers Irwell and Mersey were turned into the new channel now forming the upper portion of the ship canal. The total rise to the level of the docks at Manchester from the ordinary level of the water in the tidal portion of the canal below Latchford locks is 60 ft. 6 in.; this is obtained by an average rise of about 15 ft. at each of the sets of locks at Latchford, Irlam (7½ m. nearer Manchester), Barton (2 m. farther) and Mode Wheel (3½ m. above Barton locks at the entrance to the Manchester docks). For the greater part of this last length the canal is widened at bottom from 120 ft., its normal width, to 170 ft., to enable vessels to lie at timber and other wharves without interfering with the passage of large vessels to or from the docks. The locks are in duplicate, one being 600 ft. long by 65 ft. wide, the other 350 ft. long by 45 ft. wide, with Stoney's sluices adjacent. They are filled or emptied in five minutes by large culverts on each side with side openings into the lock. Concrete with facings of blue Staffordshire brick is largely used, and the copings, sills, hollow quoins and fender courses are of Cornish granite. The lock gates are constructed of greenheart timber. The sluices near the locks take the place of the weirs used in the old Mersey and Irwell navigation; they are 30 ft. span each, four being generally used at each set of locks. In ordinary seasons any water not used for lockage purposes passes over the tops of the sluices, which are kept closed; in flood times the sluices are raised to a height which will pass off floods with a comparatively small rise in the canal. There are eight hydraulic installations on the canal, each having duplicate steam-engines and boilers; the mains exceed 7 m. in length, the pressure being 700 ℔ to the inch. They work the cranes, lifts and capstans at the docks, lock gates and culvert sluices, coal tips, swing bridges and aqueduct.

At Barton, near Manchester, the Bridgewater canal crosses the river Irwell on the first navigable aqueduct constructed in England. It was the work of James Brindley, and since it was built at only sufficient height to allow of barges passing under it, means had to be found to allow of this important canal being maintained, and yet to permit steamers to use the ship canal below it. Brindley's canal is on one level throughout its whole length, and as its water supply is only sufficient for the flight of locks by which it descends at Runcorn to the Mersey, locks down to the ship canal would have involved the waste of a lock of water on each side and caused serious delay to the traffic. Sir E. Leader Williams surmounted the difficulty by means of a swing aqueduct for the Bridgewater canal, which when closed enables the traffic to pass as before, while it is opened to allow of ships crossing it on the lower level of the ship canal. The water in the swing portions of the aqueduct when opened is retained by closing gates at each end, similar gates being shut at the same time across the fixed portion of the aqueduct. The swing portion is a large steel trough carried by side girders, 234 ft. long and 33 ft. high in the centre, tapering 4 ft. to the ends; the waterway is 19 ft. wide and 6 ft. deep. The whole works on a central pier with similar arrangements to the largest swing bridges on the canal; it has two spans over the ship canal of 90 ft. each. It is somewhat singular that the first fixed canal aqueduct in England should, after the lapse of 136 years, be replaced by the first swing aqueduct ever constructed. The swing aqueduct is moved by hydraulic power, and has never given any trouble in working, even in times of severe frost. The weight of the movable portion, including the water, is 1600 tons.

The manner of dealing with the five lines of railways that were cut through by the canal was one of importance, both in the interests of the travelling public and the trade on the canal; they are all lines with a heavy traffic, including the main line of the London & North Western railway near Warrington, with its important route to Scotland. Swing bridges, although in use on some lines to cross navigations, are dangerous and inconvenient, and high-level deviation lines were adopted for each railway crossing the canal. No such alteration of a railway had been previously sanctioned by parliament, and it was only the importance of a ship canal to Manchester that secured the requisite powers against the strong opposition of the railway companies. Embankments were made close to and parallel with the old lines, beginning about a mile and a quarter from the canal on each side, the canal itself being crossed by viaducts which give a clear headway of 75 ft. at ordinary water-level. Vessels with high masts trading on the canal are provided with telescopic or sliding top-masts. The gradients on the railways rising up to the viaducts are 1 in 135. The span of the viaducts is so arranged as to maintain the full width of the canal for navigation; and as the railways generally cross the canal on the skew, this necessitated girders in some cases of 300 ft. span. There are nine main roads requiring swing bridges across the canal, all below Barton have a span giving a clear water-way of 120 ft. The width of these bridges varies with the importance of the roads from 20 to 36 ft., and they are constructed of steel, their weight ranging from 500 to 1000 tons each. They work on a live ring of conical cast-iron rollers and are moved by hydraulic power supplied by steam, gas or oil engines. The Trafford Road bridge at the docks at Manchester is the heaviest swing bridge on the canal; being of extra width, it weighs 1800 tons.

The canal being virtually one long dock, wharves at various points have been erected to enable chemical or manufacturing works to be carried on, widenings being provided where necessary. At Ellesmere Port coal tips and sheds have been erected, and the canal is in direct communication with the docks there as well as at Weston Point and Runcorn, where a large trade is carried on with the Staffordshire Potteries and the Cheshire salt districts. At Partington branches from the railways connect the canal with the Yorkshire and Lancashire coal-fields, and the canal is widened out 65 ft. on each side for six hydraulic coal tips. At Mode Wheel there are extensive abattoirs and lairages, erected by the Manchester Corporation; also large petroleum oil tanks, graving dock and pontoons, cold-air meat stores and other accommodation for traffic. At Manchester the area of the docks is 104 acres, with 152 acres of quay space, having over 5 m. of frontage to the docks, which are provided with a number of three-storey transit sheds, thirteen seven-storey and seven four-storey warehouses, and a large grain silo. The London & North Western and Lancashire & Yorkshire railway companies and the Cheshire Lines Committee have made branch lines to the docks, the railways and sidings at which are over 30 miles in length. Much traffic is also carted, or dealt with by inland canals in direct communication with the docks. The substitution of a wide and deep canal, nearly straight, for comparatively shallow and narrow winding rivers, and the use of large sluices in place of fixed weirs to carry off the river water, have been of great advantage to the district in greatly reducing the height of floods.

The total amount of excavation in the canal, docks and subsidiary work amounted to over 54 million cub. yds., nearly one-fourth of which was sandstone rock; the excavated material was used in forming the railway deviation embankments, filling up the old beds of the rivers and raising low lands near the canal. As many men were employed on the works as could be obtained, but the number never exceeded 17,000, and the greater part of the excavation was done by about eighty steam navvies and land dredgers. For the conveyance of excavation and materials, 228 miles of temporary railway lines were laid, and 173 locomotives, 6300 wagons and trucks, and 316 fixed and portable steam-engines and cranes were employed, the total cost of the plant being nearly £1,000,000. The expenditure on the works, including plant and equipment, to the 1st of January 1900, was £10,327,666. The purchase of the Mersey and Irwell and Bridgewater navigations (£1,786,651), land and compensation (£1,223,809), interest on capital during constructions (£1,170,733), and parliamentary, superintendence and general expenses brought up the total amount to £15,248,437.

The traffic on the canal gradually increased from 925,659 tons in 1894 to 2,778,108 tons in 1899 and 5,210,759 tons in 1907. After its opening considerable reductions were made in the railway rates of carriage and the charges at the Liverpool docks in order to meet the lower cost of conveyance by shipping passing up it. The result has been of great advantage to the trade of Lancashire and the surrounding districts, and the saving in the cost of carriage, estimated at £700,000 a year, assists manufacturers to meet the competition of their foreign opponents who have the advantage of low rates of carriage on the improved waterways of America, Germany, France and Belgium. Before the construction of the canal, large manufacturers had left Manchester to establish their works at ports like Glasgow, where they could save the cost of inland carriage. Since its opening, new industries have been started at Manchester and along its banks, warehouses and mills that were formerly empty are now occupied, while nearly 10,000 new houses have been built for the accommodation of the workpeople required to meet the enlarged trade of the city.

For further details see Sir Bosdin Leech, *History of the Manchester Ship Canal* (Manchester, 1907). (E. L. W.)

MANCHURIA, the name by which the territory in the east of Asia occupied by the Manchus is known in Europe. By the Chinese it is called the country of the Manchus, an epithet meaning "pure," chosen by the founder of the dynasty which now rules over Manchuria and China as an appropriate designation for his family. Manchuria lies in a north-westerly and south-easterly direction between 39° and 53° N. and between 116° and 134° E., and is wedged in between China and Mongolia on the west and north-west, and Korea and the Russian territory on the Amur on the east and north. More definitely, it is bounded N. by the Amur, E. by the Usuri, S. by the Gulf of Liao-tung, the Yellow Sea and Korea, and W. by Chih-li and Mongolia. The territory thus defined is about 800 m. in length and 500 m. in width, and contains about 390,000 sq. m. It is divided into three provinces, viz. Hei-lung-kiang or Northern Manchuria, Kirin or Central Manchuria, and Shĕng-king or Southern Manchuria. Physically the country is divided into two regions, the one a series of mountain ranges occupying the northern and eastern portions of the kingdom, and the other a plain which stretches southwards from Mukden, the capital, to the Gulf of Liao-tung.

A system of parallel ranges of mountains, culminating in the Chinese Ch'ang pai Shan, "the long white mountains," on the Korean frontier, runs in a north-easterly direction from the shores of the Gulf of Liao-tung. In its course through Eastern Manchuria it forms the watershed of the Sungari, Usuri and other rivers, and in the south that of the Ya-lu and many smaller streams. It also forms the eastern boundary of the great plain of Liao-tung. The mountains of this system reach their greatest height on the south-east of Kirin, where their snow-capped peaks rise to the elevation of 8000 ft. The scenery among them is justly celebrated, more especially in the neighbourhood of Haich'ĕng, Siu-yen and the Korean Gate.

The three principal rivers of Manchuria are the Sungari, Mutan-kiang and Usuri already mentioned. Of these the Sungari, which is the largest, rises on the northern slopes of the Ch'ang pai Shan range, and runs in a north-westerly direction to its junction with the Nonni, from which point it turns north-east until it empties itself into the Amur. It is navigable by native junks above Kirin, which city may also be reached by steamer. In its long course it varies greatly both in depth and width, in some parts being only a few feet deep and spreading out to a width of more than a mile, while in other and mountainous portions of its course its channel is narrowed to 300 or 400 ft., and its depth is increased in inverse ratio. The Usuri rises in about 44° N. and 131° E., and after running a north-easterly course for nearly 500 m. it also joins the Amur. The Mutan-kiang takes its rise, like the Sungari, on the northern slopes of the Ch'ang pai Shan range, and not far from the sources of that river. It takes a north-easterly course as far as the city of Ninguta, at which point it turns northward, and so continues until it joins the Sungari at San-sing. It is navigable by junks between that city and Ninguta, though the torrents in its course make the voyage backwards and forwards one of considerable difficulty. Next in importance to these rivers are the Liao and Ya-lu, the former of which rises in Mongolia, and after running in an easterly direction for about 400 m. enters Manchuria in about 43° N., and turning southward empties itself into the Gulf of Liao-tung. The Ya-lu rises in Korea, and is the frontier river of that country.

Provinces and Towns.—Mukden, or as it is called by the Chinese Shĕng-king, the capital city of Manchuria, is situated in the province of Shĕng-king, occupies a fine position on the river Hun-ho, an affluent of the Liao, and is a city of considerable pretensions. Liao-yang, which was once the capital of the country, is also in the province of Shĕng-king. The other cities in the province are Kin-chow-fu on the west of the Gulf of Liao-tung; Kin-chow, on the western extremity of the Liao-tung peninsula; Kai-ping, on the north-western shore of the same peninsula; Hai-chĕng, on the road from Niu-chwang to Mukden; Ki-yuen, a populous and prosperous city in the north of the province; and Sing-king, east of Mukden, the original seat of the founders of the present dynasty. The most important commercial place, however, is the treaty port of Niu-chwang, at the head of the Gulf of Liao-tung. According to the custom-house returns the value of the foreign imports and exports in the year 1880 was £691,954 and £1,117,790 respectively, besides a large native trade carried on in junks. In 1904 the value of foreign imports had risen to £2,757,962, but the exports amounted to £1,742,859 only, the comparatively low figure being accounted for by the Russo-Japanese war.

The province of Kirin, or Central Manchuria, is bounded on the N. and N.W. by the Sungari, on the S. by Shĕng-king and Korea, on the W. by Mongolia, and on the E. by the Usuri and the maritime Russian province. It contains an area of about 90,000 sq. m., and is entirely mountainous with the exception of a stretch of plain country in its north-western corner. This plain produces large quantities of indigo and opium, and is physically remarkable for the number of isolated conical hills which dot its surface. These sometimes occur in a direct line at intervals of 15 or 20 m., and elsewhere are scattered about "like dish-covers on a table." Kirin, the capital of the province, occupies a magnificent position, being surrounded on the north, west and south by a semicircular range of mountains with the broad stream of the Sungari flowing across the front. The local trade is considerable. A-She-ho, on the Ashe, with a population of 60,000; Petuna (Chinese, Sing-chung), on the Sungari, population 30,000; San-sing, near the junction of the Sungari and Mutan-kiang; La-lin, 120 m. to the north of Kirin, population 20,000; Harbin or Kharbin and Ninguta are the other principal cities in the province.

Hei-lung-kiang, or Northern Manchuria, which contains about 195,000 sq. m., is bounded on the N. and N.E. by the Amur, on the S. by the Sungari, and on the W. by the Nonni and Mongolia. It is traversed by the Great and Lesser Khingan mountains and their offshoots. This province is thinly populated, and is cultivated only along the lines of its rivers. The only towns of any importance are Tsitsihar and Mergen, both situated on the Nonni and Khailar in the west.

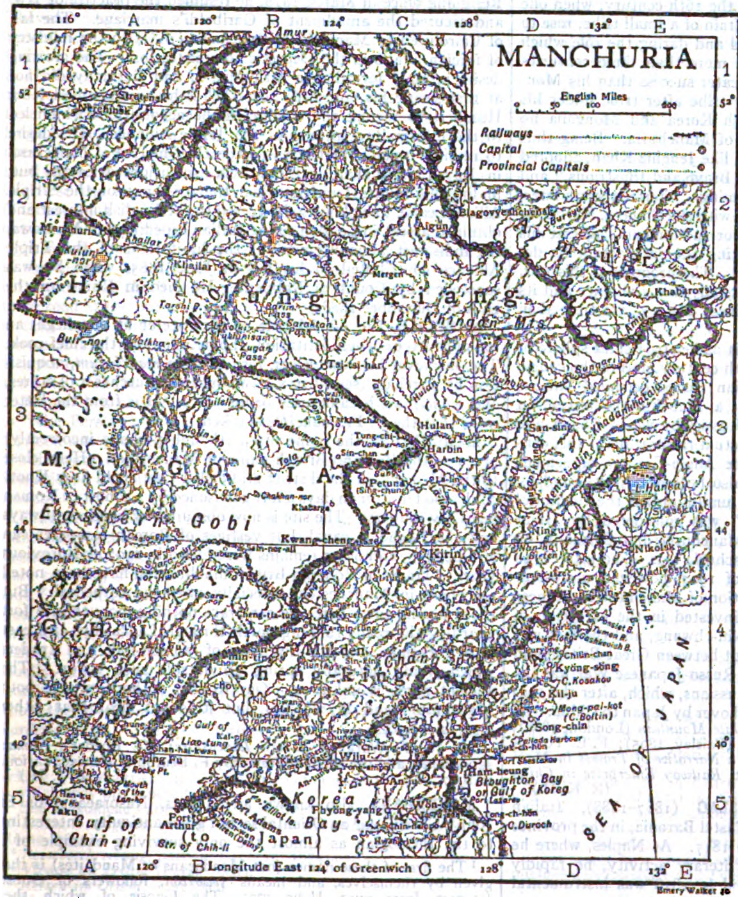
Climate, Flora, Fauna.—The climate over the greater part of the country varies between extremes of heat and cold, the thermometer ranging between 90° F. in the summer and 10° below zero in the winter. As in the north of China, the rivers are frozen up during the four winter months. After a short spring the heat of summer succeeds, which in its turn is followed by an autumn of six weeks' duration. The great plain in Shĕng-king is in many parts swampy, and in the neighbourhood of the sea, where the soil emits a saline exudation such as is also common in the north of China, it is perfectly sterile. In other parts fine crops of millet and various kinds of grain are grown, and on it trees flourish abundantly. The trees and plants are much the same as those common in England, and severe as the weather is in winter the less elevated mountains are covered to their summits with trees. The wild animals also are those known in Europe, with the addition of tigers and panthers. Bears, wild boars, hares, wolves, foxes and wild cats are very common, and in the north sables are found in great numbers. One of the most noticeable of the birds is the Mongolian lark (*Melanocorypha mongolica*), which is found in a wild state both in Manchuria and in the desert of Mongolia. This bird is exported in large numbers to northern China, where it is much prized on account of its extraordinary power of imitation. The Manchurian crane is common, as also are eagles, cuckoos, laughing doves, &c. Insects abound, owing to the swampy nature of much of the country. The rivers are well stocked with fish, especially with salmon, which forms a common article of food. In such immense shoals do these fish appear in some of the smaller streams that numbers are squeezed out on to the banks and there perish.

Products and Industries.—In minerals Manchuria is very rich: coal, gold, iron (as well as magnetic iron ore), and precious stones are found in large quantities. Gold mines are worked at several places in the northern part of Manchuria, of which the principal are on the Muho river, an affluent of the Amur, and near the Russian frontier. Mines are also worked at Kwanyin-shan, opposite the Russian frontier town of Radevska, and at Chia-pi-kou, on an affluent of the upper Sungari. Indigo and opium are the most lucrative crops. The indigo plant is grown in large quantities in the plain country to the north of Mukden, and is transported thence to the coast in carts, each of which carries rather more than a ton weight of the dye. The poppy is cultivated wherever it will grow, the crop being far more profitable than that of any other product. Cotton, tobacco, pulse, millet, wheat and barley are also grown.

Population.—The population is estimated as follows for each of the three divisions:—

Province of Shĕng-king (Fĕng T'ien)	4,000,000
„ „ Kirin	6,500,000
„ „ Hei-lung-kiang	2,000,000
Total	12,500,000

Communications.—Four principal highways traverse Manchuria. The first runs from Peking to Kirin via Mukden, where it sends off a branch to Korea. At Kirin it bifurcates, one branch going to San-sing, the extreme north-eastern town of the province of Kirin, and the other to Possiet Bay on the coast via Ninguta. The second road runs from the treaty port of Niu-chwang through Mukden to Petuna in the north-western corner of the Kirin province, and thence to Tsitsihar, Mergen and the Amur. The third also starts from Niu-chwang, and strikes southward to Kin-chow at the extremity of the Liao-tung peninsula. The fourth connects Niu-chwang with the Gate of Korea.



Manchurian Railways.

The original Manchurian railway was constructed under an agreement made in 1896 between the Chinese government and the Russo-Chinese bank, an institution founded in 1895 to develop Russian interests in the East. The Chinese Eastern Railway Company was formed by the bank under this agreement, to construct and work the line, and surveys were made in 1897, the town of Harbin being founded as headquarters for the work. The line, which affords through communication from Europe by way of the Trans-Siberian system, enters Manchuria near a station of that name in the north-west corner of the country, passes Khailar, and runs south-east, near Tsitsihar, to Harbin. Thence the main line continues in the same general direction to the eastern frontier of Manchuria, and so to Vladivostok. In 1898 Russia obtained a lease of the Liao-tung peninsula, and a clause of this contract empowered her to connect Port Arthur and Dalny (now Tairen) with the main Manchurian railway by a branch southward from Harbin. In spite of interruption caused by the Boxer outbreak, through communication was established in 1901. Under the Russo-Japanese treaty of August 1905, after the war, supplemented by a convention between Japan and China concluded in December of the same year, Japan took over the line from Port Arthur as far as Kwang-chĕng-tsze, now known as the Southern Manchurian railway (508 m.). Branches were promoted (*a*) from Mukden to Antung on the Yalu, to connect with the Korean system, and (*b*) from Kwang-chĕng-tsze to Kirin. The rest of the original Manchurian system (1088 miles) remains under Russian control. In the south-west of Manchuria a line of the imperial railways of Northern China gives connexion from Peking, and branches at Kou-pang-tsze to Sin-min-ting and to Niu-chwang, and the link between Sin-min-ting and Mukden is also under Chinese control. The lines now under Russian control were laid down, and remain, on the 5 ft. gauge which is the Russian standard; but after the Russian control of the southern lines was lost the gauge was altered from that standard.

History.—Manchu, as has been said, is not the name of the country but of the people who inhabit it. The name was adopted by a ruler who rose to power in the beginning of the 13th century. Before that time the Manchus were more or less a shifting population, and, being broken up into a number of tribes, they went mainly under the distinctive name of those clans which exercised lordship over them. Thus under the Chow dynasty (1122–225 B.C.) they were known as Sewshin, and at subsequent periods as Yih-low, Wuh-keih, Moh-hoh, Pohai, Nüchih and according to the Chinese historians also as Khitan. Throughout their history they appear as a rude people, the tribute they brought to the Chinese court consisting of stone arrow-heads, hawks, gold, and latterly ginseng. Assuming that, as the Chinese say, the Khitans were Manchus, the first appearance of the Manchus, as a people, in China dates from the beginning of the 10th century, when the Khitans, having first conquered the kingdom of Pohai, crossed the frontier into China and established the Liao or Iron dynasty in the northern portion of the empire. These invaders were in their turn overthrown two centuries later by another invasion from Manchuria. These new conquerors were Nüchihs, and therefore direct ancestors of the Manchus. On assuming the imperial yellow in China their chief adopted the title of Kin or "Golden" for his dynasty. "Iron" (Liao), he said, "rusts, but gold always keeps its purity and colour, therefore my dynasty shall be called Kin." In a little more than a century, however, the Kins were driven out of China by the Mongols under Jenghiz Khan. But before the close of their rule a miraculous event occurred on the Chang-pai-Shan mountains which is popularly believed to have laid the seeds of the greatness of the present rulers of the empire. Three heaven-born maidens, so runs the legend, were bathing one day in a lake under the Chang-pai-Shan mountains when a passing magpie dropped a ripe red fruit into the lap of one of them. The maiden ate the fruit, and in due course a child was born to her, whom she named Aisin Gioro, or the Golden. When quite a lad Aisin Gioro was elected chief over three contending clans, and established his capital at Otoli near the Chang-pai-Shan mountains. His reign, however, was brief, for his subjects rose and murdered him, with all his sons except the youngest, Fancha, who, like the infant Haitu in Mongolian history, was miraculously saved. Nothing is recorded of the facts of Aisin Gioro's reign except that he named the people over whom he reigned Manchu, or "Pure." His descendants, through the rescued Fancha, fell into complete obscurity until about the middle of the 16th century, when one of them, Nurhachu by name, a chieftain of a small tribe, rose to power. Nurhachu played with skill and daring the rôle which had been played by Jenghiz Khan more than three centuries before in Mongolia. With even greater success than his Mongolian counterpart, Nurhachu drew tribe after tribe under his sway, and after numerous wars with Korea and Mongolia he established his rule over the whole of Manchuria. Being thus the sovereign of an empire, he, again like Jenghiz Khan, adopted for himself the title of Ying-ming, "Brave and Illustrious," and took for his reign the title of T'ien-ming. Thirteen years later, in 1617, after numerous border fights with the Chinese, Nurhachu drew up a list of "seven hates," or indictments, against his southern neighbours, and, not getting the satisfaction he demanded, declared war against them. The progress of this war, the peace hastily patched up, the equally hasty alliance and its consequences, being matters of Chinese history, are treated in the article CHINA.

Manchuria was claimed by Russia as her particular sphere of interest towards the close of the 19th century, and in the course of the disturbances of 1900 Russian troops occupied various parts of the country. Eventually a Manchurian convention was arranged between China and Russia, by which Russia was to evacuate the province; but no actual ratification of this convention was made by Russia. The Anglo-German agreement of October 1900, to which Japan also became a party, and by which it was agreed to "maintain undiminished the territorial condition of the Chinese empire," was considered by Great Britain and Japan not to exclude Manchuria; but Germany, on the other hand, declared that Manchuria was of no interest to her. The Anglo-Japanese treaty of 1902, however, was ostensibly directed towards the preservation of Manchuria in Chinese hands. British capital has been invested in the extension of the Chinese Northern railway to Niu-chwang, and the fact was officially recognized by an agreement between Great Britain and Russia in 1899. One result of the Russo-Japanese War was the evacuation of Manchuria by the Russians, which, after the conclusion of peace in 1905, was handed over by Japan to China.

See H. E. M. James, *The Long White Mountain* (London, 1888); D. Christie, *Ten Years in Manchuria* (Paisley, 1895); F. E. Younghusband, *The Heart of a Continent: a Narrative of Travels in Manchuria* (London, 1896); P. H. Kent, *Railway Enterprise in China* (London, 1907). (R. K. D.)

MANCINI, PASQUALE STANISLAO (1817–1888), Italian jurist and statesman, was born at Castel Baronia, in the province of Avellino, on the 17th of March 1817. At Naples, where he studied law and displayed great literary activity, he rapidly acquired a prominent position, and in 1848 was instrumental in persuading Ferdinand II. to participate in the war against Austria. Twice he declined the offer of a portfolio in the Neapolitan cabinet, and upon the triumph of the reactionary party undertook the defence of the Liberal political prisoners. Threatened with imprisonment in his turn, he fled to Piedmont, where he obtained a university professorship and became preceptor of the crown prince Humbert. In 1860 he prepared the legislative unification of Italy, opposed the idea of an alliance between Piedmont and Naples, and, after the fall of the Bourbons, was sent to Naples as administrator of justice, in which capacity he suppressed the religious orders, revoked the Concordat, proclaimed the right of the state to Church property, and unified civil and commercial jurisprudence. In 1862 he became minister of public instruction in the Rattazzi cabinet, and induced the Chamber to abolish capital punishment. Thereafter, for fourteen years, he devoted himself chiefly to questions of international law and arbitration, but in 1876, upon the advent of the Left to power, became minister of justice in the Depretis cabinet. His Liberalism found expression in the extension of press freedom, the repeal of imprisonment for debt, and the abolition of ecclesiastical tithes. During the Conclave of 1878 he succeeded, by negotiations with Cardinal Pecci (afterwards Leo XIII.), in inducing the Sacred College to remain in Rome, and, after the election of the new pope, arranged for his temporary absence from the Vatican for the purpose of settling private business. Resigning office in March 1878, he resumed the practice of law, and secured the annulment of Garibaldi's marriage. The fall of Cairoli led to Mancini's appointment (1881) to the ministry of foreign affairs in the Depretis administration. The growing desire in Italy for alliance with Austria and Germany did not at first secure his approval; nevertheless he accompanied King Humbert to Vienna and conducted the negotiations which led to the informal acceptance of the Triple Alliance. His desire to retain French confidence was the chief motive of his refusal in July 1882 to share in the British expedition to Egypt, but, finding his efforts fruitless when the existence of the Triple Alliance came to be known, he veered to the English interest and obtained assent in London to the Italian expedition to Massawa. An indiscreet announcement of the limitations of the Triple Alliance contributed to his fall in June 1885, when he was succeeded by Count di Robilant. He died in Rome on the 26th of December 1888.

MANCIPLE, the official title of the caterer at a college, an inn of court, or other institution. Sometimes also the chief cook. The medieval Latin *manceps*, formed from *mancipium*, acquisition by purchase (see ROMAN LAW), meant a purchaser of stores, and *mancipium* became used of his office. It is from the latter word that the O. Fr. *manciple* is taken.

MANCUNIUM, the name often (though perhaps incorrectly) given as the Romano-British name of Manchester. Here, close to the Medlock, in the district still called Castlefield near Knott Mill, stood in Roman days a fort garrisoned by a cohort of Roman auxiliary soldiers. The site is now obscured by houses, railways and the Rochdale canal, but vestiges of Roman ramparts can still be seen, and other remains were found in 1907 and previous years. Traces of Romano-British inhabitation have been noted elsewhere in Manchester, especially near the cathedral. But there was no town here; we can trace nothing more than a fort guarding the roads running north through Lancashire and east into Yorkshire, and the dwellings of women-folk and traders which would naturally spring up outside such a fort. The ancient name is unknown. Our Roman authorities give both Mancunium and Mamucium, but it is not clear that either form is correct.

See W. T. Watkin's *Roman Lancashire*; C. Roeder's *Roman Manchester*, and the account edited by F. Bruton of the excavations in 1907. (F. J. H.)

MANDAEANS, also known as Sabians, Nasoraeans, or St John's Christians,[1] an Oriental sect of great antiquity, interesting to the theologian as almost the only surviving example of a religion compounded of Christian, heathen and Jewish elements on a type which is essentially that of ancient Gnosticism.

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[1] The first of these names (not Mendaeans or Mandaites) is that given by themselves, and means *γνωστικοί*, followers of Gnosis (מנדעייא, from מנדעא, Hebr. מַדָּע). The Gnosis of which they profess themselves adherents is a *personification*, the aeon and mediator "knowledge of life" (see below). The title Nasoraeans (Nāṣōrāyē), according to Petermann, they give only to those among themselves who are most distinguished for knowledge and character. Like the Arabic Naṣāra, it is originally identical with the name of the half heathen half Jewish-Christian *Ναζωραῖοι*, and indicates an early connexion with that sect. The inappropriate designation of St John's Christians arises from the early and imperfect acquaintance of Christian missionaries, who had regard merely to the reverence in which the name of the Baptist is held among them, and their frequent baptisms. In their dealings with members of other communions the designation they take is Sabians, in Arabic Ṣābi'ūna, from צבא = צבע, to baptize, thus claiming the toleration extended by the Koran (Sur. 5, 73; 22, 17; 2, 59) to those of that name.

The Mandaeans are found in the marshy lands of South Babylonia (al-baṭāih), particularly in the neighbourhood of Basra (or Bussorah), and in Khūzistān (Disful, Shuster).[1] They speak the languages of the localities in which they are settled (Arabic or Persian), but the language of their sacred books is an Aramaic dialect, which has its closest affinities with that of the Babylonian Talmud, written in a peculiar character suggestive of the old Palmyrene.[2] The existence of the Mandaeans has been known since the middle of the 17th century, when the first Christian missionaries, Ignatius a Jesu[3] and Angelus a Sancto, began to labour among them at Basra; further information was gathered at a somewhat later date by Pietro della Valle[4] and Jean de Thévenot[5] (1633–1667), and in the following century by Engelbrecht Kaempfer (1651–1716), Jean Chardin (1643–1713) and Carsten Niebuhr. In recent times they have been visited by A. H. Petermann[6] and Albrecht Socin, and Siouffi[7] published in 1880 a full and accurate account of their manners and customs, taken from the lips of a converted Mandaean. For our knowledge of their doctrinal system, however, we still depend chiefly upon the sacred books already mentioned, consisting of fragments of very various antiquity derived from an older literature.[8] Of these the largest and most important is the *Sidrā rabbā* ("Great Book"), known also as *Ginzā* ("Treasure"), consisting of two unequal parts, of which the larger is called *yamīnā* (to the right hand) and the smaller *s'mala* (to the left hand), because of the manner in which they are bound together. The former is intended for the living; the latter consists chiefly of prayers to be read at the burial of priests. As regards doctrine, the work is exhaustive; but it is diffuse, obscure, and occasionally self-contradictory, as might be expected in a work which consists of a number of unconnected paragraphs of various authorship and date. The last section of the "right-hand" part (the "Book of Kings") is one of the older portions, and from its allusion to "the Persian and Arabian kings" may be dated somewhere between A.D. 700 and 900. Many of the doctrinal portions may in substance well be still older, and date from the time of the Sassanids. None of the MSS., however, is older than the 16th century.[9]

The following sketch represents, as far as can be gathered from these heterogeneous sources, the principal features of the Mandaean system. The ground and origin of all things is *Pīrā*, or more correctly *Pērā rabbā* ("the great abyss," or from פרא, "to split," cf. the Gnostic *βυθός*, or more probably cf. Heb. *perī*, "the great fruit"), associated with whom, and forming a triad with him, are the primal aeons *Ayar sīvā rabbā*, "the great shining aether," and *Mānā rabbā d'eḳārā*, "the great spirit of glory," usually called simply *Mānā rabbā*. The last-named, the most prominent of the three, is the king of light properly so called, from whom the development of all things begins. From him emanates *Yardĕnā rabbā*, "the great Jordan," which, as the higher-world soul, permeates the whole aether, the domain of Ayar. Alongside of *Mānā rabbā* frequent mention is made of *D'mūthā*, his "image," as a female power; the name "image of the father" arises out of the same conception as that which gives rise to the name of *ἔννοια* among the Greek Gnostics. *Mānā rabbā* called into being the highest of the aeons properly so called, *Hayyē Ḳadmāyē*, "Primal Life," and then withdrew into deepest secrecy, visible indeed to the highest but not to the lowest aeons (cf. *Σοφία* and *Προπάτωρ*), yet manifesting himself also to the souls of the more pious of the Mandaeans after their separation from the body. Primal Life, who is properly speaking the Mandaean god, has the same predicates as the primal spirit, and every prayer, as well as every section of the sacred books, begins by invoking him.[10] The extremely fantastic delineation of the world of light by which *Hayyē Ḳadmāyē* is surrounded (see for example the beginning of *Sidrā rabbā*) corresponds very closely with the Manichaean description of the abode of the "king of the paradise of light." The king of light "sits in the far north in might and glory." The Primal Light unfolds himself by five great branches, viz. "the highest purest light, the gentle wind, the harmony of sounds, the voice of all the aeons, and the beauty of their forms," all these being treated as abstractions and personified. Out of the further development and combination of these primary manifestations arise numerous aeons (*'Uthrē*, "splendours," from עתר, "is rich"), of which the number is often stated to be three hundred and sixty. They are divided into a number of classes (kings, hypostases, forms, &c.); the proper names by which they are invoked are many, and for the most part obscure, borrowed doubtless, to some extent, from the Parsee angelology. From the First Life proceeds as a principal emanation the "Second Life," *Hayyē Tinyānē*, generally called *Yōshamin*. This last name is evidently meant to be Hebrew, "Yahweh of the heavens," the God of the Jews being of a secondary rank in the usual Gnostic style. The next emanation after *Yōshamin* is "the messenger of life" (*Mandā d'hayyē*, literally *γνῶσις τῆς ζωῆς*), the most important figure in the entire system, the mediator and redeemer, the *λόγος* and the Christ of the Mandaeans, from whom, as already stated, they take their name. He belongs to the heathen Gnosis, and is in his essence the same as the Babylonian Marduk. *Yōshamin* desired to raise himself above the Primal Light, but failed in the attempt, and was punished by removal out of the pure aetherial world into that of inferior light. Mandā, on the other hand, continues with the First Life and *Mānā rabbā*, and is called his "beloved son," the "first born," "high priest" and "word of life." The "Life" calls into existence in the visible world a series of three great Helpers, Hibil, Shithil and Anōsh (late Judaeo-Babylonian transformations of the well-known names of the book of Genesis), the guardians of souls. The last son of the Second Life is *Hayyē t'lithayē*, the "Third Life," usually called father of the Uthrē (*Abā d' 'Uthrē, Abāthūr*). His usual epithet is "the Ancient" (*'Aṭīqā*), and he is also called "the deeply hidden and guarded." He stands on the borderland between the here and the hereafter, like the mysterious *πρεσβύτης τρίτος* or *senex tertius* of Mani, whose becoming visible will betoken the end of the world. Abāthūr sits on the farthest verge of the world of light that lies towards the lower regions, and weighs in his balance the deeds of the departed spirits who ascend to him. Beneath him was originally nothing but a huge void with muddy black water at the bottom, in which his image was reflected, becoming ultimately solidified into P'tāhīl, his son, who now partakes of the nature of matter. The demiurge of the Mandaeans, and corresponding to the Ialdabaoth of the Ophites, he at the instance of his father frames the earth and men—according to some passages in conjunction with the seven bad planetary spirits. He created Adam and Eve, but was unable to make them stand upright, whereupon Hibil, Shithil and Anōsh were sent by the First Life to infuse into their forms spirit from *Mānā rabbā* himself. Hibil, at the instance of the supreme God, also taught men about the world of light and the aeons, and especially gave them to know that not P'tāhīl but another was their creator and supreme God, who as "the great king of light, without number, without limit," stands far above him. At the same time he enjoined the pair to marry and people the world. P'tāhīl had now lost his power over men, and was driven by his father out of the world of light into a place beneath it, whence he shall at the day of judgment be raised, and after receiving baptism be made king of the 'Uthrē with divine honours.

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[1] In 1882 they were said to have shrunk to 200 families, and to be seeking a new settlement on the Tigris, to escape the persecutions to which they are exposed.

[2] See T. Nöldeke's admirable *Mandäische Grammatik* (Halle, 1875).

[3] *Narratio originis, rituum, et errorum Christianorum S. Joannis* (Rome, 1652).

[4] *Reisebeschreibung*, part iv. (Geneva, 1674).

[5] *Voyage au Levant* (Paris, 1664).

[6] *Reisen im Orient*, ii. 447 seq.

[7] M. M. Siouffi, *Études sur la religion . . . des Soubbas* (Paris, 1880).

[8] Mandaean MSS. occur in the British Museum, the Bodleian Library, the Bibliothèque Nationale of France, and also in Rome, Weimar and Berlin. A number of Mandaean inscriptions relating to popular beliefs and superstitions have been published by H. Pognon, *Inscriptions mandaïtes* (2 vols., Paris, 1898–1899), also by M. Lidzbarski in his *Ephemeris* (Giessen, 1900 seq.).

[9] The first printed edition and translation of the *Sidra rabba*, by Matth. Norberg (*Codex Nasaraeus, liber Adami appellatus*, 3 vols., Copenhagen, 1815–1816, followed by a lexicon in 1816, and an onomasticon in 1817), is so defective as to be quite useless; even the name Book of Adam is unknown to the Mandaeans. Petermann's *Thesaurus s. Liber magnus, vulgo "Liber Adami" appellatus, opus Mandaeorum summi ponderis* (2 vols., Berlin and Leipzig, 1867), is an excellent metallographic reproduction of the Paris MS. A German translation of about a quarter of this work has been published in W. Brandt's *Mandaische Schriften*, with notes (Göttingen, 1893). A critical edition still remains a desideratum. Next in importance to the *Sidrā rābbā* is the *Sidrā d'Yahyā*, or "Book of John," otherwise known as the *D'rāschē d'Malkē*, "Discourses of the Kings," which has not as yet been printed as a whole, although portions have been published by Lorsbach and Tychsen (see *Museum f. bibl. u. orient. Lit.* (1807), and Stäudlin's *Beitr. z. Phil. u. Gesch. d. Relig. u. Sittenlehre* 1796 seq.). The *Kolāstā* (Ar. *Khulāṣa*, "Quintessence"), or according to its fuller title *'Enyānē uderāshē d'maṣbūthā umassekthā* ("Songs and Discourses of Baptism and the Ascent," viz. of the soul after death), has been admirably lithographed by Euting (Stuttgart, 1867). It is also known as *Sidrā d'neshmātha*, "Book of Souls," and besides hymns and doctrinal discourses contains prayers to be offered by the priests at sacrifice and at meals, as well as other liturgical matter. The Mandaean marriage service occurs both in Paris and in Oxford as an independent MS. The *Dīwān*, hitherto unpublished, contains the ritual for atonement. The *Asfar malwāshē*, or "Book of the Zodiac," is astrological. Of smaller pieces many are magical and used as amulets.

[10] The use of the word "life" in a personal sense is usual in Gnosticism; compare the Ζωή of Valentin and *el-ḥayāt el-muallama*, "the dark life," of Mani in the *Fihrist*.

The underworld is made up of four vestibules and three hells properly so called. The vestibules have each two rulers, Zartay and Zartanay, Hag and Mag, Gaf and Gafan, Anatan and Kin. In the highest hell rules alone, the grisly king Sh'dūm, "the warrior"; in the storey immediately beneath is Giv, "the great"; and in the lowest is Krūn or Karkūm, the oldest and most powerful of all, commonly called "the great mountain of flesh" (*Tūrā rabbā d'besrā*), but also "the first-born of darkness." In the vestibules dirty water is still to be met with, but the hells are full of scorching consuming fire, except Krūn's domain, where is nought but dust, ashes and vacancy. Into these regions descended Hibil the brilliant, in the power of *Mānā rabbā*, just as in the Manichaean mythology the "primal man," armed with the elements of the king of light, descends to a contest with the primal devil. Hibil lingers, gradually unfolding his power, in each of the vestibules, and finally passing from hell to hell reaches Karkūm. Hibil allows himself to be half swallowed by the monster, but is unhurt, and compels his antagonist to recognize the superiority of *Mānā rabbā*, the God of light, and to divulge his profoundest secret, the hidden name of darkness. Armed with this he returns through the successive hells, compelling the disclosure of every secret, depriving the rulers of their power, and barring the doors of the several regions. From the fourth vestibule he brought the female devil Rūhā, daughter of Kin, and set her over the whole four. This Rūhā, the mother of falsehood and lies, of poisoning and fornication is an anti-Christian parody of the Rūhā d'Qudshā (Holy Spirit) of the Syriac Church. She is the mother of Ur, the personified fire of hell, who in anger and pride made a violent onset on the world of light (compare the similar occurrence in the Manichaean mythology), but was mastered by Hibil and thrown in chains down to the "black water," and imprisoned within seven iron and seven golden walls. By Ur, Rūhā, while P'tāhīl was engaged in his work of creation, became mother of three sets of seven, twelve and five sons respectively; all were translated by P'tāhīl to the heavenly firmament (like the Archons of Mani), the first group forming the planets and the next the signs of the zodiac, while the third is as yet undetermined. Of the names of the planets Estera (Ishtar Venus, also called Rūhā d'Qudshā, "holy spirit"), Enba (Nebo, Mercury), Sīn (moon), Kēwān (Saturn), Bīl (Jupiter), and Nirig (Nirgal, Mars) reveal their Babylonian origin; Il or Il Il, the sun, is also known as Ḳādūsh and Adūnay (the Adonai of the Old Testament); as lord of the planetary spirits his place is in the midst of them; they are the source of all temptation and evil amongst men. The houses of the planets, as well as the earth and a second world immediately to the north of it, rest upon anvils laid by Hibil on the belly of Ur.

In the Mandaean representation the sky is an ocean of water, pure and clear, but of more than adamantine solidity, upon which the stars and planets sail. Its transparency allows us to see even to the pole star, who is the central sun around whom all the heavenly bodies move. Wearing a jewelled crown, he stands before Abāthūr's door at the gate of the world of light; the Mandaeans accordingly invariably pray with their faces turned northward. The earth is conceived of as a round disk, slightly sloping towards the south, surrounded on three sides by the sea, but on the north by a high mountain of turquoises; behind this is the abode of the blest, a sort of inferior paradise, inhabited by the Egyptians who were saved from drowning with Pharaoh in the Red Sea, and whom the Mandaeans look upon as their ancestors, Pharaoh himself having been their first high priest and king. The total duration of the earth they fix at four hundred and eighty thousand years, divided into seven epochs, in each of which one of the planets rules. The *Sidrā Rabbā* knows of three total destructions of the human race by fire and water, pestilence and sword, a single pair alone surviving in each case. In the Mandaean view the Old Testament saints are false prophets; such as Abraham, who arose six thousand years after Nū (Noah) during the reign of the sun, Mīshā (Moses), in whose time the true religion was professed by the Egyptians, and Shlīmūn (Solomon) bar Davith, the lord of the demons. Another false prophet and magician was Yishu M'shīhā, who was in fact a manifestation of the planet Mercury. Forty-two years before his day, under King Pontius Pilate, there had appeared the true prophet Yahyā or John son of Zechariah, an incarnation of Hibil, of whose birth and childhood fantastic stories are told. Yahyā by a mistake gave baptism to the false Messiah, who had feigned humility; on the completion of his mission, after undergoing a seeming execution, he returned clothed with light into the kingdom of light. As a contemporary of Yahyā and the false Messiah Hibil's younger brother Anōsh 'Uthrā came down from heaven, caused himself to be baptized by Yahyā, wrought miracles of healing and of raising the dead, and brought about the crucifixion of the false Messiah. He preached the true religion, destroyed Jerusalem ("Urashlam," *i.e.* "the devil finished it"), which had been built by Adūnay, dispersed over the world the Jews who had put Yahyā to death, and previous to his return into the worlds of light sent forth three hundred and sixty prophets for the diffusion of the true religion. All this speaks of intense hatred alike of Jews and Christians; the fasts, celibacy and monastic and anchoret life of the latter are peculiarly objectionable to the Mandaeans. Two hundred and forty years after the appearing of the false Messiah there came to the world sixty thousand saints out of Pharaoh's world to take the place of the Mandaeans, who had been completely extirpated; their high priest had his residence in Damascus. The last false prophet was M'hammad or Ahmat bar Bisbat (Mahomet), but Anōsh, who remained close beside him and his immediate successors, prevented hostilities against the true believers, who claim to have had in Babylonia, under the Abbasids, four hundred places of worship. Subsequent persecutions compelled their withdrawal to 'Ammāra in the neighbourhood of Wāsit, and ultimately to Khūzistān. At the end of the world the devil Ur will swallow up the earth and the other intermediate higher worlds, and thereupon will burst and fall into the abyss of darkness where, along with all the worlds and powers of darkness, he will ultimately cease to be, so that thenceforward the universe will consist of but one everlasting world of light.

The chief depositaries of these Mandaean mysteries are the priests, who enjoy a high degree of power and social regard. The priesthood has three grades: (1) the *Sh'kandā* or deacon is generally chosen from episcopal or priestly families, and must be without bodily blemish. The candidate for orders must be at least nineteen years old and have undergone twelve years' preparation; he is then qualified to assist the priesthood in the ceremonies of religion. (2) The *Tarmīdā* (*i.e.* "Talmīdā," "initiated") or priest is ordained by a bishop and two priests or by four priests after a long and extremely painful period of preparation. (3) The *Ganzivrā* ("treasurer") or bishop, the highest dignitary, is chosen from the whole body of the Tarmīdās after a variety of tests, and possesses unlimited authority over the clergy. A supreme priestly rank, that of *Rīsh 'ammā*, or "head of the people." is recognized, but only in theory; since the time of Pharaoh this sovereign pontificate has only once been filled. Women are admitted to priestly offices as well as men. The priestly dress, which is all white, consists of drawers, an upper garment, and a girdle with the so-called *tāgā* ("crown"); in all ceremonies the celebrants must be barefoot. By far the most frequent and important of the religious ceremonies is that of baptism (*maṣbūthā*), which is called for in a great variety of cases, not only for children but for adults, where consecration or purification is required, as for example on all Sundays and feast days, after contact with a dead body, after return from abroad, after neglect of any formality on the part of a priest in the discharge of his functions. In all these cases baptism is performed by total immersion in running water, but during the five days' baptismal festival the rite is observed wholesale by mere sprinkling of large masses of the faithful at once. The Mandaeans observe also with the elements of bread (*pehtā*) and wine (*mambūhā*, lit. "fountain") a sort of eucharist, which has a special sanctifying efficacy, and is usually dispensed at festivals, but only to baptized persons of good repute who have never willingly denied the Mandaean faith. In receiving it the communicant must not touch the host with his finger; otherwise it loses its virtue. The hosts are made by the priests from unleavened fine flour. The Mandaean places of worship, being designed only for the priests and their assistants (the worshippers remaining in the forecourt), are excessively small, and very simply furnished; two windows, a door that opens towards the south so that those who enter have their faces turned towards the pole star, a few boards in the corner, and a gabled roof complete the whole structure; there is neither altar nor decoration of any kind. The neighbourhood of running water (for baptisms) is essential. At the consecration of a church the sacrifice of a dove (the bird of Ishtar) has place among the ceremonies. Besides Sundays there are six great feasts: (1) that of the New Year (*Naurūz rabbā*), on the first day of the first month of winter; (2) *Dehwā h' nīnā*, the anniversary of the happy return of *Hibil Zīvā* from the kingdom of darkness into that of light, lasting five days, beginning with the 18th of the first month of spring; (3) the *Marwānā*, in commemoration of the drowned Egyptians, on the first day of the second month of spring; (4) the great five days' baptismal festival (*pantshā*), the chief feast, kept on the five intercalary days at the end of the second month of summer—during its continuance every Mandaean, male and female, must dress in white and bathe thrice daily; (5) *Dehwā d'daimānā*, in honour of one of the three hundred and sixty 'Uthras, on the first day of the second month of autumn; (6) *Kanshe Zahlā*, the preparation feast, held on the last day of the year. There are also fast days called m'battal (Arab.), on which it is forbidden to kill any living thing or eat flesh. These, however, are really "rest-days," as fasting is forbidden in Mandaeism. The year is solar, and has twelve months of thirty days each, with five intercalary days between the eighth and the ninth month. Of the seven days of the week, next to Sunday (habshaba) Thursday has a special sacredness as the day of *Hibil Zīvā*. As regards secular occupation, the present Mandaeans are goldsmiths, ironworkers, and house and ship carpenters. The *Sidrā Rabbā* lays great stress upon the duty of procreation, and marriage is a duty. In the 17th century, according to the old travellers, they numbered about 20,000 families, but at the present day they hardly number more than 1200 souls. In external appearance the Mandaean is distinguished from the Moslem only by a brown coat and a parti-coloured headcloth with a cord twisted round it. They have some peculiar deathbed rites: a deacon with some attendants waits upon the dying, and as death approaches administers a bath first of warm and afterwards of cold water; a holy dress, consisting of seven pieces (rastā), is then put on; the feet are directed towards the north and the head turned to the south, so that the body faces the pole star. After the burial a funeral feast is held in the house of mourning.

The Mandaeans are strictly reticent about their theological dogmas in the presence of strangers; and the knowledge they actually possess of these is extremely small. The foundation of the system is obviously to be sought in Gnosticism, and more particularly in the older type of that doctrine (known from the serpent symbol as Ophite or Naassene) which obtained in Mesopotamia and Further Asia generally. But it is equally plain that the Ophite nucleus has from time to time received very numerous and often curiously perverted accretions from Babylonian Judaism, Oriental Christianity and Parsism, exhibiting a striking example of religious syncretism. In the Gnostic basis itself it is not difficult to recognize the general features of the religion of ancient Babylonia, and thus we are brought nearer a solution of the problem as to the origin of Gnosticism in general. It is certain that Babylonia, the seat of the present Mandaeans, must be regarded also as the cradle in which their system was reared; it is impossible to think of them as coming from Palestine, or to attribute to their doctrines a Jewish or Christian origin. They do not spring historically from the disciples of John the Baptist (Acts xviii. 25; xix. 3 seq.; *Recog. Clem.* i. 54); the tradition in which he and the Jordan figure so largely is not original, and is therefore worthless; at the same time it is true that their baptismal praxis and its interpretation place them in the same religious group with the Hemerobaptists of Eusebius (*H. E.* iv. 22) and Epiphanius (*Haer.*, xvii.), or with the sect of disciples of John who remained apart from Christianity. Their reverence for John is of a piece with their whole syncretizing attitude towards the New Testament. Indeed, as has been seen, they appropriate the entire personale of the Bible from Adam, Seth, Abel, Enos and Pharaoh to Jesus and John, a phenomenon which bears witness to the close relations of the Mandaean doctrine both with Judaism and Christianity—not the less close because they were relations of hostility. The history of religion presents other examples of the degradation of holy to demonic figures on occasion of religious schism. The use of the word "Jordan," even in the plural, for "sacred water," is precisely similar to that by the Naassenes described in the *Philosophumena* (v. 7); there ὁ μέγας Ἰορδάνης denotes the spiritualizing sanctifying fluid which pervades the world of light. The notions of the Egyptians and the Red Sea, according to the same work (v. 16), are used by the Peratae much as by the Mandaeans. And the position assigned by the Sethians (Σηθιανοί) to Seth is precisely similar to that given by the Mandaeans to Abel. Both alike are merely old Babylonian divinities in a new Biblical garb. The genesis of Mandaeism and the older gnosis from the old and elaborate Babylonio-Chaldaean religion is clearly seen also in the fact that the names of the old pantheon (as for example those of the planetary divinities) are retained, but their holders degraded to the position of demons—a conclusion confirmed by the fact that the Mandaeans, like the allied Ophites, Peratae and Manichaeans, certainly have their original seat in Mesopotamia and Babylonia. It seems clear that the trinity of Anu, Bel, and Ea in the old Babylonian religion has its counterpart in the Mandaean Pīrā, Ayar, and Mānā rabbā. The D'mūthā of Mānā is the Damkina, the wife of Ea, mentioned by Damascius as Δαύκη, wife of Ἀός. Mandā d'hayyē and his image Hibil Zīvā with his incarnations clearly correspond to the old Babylonian Marduk, Merodach, the "first-born" son of Ea, with his incarnations, the chief divinity of the city of Babylon, the mediator and redeemer in the old religion. Hibil's contest with darkness has its prototype in Marduk's battle with chaos, the dragon Tiamat, which (another striking parallel) partially swallows Marduk, just as is related of Hibil and the Manichaean primal man. Other features are borrowed by the Mandaean mythology under this head from the well-known epos of Istar's *descensus ad inferos*. The sanctity with which water is invested by the Mandaeans is to be explained by the fact that Ea has his seat "in the depths of the world sea."

Cf. K. Kessler's article, "Mandäer," in Herzog-Hauck's *Realencyklopädie*, and the same author's paper, "Ueber Gnosis u. altbabylonische Religion," in the *Abhandl. d. fünften internationalen Orientalisten-congresses zu Berlin* (Berlin, 1882); also W. Brandt's *Mandäische Religion* (Leipzig, 1889), and M. N. Siouffi's *Études sur la religion des Soubbas* (Paris, 1880). (K. K.; G. W. T.)

MANDALAY, formerly the capital of independent Burma, now the headquarters of the Mandalay division and district, as well as the chief town in Upper Burma, stands on the left bank of the Irrawaddy, in 21° 59′ N. and 96° 8′ E. Its height above mean sea-level is 315 ft. Mandalay was built in 1856–1857 by King Mindōn. It is now divided into the municipal area and the cantonment. The town covers an area of 6 m. from north to south and 3 from east to west, and has well-metalled roads lined with avenues of trees and regularly lighted and watered. The cantonment consists of the area inside the old city walls, and is now called Fort Dufferin. In the centre stands the palace, a group of wooden buildings, many of them highly carved and gilt, resting on a brick platform 900 ft. by 500 ft., and 6 ft. high. The greater part of it is now utilized for military and other offices. The garrison consists of a brigade belonging to the Burma command of the Indian army. There are many fine pagodas and monastic buildings in the town. The population in 1901 was 183,816, showing a decrease of 3% in the decade. The population is very mixed. Besides Burmese there are Zerbadis (the offspring of a Mahommedan with a Burman wife), Mahommedans, Hindus, Jews, Chinese, Shans and Manipuris (called Kathe), Kachins and Palaungs. Trains run from Mandalay to Rangoon, Myit-kyina, and up the Mandalay–Kunlong railway. The steamers of the Irrawaddy Flotilla Company also ply in all directions. There are twenty bazaars, the chief of which, the Zegyo, was burnt in 1897, and again in 1906, but rebuilt.

The MANDALAY DISTRICT has an area of 2117 sq. m. and a population (1901) of 366,507, giving a density of 177 inhabitants to the square mile. About 600 sq. m. along the Irrawaddy river are flat land, nearly all cultivated. In the north and east there are some 1500 sq m. of high hills and table-lands, forming geographically a portion of the Shan table-land. Here the fall to the plains averages 3000 to 4000 ft. in a distance of 10 m. This part of the district is well wooded and watered. The Maymyo subdivision has very fine plateaus of 3000 to 3600 ft. in height. The highest peaks are between 4000 and 5000 ft. above sea-level. The Irrawaddy, the Myit-ngè and the Madaya are the chief rivers. The last two come from the Shan States, and are navigable for between 20 and 30 m. There are many canals, most of which have fallen greatly into disrepair, and the Aungbinle, Nanda and Shwepyi lakes also supply water for cultivation. A systematic irrigation scheme has been undertaken by the government. The Sagyin hills near Madaya are noted for their alabaster; rubies are also found in small quantities. There are 335 sq. m. of forest reserves in the district, but there is little teak. The climate is dry and healthy. During May and June and till August strong winds prevail. The thermometer rises to about 107° in the shade in the hot weather, and the minimum in the month of December is about 55°. The rainfall is light, the average being under 30 in.

The DIVISION includes the districts of Mandalay, Bhamo, Myitkyina, Katha and Ruby Mines, with a total area of 29,373 sq. m., and a population (1901) of 777,338, giving an average density of 30 inhabitants to the square mile. (J. G. Sc.)

MANDAMUS, WRIT OF, in English law, a high prerogative writ issuing from the High Court of Justice (named from the first word in the Latin form of the writ) containing a command in the name of the king, directed to inferior courts, corporations, or individuals, ordering them to do a specific act within the duty of their office, or which they are bound by statute to do, and performance whereof the applicant for the writ has a specific legal right to enforce. Direct orders from the sovereign to subjects commanding the performance of particular acts were common in early times, and to this class of orders *mandamus* originally belonged. It became customary for the court of king's bench, in cases where a legal duty was established but no sufficient means existed for enforcing it, to order performance by this writ. Under the Judicature Acts and the *Crown Office Rules*, 1906 (r. 49), the powers of the court of king's bench as to the grant of the prerogative writ of mandamus are exercisable only in the king's bench division of the High Court.

The writ though of right is not of course: *i.e.* the applicant cannot have it merely for the asking, but must satisfy the High Court that circumstances exist calling for its issue. The procedure regulating the grant and enforcement of the writ is determined by the *Crown Office Rules*, 1906 (rr. 49-68, 125).

Mandamus has always been regarded as an exceptional remedy to supplement the deficiencies of the common law, or defects of justice. Where another legal or equitable remedy exists, equally appropriate, convenient, speedy, beneficial and effectual, the writ will as a rule be refused. It is occasionally granted even when a remedy by indictment is available: but is not issued unless the existence of the duty and refusal to perform it are clearly established, nor where performance in fact has become impossible. The writ is used to compel inferior courts to hear and determine according to law cases within their jurisdiction, *e.g.* where a county court or justices in petty or quarter sessions refuse to assume a jurisdiction which they possess to deal with a matter brought before them. It has in recent years been employed to compel municipal bodies to discharge their duties as to providing proper sewerage for their districts and to compel anti-vaccinationist guardians of the poor to appoint officers for the execution of the Vaccination Acts; and it is also employed to compel the promoters of railway and similar undertakings to discharge duties imposed upon them towards the public by their special acts, *e.g.* with reference to highways, &c., affected by their railways or other undertakings. The courts do not prescribe the specific manner in which the duty is to be discharged, but do not stay their hands until substantial compliance is established.

Besides the prerogative common-law writ there are a number of orders, made by the High Court under statutory authority, and described as or as being in the nature of mandamus, *e.g.* mandamus to proceed to the election of a corporate officer of a municipal corporation (Municipal Corporations Act 1882, s. 225); orders in the nature of mandamus to justices to hear and determine a matter within their jurisdiction, or to state and sign a case under the enactments relating to special cases.

At common law mandamus lies only for the performance of acts of a public or official character. The enforcement of merely private obligations, such as those arising from contracts, is not within its scope. By s. 68 of the Common Law Procedure Act 1854, the plaintiff in any action other than replevin and ejectment was empowered to claim a writ of mandamus to compel the defendant to fulfil any duty in the fulfilment of which the plaintiff was personally interested. By s. 25 (8) of the Judicature Act 1873 a mandamus may be granted by an interlocutory order of the High Court in all cases in which it shall appear to the court just or convenient that such an order should be made. This enactment does not deal with the prerogative mandamus but empowers the king's bench and the chancery divisions to grant an interlocutory mandamus in any pending cause or matter by an order other than the final judgment and even by an order made after the judgment. S. 68 of the act of 1854 has been repealed and replaced by Order LIII. of the *Rules of the Supreme Court*. The remedy thus created is an attempt to engraft upon the old common law remedy by damages a right in the nature of specific performance of the duty in question. It is not limited to cases in which the prerogative writ would be granted; but mandamus is not granted when the result desired can be obtained by some remedy equally convenient, beneficial and effective, or a particular and different remedy is provided by statute. An action for mandamus does not lie against judicial officers such as justices. The mandamus issued in the action is no longer a writ of mandamus, but a judgment or order having effect equivalent to the writ formerly used.

Mandatory Injunction.—The High Court has a jurisdiction derived from the court of chancery to grant injunctions at the suit of the attorney-general or of private persons. Ordinarily these injunctions are in the form of prohibition or restraint and not of command. But occasionally mandatory injunctions are granted in the form of a direct command by the court.

Specific Performance.—The jurisdiction of the High Court, derived from the court of chancery, to decree specific performance of contracts has some resemblance to mandamus in the domains of public or quasi-public law.

Ireland.—The law of Ireland as to mandamus is derived from that of England, and differs therefrom only in minor details.

British Possessions.—In a British possession the power to issue the prerogative writ is usually vested in the Supreme Court by its charter or by local legislation.

United States.—The writ has passed into the law of the United States. "There is in the federal judiciary an employment of the writ substantially as the old prerogative writ in the king's bench practice, also as a mode of exercising appellate jurisdiction, also as a proceeding ancillary to a judgment previously rendered, in exercise of original jurisdiction, as when a circuit court having rendered a judgment against a county issues a mandamus requiring its officers to levy a tax to provide for the payment of the judgment." And in the various states mandamus is used under varying regulations, mandate being in some cases substituted as the name of the proceeding.

MANDAN, a tribe of North American Indians of Siouan stock. When first met they were living on the Missouri at the mouth of the Heart river. At the beginning of the 19th century they were driven up the Missouri by the Sioux. In 1845 they joined the Gros Ventres and later the Arikaras, and settled in their present position at Fort Berthold reservation, North Dakota. The Mandans have always been agricultural; they are noted for their ceremonies, and from the tattooing on face and breast were described in the sign language as "the tattooed people."

MANDARIN, the common name for all public officials in China, the Chinese name for whom is *kwan* or *kwăn*. The word comes through the Portuguese from Malay *mantri*, a counsellor or minister of state. The ultimate origin of this word is the Sanskrit root *man-*, meaning to "think," seen in "man," "mind," &c. The term "mandarin" is not, in its western usage, applied indiscriminately to all civil and military officials, but only to those who are entitled to wear a "button," which is a spherical knob, about an inch in diameter, affixed to the top of the official cap or hat. These officials, civil and military alike, are divided into nine grades or classes, each grade being distinguished by a button of a particular colour. The grade to which an official belongs is not necessarily related to the office he holds. The button which distinguishes the first grade is a transparent red stone; the second grade, a red coral button; the third, a sapphire; the fourth, a blue opaque stone; the fifth, a crystal button; the sixth, an opaque white shell button; the seventh, a plain gold button; the eighth, a worked gold button; and the ninth, a worked silver button. The mandarins also wear certain insignia embroidered on their official robes, and have girdle clasps of different material. The first grade have, for civilians an embroidered Manchurian crane on the breast and back, for the military an embroidered unicorn with a girdle clasp of jade set in rubies. The second grade, for civilians an embroidered golden pheasant, for the military a lion with a girdle clasp of gold set in rubies. The third grade, for civilians a peacock, for the military a leopard with a clasp of worked gold. The fourth grade, for civilians a wild goose, for the military a tiger, and a clasp of worked gold with a silver button. The fifth grade, for civilians a silver pheasant, for the military a bear and a clasp of plain gold with a silver button. The sixth grade, for civilians an egret, for the military a tiger-cat with a mother-of-pearl clasp. The seventh grade, for civilians a mandarin duck, for the military a mottled bear with a silver clasp. The eighth grade, for civilians a quail, for the military a seal with a clear horn clasp. The ninth grade, for civilians a long-tailed jay, for the military a rhinoceros with a buffalo-horn clasp.

The "mandarin language" is the Chinese, which is spoken in official and legal circles; it is also spoken over a considerable portion of the country, particularly the northern and central parts, though not perhaps with the same purity. Mandarin duck (*anas galericulata*) and Mandarin orange (*citrus nobilis*) possibly derive their names, by analogy, from the sense of superiority implied in the title "mandarin."

See *Society in China*, by Sir R. K. Douglas; *L'Empire du milieu*, by E. and O. Reclus.

MANDASOR, or MANDSAUR, a town of Central India, in the native state of Gwalior, on the Rajputana railway, 31 m. S. of Neemuch. Pop. (1901), 20,936. It gave its name to the treaty with Holkar, which concluded the Mahratta-Pindari War in 1818. It is a centre of the Malwa opium trade.

Mandasor and its neighbourhood are full of archaeological interest. An inscription discovered near the town indicated the erection of a temple of the sun in 437, and at Sondani are two great monolith pillars recording a victory of Yasodharma, king of Malwa, in 528. The fort dates from the 14th and 15th centuries. Hindu and Jain remains are numerous, though the town is now entirely Mahommedan.

MANDATE (*Mandatum*), a contract in Roman law constituted by one person (the *mandatarius*) promising to do something gratuitously at the request of another (the *mandator*), who undertakes to indemnify him against loss. The jurist distinguished the different cases of mandatum according as the object of the contract was the benefit of the mandator or a third person singly, or the mandator and a third person, the mandator and the mandatarius, or the mandatarius and a third person together. When the benefit was that of the mandatarius alone, the obligations of the contract were held not to arise, although the form of the contract might exist, the commission being held to be merely advice tendered to the mandatarius, and acted on by him at his own risk. Mandatum was classified as one of the contracts established by consent of the parties alone; but, as there was really no obligation of any kind until the mandatarius had acted on the mandate, it has with more propriety been referred to the contracts created by the supply of some fact (*re*). The obligations of the mandatarius under the contract were, briefly, to do what he had promised according to his instructions, observing ordinary diligence in taking care of any property entrusted to him, and handing over to his principal the results of his action, including the right to sue in his name. On the other hand, the principal was bound to recoup him his expenses and indemnify him against loss through obligations he might have incurred.

The essentials and the terminology of the contract are preserved in most modern systems of law. But in English law mandate, under that name, can hardly be said to exist as a separate form of contract. To some extent the law of mandatum corresponds partly to the law of principal and agent, partly to that of principal and surety." Mandate" is retained to signify the contract more generally known as gratuitous bailment. It is restricted to personal property, and it implies the delivery of something to the bailee, both of which conditions are unknown in the mandatum of the civil law (see BAILMENT).

MANDAUE, a town of the province of Cebú, island of Cebú, Philippine Islands, on the E. coast and E. coast road, about 4 m. N.E. of the town of Cebú, the capital. Pop. (1903), 11,078; in the same year the town of Consolación (pop. 5511) was merged with Mandaue. Its climate is very hot, but healthy. The principal industries are the raising of Indian corn and sugar-cane and the manufacture of salt from sea-water. Cebú-Visayan is the language.

MANDELIC ACID (Phenylglycollic Acid), $C_8H_8O_3$ or $C_6H_5 \cdot CH(OH) \cdot COOH$, an isomer of the cresotinic and the oxymethylbenzoic acids. Since the molecule contains an asymmetric carbon atom, the acid exists in three forms, one being an inactive "racemic" mixture, and the other two being optically active forms. The inactive variety is known as *paramandelic acid*. It may be prepared by the action of hydrochloric acid on the addition compound of benzaldehyde and hydrocyanic acid:—

$$C_6H_5CHO + HCN + HCl + 2H_2O = C_6H_5 \cdot CHOH \cdot COOH + NH_4Cl,$$

(F. L. Winckler, *Ann.*, 1836, 18, 310), by boiling phenylchloracetic acid with alkalis (A. Spiegel, *Ber.*, 1881, 14, 239), by heating benzoylformaldehyde with alkalis (H. v. Pechmann, *Ber.*, 1887, 20, 2905), and by the action of dilute alkalies on ω-dibromacetophenone (C. Engler, *Ber.*, 1887, 20, 2202):—

$$C_6H_5COCHBr_2 + 3KHO = 2KBr + H_2O + C_6H_5 \cdot CHOH \cdot CO_2K.$$

It crystallizes from water in large rhombic crystals, which melt at 118° C. Oxidizing agents convert it into benzaldehyde. When heated with hydriodic acid and phosphorus it forms phenylacetic acid; whilst concentrated hydrobromic acid and hydrochloric acid at moderate temperatures convert it into phenylbrom- and phenylchlor-acetic acids. The inactive mixture may be resolved into its active components by fractional crystallization of the cinchonine salt, when the salt of the *dextro* modification separates first; or the ammonium salt may be fermented by *Penicillium glaucum*, when the *laevo* form is destroyed and the *dextro* form remains untouched; on the other hand, *Saccharomyces ellipsoïdeus* destroys the *dextro* form, but does not touch the *laevo* form. A mixture of the two forms in equivalent quantities produces the inactive variety, which is also obtained when either form is heated for some hours to 160° C.

MANDER, CAREL VAN (1548–1606), Dutch painter, poet and biographer, was born of a noble family at Meulebeke. He studied under Lucas de Heere at Ghent, and in 1568–1569 under Pieter Vlerick at Kortryck. The next five years he devoted to the writing of religious plays for which he also painted the scenery. Then followed three years in Rome (1574–1577), where he is said to have been the first to discover the catacombs. On his return journey he passed through Vienna, where, together with the sculptor Hans Mont, he made the triumphal arch for the entry of the emperor Rudolph. After many vicissitudes caused by war, loss of fortune and plague, he settled at Haarlem where, in conjunction with Goltzius and Cornelisz, he founded a successful academy of painting. His fame is, however, principally based upon a voluminous biographical work on the paintings of various epochs—a book that has become for the northern countries what Vasari's *Lives of the Painters* became for Italy. It was completed in 1603 and published in 1604, in which year Van Mander removed to Amsterdam, where he died in 1606.

MANDEVILLE, BERNARD DE (1670–1733), English philosopher and satirist, was born at Dordrecht, where his father practised as a physician. On leaving the Erasmus school at Rotterdam he gave proof of his ability by an *Oratio scholastica de medicina* (1685), and at Leiden University in 1689 he maintained a thesis *De brutorum operationibus*, in which he advocated the Cartesian theory of automatism among animals. In 1691 he took his medical degree, pronouncing an "inaugural disputation," *De chylosi vitiata*. Afterwards he came to England "to learn the language," and succeeded so remarkably that many refused to believe he was a foreigner. As a physician he seems to have done little, and lived poorly on a pension given him by some Dutch merchants and money which he earned from distillers for advocating the use of spirits. His conversational abilities won him the friendship of Lord Macclesfield (chief justice 1710–1718) who introduced him to Addison, described by Mandeville as "a parson in a tye-wig." He died in January (19th or 21st) 1733/4 at Hackney.

The work by which he is known is the *Fable of the Bees*, published first in 1705 under the title of *The Grumbling Hive, or Knaves Turn'd Honest* (two hundred doggerel couplets). In 1714 it was republished anonymously with *Remarks* and *An Enquiry into the Origin of Moral Virtue*. In 1723 a later edition appeared, including *An Essay on Charity and Charity Schools*, and *A Search into the Nature of Society*. The book was primarily written as a political satire on the state of England in 1705, when the Tories were accusing Marlborough and the ministry of advocating the French War for personal reasons. The edition of 1723 was presented as a nuisance by the Grand Jury of Middlesex, was denounced in the *London Journal* by "Theophilus Philo-Britannus," and attacked by many writers, notably by Archibald Campbell (1691–1756) in his *Aretelogia* (published as his own by Alexander Innes in 1728; afterwards by Campbell, under his own name, in 1733, as *Enquiry into the Original of Moral Virtue*). The *Fable* was reprinted in 1729, a ninth edition appeared in 1755, and it has often been reprinted in more recent times. Berkeley attacked it in the second dialogue of the *Alciphron* (1732) and John Brown criticized him in his *Essay upon Shaftesbury's Characteristics* (1751).

Mandeville's philosophy gave great offence at the time, and has always been stigmatized as false, cynical and degrading. His main thesis is that the actions of men cannot be divided into lower and higher. The higher life of man is merely a fiction introduced by philosophers and rulers to simplify government and the relations of society. In fact, virtue (which he defined as "every performance by which man, contrary to the impulse of nature, should endeavour the benefit of others, or the conquest of his own passions, out of a rational ambition of being good") is actually detrimental to the state in its commercial and intellectual progress, for it is the vices (*i.e.* the self-regarding actions of men) which alone, by means of inventions and the circulation of capital in connexion with luxurious living, stimulate society into action and progress. In the *Fable* he shows a society possessed of all the virtues "blest with content and honesty," falling into apathy and utterly paralyzed. The absence of self-love (cf. Hobbes) is the death of progress. The so-called higher virtues are mere hypocrisy, and arise from the selfish desire to be superior to the brutes. "The moral virtues are the political offspring which flattery begot upon pride." Similarly he arrives at the great paradox that "private vices are public benefits." But his best work and that in which he approximates most nearly to modern views is his account of the origin of society. His *a priori* theories should be compared with Maine's historical inquiries (*Ancient Law*, c. V.). He endeavours to show that all social laws are the crystallized results of selfish aggrandizement and protective alliances among the weak. Denying any form of moral sense or conscience, he regards all the social virtues as evolved from the instinct for self-preservation, the give-and-take arrangements between the partners in a defensive and offensive alliance, and the feelings of pride and vanity artificially fed by politicians, as an antidote to dissension and chaos. Mandeville's ironical paradoxes are interesting mainly as a criticism of the "amiable" idealism of Shaftesbury, and in comparison with the serious egoistic systems of Hobbes and Helvetius. It is mere prejudice to deny that Mandeville had considerable philosophic insight; at the same time he was mainly negative or critical, and, as he himself said, he was writing for "the entertainment of people of knowledge and education." He may be said to have cleared the ground for the coming utilitarianism.

WORKS.—*Typhon: a Burlesque Poem* (1704); *Aesop Dress'd, or a Collection of Fables writ in Familiar Verse* (1704); *The Planter's Charity* (1704); *The Virgin Unmasked* (1709, 1724, 1731, 1742), a work in which the coarser side of his nature is prominent; *Treatise of the Hypochondriack and Hysterick Passions* (1711, 1715, 1730) admired by Johnson (Mandeville here protests against merely speculative therapeutics, and advances fanciful theories of his own about animal spirits in connexion with "stomachic ferment": he shows a knowledge of Locke's methods, and an admiration for Sydenham); *Free Thoughts on Religion* (1720); *A Conference about Whoring* (1725); *An Enquiry into the Causes of the Frequent Executions at Tyburn* (1725); *The Origin of Honour and the Usefulness of Christianity in War* (1732). Other works attributed, wrongly, to him are *A Modest Defence of Public Stews* (1724); *The World Unmasked* (1736) and *Zoologia medicinalis hibernica* (1744).

See Hill's *Boswell*, iii. 291–293; L. Stephen's *English Thought in the Eighteenth Century*; A. Bain's *Moral Science* (593–598); Windelband's *History of Ethics* (Eng. trans. Tufts); J. M. Robertson, *Pioneer Humanists* (1907); P. Sakmann, *Bernard de Mandeville und die Bienenfabel-Controverse* (Freiburg i/Br., 1897), and compare articles ETHICS, SHAFTESBURY, HOBBES. (J. M. M.).

MANDEVILLE, GEOFFREY DE (d. 1144), earl of Essex, succeeded his father, William, as constable of the Tower of London in or shortly before 1130. Though a great Essex landowner, he played no conspicuous part in history till 1140, when Stephen created him earl of Essex in reward for his services against the empress Matilda. After the defeat and capture of Stephen at Lincoln (1141) the earl deserted to Matilda, but before the end of the year, learning that Stephen's release was imminent, returned to his original allegiance. In 1142 he was again intriguing with the empress; but before he could openly join her cause he was detected and deprived of his castles by the king. In 1143–1144 Geoffrey maintained himself as a rebel and a bandit in the fen-country, using the Isle of Ely and Ramsey Abbey as his headquarters. He was besieged by Stephen in the fens, and met his death in September 1144 in consequence of a wound received in a skirmish. His career is interesting for two reasons. The charters which he extorted from Stephen and Matilda illustrate the peculiar form taken by the ambitions of English feudatories. The most important concessions are grants of offices and jurisdictions which had the effect of making Mandeville a viceroy with full powers in Essex, Middlesex and London, and Hertfordshire. His career as an outlaw exemplifies the worst excesses of the anarchy which prevailed in some parts of England during the civil wars of 1140–1147, and it is probable that the deeds of Mandeville inspired the rhetorical description, in the Peterborough Chronicle of this period, when "men said openly that Christ and his saints were asleep."

See J. H. Round, *Geoffrey de Mandeville, a Study of the Anarchy* (London, 1892). (H. W. C. D.)

MANDEVILLE, JEHAN DE ("Sir John Mandeville"), the name claimed by the compiler of a singular book of travels, written in French, and published between 1357 and 1371. By aid of translations into many other languages it acquired extraordinary popularity, while a few interpolated words in a particular edition of an English version gained for Mandeville in modern times the spurious credit of being "the father of English prose."

In his preface the compiler calls himself a knight, and states that he was born and bred in England, of the town of St Albans; had crossed the sea on Michaelmas Day 1322; had travelled by way of Turkey (Asia Minor), Armenia the little (Cilicia) and the great, Tartary, Persia, Syria, Arabia, Egypt upper and lower, Libya, great part of Ethiopia, Chaldaea, Amazonia, India the less, the greater and the middle, and many countries about India; had often been to Jerusalem, and had written in Romance as more generally understood than Latin. In the body of the work we hear that he had been at Paris and Constantinople; had served the sultan of Egypt a long time in his wars against the Bedawin, had been vainly offered by him a princely marriage and a great estate on condition of renouncing Christianity, and had left Egypt under sultan Melech Madabron, *i.e.* Muzaffar or Mudhaffar[1] (who reigned in 1346–1347); had been at Mount Sinai, and had visited the Holy Land with letters under the great seal of the sultan, which gave him extraordinary facilities; had been in Russia, Livonia, Cracow, Lithuania, "en roialme daresten" (? de Daresten or Silistria), and many other parts near Tartary, but not in Tartary itself; had drunk of the well of youth at Polombe (Quilon on the Malabar coast), and still seemed to feel the better; had taken astronomical observations on the way to Lamory (Sumatra), as well as in Brabant, Germany, Bohemia and still farther north; had been at an isle called Pathen in the Indian Ocean; had been at Cansay (Hangchow-fu) in China, and had served the emperor of China fifteen months against the king of Manzi; had been among rocks of adamant in the Indian Ocean; had been through a haunted valley, which he places near "Milstorak" (*i.e.* Malasgird in Armenia); had been driven home against his will in 1357 by arthritic gout; and had written his book as a consolation for his "wretched rest." The paragraph which states that he had had his book confirmed at Rome by the pope is an interpolation of the English version.

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[1] The *on* in Madabron apparently represents the Arabic nunation, though its use in such a case is very odd.

Part at least of the personal history of Mandeville is mere invention. Nor is any contemporary corroboration of the existence of such a Jehan de Mandeville known. Some French MSS., not contemporary, give a Latin letter of presentation from him to Edward III., but so vague that it might have been penned by any writer on any subject. It is in fact beyond reasonable doubt that the travels were in large part compiled by a Liége physician, known as Johains à le Barbe or Jehan à la Barbe, otherwise Jehan de Bourgogne.

The evidence of this is in a modernized extract quoted by the Liége herald, Louis Abry[1] (1643–1720), from the lost fourth book of the *Myreur des Hystors* of Johans des Preis, styled d'Oultremouse. In this "Jean de Bourgogne, dit à la Barbe," is said to have revealed himself on his deathbed to d'Oultremouse, whom he made his executor, and to have described himself in his will as "messire Jean de Mandeville, chevalier, comte de Montfort en Angleterre et seigneur de l'isle de Campdi et du château Pérouse." It is added that, having had the misfortune to kill an unnamed count in his own country, he engaged himself to travel through the three parts of the world, arrived at Liége in 1343, was a great naturalist, profound philosopher and astrologer, and had a remarkable knowledge of physic. And the identification is confirmed by the fact that in the now destroyed church of the Guillelmins was a tombstone of Mandeville, with a Latin inscription stating that he was otherwise named "ad Barbam," was a professor of medicine, and died at Liége on the 17th of November 1372: this inscription is quoted as far back as 1462.

Even before his death the Liége physician seems to have confessed to a share in the composition of the work. In the common Latin abridged version of it, at the end of c. vii., the author says that when stopping in the sultan's court at Cairo he met a venerable and expert physician of "our" parts, that they rarely came into conversation because their duties were of a different kind, but that long afterwards at Liége he composed this treatise at the exhortation and with the help (*hortatu et adiutorio*) of the same venerable man, as he will narrate at the end of it. And in the last chapter he says that in 1355, in returning home, he came to Liége, and being laid up with old age and arthritic gout in the street called Bassesauenyr, *i.e.* Basse Savenir, consulted the physicians. That one came in who was more venerable than the others by reason of his age and white hairs, was evidently expert in his art, and was commonly called Magister Iohannes ad Barbam. That a chance remark of the latter caused the renewal of their old Cairo acquaintance, and that Ad Barbam, after showing his medical skill on Mandeville, urgently begged him to write his travels; "and so at length, by his advice and help, *monitu et adiutorio*, was composed this treatise, of which I had certainly proposed to write nothing until at least I had reached my own parts in England." He goes on to speak of himself as being now lodged in Liége, "which is only two days distant from the sea of England"; and it is stated in the colophon (and in the MSS.) that the book was first published in French by Mandeville, its author, in 1355, at Liége, and soon after in the same city translated into "the said" Latin form. Moreover, a MS. of the French text extant at Liége about 1860[2] contained a similar statement, and added that the author lodged at a hostel called "al hoste Henkin Levo": this MS. gave the physician's name as "Johains de Bourgogne dit ale barbe," which doubtless conveys its local form.

There is no contemporary English mention of any English knight named Jehan de Mandeville, nor are the arms said to have been on the Liége tomb like any known Mandeville arms. But Dr G. F. Warner has ingeniously suggested that de Bourgogne may be a certain Johan de Bourgoyne, who was pardoned by parliament on the 20th of August 1321 for having taken part in the attack on the Despensers, but whose pardon was revoked in May 1322, the year in which "Mandeville" professes to have left England. And it should now be added that among the persons similarly pardoned *on the recommendation of the same nobleman* was a John Mangevilayn, whose name appears closely related to that of "de Mandeville"[3]—which is merely a later form of "de Magneville."

Mangeuilain occurs in Yorkshire as early as 16 Hen. I. (*Pipe Roll Soc.*, xv. 40), but is very rare, and (failing evidence of any place named Mangeville) seems to be merely a variant spelling of Magnevillain. The meaning may be simply "of Magneville," *de* Magneville; but the family of a 14th century bishop of Nevers were called both "Mandevilain" and "de Mandevilain"—where Mandevilain seems a derivative place-name, meaning the Magneville or Mandeville district. In any case it is clear that the name "de Mandeville" might be suggested to de Bourgogne by that of his fellow-culprit Mangevilayn, and it is even possible that the two fled to England together, were in Egypt together, met again at Liége, and shared in the compilation of the *Travels*.

Whether after the appearance of the *Travels* either de Bourgogne or "Mangevilayn" visited England is very doubtful. St Albans Abbey had a sapphire ring, and Canterbury a crystal orb, said to have been given by Mandeville; but these might have been sent from Liége, and it will appear later that the Liége physician possessed and wrote about precious stones. St Albans also had a legend that a ruined marble tomb of Mandeville (represented cross-legged and in armour, with sword and shield) once stood in the abbey; this may be true of "Mangevilayn" or it may be a mere myth.

It is a little curious that the name preceding Mangevilayn in the list of persons pardoned is "Johan le Barber." Did this suggest to de Bourgogne the *alias* "à le Barbe," or was that only a Liége nickname? Note also that the arms on Mandeville's tomb were borne by the Tyrrells of Hertfordshire (the county in which St Albans lies); for of course the crescent on the lion's breast is only the "difference" indicating a second son.

Leaving this question, there remains the equally complex one whether the book contains any facts and knowledge acquired by actual travels and residence in the East. Possibly it may, but only as a small portion of the section which treats of the Holy Land and the ways of getting thither, of Egypt, and in general of the Levant. The prologue, indeed, points almost exclusively to the Holy Land as the subject of the work. The mention of more distant regions comes in only towards the end of this prologue, and (in a manner) as an afterthought.

By far the greater part of these more distant travels, extending in fact from Trebizond to Hormuz, India, the Malay Archipelago, and China, and back again to western Asia, has been appropriated from the narrative of Friar Odoric (written in 1330). These passages, as served up by Mandeville, are almost always, indeed, swollen with interpolated particulars, usually of an extravagant kind, whilst in no few cases the writer has failed to understand the passages which he adopts from Odoric and professes to give as his own experiences. Thus (p. 209),[4] where Odoric has given a most curious and veracious account of the Chinese custom of employing tame cormorants to catch fish, the cormorants are converted by Mandeville into "little beasts called *loyres* (*layre*, B), which are taught to go into the water" (the word *loyre* being apparently used here for "otter," *lutra*, for which the Provençal is *luria* or *loiria*).

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[1] Quoted again from him by the contemporary Liége herald, Lefort, and from Lefort in 1866 by Dr S. Bormans. Dr J. Vogels communicated it in 1884 to Mr E. W. B. Nicholson, who wrote on it in the *Academy* of April 12, 1884.

[2] See Dr G. F. Warner's edition (Roxburghe Club), p. 38. In the *Bull. de l'Institut archéologique Liégeois*, iv. (1860), p. 171, M. Ferd. Henaux quotes the passage from "MSS. de la Bibliothèque publique de Liége, à l'Université, no. 360, fol. 118," but the MS. is not in the 1875 printed catalogue of the University Library, which has no Old French MS. of Mandeville at present. It was probably lent out and not returned.

[3] The de Mandevilles, earls of Essex, were originally styled de Magneville, and Leland, in his *Comm. de Script. Britt.* (CDV), calls our Mandeville himself "Joannes Magnovillanus, alias Mandeville."

[4] Page indications like this refer to passages in the 1866 reissue of Halliwell's edition, as being probably the most ready of access.

At a very early date the coincidence of Mandeville's stories with those of Odoric was recognized, insomuch that a MS. of Odoric which is or was in the chapter library at Mainz begins with the words: *Incipit Itinerarius fidelis fratris Odorici socii Militis Mendavil per Indian; licet hic* [read *ille*] *prius et alter posterius peregrinationem suam descripsit.* At a later day Sir T. Herbert calls Odoric "travelling companion of our Sir John"; and Purchas, with most perverse injustice, whilst calling Mandeville, next to Polo, "if next . . . the greatest Asian traveller that ever the world had," insinuates that Odoric's story was stolen from Mandeville's. Mandeville himself is crafty enough, at least in one passage, to anticipate criticism by suggesting the probability of his having travelled with Odoric (see p. 282 and below).

Much, again, of Mandeville's matter, particularly in Asiatic geography and history, is taken bodily from the *Historiae Orientis* of Hetoum, an Armenian of princely family, who became a monk of the Praemonstrant order, and in 1307 dictated this work on the East, in the French tongue at Poitiers, out of his own extraordinary acquaintance with Asia and its history in his own time.

It is curious that no passage in Mandeville can be plausibly traced to Marco Polo, with one exception. This is (p. 163) where he states that at Hormuz the people during the great heat lie in water—a circumstance mentioned by Polo, though not by Odoric. We should suppose it most likely that this fact had been interpolated in the copy of Odoric used by Mandeville; for if he had borrowed it direct from Polo he would have borrowed more.

A good deal about the manners and customs of the Tatars is demonstrably derived from the famous work of the Franciscan Ioannes de Plano Carpini, who went as the pope's ambassador to the Tatars in 1245–1247; but Dr Warner considers that the immediate source for Mandeville was the *Speculum historiale* of Vincent de Beauvais. Though the passages in question are all to be found in Plano Carpini more or less exactly, the expression is condensed and the order changed. For examples compare Mandeville, p. 250, on the tasks done by Tatar women, with Plano Carpini, p. 643;[1] Mandeville. p. 250, on Tatar habits of eating, with Plano Carpini, pp. 639–640; Mandeville, p. 231, on the titles borne on the seals of the Great Khan, with Plano Carpini, p. 715, &c.

The account of Prester John is taken from the famous *Epistle* of that imaginary potentate, which was so widely diffused in the 13th century, and created that renown which made it incumbent on every traveller in Asia to find some new tale to tell of him. Many fabulous stories, again, of monsters, such as cyclopes, sciapodes, hippopodes, monoscelides, anthropophagi, and men whose heads did grow beneath their shoulders, of the phoenix and the weeping crocodile, such as Pliny has collected, are introduced here and there, derived no doubt from him, Solinus, the bestiaries, or the *Speculum naturale* of Vincent de Beauvais. And interspersed, especially in the chapters about the Levant, are the stories and legends that were retailed to every pilgrim, such as the legend of Seth and the grains of paradise from which grew the wood of the cross, that of the shooting of old Cain by Lamech, that of the castle of the sparrow-hawk (which appears in the tale of Melusina), those of the origin of the balsam plants at Maṭarīya, of the dragon of Cos, of the river Sabbation, &c.

Even in that part of the book which might be supposed to represent some genuine experience there are the plainest traces that another work has been made use of, more or less—we might almost say as a framework to fill up. This is the itinerary of the German knight Wilhelm von Boldensele, written in 1336 at the desire of Cardinal Talleyrand de Perigord.[2] A cursory comparison of this with Mandeville leaves no doubt that the latter has followed its thread, though digressing on every side, and too often eliminating the singular good sense of the German traveller. We may indicate as examples Boldensele's account of Cyprus (Mandeville, p. 28 and p. 10), of Tyre and the coast of Palestine (Mandeville, 29, 30, 33, 34), of the journey from Gaza to Egypt (34), passages about Babylon of Egypt (40), about Mecca (42), the general account of Egypt (45), the pyramids (52), some of the wonders of Cairo, such as the slave-market, the chicken-hatching stoves, and the apples of paradise, *i.e.* plantains (49), the Red Sea (57), the convent on Sinai (58, 60), the account of the church of the Holy Sepulchre (74–76), &c. There is, indeed, only a small residuum of the book to which genuine character, as containing the experiences of the author, can possibly be attributed. Yet, as has been intimated, the borrowed stories are frequently claimed as such experiences. In addition to those already mentioned, he alleges that he had witnessed the curious exhibition of the garden of transmigrated souls (described by Odoric) at Cansay, *i.e.* Hangchow-fu (211). He and his fellows with their valets had remained fifteen months in service with the emperor of Cathay in his wars against the king of Manzi—Manzi, or Southern China, having ceased to be a separate kingdom some seventy years before the time referred to. But the most notable of these false statements occurs in his adoption from Odoric of the story of the Valley Perilous (282). This is, in its original form, apparently founded on real experiences of Odoric viewed through a haze of excitement and superstition. Mandeville, whilst swelling the wonders of the tale with a variety of extravagant touches, appears to safeguard himself from the reader's possible discovery that it was stolen by the interpolation: "And some of our fellows accorded to enter, and some not. So there were with us two worthy men, Friars Minor, that were of Lombardy, who said that if any man would enter they would go in with us. And when they had said so, upon the gracious trust of God and of them, we caused mass to be sung, and made every man to be shriven and houselled; and then we entered, fourteen persons; but at our going out we were but nine," &c.

In referring to this passage it is only fair to recognize that the description (though the suggestion of the greatest part exists in Odoric) displays a good deal of imaginative power; and there is much in the account of Christian's passage through the Valley of the Shadow of Death, in Bunyan's famous allegory, which indicates a possibility that John Bunyan may have read and remembered this episode either in Mandeville or in Hakluyt's Odoric.

Nor does it follow that the whole work is borrowed or fictitious. Even the great Moorish traveller Ibn Batuta, accurate and veracious in the main, seems—in one part at least of his narrative—to invent experiences; and in such works as those of Jan van Hees and Arnold von Harff we have examples of pilgrims to the Holy Land whose narratives begin apparently in sober truth, and gradually pass into flourishes of fiction and extravagance. So in Mandeville also we find particulars not yet traced to other writers, and which may therefore be provisionally assigned either to the writer's own experience or to knowledge acquired by colloquial intercourse in the East.

It is difficult to decide on the character of his statements as to recent Egyptian history. In his account of that country (pp. 37, 38) though the series of the Comanian (*i.e.* of the Bahri Mameluke) sultans is borrowed from Hetoum down to the accession of *Melechnasser*, *i.e.* Malik al-Nāṣir (Nāṣir ud-din Mahommed), who came first to the throne in 1293, Mandeville appears to speak from his own knowledge when he adds that this "*Melechnasser* reigned long and governed wisely." In fact, though twice

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But all these passages have also been verified as substantially occurring in Barrois's French MS. Nouv. Acq. Franç. 4515 in the Bibliothèque Nationale, Paris, mentioned below (of A.D. 1371), cited B, and in that numbered xxxix. of the Grenville collection (British Museum), which dates probably from the early part of the 15th century, cited G.

[1] Viz. in D'Avezac's ed. in tom. iv. of *Rec. de voyages et de mémoires* pub. by the Soc. de Géog., 1839.

[2] It is found in the *Thesaurus* of Canisius (1604), v. pt. ii. p. 95, and in the ed. of the same by Basnage (1725), iv. 337.

displaced in the early part of his life, Malik Nāṣir reigned till 1341, a duration unparalleled in Mahommedan Egypt, whilst we are told that during the last thirty years of his reign Egypt rose to a high pitch of wealth and prosperity. Mandeville, however, then goes on to say that his eldest son, *Melechemader*, was chosen to succeed; but this prince was caused privily to be slain by his brother, who took the kingdom under the name of *Melechmadabron*. "And he was Soldan when I departed from those countries." Now Malik Nāṣir Mahommed was followed in succession by no less than eight of his sons in thirteen years, the first three of whom reigned in aggregate only a few months. The names mentioned by Mandeville appear to represent those of the fourth and sixth of the eight, viz. Ṣaliḥ 'Imād ud-din Ismā'īl, and Moẓaffar (Saif ud-din Ḥajjī); and these the statements of Mandeville do not fit.

On several occasions Arabic words are given, but are not always recognizable, owing perhaps to the carelessness of copyists in such matters. Thus, we find (p. 50) the names (not satisfactorily identified) of the wood, fruit and sap of the balsam plant; (p. 99) of bitumen, "alkatran" (*al-Kāṭrān*); (p. 168) of the three different kinds of pepper (long pepper, black pepper and white pepper) as *sorbotin*, *fulful* and *bano* or *bauo* (*fulful* is the common Arabic word for pepper; the others have not been satisfactorily explained). But these, and the particulars of his narrative for which no literary sources have yet been found, are too few to constitute a proof of personal experience.

Mandeville, again, in some passages shows a correct idea of the form of the earth, and of position in latitude ascertained by observation of the pole star; he knows that there are antipodes, and that if ships were sent on voyages of discovery they might sail round the world. And he tells a curious story, which he had heard in his youth, how a worthy man did travel ever eastward until he came to his own country again (p. 183). But he repeatedly asserts the old belief that Jerusalem was in the centre of the world (79, 183), and maintains in proof of this that at the equinox a spear planted erect in Jerusalem casts no shadow at noon, which, if true, would equally consist with the sphericity of the earth, provided that the city were on the equator.

The sources of the book, which include various authors besides those whom we have specified, have been laboriously investigated by Dr Albert Bovenschen[1] and Dr G. F. Warner,[2] and to them the reader must be referred for more detailed information on the subject.

The oldest known MS. of the original—once Barrois's, afterwards the earl of Ashburnham's, now Nouv. Acq. Franç. 4515 in the Bibliothèque Nationale, Paris—is dated 1371, but is nevertheless very inaccurate in proper names. An early printed Latin translation made from the French has been already quoted, but four others, unprinted, have been discovered by Dr J. Vogels.[3] They exist in eight MSS., of which seven are in Great Britain, while the eighth was copied by a monk of Abingdon; probably, therefore, all these unprinted translations were executed in this country. From one of them, according to Dr Vogels,[4] an English version was made which has never been printed and is now extant only in free abbreviations, contained in two 15th century MSS. in the Bodleian Library, Oxford—MS. e Museo 116, and MS. Rawlinson D. 99: the former, which is the better, is in Midland dialect, and may possibly have belonged to the Augustinian priory of St Osyth in Essex, while the latter is in Southern dialect.

The first English translation direct from the French was made (at least as early as the beginning of the 15th century) from a MS. of which many pages were lost.[5] Writing of the name Califfes (Khalif), the author says (*Roxburghe Club ed.*, p. 18) that it is *tant a dire come roi* (*s*). *Il y soleit auoir v. soudans*—"as much as to say king. There used to be 5 sultans." In the defective French MS. a page ended with *Il y so*; then came a gap, and the next page went on with part of the description of Mount Sinai, *Et est celle vallee mult froide* (ibid. p. 32). Consequently the corresponding English version has "That ys to say amonge hem *Roys Ils* and this vale ys ful colde"! All English printed texts before 1725, and Ashton's 1887 edition, follow these defective copies, and in only two known MSS. has the lacuna been detected and filled up.

One of them is the British Museum MS. Egerton 1982 (Northern dialect, about 1410–1420?), in which, according to Dr Vogels, the corresponding portion has been borrowed from that English version which had already been made from the Latin. The other is in the British Museum MS. Cotton Titus C. xvi. (Midland dialect, about 1410–1420?), representing a text completed, and revised throughout, from the French, though not by a competent hand. The Egerton text, edited by Dr G. F. Warner, has been printed by the Roxburghe Club, while the Cotton text, first printed in 1725 and 1727, is in modern reprints the current English version.

That none of the forms of the English version can be from the same hand which wrote the original is made patent by their glaring errors of translation, but the Cotton text asserts in the preface that it was made by Mandeville himself, and this assertion was till lately taken on trust by almost all modern historians of English literature. The words of the original "je eusse cest livret mis en latin . . . mais . . . je l'ay mis en rōmant" were mistranslated as if "je eusse" meant "I had" instead of "I should have," and then (whether of fraudulent intent or by the error of a copyist thinking to supply an accidental omission) the words were added "and translated it aȝen out of Frensche into Englyssche." Mätzner (*Altenglische Sprachproben*, I., ii., 154–155) seems to have been the first to show that the current English text cannot possibly have been made by Mandeville himself. Of the original French there is no satisfactory edition, but Dr Vogels has undertaken a critical text, and Dr Warner has added to his Egerton English text the French of a British Museum MS. with variants from three others.

It remains to mention certain other works bearing the name of Mandeville or de Bourgogne.

MS. Add. C. 280 in the Bodleian appends to the "Travels" a short French life of St Alban of *Germany*, the author of which calls himself John Mandivill[e], knight, formerly of the town of St Alban, and says he writes to correct an impression prevalent among his countrymen that there was no other saint of the name: this life is followed by part of a French herbal.

To Mandeville (by whom de Bourgogne is clearly meant) d'Oultremouse[6] ascribes a Latin "lappidaire selon l'oppinion des Indois," from which he quotes twelve passages, stating that the author (whom he calls knight, lord of Montfort, of Castelperouse, and of the isle of Campdi) had been "baillez en Alexandrie" seven years, and had been presented by a Saracen friend with some fine jewels which had passed into d'Oultremouse's own possession: of this *Lapidaire*, a French version, which seems to have been completed after 1479, has been several times printed.[7] A MS. of Mandeville's travels offered for sale in 1862[8] is said to have been divided into five books: (1) the travels, (2) *de là forme de la terre et comment et par quelle manière elle fut faite*, (3) *de la forme del ciel*, (4) *des herbes selon les yndois et les philosophes par de là*, and (5) *ly lapidaire*—while the cataloguer supposed Mandeville to have been the author of a concluding piece entitled *La Venianche de nostre Signeur Ihesu-Crist fayte par Vespasian fil del empereur de Romme et comment Iozeph daramathye fu deliures de la prizon.* From the treatise on herbs a passage is quoted asserting it to have been composed in 1357 in honour of the author's natural lord, Edward, king of England. This date is corroborated by the title of king of Scotland given to Edward, who had received from Baliol the surrender of the crown and kingly dignity on the 20th of January 1356, but on the 3rd of October 1357 released King David and made peace with Scotland: unfortunately we are not told whether the treatise contains the author's name, and, if so, *what* name. Tanner (*Bibliotheca*) alleges that Mandeville wrote several books on medicine, and among the Ashmolean MSS. in the Bodleian are a medical receipt by John de Magna Villa (No. 1479), an alchemical receipt by him (No. 1407), and another alchemical receipt by Johannes de Villa Magna (No. 1441).

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[1] *Die Quellen für die Reisebeschreibung des Johann von Mandeville, Inaugural-Dissertation . . . Leipzig* (Berlin, 1888). This was revised and enlarged as "Untersuchungen über Johann von Mandeville und die Quellen seiner Reisebeschreibung," in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, Bd. 23, Heft 3 u. 4 (No. 135, 136).

[2] In his edition (Roxburghe Club).

[3] *Die ungedruckten lateinischen Versionen Mandeville's* (Crefeld, 1886).

[4] *Handschriftliche Untersuchungen über die englische Version Mandeville's* (Crefeld, 1891), p. 46.

[5] Dr Vogels controverts these positions, arguing that the first English version from the French was the complete Cotton text, and that the defective English copies were made from a defective *English* MS. His supposed evidences of the priority of the Cotton text equally consist with its being a later revision, and for *Roys Ils* in the defective English MSS. he has only offered a laboured and improbable explanation.

[6] Stanislas Bormans, Introduction to d'Oultremouse's Chronicle, pp. lxxxix., xc.; see also Warner's edition of the Travels, p. xxxv. The ascription is on ff. 5 and 6 of *Le Tresorier de philosophie naturele des pierres precieuses*, an unprinted work by d'Oultremouse in *MS. Fonds français* 12326 of the Bibliothèque Nationale, Paris. The passage about Alexandria is on f. 81.

[7] See L. Pannier, *Les Lapidaires français*, pp. 189–204: not knowing d'Oultremouse's evidence, he has discredited the attribution to Mandeville and doubted the existence of a Latin original.

[8] *Description . . . d'une collection . . . d'anciens manuscrits . . . réunis par les soins de M. J. Techener*, pt. i. (Paris, 1862), p. 159 (referred to by Pannier, pp. 193–194).

Finally, de Bourgogne wrote under his own name a treatise on the plague,[1] extant in Latin, French and English texts, and in Latin and English abridgments. Herein he describes himself as Johannes de Burgundia, otherwise called *cum Barba*, citizen of Liége and professor of the art of medicine; says that he had practised forty years and had been in Liége in the plague of 1365; and adds that he had previously written a treatise on the cause of the plague, according to the indications of astrology (beginning *Deus deorum*), and another on distinguishing pestilential diseases (beginning *Cum nimium propter instans tempus epidimiale*). "Burgundia" is sometimes corrupted into "Burdegalia," and in English translations of the abridgment almost always appears as "Burdews" (Bordeaux) or the like. MS. Rawlinson D. 251 (15th century) in the Bodleian also contains a large number of English medical receipts, headed "Practica phisicalia M*agist*ri Joh*ann*is de Burgundia."

See further Dr G. F. Warner's article in the *Dictionary of National Biography* for a comprehensive account, and for bibliographical references; Ulysse Chevalier's *Répertoire des sources historiques du moyen age* for references generally; and the *Zeitschr. f. celt. Philologie* II., i. 126, for an edition and translation, by Dr Whitley Stokes, of Fingin O'Mahony's Irish version of the *Travels*.

(E. W. B. N.; H. Y.)

MANDHATA, a village with temples in India, in Nimar district of the Central Provinces, on the south bank of the Narbada. Pop. (1901), 832. It is a famous place of Hindu pilgrimage, as containing one of the twelve great *lingas* of Siva; and as late as the beginning of the 19th century it was the scene of the self-immolation of devotees who threw themselves from the cliffs into the river.

MANDI, a native state of India, within the Punjab. It ranks as the most important of the hill states to which British influence extended in 1846 after the first Sikh War. The territory lies among the lower ranges of the Himalaya, between Kangra and Kulu. The country is mountainous, being intersected by two great parallel ranges, reaching to an average height of 5000 to 7000 ft. above sea-level. The valleys between the hill ranges are fertile, and produce all the ordinary grains, besides more valuable crops of rice, maize, sugar-cane, poppy and tobacco. Iron is found in places, and also gold in small quantities. Area, 1200 sq. m.; pop. (1901), 174,045; estimated revenue, £28,000; tribute, £6666. The chief, whose title is raja, is a Rajput of old family. Considerable sums have been expended on roads and bridges. An important product of the state is salt, which is mined in two places.

The town of Mandi is on the Beas, which is here a mountain torrent, crossed by a fine iron bridge; 2991 ft. above sea-level; 88 m. from Simla. Pop. (1901), 8144. It was founded in 1527, and contains a palace of the 17th century and other buildings of interest. It is a mart for transfrontier trade with Tibet and Yarkand.

See *Mandi State Gazetteer* (Lahore, 1908).

MANDINGO, the name currently given to a very important division of negro peoples in West Africa. It is seemingly a corruption of a term applied to an important section of this group, the Mande-nka or Mande-nga. The present writer has usually heard this word pronounced by the Mandingo themselves "Mandina," or even "Madiña." It seems to be derived from the racial name *Mande*, coupled with the suffix *nka* or *nke*, meaning "people," the people of Mande. Then again this word *Mande* seems to take the varying forms of *Male*, *Meli*, *Mane*, *Madi*, and, according to such authorities as Binger, Delafosse and Desplagnes, it is connected with a word *Mali*, which means "hippopotamus" or else "manati"—probably the latter. According to Desplagnes, the word is further divisible into *ma*, which would have meant "fish," and *nde*, a syllable to which he ascribes the meaning of "father." In no Mandingo dialect known to the present writer (or in any other known African language) does the vocable *ma* apply to "fish," and in only one very doubtful far eastern Mandingo dialect is the root *nde* or any other similar sound applied to "father." This etymology must be abandoned, probably in favour of *Mani*, *Mali*, *Madi*, *Mande*, meaning "hippopotamus," and in some cases the other big water mammal, the manati.[2]

The West African tribes speaking Mandingo languages vary very much in outward appearance. Some of them may be West African negroes of the forest type with little or no intermixture with the Caucasian; others, such as the typical Mandingos or the Susus, obviously contain a non-negro element in their physique. This last type resembles very strongly the Swahilis of the Zanzibar littoral or other crosses between the Arab and the negro; and though nearly always black-skinned, often has a well-shaped nose and a fairly full beard. The tribes dwelling in the West African forest, but speaking languages of Mandingo type, do not perhaps exhibit the very prognathous, short-limbed, "ugly" development of West African negro, but are of rather a refined type, and some of them are lighter in skin colour than the more Arab-looking Mandingos of the north. But in these forest Mandingos the beard is scanty. Occasionally the Mandingo physical type appears in eastern Liberia and on the Ivory Coast amongst people speaking Kru languages. In other cases it is associated with the Senufo speech-family.

Delafosse divides the Mandingo group linguistically into three main sections: (1) the *Mande-tamu*, (2) the *Mande-fu*, and (3) the *Mande-tă*, according as they use for the numeral 10 the root *tamu*, *tă* or *fu*. Of the first group are the important tribes of the Soni-nké (called Sarakulle by the Fula, and Sarakolé by the French); the Swaninki people of Azer, and the oases of Tishitt, Wadan and Walata in the south-west Sahara; and the Bozo, who are the fishermen along the banks of the Upper Niger and the Bani from Jenné to Timbuktu. The Soni-nké are also known as Marka, and they include (according to Binger) the Samogho and even the Kurtei along the banks of the Niger east of Timbuktu as far as Say.

The group of Mande-tă would include the Bamana (incorrectly called Bambara) of the upper Senegal and of Segu on the Upper Niger, the Toronke, the Mandenga, the Numu of the district west of the Black Volta, the Vai of south-western Liberia, and the Dyula or Gyula of the region at the back of the Ivory Coast.

The group of the Mande-fu includes a great many different languages and dialects, chiefly in the forest region of Sierra Leone and Liberia, and also the dialects of the celebrated Susu or Soso tribe, and the Mandingo tribes of Futa Jallon, of the Grand Scarcies River and of the interior of the Ivory Coast, and of the regions between the eastern affluents of the Upper Niger and the Black Volta. To this group Delafosse joins the Boko dialect spoken by people dwelling to the west of the Lower Niger at Bussa—between Bussa and Borgu. If this hypothesis be correct it gives a curious eastern extension to the range of the Mandingo family at the present day; or it may be a vestige left by the Mandingo invasion which, according to legend, came in prehistoric times from the Hausa countries across the Niger to Senegambia. It is remarkable that this Boko dialect as recorded by the missionary Koelle most resembles certain dialects in central Liberia and in the Ivory Coast hinterland.

The Mandingos, coming from the East and riding on horses (according to tradition), seem to have invaded western Nigeria about A.D. 1000 (if not earlier), and to have gradually displaced and absorbed the Songhai or Fula (in other words, Negroid, "White") rulers of the countries in the basin of the Upper Niger or along its navigable course as far as the Bussa Rapids and the forest region. On the ruins of these Songhai, Berber, or Fula kingdoms rose the empire of Mali (Melle). Considerable sections of the Mandingo invaders had adopted Mahommedanism, and extended a great Mahommedan empire of western Nigeria far northwards into the Sahara Desert. In the 16th century the Songhai regained supreme power. See *infra*, § *The Melle Empire*.

Although the Mandingos, and especially the Susu section, may have come as conquerors, they devoted themselves through the succeeding centuries more and more to commerce. They became to the extreme west of Africa what the Hausa are in the west-central regions. Some of the Mandingo invasions, especially in the forest region, left little more than the imposition of their language; but where there was any element of Caucasian blood (for the original Mandingo invaders were evidently dashed with the Caucasian by intermingling with some of the negroid races of north-central Africa), they imposed a degree of civilization which excluded cannibalism (still rampant in much of the forest region of West Africa), introduced working in leather and in metals, and was everywhere signalized by a passionate love of music, a characteristic of all true Mandingo tribes at the present day. It is noteworthy that many of the instruments affected by the Mandingos are found again in the more civilized regions of Bantu Africa, as well as in the central Sudan. Many of these types of musical instruments can also be traced originally to ancient Egypt. The Mandingos also seem to have brought with them in their westward march the Egyptian type of ox, with the long, erect horns. It would almost seem as if this breed had been preceded by the zebu or humped ox; though these two types are evidently of common origin so far as derivation from one wild species is concerned. The Mandingos maintain the system of totems or clans, and each section or tribe identifies itself with a symbol, which is usually an animal or a plant. The Mandenga are supposed to have either the manati or the hippopotamus as *tanna* (totem). (Binger states that the manati was the totem of the Mando group, to which perhaps belonged originally the Susu and the Dyula.) The Bamana are the people of the crocodile; the Samanke are the people of the elephant; the Samokho of the snake. Other totems or symbols of special families or castes are the dog, the calabash or gourd, the lion, the green monkey, the leopard, the monitor lizard, a certain spice called bandugu, certain rats, the python, the puff-adder, &c.

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[1] Respecting this, see David Murray, *The Black Book of Paisley*, &c. (1885), and *John de Burdeus*, &c. (1891).

[2] Indeed it is possible that the European name for this Sirenian—manati—derived from the West Indies, is the corruption of a West African word *manti*, applied very naturally to the animal by the West African slaves, who at once recognized it as similar to the creature found on the West African coast in their own rivers, and also on the Upper Niger.

AUTHORITIES.—The bibliography dealing with the Mandingo peoples is very extensive, but only the following works need be cited: Captain L. G. Binger, *Du Niger au Golfe de Guinée*, &c. (1892); Maurice Delafosse, *Vocabulaires comparatifs de plus de 60 langues et dialectes parlés à la Côte d'Ivoire*, &c. (1904); Lieut. Desplagnes, *Le Plateau central nigérien* (1907); Lady Lugard, *A Tropical Dependency* (1905); Sir Harry Johnston, *Liberia* (1906). Most of these works contain extensive bibliographies. (H. H. J.)

The Melle Empire.—The tradition which ascribes the arrival of the Mandingo in the western Sudan to the 10th or 11th century is referred to in the previous section. It is not known by whom the Melle (Mali) state was founded. Neither is there certainty as to the site of the capital, also called Melle. Idrisi in the 12th century describes the Wangara (a Hausa name for the Mandingo) as a powerful people, and El Bakri writes in similar terms. But the first king whose name is preserved was Baramindana, believed to have reigned from 1213 to 1235. His territory lay south of that of Jenné, partly within the bend of the Niger and partly west of that river. The people were already Moslem, and the capital was a rendezvous for merchants from all parts of the western Sudan and the Barbary States. Mari Jatah (or Diara), Baramindana's successor, about the middle of the 13th century conquered the Susu, then masters of Ghanata (Ghana). Early in the 14th century Mansa, *i.e.* Sultan, Kunkur Musa, extended the empire, known as the Mellistine, to its greatest limits, making himself master of Timbuktu, Gao and all the Songhoi dominions. His authority extended northward over the Sahara to the Tuat oases. Mansa Suleiman was on the throne when in 1352–1353 Melle was visited by Ibn Batuta. By this monarch the empire was divided into three great provinces, ruled by viceroys. For a century afterwards Melle appears to have been the dominant Sudan state west of the Lower Niger, but it had to meet the hostility of the growing power of the pagan Mossi, of the Tuareg in the north and of the Songhoi, who under Sunni Ali (*c.* 1325) had already regained a measure of independence. Cadamosto nevertheless describes Melle in 1454 as being still the most powerful of the negro-land kingdoms and the most important for its traffic in gold and slaves. The Songhoi sovereign Askia is said to have completed the conquest of Melle at the beginning of the 16th century. It nevertheless retained some sort of national existence—though with the advent of the Moors in the Niger countries (end of the 16th century) native civilization suffered a blow from which it never recovered. Civil war is said to have finally wrought the ruin of Melle about the middle of the 17th century.[1] The Portuguese, from their first appearance on the Senegal and Gambia, entered into friendly relations with the rulers of Melle. Barros relates (*Da Asia*, Decade I.) that John II. of Portugal sent embassies to the court of Melle by way of the Gambia (end of the 15th century). At that time the authority of Melle was said to extend westward to the coast. The king, pressed by the Mossi, the Songhoi and the Fula, solicited the help of his "friends and allies" the Portuguese—with what result does not appear; but in 1534 Barros himself despatched an ambassador to the king of Melle concerning the trade of the Gambia. By way of that river the Portuguese themselves penetrated as far as Bambuk, a country conquered by the Mandingo in the 12th century. By Barros the name of the Melle ruler is given as Mandi Mansa, which may be the native form for "Sultan of the Mandi" (Mandingo).

See further TIMBUKTU and the authorities there cited; cf. also L. Marc, *Le Pays Mossi* (Paris, 1909). Lists of Mandingo sovereigns are given in Stokvis, *Manuel d'histoire*, vol. i. (Leiden, 1888). (F. R. C.)

MANDLA, a town and district of British India, in the Jubbulpore division of the Central Provinces. The town is on the river Nerbudda, 1787 ft. above the sea. It has a manufacture of bell-metal vessels. Pop. (1901), 5054. The district of Mandla, among the Satpura hills, has an area of 5054 sq. m. It consists of a wild highland region, broken up by the valleys of numerous rivers and streams. The Nerbudda flows through the centre of the district, receiving several tributaries which take their rise in the Maikal hills, a range densely clothed with *sāl* forest, and forming part of the great watershed between eastern and western India. The loftiest mountain is Chauradadar, about 3400 ft. high. Tigers abound, and the proportion of deaths caused by wild animals is greater than in any other district of the Central Provinces. The magnificent *sāl* forests which formerly clothed the highlands have suffered greatly from the nomadic system of cultivation practised by the hill tribes, who burned the wood and sowed their crops in the ashes; but measures have been taken to prevent further damage. The population in 1901 was 318,400, showing a decrease of 6·5% in the decade, due to famine. The aboriginal or hill tribes are more numerous in Mandla than in any other district of the Central Provinces, particularly the Gonds. The principal crops are rice, wheat, other food grains, pulse and oil-seeds. There is a little manufacture of country cloth. A branch of the Bengal-Nagpur railway touches the south-western border of the district. Mandla suffered most severely from the famine of 1896–1897, partly owing to its inaccessibility, and partly from the shy habits of the aboriginal tribes. The registered death-rate in 1907 was as high as 96 per thousand.

MANDOLINE (Fr. *mandoline*; Ger. *Mandoline*; It. *mandolina*), the treble member of the lute family, and therefore a stringed instrument of great antiquity. The mandoline is classified amongst the stringed instruments having a vaulted back, which is more accentuated than even that of the lute. The mandoline is strung with steel and brass wire strings. There are two varieties of mandolines, both Italian: (1) the *Neapolitan*, 2 ft. long, which is the best known, and has four courses of pairs of unisons tuned like the violin in fifths; (2) the *Milanese*, which is slightly larger and has five or six courses of pairs of unisons. The neck is covered by a finger-board, on which are distributed the twelve or more frets which form nuts at the correct points under the strings on which the fingers must press to obtain the chromatic semitones of the scale. The strings are twanged by means of a plectrum or pick, held between the thumb and first finger of the right hand. In order to strike a string the pick is given a gliding motion over the string combined with a *down* or an *up* movement, respectively indicated by signs over the notes. In order to sustain notes on the mandoline the effect known as *tremolo* is employed; it is produced by means of a double movement of the pick up and down over a pair of strings.

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[1] On the ruins of the old Melle dominions arose five smaller kingdoms, representing different sections of the Mandingo peoples.

The mandoline is a derivative of the mandola or mandore, which was smaller than the lute but larger than either of the mandolines described above. It had from four to eight courses of strings, the *chanterelle* or melody string being single and the others in pairs of unisons. The mandore is mentioned in Robert de Calenson (12th cent.), and elsewhere; it may be identified with the pandura.

The Neapolitan mandoline was scored for by Mozart as an accompaniment to the celebrated serenade in *Don Juan*. Beethoven wrote for it a *Sonatina per il mandolino*, dedicated to his friend Krumpholz. Grétry and Paisiello also introduced it into their operas as an accompaniment to serenades.

The earliest method for the mandoline was published by Fouchette in Paris in 1770. The earliest mention of the instrument in England, in 1707, is quoted in Ashton's *Social Life in the Reign of Queen Anne*: "Signior Conti will play . . . . on the mandoline, an instrument not known yet." (K. S.)

MANDRAKE (*Mandragora officinarum*), a plant of the potato family, order Solanaceae, a native of the Mediterranean region. It has a short stem bearing a tuft of ovate leaves, with a thick fleshy and often forked root. The flowers are solitary, with a purple bell-shaped corolla; the fruit is a fleshy orange-coloured berry. The mandrake has been long known for its poisonous properties and supposed virtues. It acts as an emetic, purgative and narcotic, and was much esteemed in old times; but, except in Africa and the East, where it is used as a narcotic and anti-spasmodic, it has fallen into well-earned disrepute. In ancient times, according to Isidorus and Serapion, it was used as a narcotic to diminish sensibility under surgical operations, and the same use is mentioned by Ḳazwīnī, i. 297, *s.v.* "Luffāḥ." Shakespeare more than once alludes to this plant, as in *Antony and Cleopatra*: "Give me to drink mandragora." The notion that the plant shrieked when touched is alluded to in *Romeo and Juliet*: "And shrieks like mandrakes torn out of the earth, that living mortals, hearing them, run mad." The mandrake, often growing like the lower limbs of a man, was supposed to have other virtues, and was much used for love philtres, while the fruit was supposed, and in the East is still supposed, to facilitate pregnancy (Aug., *C. Faust.* xxii. 56; cf. Gen. xxx. 14, where the Hebrew דודאים is undoubtedly the mandrake). Like the mallow, the mandrake was potent in all kinds of enchantment (see Maimonides in Chwolson, *Ssabier*, ii. 459). Dioscorides identifies it with the *κιρκαία*, the root named after the enchantress Circe. To it appears to apply the fable of the magical herb Baaras, which cured demoniacs, and was procured at great risk or by the death of a dog employed to drag it up, in Josephus (*B. J.* vii. 6, § 3). The German name of the plant (*Alraune*; O. H. G. *Alrûna*) indicates the prophetic power supposed to be in little images (homunculi, Goldmännchen, Galgenmännchen) made of this root which were cherished as oracles. The possession of such roots was thought to ensure prosperity. (See Du Cange, *s.vv.* "Mandragora" and Littré.)

Gerard in 1597 (*Herball*, p. 280) described male and female mandrakes, and Dioscorides also recognizes two such plants corresponding to the spring and autumn species (*M. vernalis* and *M. officinarum* respectively), differing in the colour of the foliage and shape of fruit.

MANDRILL (a name formed by the prefix "man" to the word "drill," which was used in ancient literature to denote an ape, and is probably of West African origin), the common title of the most hideous and most brilliantly coloured of all the African monkeys collectively denominated baboons and constituting the genus *Papio*. Together with the *drill* (*q.v.*), the mandrill, *Papio maimon*, constitutes the subgenus *Maimon*, which is exclusively West African in distribution, and characterized, among other peculiarities, by the extreme shortness of the tail, and the great development of the longitudinal bony swellings, covered during life with naked skin, on the sides of the muzzle. As a whole, the mandrill is characterized by heaviness of body, stoutness and strength of limb, and exceeding shortness of tail, which is a mere stump, not 2 in. long, and usually carried erect. It is, moreover, remarkable for the prominence of its brow-ridges, beneath which the small and closely approximated eyes are deeply sunk; the immense size of the canine teeth; and more especially for the extraordinarily vivid colouring of some parts of the skin. The body generally is covered with soft hair—light olive-brown above and silvery grey beneath—and the chin is furnished underneath with a small pointed yellow beard. The hair of the forehead and temples is directed upwards so as to meet in a point on the crown, which gives the head a triangular appearance. The ears are naked, and bluish black. The hands and feet are naked, and black. A large space around the greatly developed callosities on the buttocks, as well as the upper part of the insides of the thighs, is naked and of a crimson colour, shading off on the sides to lilac or blue, which, depending upon injection of the superficial blood-vessels, varies in intensity according to the condition of the animal—increasing under excitement, fading during sickness, and disappearing after death. It is, however, in the face that the most remarkable disposition of vivid hues occurs, more resembling those of a brilliantly coloured flower than what might be expected in a mammal. The cheek-prominences are of an intense blue, the effect of which is heightened by deeply sunk longitudinal furrows of a darker tint, while the central line and termination of the nose are bright scarlet. It is only to fully adult males that this description applies. The female is of much smaller size, and more slender; and, though the general tone of the hairy parts of the body is the same, the prominences, furrows, and colouring of the face are much less marked. The young males have black faces.

Old males are remarkable for the ferocity of their disposition, as well as for other disagreeable qualities; but when young they can easily be tamed. Like baboons, mandrills appear to be indiscriminate eaters, feeding on fruit, roots, reptiles, insects, scorpions, &c., and inhabit open rocky ground rather than forests. Not much is known of the mandrill's habits in the wild state, nor of the exact limits of its geographical distribution; the specimens brought to Europe coming from the west coast of tropical Africa, from Guinea to the Gaboon. (See also PRIMATES.) (W. H. F.; R. L.*)

MANDU, or MANDOGARH, a ruined city in the Dhar state of Central India, the ancient capital of the Mahommedan kingdom of Malwa. The city is situated at an elevation of 2079 ft. and extends for 8 m. along the crest of the Vindhyan mountains. It reached its greatest splendour in the 15th century under Hoshang Shah (1405–1434). The circuit of the battlemented wall is nearly 23 m., enclosing a large number of palaces, mosques and other buildings. The oldest mosque dates from 1405; the finest is the Jama Masjid or great mosque, a notable example of Pathan architecture, founded by Hoshang Shah. The marble-domed tomb of this ruler is also magnificent.

For a description and history of Mandu, see Sir James Campbell's *Gazetteer of Bombay*, vol. i. part ii. (1896), and *Journal of the Bombay Asiatic Society* (vol. xxi.).

MANDURIA, a city of Apulia, Italy, in the province of Lecce, from which it is 27 m. W. by road (22 m. E. of Taranto), 270 ft. above sea-level, and 8 m. N. of the coast. Pop. (1901), 12,199 (town); 13,190 (commune). It is close to the site of the ancient Manduria, considerable remains of the defences of which can still be seen; they consisted of a double line of wall built of rectangular blocks of stone, without mortar, and with a broad ditch in front. Some tombs with gold ornaments were found in 1886 (L. Viola in *Notizie degli Scavi*, 1886, 100). It was an important stronghold of the Messapii against Tarentum, and Archidamus III., king of Sparta, fell beneath its walls in 338 B.C., while leading the army of the latter (Plut., *Agis*, 3, calls the place Mandonion: see *s.v.* ARCHIDAMUS). It revolted to Hannibal, but was stormed by the Romans in 209 B.C. Pliny mentions a spring here which never changed its level, and may still be seen. The town was destroyed by the Saracens in the 10th century; the inhabitants settled themselves on the site of the present town, at first called Casalnuovo, which resumed the old name in 1700. (T. As.)

MANDVI, a seaport of India, in the native state of Cutch, within the Gujarat province of Bombay, 36 m. from Bhuj, and 182 m. by sea from Karachi. Pop. (1901), 24,683. It is a weekly port of call for steamers of the British India line, vessels of 70 tons cannot come nearer than 500 yards. The pilots and sailors of Mandvi have a high reputation.

MANES, in Roman mythology, the disembodied and immortal spirits of the dead. The word is an old adjective—*manis*, *manus*, meaning "good," the opposite of which is *immanis*; hence the Manes, clearly a euphemistic term, are the "good people." They were looked upon as gods; hence the dedication, of great antiquity and frequent occurrence, *Divis* or *Dis Manibus* in sepulchral inscriptions, used even in Christian times. When a body was consumed on the funeral pyre, relations and friends invoked the deceased as a divinity, and the law of the Twelve Tables prescribed that the rights of the divine Manes should be respected, and that each man should regard the dead members of his family as gods. Their home was in the bowels of the earth, from which they only emerged at certain times. It was an old Italian custom—especially at the foundation of cities—to dig a pit in the form of an inverted sky (hence called *mundus*), the lower part of which was supposed to be sacred to the gods of the underworld, including the Manes. Such a pit existed on the Palatine at Rome. It was covered by a stone called *lapis manalis*, representing the entrance to the lower world, which was removed three times in the year (Aug. 24, Oct. 5, Nov. 8). The Manes were then believed to issue forth, and these days were regarded as *religiosi*—that is, all important business in public and private life was suspended. Offerings were made to propitiate the dead: libations of water, wine, warm milk, honey, oil, and the blood of sacrificial victims—black sheep, pigs and oxen (*suovetaurilia*)—was poured upon the graves; ointment and incense were offered, lamps were lighted, and the grave was adorned with garlands of flowers, especially roses and violets. Beans, eggs, lentils, salt, bread and wine, placed on the grave, formed the chief part of a meal partaken of by the mourners. There was also a public state festival in honour of the dead, called Parentalia, held from the 13th to the 21st of February, the last month of the old Roman year, the last day of the festival being called Feralia. During its continuance all the temples were shut, marriages were forbidden, and the magistrates had to appear without the insignia of their office.

There was considerable analogy between the Manes and the received idea of "souls"—and there was a corresponding idea that they could be conjured up and appear as ghosts. They were also supposed to have the power of sending dreams. It is to be noticed that, unlike the Lares, the Manes are never spoken of singly.

For authorities, see LARES and PENATES.

MANET, ÉDOUARD (1832–1883), French painter, regarded as the most important master of Impressionism (*q.v.*), was born in Paris on the 23rd of January 1832. After spending some time under the tuition of the Abbé Poiloup, he entered the Collège Rollin, where his passion for drawing led him to neglect all his other lessons. His studies finished in 1848, he was placed on board the ship *Guadeloupe*, voyaging to Rio de Janeiro. On his return he first studied in Couture's studio (1851), where his independence often infuriated his master. For six years he was an intermittent visitor to the studio, constantly taking leave to travel, and going first to Cassel, Dresden, Vienna and Munich, and afterwards to Florence, Rome and Venice, where he made some stay. Some important drawings date from this period, and one picture, "A Nymph Surprised." Then, after imitating Couture, more or less, in "The Absinthe-drinker" (1866), and Courbet in "The Old Musician," he devoted himself almost exclusively to the study of the Spanish masters in the Louvre. A group was already gathering round him—Whistler, Legros, and Fantin-Latour haunted his studio in the Rue Guyot. His "Spaniard playing the Guitar," in the Salon of 1861, excited much animadversion. Delacroix alone defended Manet, but, this notwithstanding, his "Fifer of the Guard" and "Breakfast on the Grass" were refused by the jury. Then the "Exhibition of the Rejected" was opened, and round Manet a group was formed, including Bracquemond, Legros, Jongkind, Whistler, Harpignies and Fantin-Latour, the writers Zola, Duranty and Duret, and Astruc the sculptor. In 1863, when an amateur, M. Martinet, lent an exhibition-room to Manet, the painter exhibited fourteen pictures; and then, in 1864, contributed again to the Salon "The Angels at the Tomb" and "A Bullfight." Of this picture he afterwards kept nothing but the toreador in the foreground, and it is now known as "The Dead Man." In 1865 he sent to the Salon "Christ reviled by the Soldiers" and the famous "Olympia," which was hailed with mockery and laughter. It represents a nude woman reclining on a couch, behind which is seen the head of a negress who carries a bunch of flowers. A black cat at her feet emphasizes the whiteness of the sheet on which the woman lies. This work (now in the Louvre) was presented to the Luxembourg by a subscription started by Claude Monet (1890). It was hung in 1897 among the Caillebotte collection, which included the "Balcony," and a study of a female head called "Angelina." This production, of a highly independent individuality, secured Manet's exclusion from the Salon of 1866, so that he determined to exhibit his pictures in a place apart during the Great Exhibition of 1867. In a large gallery in the Avenue de l'Alma, half of which was occupied by Courbet, he hung no fewer than fifty paintings. Only one important picture was absent, "The Execution of the Emperor Maximilian"; its exhibition was prohibited by the authorities. From that time, in spite of the fierce hostility of some adversaries, Manet's energy and that of his supporters began to gain the day. His "Young Girl" (Salon of 1868) was justly appreciated, as well as the portrait of Lola; but the "Balcony" and the "Breakfast" (1869) were as severely handled as the "Olympia" had been. In 1870 he exhibited "The Music Lesson" and a portrait of Mlle E. Gonzales. Not long before the Franco-Prussian War, Manet, finding himself in the country with a friend, for the first time discovered the true value of open air to the effects of painting in his picture "The Garden," which gave rise to the "open air" or *plein air* school. After fighting as a gunner, he returned to his family in the Pyrenees, where he painted "The Battle of the *Kearsarge* and the *Alabama*." His "Bon Bock" (1873) created a *furore*. But in 1875, as in 1869, there was a fresh outburst of abuse, this time of the "Railroad," "Polichinelle," and "Argenteuil," and the jury excluded the artist, who for the second time arranged an exhibition in his studio. In 1877 his "Hamlet" was admitted to the Salon, but "Nana" was rejected. The following works were exhibited at the Salon of 1881: "In the Conservatory," "In a Boat," and the portraits of Rochefort and Proust; and the Cross of the Legion of Honour was conferred on the painter on the 31st of December in that year. Manet died in Paris on the 20th of April 1883. He left, besides his pictures, a number of pastels and engravings. He illustrated *Les Chats* by Champfleury, and Edgar Allan Poe's *The Raven*.

See Zola, *Manet* (Paris, 1867); E. Bazire, *Manet* (Paris, 1884); G. Geffroy, *La Vie artistique* (1893). (H. FR.)

MANETENERIS, a tribe of South American Indians of the upper Purus river, and between it and the Jurua, north-western Brazil. They manufacture cotton cloth, and have iron axes and fish hooks. The men wear long ponchos, the women sacks open at the bottom. The Maneteneris are essentially a waterside people. Their cedarwood canoes are very long and beautifully made.

MANETHO (Μανέθων in an inscription of Carthage; Μανεθῶς in a papyrus), Egyptian priest and annalist, was a native of Sebennytus in the Delta. The name which he bears has a good Egyptian appearance, and has been found on a contemporary papyrus probably referring to the man himself. The evidence of Plutarch and other indications connect him with the reigns of Ptolemy I. and II. His most important work was an Egyptian history in Greek, for which he translated the native records. It is now only known by some fragments of narrative in Josephus's treatise *Against Apion*, and by tables of dynasties and kings with lengths of reigns, divided into three books, in the works of Christian chronographers. The earliest and best of the latter is Julius Africanus, besides whom Eusebius and some falsifying apologists offer the same materials; the chief text is that preserved in the *Chronographia* of Georgius Syncellus. It is difficult to judge the value of the original from these extracts: it is clear from the different versions of the lists that they have been corrupted. Manetho's work was probably based on native lists like that of the Turin Papyrus of Kings: even his division into dynasties may have been derived from such. The fragments of narrative give a very confused idea of Egyptian history in the time of the Hyksos and the XVIIIth Dynasty. The royal lists, too, are crowded with errors of detail, both in the names and order of the kings, and in the lengths attributed to the reigns. The brief notes attached to some of the names may be derived from Manetho's narrative, but they are chiefly references to kings mentioned by Herodotus or to marvels that were supposed to have occurred: they certainly possess little historical value. A puzzling annotation to the name of Bocchoris, "in whose time a lamb spake 990 years," has been well explained by Krall's reading of a demotic story written in the twenty-third year of Augustus. According to this a lamb prophesied that after Bocchoris's reign Egypt should be in the hands of the oppressor 900 years; in Africanus's day it was necessary to lengthen the period in order to keep up the spirits of the patriots after the stated term had expired. This is evidently not from the pure text of Manetho. Notwithstanding all their defects, the fragments of Manetho have provided the accepted scheme of Egyptian dynasties and have been of great service to scholars ever since the first months of Champollion's decipherment.

See C. Müller, *Fragmenta historicorum graecorum*, ii. 511–616; A. Wiedemann, *Aegyptische Geschichte* (Gotha, 1884), pp. 121 et sqq.; J. Krall in *Festgaben für Büdinger* (Innsbruck, 1898); Grenfell and Hunt, *El Hibeh Papyri*, i. 223; also the section on chronology in EGYPT, and generally books on Egyptian history and chronology. (F. LL. G.)

MANFRED (*c.* 1232–1266), king of Sicily, was a natural son of the emperor Frederick II. by Bianca Lancia, or Lanzia, who is reported on somewhat slender evidence to have been married to the emperor just before his death. Frederick himself appears to have regarded Manfred as legitimate, and by his will named him as prince of Tarentum and appointed him as the representative in Italy of his half-brother, the German king, Conrad IV. Although only about eighteen years of age Manfred acted loyally and with vigour in the execution of his trust, and when Conrad appeared in southern Italy in 1252 his authority was quickly and generally acknowledged. When in May 1254 the German king died, Manfred, after refusing to surrender Sicily to Pope Innocent IV., accepted the regency on behalf of Conradin, the infant son of Conrad. But the strength of the papal party in the Sicilian kingdom rendered the position of the regent so precarious that he decided to open negotiations with Innocent. By a treaty made in September 1254, Apulia passed under the authority of the pope, who was personally conducted by Manfred into his new possession. But Manfred's suspicions being aroused by the demeanour of the papal retinue, he fled to the Saracens at Lucera. Aided by Saracen allies, he defeated the papal troops at Foggia on the 2nd of December 1254, and soon established his authority over Sicily and the Sicilian possessions on the mainland.

Taking advantage in 1258 of a rumour that Conradin was dead, Manfred was crowned king of Sicily at Palermo on the 10th of August in that year. The falsehood of this report was soon manifest; but the new king, supported by the popular voice, declined to abdicate, and pointed out to Conradin's envoys the necessity for a strong native ruler. But the pope, to whom the Saracen alliance was a serious offence, declared Manfred's coronation void and pronounced sentence of excommunication. Undeterred by this sentence Manfred sought to obtain power in central and northern Italy, and in conjunction with the Ghibellines his forces defeated the Guelphs at Monte Aperto on the 4th of September 1260. He was then recognized as protector of Tuscany by the citizens of Florence, who did homage to his representative, and he was chosen senator of the Romans by a faction in the city. Terrified by these proceedings, Pope Urban IV. implored aid from France, and persuaded Charles count of Anjou, a brother of King Louis IX., to accept the investiture of the kingdom of Sicily at his hands. Hearing of the approach of Charles, Manfred issued a manifesto to the Romans, in which he not only defended his rule over Italy but even claimed the imperial crown. The rival armies met near Benevento on the 26th of February 1266, where, although the Germans fought with undaunted courage, the cowardice of the Italians quickly brought destruction on Manfred's army. The king himself, refusing to fly, rushed into the midst of his enemies and was killed. Over his body, which was buried on the battlefield, a huge heap of stones was placed, but afterwards with the consent of the pope the remains were unearthed, cast out of the papal territory, and interred on the banks of the Liris. Manfred was twice married. His first wife was Beatrice, daughter of Amadeus IV. count of Savoy, by whom he had a daughter, Constance, who became the wife of Peter III. king of Aragon; and his second wife, who died in prison in 1271, was Helena, daughter of Michael II. despot of Epirus. Contemporaries praise the noble and magnanimous character of Manfred, who was renowned for his physical beauty and intellectual attainments.

Manfred forms the subject of dramas by E. B. S. Raupach, O. Marbach and F. W. Roggee. Three letters written by Manfred are published by J. B. Carusius in *Bibliotheca historica regni Siciliae* (Palermo, 1732). See Cesare, *Storia di Manfredi* (Naples, 1837); Münch, *König Manfred* (Stuttgart, 1840); Riccio, *Alcuni studii storici intorno a Manfredi e Conradino* (Naples, 1850); F. W. Schirrmacher, *Die letzten Hohenstaufen* (Göttingen, 1871); Capesso, *Historia diplomatica regni Siciliae* (Naples, 1874); A. Karst, *Geschichte Manfreds vom Tode Friedrichs II. bis zu seiner Krönung* (Berlin, 1897); and K. Hampe, *Urban IV. und Manfred* (Heidelberg, 1905).

MANFREDONIA, a town and archiepiscopal see (with Viesti) of Apulia, Italy, in the province of Foggia, from which it is 22½ m. N.E. by rail, situated on the coast, facing E., 13 ft. above sea-level, to the south of Monte Gargano, and giving its name to the gulf to the east of it. Pop. (1901), 11,549. It was founded by Manfred in 1263, and destroyed by the Turks in 1620; but the medieval castle of the Angevins and parts of the town walls are well preserved. In the church of S. Domenico, the chapel of the Maddalena contains old paintings of the 14th century. Two miles to the south-west is the fine cathedral of S. Maria Maggiore di Siponto, built in 1117 in the Romanesque style, with a dome and crypt. S. Leonardo, nearer Foggia, belonging to the Teutonic order, is of the same date. This marks the site of the ancient Sipontum, the harbour of Arpi, which became a Roman colony in 194 B.C., and was not deserted in favour of Manfredonia until the 13th century, having become unhealthy owing to the stagnation of the water in the lagoons.

See A. Beltramelli, *Il Gargano* (Bergamo, 1907). (T. As.)

MANGABEY, a name (probably of French origin) applied to the West African monkeys of the genus *Cercocebus*, the more typical representatives of which are characterized by their bare, flesh-coloured upper eye-lids, and the uniformly coloured hairs of the fur. (See PRIMATES.)

MANGALIA, a town in the department of Constantza Rumania, situated on the Black Sea, and at the mouth of a small stream, the Mangalia, 10 m. N. of the Bulgarian frontier. Pop. (1900), 1459. The inhabitants, among whom are many Turks and Bulgarians, are mostly fisherfolk. Mangalia is to be identified with the Thracian Kallatis or Acervetis, a colony of Miletus which continued to be a flourishing place to the close of the Roman period. In the 14th century it had 30,000 inhabitants, and a large trade with Genoa.

MANGALORE, a seaport of British India, administrative headquarters of the South Kanara district of Madras, and terminus of the west coast line of the Madras railway. Pop. (1901), 44,108. The harbour is formed by the backwater of two small rivers. Vessels ride in 24 to 30 ft. of water, and load from and unload into lighters. The chief exports are coffee, coco-nut products, timber, rice and spices. Mangalore clears and exports all the coffee of Coorg, and trades directly with Arabia and the

Persian Gulf. There is a small shipbuilding industry. The town has a large Roman Catholic population, with a European bishop, several churches, a convent and a college. It is the headquarters of the Basel Lutheran mission, which possesses one of the most active printing presses in southern India, and has also successfully introduced the industries of weaving and the manufacture of tiles. Two colleges (Government and St Aloysius) are situated here. Mangalore was gallantly defended by Colonel John Campbell of the 42nd regiment from May 6, 1783, to January 30, 1784, with a garrison of 1850 men, of whom 412 were English, against Tippoo Sultan's whole army.

MANGAN, JAMES CLARENCE (1803–1849), Irish poet, was born in Dublin on the 1st of May 1803. His baptismal name was James, the "Clarence" being his own addition. His father, a grocer, who boasted of the terror with which he inspired his children, had ruined himself by imprudent speculation and extravagant hospitality. The burden of supporting the family fell on James, who entered a scrivener's office, at the age of fifteen, and drudged as a copying clerk for ten years. He was employed for some time in the library of Trinity College, and in 1833 he found a place in the Irish Ordnance Survey. He suffered a disappointment in love, and continued ill health drove him to the use of opium. He was habitually the victim of hallucinations which at times threatened his reason. For Charles Maturin, the eccentric author of *Melmoth*, he cherished a deep admiration, the results of which are evident in his prose stories. He belonged to the Comet Club, a group of youthful enthusiasts who carried on war in their paper, the *Comet*, against the levying of tithes on behalf of the Protestant clergy. Contributions to the *Dublin Penny Journal* followed; and to the *Dublin University Magazine* he sent translations from the German poets. The mystical tendency of German poetry had a special appeal for him. He chose poems that were attuned to his own melancholy temperament, and did much that was excellent in this field. He also wrote versions of old Irish poems, though his knowledge of the language, at any rate at the beginning of his career, was but slight. Some of his best-known Irish poems, however, *O'Hussey's Ode to the Maguire*, for instance, follow the originals very closely. Besides these were "translations" from Arabic, Turkish and Persian. How much of these languages he knew is uncertain, but he had read widely in Oriental subjects, and some of the poems are exquisite though the original authors whom he cites are frequently mythical. He took a mischievous pleasure in mystifying his readers, and in practising extraordinary metres. For the *Nation* he wrote from the beginning (1842) of its career, and much of his best work appeared in it. He afterwards contributed to the *United Irishman*. On the 20th of June 1849 he died at Meath Hospital, Dublin, of cholera. It was alleged at the time that starvation was the real cause. This statement was untrue, but there is no doubt that his wretched poverty made him ill able to withstand disease.

Mangan holds a high place among Irish poets, but his fame was deferred by the inequality and mass of his work, much of which lay buried in inaccessible newspaper files under his many pseudonyms, "Vacuus," "Terrae Filius," "Clarence," &c. Of his genius, morbid though it sometimes is, as in his tragic autobiographical ballad of *The Nameless One*, there can be no question. He expressed with rare sincerity the tragedy of Irish hopes and aspirations, and he furnished abundant proof of his versatility in his excellent nonsense verses, which are in strange contrast with the general trend of his work.

An autobiography which appeared in the *Irish Monthly* (1882) does not reproduce the real facts of his career with any fidelity. For some time after his death there was no adequate edition of his works, but *German Anthology* (1845), and *The Poets and Poetry of Munster* (1849) had appeared during his lifetime. In 1850 Hercules Ellis included thirty of his ballads in his *Romances and Ballads of Ireland*. Other selections appeared subsequently, notably one (1897), by Miss L. I. Guiney. *The Poems of James Clarence Magan* (1903), and the *Prose Writings* (1904), were both edited by D. J. O'Donoghue, who wrote in 1897 a complete account of the *Life and Writings* of the poet.

MANGANESE [symbol Mn; atomic weight, 54·93 (O = 16)], a metallic chemical element. Its dioxide (pyrolusite) has been known from very early times, and was at first mistaken for a magnetic oxide of iron. In 1740 J. H. Pott showed that it did not contain iron and that it yielded a definite series of salts, whilst in 1774 C. Scheele proved that it was the oxide of a distinctive metal. Manganese is found widely distributed in nature, being generally found to a greater or less extent associated with the carbonates and silicates of iron, calcium and magnesium, and also as the minerals braunite, hausmannite, psilomelane, manganite, manganese spar and hauerite. It has also been recognized in the atmosphere of the sun (A. Cornu, *Comptes rendus*, 1878, 86, pp. 315, 530), in sea water, and in many mineral waters.

The metal was isolated by J. G. Gahn in 1774, and in 1807 J. F. John (*Gehlen's Jour. chem. phys.*, 1807, 3, p. 452) obtained an impure metal by reducing the carbonate at a high temperature with charcoal, mixed with a small quantity of oil. R. Bunsen prepared the metal by electrolysing manganese chloride in a porous cell surrounded by a carbon crucible containing hydrochloric acid. Various reduction methods have been employed for the isolation of the metal. C. Brunner (*Pogg. Ann.*, 1857, 101, p. 264) reduced the fluoride by metallic sodium, and E. Glatzel (*Ber.*, 1889, 22, p. 2857) the chloride by magnesium, H. Moissan (*Ann. Chim. Phys.*, 1896 (7) 9, p. 286) reduced the oxide with carbon in the electric furnace; and H. Goldschmidt has prepared the metal from the oxide by means of his "thermite" process (see CHROMIUM). W. H. Green and W. H. Wahl [German patent 70773 (1893)] prepare a 97% manganese from pyrolusite by heating it with 30% sulphuric acid, the product being then converted into manganous oxide by heating in a current of reducing gas at a dull red heat, cooled in a reducing atmosphere, and finally reduced by heating with granulated aluminium in a magnesia crucible with lime and fluorspar as a flux. A purer metal is obtained by reducing manganese amalgam by hydrogen (O. Prelinger, *Monats.*, 1894, 14, p. 353).

Prelinger's manganese has a specific gravity of 7·42, and the variety obtained by distilling pure manganese amalgam *in vacuo* is pyrophoric (A. Guntz, *Bull. Soc.* [3], 7, 275), and burns when heated in a current of sulphur dioxide. The pure metal readily evolves hydrogen when acted upon by sulphuric and hydrochloric acids, and is readily attacked by dilute nitric acid. It precipitates many metals from solutions of their salts. It is employed commercially in the manufacture of special steels. (See IRON AND STEEL.)

COMPOUNDS

Manganese forms several oxides, the most important of which are manganous oxide, MnO, trimanganese tetroxide, Mn_3O_4, manganese sesquioxide, Mn_2O_3, manganese dioxide, MnO_2, manganese trioxide, MnO_3, and manganese heptoxide, Mn_2O_7.

Manganous oxide, MnO, is obtained by heating a mixture of anhydrous manganese chloride and sodium carbonate with a small quantity of ammonium chloride (J. v. Liebig and F. Wöhler, *Pogg. Ann.*, 1830, 21, p. 584); or by reducing the higher oxides with hydrogen or carbon monoxide. It is a dark coloured powder of specific gravity 5·09. *Manganous hydroxide*, $Mn(OH)_2$, is obtained as a white precipitate on adding a solution of a caustic alkali to a manganous salt. For the preparation of the crystalline variety identical with the mineral pyrochroite (see A. de Schulten, *Comptes rendus*, 1887, 105, p. 1265). It rapidly oxidizes on exposure to air and turns brown, going ultimately to the sesquioxide. *Trimanganese tetroxide*, Mn_3O_4, is produced more or less pure when the other oxides are heated. It may be obtained crystalline by heating manganese sulphate and potassium sulphate to a bright red heat (H. Debray, *Comptes rendus*, 1861, 52, p. 985). It is a reddish-brown powder, which when heated with hydrochloric acid yields chlorine. *Manganese sesquioxide*, Mn_2O_3, found native as the mineral braunite, may be obtained by igniting the other oxides in a mixture of nitrogen and oxygen, containing not more than 26% of the latter gas (W. Dittmar, *Jour. Chem. Soc.*, 1864, 17, p. 294). The hydrated form, found native as the mineral manganite, is produced by the spontaneous oxidation of manganous hydroxide. In the hydrated condition it is a dark brown powder which readily loses water at above 100° C., it dissolves in hot nitric acid, giving manganous nitrate and manganese dioxide: $2MnO(OH) + 2HNO_3 = Mn(NO_3)_2 + MnO_2 + 2H_2O$. *Manganese dioxide*, or pyrolusite (*q.v.*), MnO_2, the most important oxide, may be prepared by heating crystallized manganous nitrate until red fumes are given off, decanting the clear liquid, and heating to 150° to 160° C. for 40 to 60 hours (A. Gorgen, *Bull. Soc.*, 1890 [3], 4, p. 16), or by heating manganese carbonate to 260° C. in the presence of air and washing the residue with very dilute cold hydrochloric acid. It is a hard black solid which readily loses oxygen when strongly heated, leaving a residue of Mn_3O_4. When heated with concentrated hydrochloric acid it yields chlorine, and with concentrated sulphuric acid it yields oxygen. It is reduced to the monoxide when heated in a current of hydrogen. It is a strong oxidizing agent. It dissolves in cold concentrated hydrochloric acid, forming a dark brown solution which probably contains manganic chloride (see R. J. Meyer, *Zeit. anorg. Chem.*, 1899, 22, p. 169; G. Neumann, *Monats.*, 1894, 15, p. 489). It is almost impossible to prepare a pure hydrated manganese dioxide owing to the readiness with which it loses oxygen, leaving residues of the type $x\mathrm{MnO}\cdot y\mathrm{MnO_2}$. Such mixtures are obtained by the action of alkaline hypochlorites on manganous salts, or by suspending manganous carbonate in water and passing chlorine through the mixture. The solid matter is filtered off, washed with water, and warmed with 10% nitric acid (A. Gorgen). It is a dark brown powder, which reddens litmus. Manganese dioxide combines with other basic oxides to form *manganites*, and on this property is based the Weldon process for the recovery of manganese from the waste liquors of the chlorine stills (see CHLORINE). The manganites are amorphous brown solids, insoluble in water, and decomposed by hydrochloric acid with the evolution of chlorine. *Manganese trioxide*, MnO_3, is obtained in small quantity as an unstable deliquescent red solid by dropping a solution of potassium permanganate in sulphuric acid on to dry sodium carbonate (B. Franke, *Jour. prak. Chem.*, 1887 [2], 36, p. 31). Above 50° C. it decomposes into the dioxide and oxygen. It dissolves in water forming manganic acid, H_2MnO_4. *Manganese heptoxide*, Mn_2O_7, prepared by adding pure potassium permanganate to well cooled, concentrated sulphuric acid, when the oxide separates as a dark oil (H. Aschoff, *Pogg. Ann.*, 1860, 111, p. 217), is very unstable, continually giving off oxygen. It decomposes violently on heating, and explodes in contact with hydrogen, sulphur, phosphorus, &c. It dissolves in water to form a deep red solution which contains *permanganic acid*, $HMnO_4$. This acid is also formed by decomposing barium or lead permanganate with dilute sulphuric acid. It is only known in aqueous solution. This solution is of a deep violet-red colour, and is somewhat fluorescent; it decomposes on exposure to light, or when heated. It is a monobasic acid, and a very powerful oxidizing agent (M. M. P. Muir, *Jour. Chem. Soc.*, 1907, 91, p. 1485).

Manganous Salts.—The anhydrous *chloride*, $MnCl_2$, is obtained as a rose-red crystalline solid by passing hydrochloric acid gas over manganese carbonate, first in the cold and afterwards at a moderate red heat. The hydrated chloride, $MnCl_2\cdot4H_2O$, is obtained in rose-red crystals by dissolving the metal or its carbonate in aqueous hydrochloric acid and concentrating the solution. It may be obtained in at least two different forms, one isomorphous with $NaCl\cdot2H_2O$, by concentrating the solution between 15° C. and 20° C.; the other, isomorphous with $FeCl_2\cdot4H_2O$, by slow evaporation of the mother liquors from the former. It forms double salts with the chlorides of the alkali metals. The *bromide* $MnBr_2\cdot4H_2O$, *iodide*, MnI_2, and *fluoride*, MnF_2, are known.

Manganous Sulphate, $MnSO_4$, is prepared by strongly heating a paste of pyrolusite and concentrated sulphuric acid until acid fumes cease to be evolved. The ferric and aluminium sulphates present are thus converted into insoluble basic salts, and the residue yields manganous sulphate when extracted with water. The salt crystallizes with varying quantities of water, according to the temperature at which crystallization is effected: between −4° C. and +6° C. with $7H_2O$, between 15° C. and 20° C. with $5H_2O$, and between 25° C. and 31° C, with $4H_2O$. It crystallizes in large pink crystals, the colour of which is probably due to the presence of a small quantity of manganic sulphate or of a cobalt sulphate. It combines with the sulphates of the alkali metals to form double salts.

Manganous Nitrate, $Mn(NO_3)_2\cdot6H_2O$, obtained by dissolving the carbonate in nitric acid and concentrating the solution, crystallizes from nitric acid solutions in long colourless needles, which melt at 25·8° C. and boil at 129·5° C. with some decomposition.

Manganous Carbonate, $MnCO_3$, found native as manganese spar, may be prepared as an amorphous powder by heating manganese chloride with sodium carbonate in a sealed tube to 150° C., or in the hydrated form as a white flocculent precipitate by adding sodium carbonate to a manganous salt. In the moist condition it rapidly turns brown on exposure to air.

Manganous Sulphide, MnS, found native as manganese glance, may be obtained by heating the monoxide or carbonate in a porcelain tube in a current of carbon bisulphide vapour. R. Schneider (*Pogg. Ann.*, 1874, 151, 449) obtained a crystalline variety by melting sulphur with anhydrous manganous sulphate and dry potassium carbonate, extracting the residue and drying it in a current of hydrogen. Four sulphides are known; the red and green are anhydrous, a grey variety contains much water, whilst the pink is a mixture of the grey and red (J. C. Olsen and W. S. Rapalje, *Jour. Amer. Chem. Soc.*, 1904, 26, p. 1615). Ammonium sulphide alone gives incomplete precipitation of the sulphide. In the presence of ammonium salts the precipitate is dirty white in colour, whilst in the presence of free ammonia it is a buff colour. This form of the sulphide is readily oxidized when exposed in the moist condition, and is easily decomposed by dilute mineral acids.

Manganese Disulphide, MnS_2, found native as hauerite, is formed as a red coloured powder by heating manganous sulphate with potassium polysulphide in a sealed tube at 160°–170° C. (H. v. Senarmont, *Jour. prak. Chem.*, 1850, 51, p. 385).

Manganic Salts.—The sulphate, $Mn_2(SO_4)_3$, is prepared by gradually heating at 138° C. a mixture of concentrated sulphuric and manganese dioxide until the whole becomes of a dark green colour. The excess of acid is removed by spreading the mass on a porous plate, the residue stirred for some hours with nitric acid, again spread on a porous plate, and finally dried quickly at about 130° C. It is a dark green deliquescent powder which decomposes on heating or on exposure to moist air. It is readily decomposed by dilute acids. With potassium sulphate in the presence of sulphuric acid it forms potassium manganese alum, $K_2SO_4\cdot Mn_2(SO_4)_3\cdot24H_2O$. A. Piccini (*Zeit. anorg. Chem.* 1898, 17, p. 355) has also obtained a manganese caesium alum. *Manganic Fluoride*, MnF_3, a solid obtained by the action of fluorine on manganous chloride, is decomposed by heat into manganous fluoride and fluorine. By suspending the dioxide in carbon tetrachloride and passing in hydrochloric acid gas, W. B. Holmes (*Abst. J.C.S.*, 1907, ii., p. 873) obtained a black trichloride and a reddish-brown tetrachloride.

Manganese Carbide, Mn_3C, is prepared by heating manganous oxide with sugar charcoal in an electric furnace, or by fusing manganese chloride and calcium carbide. Water decomposes it, giving methane and hydrogen (H. Moissan); $Mn_3C+6H_2O=3Mn(OH)_2+CH_4+H_2$.

Manganates.—These salts are derived from manganic acid H_2MnO_4. Those of the alkali metals are prepared by fusing manganese dioxide with sodium or potassium hydroxide in the presence of air or of some oxidizing agent (nitre, potassium chlorate, &c.); $MnO_2+2KHO+O=K_2MnO_4+H_2O$. In the absence of air the reaction proceeds slightly differently, some manganese sesquioxide being formed; $3MnO_2+2KHO=K_2MnO_4+Mn_2O_3+H_2O$. The fused mass has a dark olive-green colour, and dissolves in a small quantity of cold water to a green solution, which is, however, only stable in the presence of an excess of alkali. The green solution is readily converted into a pink one of permanganate by a large dilution with water, or by passing carbon dioxide through it: $3K_2MnO_4+2CO_2=2K_2CO_3+2KMnO_4+MnO_2$.

Permanganates are the salts of permanganic acid, $HMnO_4$. The *potassium* salt, $KMnO_4$, may be prepared by passing chlorine or carbon dioxide through an aqueous solution of potassium manganate, or by the electrolytic oxidation of the manganate at the anode [German patent 101710 (1898)]. It crystallizes in dark purple-red prisms, isomorphous with potassium perchlorate. It acts as a powerful oxidizing agent, both in acid and alkaline solution; in the first case two molecules yield five atoms of available oxygen and in the second, three atoms:

$$2KMnO_4+3H_2SO_4=K_2SO_4+2MnSO_4+3H_2O+5O;$$
$$2KMnO_4+3H_2O\quad=2MnO_2\cdot H_2O+2KHO+3O.$$

It completely decomposes hydrogen peroxide in sulphuric acid solution—

$$2KMnO_4+5H_2O_2+3H_2SO_4=K_2SO_4+2MnSO_4+8H_2O+5O_2.$$

It decomposes when heated to

$$200°-240°C.: 2KMnO_4=K_2MnO_4+MnO_2+O_2;$$

and when warmed with hydrochloric acid it yields chlorine:

$$2KMnO_4+16HCl=2KCl+2MnCl_2+8H_2O+5Cl_2.$$

Sodium Permanganate, $NaMnO_4\cdot3H_2O$ (?), may be prepared in a similar manner, or by precipitating the silver salt with sodium chloride. It crystallizes with great difficulty. A solution of the crude salt is used as a disinfectant under the name of "Condy's fluid."

Ammonium Permanganate, $NH_4\cdot MnO_4$, explodes violently on rubbing, and its aqueous solution decomposes on boiling (W. Muthmann, *Ber.*, 1893, 26, p. 1018); $NH_4\cdot MnO_4=MnO_2+N_2+2H_2O$.

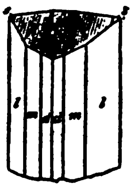
Barium Permanganate, $BaMn_2O_8$, crystallizes in almost black needles, and is formed by passing carbon dioxide through water containing suspended barium manganate.

Detection.—Manganese salts can be detected by the amethyst colour they impart to a borax-bead when heated in the Bunsen flame, and by the green mass formed when they are fused with a mixture of sodium carbonate and potassium nitrate. Manganese may be estimated quantitatively by precipitation as carbonate, this salt being then converted into the oxide, Mn_3O_4 by ignition; or by precipitation as hydrated dioxide by means of ammonia and bromine water, followed by ignition to Mn_3O_4. The valuation of pyrolusite is generally carried out by means of a distillation with hydrochloric acid, the liberated chlorine passing through a solution of potassium iodide, and the amount of iodine liberated being ascertained by means of a standard solution of sodium thiosulphate.

The atomic weight of manganese has been frequently determined. J. Berzelius, by analysis of the chloride, obtained the value 54·86; K. v. Hauer (*Sitzb. Akad. Wien.*, 1857, 25, p. 132), by conversion of the sulphate into sulphide, obtained the value 54·78; J. Dewar and A. Scott (*Chem. News*, 1883, 47, p. 98), by analysis of silver permanganate, obtained the value 55·038; J. M. Weeren (*Stahl. u.*

Eisen, 1893, 13, p. 559), by conversion of manganous oxide into the sulphate obtained the value 54·883, and of the sulphate into sulphide the value 54·876 (H = 1), and finally G. P. Baxter and Hines (*Jour. Amer. Chem. Soc.*, 1906, 28, p. 1360), by analyses of the chloride and bromide, obtained 54·96 (O = 16).

MANGANITE, a mineral consisting of hydrated manganese sesquioxide, $Mn_2O_3 \cdot H_2O$, crystallizing in the orthorhombic system and isomorphous with diaspore and göthite. Crystals are prismatic and deeply striated parallel to their length; they are often grouped together in bundles. The colour is dark steel-grey to iron-black, and the lustre brilliant and submetallic: the streak is dark reddish-brown. The hardness is 4, and the specific gravity 4·3. There is a perfect cleavage parallel to the brachypinacoid, and less perfect cleavage parallel to the prism faces *m*. Twinned crystals are not infrequent. The mineral contains 89·7% of manganese sesquioxide; it dissolves in hydrochloric acid with evolution of chlorine. The best crystallized specimens are those from Ilfeld in the Harz, where the mineral occurs with calcite and barytes in veins traversing porphyry. Crystals have also been found at Ilmenau in Thuringia, Neukirch near Schlettstadt in Alsace ("newkirkite"), Granam near Towie in Aberdeenshire, Upton Pyne near Exeter and Negaunee in Michigan. As an ore of manganese it is much less abundant than pyrolusite or psilomelane. The name manganite was given by W. Haidinger in 1827: French authors adopt F. S. Beudant's name "acerdèse," (Gr. ἀκερδής, unprofitable) because the mineral is of little value for bleaching purposes as compared with pyrolusite.



(L. J. S.)

MANGBETTU (*Monbuttu*), a negroid people of Central Africa living to the south of the Niam-Niam in the Welle district of Belgian Congo. They number about a million. Their country is a table-land at an altitude of 2500 to 2800 ft. Despite its abundant animal life, luxuriant vegetation and rich crops of plantain and oil-palm, the Mangbettu have been some of the most inveterate cannibals in Africa; but since the Congo State established posts in the country (*c.* 1895) considerable efforts have been made to stamp out cannibalism. Physically the Mangbettu differ greatly from their negro neighbours. They are not so black and their faces are less negroid, many having quite aquiline noses. The beard, too, is fuller than in most negroes. They appear to have imposed their language and customs on the surrounding tribes, the Mundu, Abisanga, &c. Once a considerable power, they have practically disappeared as far as the original stock is concerned; their language and culture, however, remain, maintained by their subjects, with whom they have to a large extent intermixed. The men wear bark cloth, the art of weaving being unknown, the women a simple loin cloth, often not that. Both sexes paint the body in elaborate designs. As potters, sculptors, boatbuilders and masons the Mangbettu have had few rivals in Africa. Their huts, with pointed roofs, were not only larger and better built, but were cleaner than those of their neighbours, and some of their more important buildings were of great size and exhibited some skill in architecture.

See G. A. Schweinfurth, *Heart of Africa* (1874); W. Junker, *Travels in Africa* (1890); G. Casati, *Ten Years in Equatoria* (1891).

MANGEL-WURZEL, or field-beet, a variety of the common beet, known botanically as *Beta vulgaris*, var. *macrorhiza*. The name is German and means literally "root of scarcity." R. C. A. Prior (*Popular Names of British Plants*) says it was originally mangold, a word of doubtful meaning. The so-called root consists of the much thickened primary root together with the "hypocotyl," *i.e.* the original stem between the root and the seed-leaves. A transverse section of the root shows a similar structure to the beet, namely a series of concentric rings of firmer "woody" tissue alternating with rings of soft thin-walled parenchymatous "bast-tissue" which often has a crimson or yellowish tint. The root is a store of carbohydrate food-stuff in the form of sugar, which is formed in the first year of growth when the stem remains short and bears a rosette of large leaves. If the plant be allowed to remain in the ground till the following year strong leafy angular aerial stems are developed, 3 ft. or more in height, which branch and bear the inflorescences. The flowers are arranged in dense sessile clusters subtended by a small bract, and resemble those of the true beet. The so-called seeds are clusters of spurious fruits. After fertilization the fleshy receptacle and the base of the perianth of each flower enlarge and the flowers in a cluster become united; the fleshy parts with the ovaries, each of which contains one seed, become hard and woody. Hence several seeds are present in one "seed" of commerce, which necessitates the careful thinning of a young crop, as several seedlings may spring from one "seed."

This plant is very susceptible of injury from frost, and hence in the short summer of Scotland it can neither be sown so early nor left in the ground so late as would be requisite for its mature growth. But it is peculiarly adapted for those southern parts of England where the climate is too hot and dry for the successful cultivation of the turnip. In feeding quality it rivals the swede; it is much relished by livestock—pigs especially doing remarkably well upon it; and it keeps in good condition till midsummer if required. The valuable constituent of mangel is dry matter which averages about 12% as against 11% in swedes. Of this two-thirds may be sugar, which only develops fully during storage. Indeed, it is only after it has been some months in the store heap that mangel becomes a palatable and safe food for cattle. It is, moreover, exempt from the attacks of the turnip beetle. On all these accounts, therefore, it is peculiarly valuable in those parts of Great Britain where the summer is usually hot and dry.

Up to the act of depositing the seed, the processes of preparation for mangel are similar to those described for the turnip; winter dunging being even more appropriate for the former than for the latter. The common drilling machines are easily fitted for sowing its large rough seeds, which should be sown from the beginning of April to the middle of May and may be deposited either on ridges or on the flat. The after culture is like that of the turnip. The plants are thinned out at distances of not less than 15 in. apart. Transplanting can be used for filling up of gaps with more certainty of success than in the case of swedes, but it is much more economical to avoid such gaps by sowing a little swede seed along with the mangel. Several varieties of the plant are cultivated—those in best repute being the long red, the yellow globe and the tankard, intermediate in shape. This crop requires a heavier dressing of manure than the turnip to grow it in perfection, and is much benefited by having salt mixed with the manure at the rate of 2 or 3 cwt. per acre. Nitrogenous manures are of more marked value than phosphatic manures. The crop requires to be secured in store heaps as early in autumn as possible, as it is easily injured by frost.

MANGLE. (1) A machine for pressing and smoothing clothes after washing (see LAUNDRY). The word was adopted from the Dutch; *mangel-stok* means a rolling pin, and *linnen mangelen*, to press linen by rolling; similarly in O. Ital. *mangano* meant, according to Florio, "a presse to press buckrom," &c. The origin of the word is to be found in the medieval Latin name, *manganum*, *mangonus* or *mangana*, for an engine of war, the "mangonel," for hurling stones and other missiles (see CATAPULT). The Latin word was adapted from the Greek μάγγανον, a trick or device, cognate with μηχανή, a machine. (2) To cut in pieces, to damage or disfigure; to mutilate. This word is of obscure origin. According to the *New English Dictionary* it presents an Anglo-French *mahangler*, a form of *mahaigner* from which the English "maim" is derived, cf. the old form "mayhem," surviving in legal phraseology. Skeat connects the word with the Latin *mancus*, maimed, with which "maim" is not cognate.

MANG LÖN, a state in the northern Shan states of Burma. It is the chief state of the Wa or Vü tribes, some of whom are head-hunters, and Mang Lön is the only one which as yet has direct relations with the British government. Estimated area, 3000 sq. m.; estimated population, 40,000. The state extends from about 21° 30′ to 23° N., or for 100 m. along the river

Salween. Its width varies greatly, from a mile or even less on either side of the river to perhaps 40 m. at its broadest part near Taküt, the capital. It is divided into East and West Mang Lön, the boundary being the Salween. There are no Wa in West Mang Lön. Shans form the chief population, but there are Pálaungs, Chinese and Yanglam, besides Lahu. The bulk of the population in East Mang Lön is Wa, but there are many Shans and Lahu. Both portions are very hilly; the only flat land is along the banks of streams in the valleys, and here the Shans are settled. There are prosperous settlements and bazaars at Nawng Hkam and Möng Kao in West Mang Lön. The Wa of Mang Lön have given up head-hunting, and many profess Buddhism. The capital, Taküt, is perched on a hill-top 6000 ft. above sea-level. The sawbwa is a Wa, and has control over two sub-states, Möt Hai to the north and Maw Hpa to the south.

MANGNALL, RICHMAL (1769–1820), English schoolmistress, was born, probably at Manchester, on the 7th of March 1769. She was a pupil and finally mistress of a school at Crofton Hall, near Wakefield, Yorkshire, which she conducted most successfully until her death there on the 1st of May 1820. She was the author of *Historical and Miscellaneous Questions for the Use of Young People* (1800), generally known as "Mangnall's Questions," which was prominent in the education of English girls in the first half of the 19th century.

MANGO. The mango-tree (*Mangifera indica*, natural order Anacardiaceae) is a native of tropical Asia, but is now extensively cultivated in the tropical and subtropical regions of the New as well as the Old World. It is indigenous in India at the base of the Himalayas, and in Further India and the Andaman Islands (see A. de Candolle, *Origin of Cultivated Plants*). The cultivation of the fruit must have spread at an early age over the Indian Peninsula, and it now grows everywhere in the plains. It grows rapidly to a height of 30 to 40 ft., and its dense, spreading and glossy foliage would secure its cultivation for the sake of its shade and beauty alone. Its fruit, a drupe, though in the wild variety (not to be confused with that of *Spondias mangifera*, belonging to the same order, also called wild mango in India) stringy and sour, from its containing much gallic acid, and with a disagreeable flavour of turpentine, has become sweet and luscious through culture and selection, to which we owe many varieties, differing not only in flavour but also in size, from that of a plum to that of an apple. When unripe, they are used to make pickles, tarts and preserves; ripe, they form a wholesome and very agreeable dessert. In times of scarcity the kernels also are eaten. The timber, although soft and liable to decay, serves for common purposes, and, mixed with sandal-wood, is employed in cremation by the Hindus. It is usually propagated by grafts, or by layering or inarching, rather than by seed.

See G. Watt, *Dictionary of the Economic Products of India* (1891).

MANGOSTEEN (*Garcinia Mangostana*), a tree belonging to the order Guttiferae. It is a native of the Malay Peninsula, and is extensively cultivated in southern Tenasserim, and in some places in the Madras presidency. Poor results have followed the attempt to introduce it to other countries; and A. de Candolle refers to it as one of the most local among cultivated plants both in its origin, habitation and cultivation. It belongs to a family in which the mean area of the species is very restricted. It is an evergreen about 20 ft. high, and is somewhat fir-like in general form, but the leaves are large, oval, entire, leathery and glistening. Its fruit, the much-valued mangosteen, is about the size and shape of an orange, and is somewhat similarly partitioned, but is of a reddish-brown to chestnut colour. Its thick rind yields a very astringent juice, rich in tannin, and containing a gamboge-like resin. The soft and juicy pulp is snow-white or rose-coloured, and of delicious flavour and perfume. It is wholesome, and may be administered in fever.

The genus *Garcinia* is a genus of trees containing about fifty species in the tropics of the Old World, and usually yielding a yellow gum-resin (gamboge). *G. Morella*, a native of India, yields the true gamboge.

MANGROVE. The remarkable "mangrove forests" which fringe tidal estuaries, overrun salt marshes, and line muddy coasts in the tropics of both Old and New Worlds, are composed of trees and shrubs belonging mainly to the Rhizophoraceae, but including, especially in the eastern mangrove formations of Further India and the Malay Archipelago, members of other orders of Dicotyledons, such as Lythraceae (*Sonneratia*), Verbenaceae (*Avicennia*), and the acaulescent Nipa-palm. Their trunks and branches constantly emit adventitious roots, which, descending in arched fashion, strike at some distance from the parent stem, and send up new trunks, the forest thus spreading like a banyan grove. An advantage in dispersal, very characteristic of the order, is afforded by the seeds, which have a striking peculiarity of germination. While the fruit is still attached to the parent branch the long radicle emerges from the seed and descends rapidly towards the mud, where it may even establish itself before falling off. Owing to its clubbed shape, this is always in the right position; the plumule then makes its appearance. An interesting feature of the mangrove is the air-roots, erect or kneed branches of the roots, which project above the mud, and are provided with minute openings (stomata or lenticels), into which the air passes and is then carried by means of passages in the soft spongy tissue to the roots which spread beneath the mud. The wood of some species is hard and durable, and the astringent bark is used in tanning. The fruit of the common mangrove, *Rhizophora Mangle*, is sweet and wholesome, and yields a light wine.

MANICHAEISM. Towards the close of the 3rd century two great religions stood opposed to one another in western Europe, one wholly Iranian, namely Mithraism, the other of Jewish origin, but not without Iranian elements, part and parcel probably of the Judaism which gave it birth, namely Christianity. Professor Franz Cumont has traced the progress of Mithraism all over the Balkan Peninsula, Italy, the Rhine-lands, Britain, Spain and Latin Africa. It was peculiarly the religion of the Roman garrisons, and was carried by the legionaries wherever they went. It was an austere religion, inculcating self-restraint, courage and honesty; it secured peace of conscience through forgiveness of sins, and abated for those who were initiated in its mysteries the superstitious terrors of death and the world to come. In these respects it resembled Christianity. Soldiers may have espoused it rather than the rival faith, because in the primitive age Christian discipline denied them the sacraments, on the ground that they were professional shedders of blood. The cumbrous mythology and cosmogony of Mithraism at last weakened its hold upon men's minds, and it disappeared during the 4th century before a victorious Catholicism, yet not until another faith, equally Iranian in its mythology and cosmological beliefs, had taken its place. This new faith was that of Mani, which spread with a rapidity only to be explained by supposing that Mithraism had prepared men's minds for its reception.

Mani professed to blend the teachings of Christ with the old Persian Magism. Kessler, the latest historian of Manichaeism, opines that Mani's own declaration on this point is not to be relied upon, and has tried to prove that it was rather of Semitic or Chaldaic origin. He certainly shows that the old Assyrian mythology influenced Mani, but not that this element did not reach him through Persian channels. In genuine Manichaean documents we only find the name Mani, but Manes, Μάνης, Manichaeus, meet us in 4th-century Greek and Latin documents. In the *Acta Archelai* his first name is said to have been Cubricus, which Kessler explains as a corruption of Shuravik, a name common among the Arabs of the Syrian desert.

Life of Mani.—According to the Mahommedan tradition, which is more trustworthy than the account contained in these *Acta*, Mani was a high-born Persian of Ecbatana. The year of his birth is uncertain, but Kessler accepts as reliable the statement made by Biruni, that Mani was born in the year 527 of the astronomers of Babylon (A.D. 215–216). He received a careful education at Ctesiphon from his father Fatak, Babak or Patak (Πατέκιος). As the father connected himself at a later period with the confession of the *Moghtasilah*, or "Baptists," in southern Babylonia, the son also was brought up in the religious doctrines and exercises of this sect. These Baptists (see the *Fihrist*) were apparently connected with the Elkesaites and the Hemerobaptists, and certainly with the Mandaeans. It is probable that this Babylonian sect had absorbed Christian elements. Thus the boy early became acquainted with very different forms of religion. If even a small part of the stories about his father is founded on fact, it was he who first introduced Mani to that medley of religions out of which his system arose. Manichaean tradition relates that Mani received revelations while yet a boy, and assumed a critical attitude towards the religious instruction that was being imparted to him. This is the more incredible since the same tradition informs us that the boy was as yet prohibited from making public use of his new religious views. It was only when Mani had reached the age of twenty-five or thirty years that he began to proclaim his new religion. This he did at the court of the Persian king, Shāpūr I., and, according to the story, on the coronation day of that monarch (241/2). A Persian tradition says that he had previously been a Christian presbyter, but this is certainly incorrect. Mani did not remain long in Persia, but undertook long journeys for the purpose of spreading his religion, and also sent forth disciples. According to the *Acta Archelai*, his missionary activity extended westwards into the territory of the Christian church; but from Oriental sources it is certain that Mani rather went into Transoxiana, western China, and southwards as far as India. His labours there as well as in Persia were not without result. Like Mahomet after him and the founder of the Elkesaites before him, he gave himself out for the last and highest prophet, who was to surpass all previous divine revelation, which only possessed a relative value, and to set up the perfect religion. In the closing years of the reign of Shāpūr I. (*c.* 270) Mani returned to the Persian capital, and gained adherents even at court. But the dominant priestly caste of the Magians, on whose support the king was dependent, were naturally hostile to him, and after some successes Mani was made a prisoner, and had then to flee. The successor of Shāpūr, Hōrmizd (272–273), appears to have been favourably disposed towards him, but Bahrām I. abandoned him to the fanaticism of the Magians, and caused him to be crucified in the capital in the year 276/7. The corpse was flayed, and Mani's adherents were cruelly persecuted by the king.

Mani's Writings.—Mani himself composed a large number of works and epistles, which were in great part still known to the Mahommedan historians, but are now mostly lost. The later heads of the Manichaean churches also wrote religious treatises, so that the ancient Manichaean literature must have been very extensive. According to the *Fihrist*, Mani made use of the Persian and Syriac languages; but, like the Oriental Marcionites before him, he invented an alphabet of his own, which the *Fihrist* has handed down to us. In this alphabet the sacred books of the Manichaeans were written, even at a later period. The *Fihrist* reckons seven principal works of Mani, six being in the Syriac and one in the Persian language; regarding some of these we also have information in Epiphanius, Augustine, Titus of Bostra, and Photius, as well as in the formula of abjuration (Cotelerius, *PP. Apost. Opp.* i. 543) and in the *Acta Archelai*. They are (1) *The Book of Secrets* (see *Acta Archel.*), containing discussions bearing on the Christian sects spread throughout the East, especially the Marcionites and Bardesanites, and dealing also with their conception of the Old and New Testaments; (2) *The Book of the Giants* (Demons?); (3) *The Book of Precepts for Hearers* (probably identical with the *Epistola Fundamenti* of Augustine and with the *Book of Chapters* of Epiphanius and the *Acta Archelai*; this was the most widely spread and most popular Manichaean work, having been translated into Greek and Latin; it contained a short summary of all the doctrines of fundamental authority); (4) *The Book Shāhpūrakān* (Flügel was unable to explain this name; according to Kessler it signifies "epistle to King Shāpūr"; the treatise was of an eschatological character); (5) *The Book of Quickening* (Kessler identifies this work with the "Thesaurus [vitae]" of the *Acta Archelai*, Epiphanius, Photius and Augustine, and if this be correct it also must have been in use among the Latin Manichaeans); (6) *The Book πραγματεία* (of unknown contents); (7) a book in the Persian language, the title of which is not given in our present text of the *Fihrist*, but which is in all probability identical with the "holy gospel" of the Manichaeans (mentioned in the *Acta Archel.* and many other authorities). It was this work which the Manichaeans set up in opposition to the Gospels. Besides these principal works, Mani also wrote a large number of smaller treatises and epistles. The practice of writing epistles was continued by his successors. These Manichaean dissertations also became known in the Graeco-Roman Empire, and existed in collections.[1] There also existed a Manichaean book of memorabilia, and of prayers, in Greek, as well as many others,[2] all of which were destroyed by the Christian bishops acting in conjunction with the authorities. A Manichaean epistle, addressed to one Marcellus, has, however, been preserved for us in the *Acta Archelai*.[3]

Manichaean System.—Though the leading features of Manichaean doctrine can be exhibited clearly even at the present day, and though it is undoubted that Mani himself drew up a complete system, many details are nevertheless uncertain, since they are differently described in different sources, and it often remains doubtful which of the accounts that have been transmitted to us represents the original teaching of the founder.

The Manichaean system is one of consistent, uncompromising dualism, in the form of a fantastic philosophy of nature. The physical and the ethical are not distinguished, and in this respect the character of the system is thoroughly materialistic; for when Mani co-ordinates good with light, and evil with darkness, this is no mere figure of speech, but light is actually good and darkness evil. From this it follows that religious knowledge involves the knowledge of nature and her elements, and that redemption consists in a physical process of freeing the element of light from the darkness. Under such circumstances ethics becomes a doctrine of abstinence in regard to all elements which have their source within the sphere of darkness.

The self-contradictory character of the present world forms the point of departure for Mani's speculations. This contradiction presents itself to his mind primarily as elemental, and only in the second instance as ethical, inasmuch as he considers the sensual nature of man to be the outflow of the evil elements in nature. From the contradictory character of the world he concludes the existence of two beings, originally quite separate from each other—light and darkness. Each is to be thought of according to the analogy of a kingdom. Light presents itself to us as the good primal spirit (God, radiant with the ten [twelve] virtues of love, faith, fidelity, high-mindedness, wisdom, meekness, knowledge, understanding, mystery and insight), and then further as the heavens of light and the earth of light, with their guardians the glorious aeons. Darkness is likewise a spiritual kingdom (more correctly, it also is conceived of as a spiritual and feminine personification), but it has no "God" at its head. It embraces an "earth of darkness." As the earth of light has five tokens (the mild zephyr, cooling wind, bright light, quickening fire, and clear water), so has the earth of darkness also five (mist, heat, the sirocco, darkness and vapour). Satan with his demons was born from the kingdom of darkness. These two kingdoms stood opposed to each other from all eternity, touching each other on one side, but remaining unmingled. Then Satan began to rage, and made an incursion into the kingdom of light, into the earth of light. The God of light, with his *syzygy*, "the spirit of his right hand," now begot the primal man, and sent him, equipped with the five pure elements, to fight against Satan. But the latter proved himself the stronger, and the primal man was for a moment vanquished. And although the God of light himself now took to the field, and with the help of new aeons (the spirit of life, &c.) inflicted total defeat upon Satan, and set the primal man free; the latter had already been robbed of part of his light by the darkness, and the five dark elements had already mingled themselves with the generations of light. It only remained now for the primal man to descend into the abyss and prevent the further increase of the generations of darkness by cutting off their roots; but he could not immediately separate again the elements that had once mingled. These mixed elements are the elements of the present visible world, which was formed from them at the command of the God of light. The forming of the world is in itself the beginning of the deliverance of the imprisoned elements of light. The world is represented as an orderly structure of various heavens and various earths, which is borne and supported by the aeons, the angels of light. It possesses in the sun and moon, which are in their nature almost quite pure, large reservoirs, in which the portions of light that have been rescued are stored up. In the sun dwells the primal man himself, as well as the glorious spirits which carry on the work of redemption; in the moon the mother of life is enthroned. The twelve constellations of the zodiac form an ingenious machine, a great wheel with buckets, which pour into the sun and moon, those shining ships that sail continually through space, the portions of light set free from the world. Here they are purified anew, and attain finally to the kingdom of pure light and to God Himself. The later Western Manichaeans termed those portions of light which are scattered throughout the world—in its elements and organisms—awaiting their deliverance, the *Jesus patibilis*.

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[1] A βιβλίον ἐπιστολῶν is spoken of in the formula of abjuration, and an *Epistola ad virginem Menoch* by Augustine. Fabricius has collected the "Greek Fragments of Manichaean Epistles" in his *Bibliotheca Graeca* (vii. 311 seq.).

[2] The *Canticum amatorium* is cited by Augustine.

[3] Zittwitz assumes that this epistle was in its original form of much larger extent, and that the author of the *Acts* took out of it the matter for the speeches which he makes Mani deliver during his disputation with Bishop Archelaus. The same scholar traces back the account by Turbo in the *Acts*, and the historical data given in the fourth section, to the writings of Turbo, a Mesopotamian, who is assumed to have been a Manichaean renegade and a Christian. But as to this difference of opinion is at least allowable.

It is significant of the materialistic and pessimistic character of the system that, while the formation of the world is considered as a work of the good spirits, the creation of man is referred to the princes of darkness. The first man, Adam, was engendered by Satan in conjunction with "sin," "cupidity," "desire." But the spirit of darkness drove into him all the portions of light he had stolen, in order to be able to dominate them the more securely. Hence Adam is a discordant being, created in the image of Satan, but carrying within him the stronger spark of light. Eve is given him by Satan as his companion. She is seductive sensuousness, though also having in her a small spark of light. But if the first human beings thus stood entirely under the dominion of the devil, the glorious spirits took them under their care from the very outset, sending aeons down to them (including Jesus), who instructed them regarding their nature, and in particular warned Adam against sensuality. But this first man fell under the temptation of sexual desire. Cain and Abel indeed are not sons of Adam, but of Satan and Eve; Seth, however, who is full of light, is the offspring of Adam by Eve. Thus did mankind come into existence, its various members possessing very different shares of light, but the men having uniformly a larger measure of it than the women. In the course of history the demons sought to bind men to themselves by means of sensuality, error and false religions (among which is to be reckoned above all the religion of Moses and the prophets), while the spirits of light carried on their process of distillation with the view of gaining the pure light which exists in the world. But these good spirits can only save men by imparting to them the true *gnosis* concerning nature and her forces, and by calling them away from the service of darkness and sensuality. To this end prophets, preachers of true knowledge, have been sent into the world. Mani, following the example of the gnostic Jewish Christians, appears to have held Adam, Noah, Abraham (perhaps Zoroaster and Buddha) to be such prophets. Probably Jesus was also accounted a prophet who had descended from the world of light—not, however, the historical Jesus, the devilish Messiah of the Jews, but a contemporaneous phantom Jesus, who neither suffered nor died (*Jesus impatibilis*). According to the teaching of some Manichaeans, it was the primal man who disseminated the true gnosis in the character of Christ. But at all events Mani himself, on his own claim, is to be reckoned the last and greatest prophet, who took up the work of Jesus impatibilis and of Paul (for he too finds recognition), and first brought full knowledge. He is the "leader," the "ambassador of the light," the "Paraclete." It is only through his agency and that of his imitators, "the elect," that the separation of the light from the darkness can be completed. The system contains very fantastic descriptions of the processes by which the portions of light when once set free finally ascend even to the God of light. He who during his lifetime did not become one of the elect, who did not completely redeem himself, has to go through a severe process of purification on the other side of the grave, till he too is gathered to the blessedness of the light. It is erroneous, however, to ascribe, as has been done, a doctrine of transmigration to the Manichaeans. Of course men's bodies as well as the souls of the unsaved, who according to the oldest conception have in them no light whatever, fall under the sway of the powers of darkness. A later view, adapted to the Christian one, represents the portions of light in the unsaved as actually becoming lost. When the elements of light have at last been completely, or as far as possible, delivered from the world, the end of all things comes. All glorious spirits assemble, the God of light himself appears, accompanied by the aeons and the perfected just ones. The angels supporting the world withdraw themselves from their burden, and everything falls in ruins. A tremendous conflagration consumes the world; the perfect separation of the two powers takes place once more; high above is the kingdom of light, again brought into a condition of completeness, and deep below is the (? now powerless) darkness.

Ethics, Social Polity and Worship of the Manichaeans.—On the basis of such a cosmical philosophy, ethics can only have a dualistic ascetic character. Manichaean ethics is not merely negative, however, since it is necessary to cherish, strengthen and purify the elements of light, as well as free oneself from the elements of darkness. The aim is not self-destruction, but self-preservation; and yet the ethics of Manichaeism appears in point of fact as thoroughly ascetic. The Manichaean had, above all, to refrain from sensual enjoyment, shutting himself up against it by three seals—the *signaculum oris, manus* and *sinus*. The *signaculum oris* forbids all eating of unclean food (which included all bodies of animals, wine, &c.—vegetable diet being allowed because plants contained more light, though the killing of plants, or even plucking their fruit and breaking their twigs, was not permitted), as well as all impure speech. The *signaculum manus* prohibits all traffic with things generally, in so far as they carry in them elements of darkness. Finally, by the *signaculum sinus* every gratification of sexual desire, and hence also marriage, are forbidden. Besides all this, life was further regulated by an exceedingly rigorous system of fasts. Certain astronomical conjunctions determined the selection of the fast-days, which in their total number amounted to nearly a quarter of the year. Sunday was regularly solemnized as one, and the practice was also generally observed on Monday. Hours of prayer were determined with equal exactness. The Manichaean had to pray four times a day, each prayer being preceded by ablutions. The worshipper turned towards the sun, or the moon, or the north, as the seat of light; but it is erroneous to conclude from this, as has been done, that in Manichaeism the sun and moon were themselves objects of worship. Forms of prayer used by the Manichaeans have been preserved to us in the *Fihrist*. The prayers are addressed to the God of light, to the whole kingdom of light, to the glorious angels, and to Mani himself, who is apostrophized in them as "the great tree, which is all salvation." According to Kessler, these prayers are closely related to the Mandaean and the ancient Babylonian hymns. An asceticism so strict and painful as that demanded by Manichaeism could only be practised by few; hence the religion must have abandoned all attempts at an extensive propaganda had it not conceded the principle of a twofold morality. A distinction was made in the community between the *electi* (*perfecti*), the perfect Manichaeans, and the *catechumeni* (*auditores*), the secular Manichaeans. Only the former submitted themselves to all the demands made by their religion; for the latter the stringency of the precepts was relaxed. They had to avoid idolatry, sorcery, avarice, falsehood, fornication, &c.; above all, they were not allowed to kill any living being (the ten commandments of Mani). They had also to free themselves as much as possible from the world; but in truth they lived very much as their non-Manichaean fellow-citizens. We have here essentially the same condition of things as in the Catholic Church, where a twofold morality was also in force, that of the religious orders and that of secular Christians—only that the position of the electi in Manichaeism was a more distinguished one than that of the monks in Catholicism. For, after all, the Christian monks never quite forgot that salvation is given by God through Christ, whereas the Manichaean *electi* were actually themselves redeemers. Hence it was the duty of the *auditores* to pay the greatest respect and most assiduous attention to the *electi*. These "perfect ones," wasting away under their asceticism, were objects of admiration and of the most elaborate solicitude.[1] Food was presented to them in abundance, and by their eating it the *electi* set free the portions of light from the vegetables. They prayed for the *auditores*, they blessed them and interceded for them, thereby shortening the process of purification the latter had to pass through after death. It was only the *electi*, too, who possessed full knowledge of religious truths, a point of distinction from Catholicism.

The distinction between *electi* and *auditores*, however, does not exhaust the conception of the Manichaean Church; on the contrary, the latter possessed a hierarchy of three ranks, so that there were altogether five gradations in the community. These were regarded as a copy of the ranks of the kingdom of light. At the head stood the *teachers* ("the sons of meekness," Mani himself and his successors); then follow the *administrators* ("the sons of knowledge," the bishops); then the *elders* ("the sons of understanding," the presbyters); the *electi* ("the sons of mystery"); and finally the *auditores* ("the sons of insight"). The number of the *electi* must always have been small. According to Augustine the teachers were twelve and the bishops seventy-two in number. One of the teachers appears to have occupied the position of superior at the head of the whole Manichaean Church. At least Augustine speaks of such a personage, and the *Fihrist* also has knowledge of a chief of all Manichaeans. The constitution, therefore, had a monarchic head.

The worship of the Manichaeans must have been very simple, and must have essentially consisted of prayers, hymns and ceremonies of adoration. This simple service promoted the secret dissemination of their doctrines. The Manichaeans too, at least in the West, appear to have adapted themselves to the Church's system of festivals. The *electi* celebrated special feasts; but the principal festival with all classes was the *Bema* (*βῆμα*), the feast of the "teacher's chair," held in commemoration of the death of Mani in the month of March. The faithful prostrated themselves before an adorned but empty chair, which was raised upon a podium of five steps. Long fasts accompanied the feasts. The Christian and Mahommedan historians could learn little of the Manichaean mysteries and "sacraments," and hence the former charged them with obscene rites and abominable usages. It may be held as undoubted that the later Manichaeans celebrated mysteries analogous to Christian baptism and the Lord's Supper, which may have rested upon ancient consecration rites and other ceremonies instituted by Mani himself and having their origin in nature worship.

Recent Discoveries.—F. Cumont (*Revue d'histoire et de littérature religieuse*, t. xii., 1907, No. 2) showed that one at least of the fundamental myths of Mani was borrowed from the Avesta, namely, that which recounts how through the manifestation of the virgin of light and of the messenger of salvation to the libidinous princes of darkness the vital substance or light held captive in their limbs was liberated and recovered for the realm of light. The legend of the *Omophorus* and *Splenditenens*, rival giants who sustain earth and luminous heavens on their respective shoulders, even if it already figures in the cuneiform texts of Assyria, is yet to be traced in Mithraic bas-reliefs. It also may therefore have come to Mani through Magian channels.

When, however, we turn to the numerous fragments of authentic Manichaean liturgies and hymns lately discovered in Turfan in East Turkestan, Mani's direct indebtedness to the cycle of Magian legends rather than to Chaldaic sources (as Kessler argued) is clearly exhibited.

In fr. 472, taken from the Shāpūrakān, as part of a description of the sun-god in his ship or reservoir the sun, we have a mention of Āz and Āhriman and the devas (demons), the Pairikas. Āz in the Avestan mythology was the demon serpent who murders Gayomert in the old Persian legend, and an ally of Ahriman, as also are the *Pairikas* or Peris. In the same fragment we read of the ruin of *Ažidahāka Māzainya*, which name Darmesteter interprets in the Persian sources as the demon serpent, the sorcerer (*Ormazd et Ahriman*, Paris, 1877, p. 157). In fr. 470, descriptive of the conflagration of the world, we read of how, after Az and the demons have been struck down, the pious man is purified and led up to sun and moon and to the being of Ahura Mazda, the Divine.

In another fragment (388) of a hymn Mani describes himself as "the first stranger" (cf. Matt. xxv. 43), the son of the god Zarvān, the Ruler-Child. In the orthodox literature of fire-worship Zarvān was Time or Destiny. Later on Zarvān was elevated to the position of supreme principle, creator of Ormazd and Ahriman, and, long before Mani, Zarvān accompanied Mithras in all his westward migrations.

In fr. 20, in an enumeration of angels, we hear of Narsus, who may be the Nēryōsang (Armenian Nerses or Narsai) of the Avesta. The other angels are Jacob, the mighty angel and leader of angels, the Lord Bar Simūs, Qaftinus the mighty, Raphael, Gabriel, Michael, Sarael and Nastikus—a truly Catholic list.

In fr. 4 a rubric enjoins the recital of the hymn of the *Frašēgērd*. Here we recognize a technical term of the Avesta—namely, the "Frashō-kereti," that is the reanimation of the world or resurrection of the dead (Darmesteter, *op. cit.*, p. 239). In this hymn we read how the gods shall release us from this sinful time, from the oppression of this world. In fr. 4, under the rubric Bar Simūs, we find the god Mihir (Mīḥryazd), the liberator, the compassionate, invoked along with Frēdōn, the good; and later on we read as follows: "with his mighty glance may the god of pure name, Prēdōn, the king and Jacob Narēman, protect religion and us the sons." Mihr or Mithras and Fēridoun or Thraētaona, the slayer of Ajis (or Azi) Dahāka, also Narīmān, spelled Nairimanau, are familiar figures in the old Persian pantheon. In the same prayer the votary begs that "new blessing may come, new victory from the god Zarvān over the glories and angels, the spirits of this world, to the end that he accept our holy religion, become a watcher within and without, helper and protector," and the prayer ends thus: "I invoke the angels, the strong ones, the mighty, Raphael, Michael, Gabriel, Sarael, who shall protect us from all adversity, and free us from the wicked Ahriman."

In fr. 176 Jesus is invoked: "Jesus, of the gods first new moon, thou art God. . . . Jesus, O Lord, of waxing fame full moon, O Jesus. Lord . . . light, our hearts' prayer. Jesus, God and Vahman. Sheen God! We will praise the God Narēsaf. Mār Mānī will we bless. O new moon and spring. Lord, we will bless. The angels, the gods . , . New sun, Mihr."

In the above Vahman is Vohu Manō, the good thought or inspiration of the Zoroastrian religion. Mihr is Mithras. The god Narēsaf is also invoked in other fragments.

In fr. 74 is invoked, together with Jesus and Mani, the "strong mighty Zrōsch, the redeemer of souls." In the Avesta Sraosha is the angel that guards the world at night from demons, and is styled "the righteous" or "the strong."

Fr. 38 is as follows: "Mithras (MS. Mītrā) great . . . messenger of the gods, mediator (or interpreter) of religion, of the elect one Jesus—virgin of light. Mār Mānī, Jesus—virgin of light, Mār Mānī. Do thou in me make peace, O light-bringer, mayest thou redeem my soul from this born-dead (existence)."

Fr. 543 runs thus: ". . . and ladder of the Mazdean faith. Thou, new teacher of Chorasan (of the East), and promoter of those that have the good faith. For thou wast born under a glittering star in the family of the rulers. Elect are these—Jesus and Vahman."

The above examples bear out Mani's own declaration, as reported by the *Fihrist*, that his faith was a blend of the old Magian cult with Christianity. Whether the Hebrew names of angels came to him direct from the Jews or not we cannot tell, but they were, as the Greek magical papyri prove, widely diffused among the Gentiles long before his age. The Armenian writer Eznik (*c.* 425) also attests that Mani's teaching was merely that of the Magi, *plus* an ascetic morality, for which they hated and slew him.

Just as the background of Christianity was formed by the Hebrew scriptures, and just as the Hebrew legends of the creation became the basis of its scheme of human redemption from evil, so the Avesta, with its quaint cosmogony and myths, formed the background of Mani's new faith. He seems to have quarrelled with the later Magism because it was not dualistic enough, for in fr. 28 we have such a passage as the following: "They also that adore the fire, the burning, by this they themselves recognize that their end shall be in fire. And they say that Ormuzd and Ahriman are brothers, and in consequence of this saying they shall come to annihilation." In the same fragment the Christians are condemned as worshippers of idols, unless indeed the writer has genuine pagans in view There is a mention of Marcion in the same context, but it is unintelligible. There can be no doubt that in the form in which Mani became acquainted with it Christianity had been disengaged and liberated from the womb of Judaism which gave it birth. This presentation of it as an ethical system of universal import was the joint work of Paul and Marcion.

It remains to add that in these newly found fragments Mani styles himself "the apostle (*lit.* the sent forth) of Jesus the friend in the love of the Father, of God." He uses the formula:

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[1] Analogous to this is the veneration in which the Catholic monks and the Neoplatonic "philosophers" were held; but the prestige of the Manichaean *electi* was greater than that of the monks and the philosophers.

"Praise and laud to the Father and the Son and the Holy Spirit." In fr. 4 he attests that he was sprung from the land Babel; in fr. 566 that he was a physician from the land Babel. Fr. 3 recounts his interview with King Shāpūr I. The Gospel of Peter seems to have been in use, for one lengthy citation is taken from it in fr. 18. The Manichaeans of Chinese Turkestan also used a version of the *Shepherd* of Hermas. Several of the hymns (*e.g.* in fr. 7 and 32) reproduce the ideas and almost the phases of the Syriac "Hymn of the Soul," so confirming the hypothesis that Mani was influenced by Bardesanes.

With the exception of a few fragments written in a Pehlevi dialect, all this recovered Manichaean literature is in the Ouigour or Vigur dialect of Tatar. The alphabet used is the one adapted by Mani himself from the Syriac estrangelo. The fragments are 800 in number, both on paper and vellum, written and adorned with the pious care and good taste which the Manichaeans are known to have bestowed on their manuscripts. They were brought back by Professor Grünwedel and Dr Huth from Turfan in East Turkestan, and were partly translated by Dr F. W. K. Müller in the *Abhandlungen der k. preuss. Akademie der Wissenschaften* (Berlin, 1904). Much of this literature is still left in Turfan, where the natives use the sheets of Vigur and Chinese vellum MSS. as window-panes in their huts. The Russian and German governments have sent out fresh expeditions to rescue what is left before it is too late. We may thus hope to recover some priceless monuments of early Christianity, hymns and treatises perhaps of Marcion and Bardesanes, the Gospel of Peter, and even the Diatessaron. Müller's translations includes a long extract of Mani's book called *Schāpūrakān*, parts of his *Evangelium*, and epistles, with liturgies, hymns and prayers, for Tatar Khāns who espoused the faith in Khorasan.

Manichaeism and Christianity.—It is very difficult to determine what was the extent of Mani's knowledge of Christianity, how much he himself borrowed from it, and through what channels it reached him. It is certain that Manichaeism, in those districts where it was brought much into contact with Christianity, became additionally influenced by the latter at a very early period. The Western Manichaeans of the 4th and 5th centuries are much more like Christians than their Eastern brethren. In this respect Manichaeism experienced the same kind of development as Neo-Platonism. As regards Mani himself, it is safest to assume that he held both Judaism and Catholic Christianity to be entirely false religions. It is indeed true that he not only described himself as the promised Paraclete—for this designation probably originated with himself—but also conceded a high place in his system to "Jesus"; we can only conclude from this, however, that he distinguished between Christianity and Christianity. The religion which had proceeded from the historical Jesus he repudiated together with its founder, and Catholicism as well as Judaism he looked upon as a religion of the devil. But he distinguished between the Jesus of darkness and the Jesus of light who had lived and acted contemporaneously with the former. This distinction agrees with that made by the gnostic Basilides no less strikingly than the Manichaean criticism of the Old Testament does with that propounded by the Marcionites (see the *Acta Archelai*, in which Mani is made to utter the antitheses of Marcion). Finally, the Manichaean doctrines exhibit points of similarity to those of the Christian Elkesaites. The historical relation of Mani to Christianity is then as follows. From Catholicism, which he very probably had no detailed knowledge of, he borrowed nothing, rejecting it as devilish error. On the other hand, he looked upon what he considered to be Christianity proper—that is, Christianity as it had been developed among the sects of Basilidians, Marcionites, and perhaps Bardesanites, as a comparatively valuable and sound religion. He took from it the moral teaching of the Sermon on the Mount, and a criticism of the Old Testament and of Judaism so far as he required it. Indications of the influence of Marcionitism are found in the high estimation in which Mani held the apostle Paul, and in the fact that he explicitly rejects the Book of Acts. Mani appears to have given recognition to a portion of the historical matter of the Gospels, and to have interpreted it in accordance with his own doctrine.

Manichaeism and Buddhism.—It remains to be asked whether Buddhistic elements can also be detected in Manichaeism. Most modern scholars since F. C. Baur have answered this question in the affirmative. According to Kessler, Mani made use of the teaching of Buddha, at least as far as ethics was concerned. It cannot be doubted that Mani, who undertook long journeys as far as India, knew of Buddhism. The name Buddha (Buddas) which occurs in the legendary account of Mani, and perhaps in the latter's own writings, indicates further that he had occupied his attention with Buddhism when engaged in the work of founding his new religion. But his borrowings from this source must have been quite insignificant. A detailed comparison shows the difference between Buddhism and Manichaeism in all their principal doctrines to be very great, while it becomes evident that the points of resemblance are almost everywhere accidental. This is also true of the ethics and the asceticism of the two systems. There is not a single point in Manichaeism which demands for its explanation an appeal to Buddhism. Such being the case, the relationship between the two religions remains a mere possibility, a possibility which the inquiry of Geyler (*Das System des Manichaeismus und sein Verhältniss zum Buddhismus*, Jena, 1875) has not been able to elevate into a probability.

The Secret of Manichaeism.—How are we to explain the rapid spread of Manichaeism, and the fact that it really became one of the great religions? What gave it strength was that it united an ancient mythology and a thorough-going materialistic dualism with an exceedingly simple spiritual worship and a strict morality. On comparing it with the Semitic religions of nature we perceive that it was free from their sensuous *cultus*, substituting instead a spiritual worship as well as a strict morality. Manichaeism was thus able to satisfy the new wants of an old world. It offered revelation, redemption, moral virtue and immortality, spiritual benefits on the basis of the religion of nature. A further source of strength lay in the simple yet firm social organization which was given by Mani himself to his new institution. The wise man and the ignorant, the enthusiast and the man of the world, could all find acceptance here, and there was laid on no one more than he was able and willing to bear. Each one, however, was attached and led onward by the prospect of a higher rank to be attained, while the intellectually gifted had an additional inducement in the assurance that they did not require to submit themselves to any authority, but would be led to God by pure reason. Thus adapted from the first to individual requirements, this religion also showed itself able to appropriate from time to time foreign elements. Originally furnished from fragments of various religions, it could increase or diminish this possession without rupturing its own elastic framework. And, after all, great adaptability is just as necessary for a universal religion as a divine founder in whom the highest revelation of God may be seen and reverenced. Manichaeism indeed, though it applies the title "redeemer" to Mani, has really no knowledge of a redeemer, but only of a physical and gnostic process of redemption; on the other hand, it possesses in Mani the supreme prophet of God. If we consider in conclusion that Manichaeism gave a simple, apparently profound, and yet convenient solution of the problem of good and evil, a problem that had become peculiarly oppressive to the human race in the 2nd and 3rd centuries, we shall have named the most important factors which account for the rapid spread of the system.

Sketch of the History of Manichaeism.—Manichaeism first gained a firm footing in the East, *i.e.* in Persia, Mesopotamia and Transoxiana. The persecutions it had to endure did not hinder its extension. The seat of the Manichaean pope was for centuries in Babylon, at a later period in Samarkand. Even after the conquests of Islam the Manichaean Church continued to maintain itself, indeed it seems to have become still more widely diffused by the victorious campaigns of the Mahommedans, and it frequently gained secret adherents among the latter themselves. Its doctrine and discipline underwent little change in the East; in particular, it drew no nearer to the Christian religion. More than once, however, Manichaeism experienced attempts at reformation; for of course the *auditores* very easily became worldly in character, and movements of reformation led temporarily to divisions and the formation of sects. Towards the close of the 10th century, at the time the *Fihirst* was written, the Manichaeans in Mesopotamia and Persia had already been in large measure ousted from the towns, and had withdrawn to the villages. But in Turkestan, and as far as the Chinese frontier, there existed numerous Manichaean communities and even whole tribes that had adopted the name of Mani. Probably it was the great migrations of the Mongolian race that first put an end to Manichaeism in Central Asia. But even in the 15th century there were Manichaeans living beside the Thomas-Christians on the coast of Malabar in India (see Germann, *Die Thomas-Christen*, 1875). Manichaeism first penetrated the Greek-Roman Empire about the year 280, in the time of the emperor Probus (see the *Chronicon* of Eusebius). If we may take the edict of Diocletian against the Manichaeans as genuine, the system must have gained a firm footing in the West by the beginning of the 4th century, but we know that as late as about the year 325 Eusebius had not any accurate knowledge of the sect. It was only subsequent to about 330 that Manichaeism spread rapidly in the Roman Empire. Its adherents were recruited on the one hand from the old gnostic sects (especially from the Marcionites—Manichaeism exerted besides this a strong influence on the development of the Marcionite churches of the 4th century), on the other hand from the large number of the "cultured," who were striving after a "rational" and yet in some manner Christian religion. Its polemics and its criticism of the Catholic Church now became the strong side of Manichaeism, especially in the West. It admitted the stumbling-blocks which the Old Testament offers to every intelligent reader, and gave itself out as a Christianity without the Old Testament. Instead of the subtle Catholic theories concerning divine predestination and human freedom, and instead of a difficult theodicaea, it offered an exceedingly simple conception of sin and goodness. The doctrine of the incarnation of God, which was especially objectionable to those who were going over to the new universal religion from the old cults, was not proclaimed by Manichaeism. In its rejection of this doctrine Manichaeism agreed with Neo-Platonism; but, while the latter, notwithstanding all its attempts to conform itself to Christianity, could find no formula by which to inaugurate within its own limits the special veneration of Christ, the Western Manichaeans succeeded in giving their teaching a Christian tinge. The only part of the Manichaean mythology that became popular was the crude, physical dualism. The barbaric elements were judiciously screened from view as a "mystery"; they were, indeed, here and there explicitly disavowed even by the initiated. The farther Manichaeism advanced into the West the more Christian and philosophic did it become. In Syria it maintained itself in comparative purity. In North Africa it found its most numerous adherents, gaining secret support even among the clergy. Augustine was an *auditor* for nine years, while Faustus was at that time the most esteemed Manichaean teacher in the West. Augustine in his later writings against the Manichaeans deals chiefly with the following problems: (1) the relation between knowledge and faith, and between reason and authority; (2) the nature of good and evil, and the origin of the latter; (3) the existence of free will, and its relation to the divine omnipotence; (4) the relation of the evil in the world to the divine government.

The Christian Byzantine and Roman emperors, from Valens onwards, enacted strict laws against the Manichaeans. But at first these bore little fruit. The *auditores* were difficult to trace out, and besides they really gave little occasion for persecution. In Rome itself between 370 and 440 Manichaeism gained a large amount of support, especially among the scholars and public teachers. It also made its way into the life of the people by means of a popular literature in which the apostles were made to play a prominent part (*Apocryphal Acts of the Apostles*). Manichaeism in the West had also some experience of attempts at reformation from the ascetic side, but of these we know little. In Rome Leo the Great was the first who took energetic measures, along with the state authorities, against the system. Valentinian III. decreed banishment against its adherents, Justinian the punishment of death. In North Africa Manichaeism appears to have been extinguished by the persecution of the Vandals. But it still continued to exist elsewhere, both in the Byzantine Empire and in the West, and in the earlier part of the middle ages it gave an impulse to the formation of new sects, which remained related to it. And if it has not been quite proved that so early as the 4th century the Priscillianists of Spain were influenced by Manichaeism, it is at least undoubted that the Paulicians and Bogomiles, as well as the Catharists and the Albigenses, are to be traced back to Manichaeism (and Marcionitism). Thus the system, not indeed of Mani the Persian, but of Manichaeism as modified by Christian influences, accompanied the Catholic Church until the 13th century.

Sources.—(*a*) Oriental. Among the sources for a history of Manichaeism the most important are the Oriental. Of these the Mahommedan, though of comparatively late date, are distinguished by the excellent manner in which they have been transmitted to us, as well as by their impartiality. They must be named first, because ancient Manichaean writings have been used in their construction. At the head of all stands En-Nedīm, *Fihrist* (*c.* 980), ed. by Flügel (1871–1872); cf. the latter's work *Mani, seine Lehre u. seine Schriften* (1862). See also Shahrastānī, *Kitab al-milal wan-nuḥal* (12th cent.), ed. by Cureton (1846) and translated into German by Haarbrücker (1851), and individual notes and excerpts by Tabarī (10th cent.), Al-Bīrūnī (11th cent.), and other Arabian and Persian historians. Next come the Turfan fragments described in the body of this article. See also W. Brandt, *Schriften aus der Genza oder Sidvā Rabba* (Göttingen, 1893).

Of the Christian Orientals those that afford most information are Ephraem Syrus (d. 373), in various writings; the Armenian Esnik (German translation by J. M. Schmid, Vienna, 1900, see also *Zeitsch. f. hist. Theol.*, 1840, ii.; Langlois, *Collection*, ii. 375 seq.), who wrote in the 5th century against Marcion and Mani; and the Alexandrian patriarch Eutychius d. 916), *Annales*, ed. Pococke (1628). There are, besides, scattered pieces of information in Aphraates (4th cent.), Barhebraeus (13th cent.) and others. The newly found Syriac *Book of Scholia* of Theodor bar Khouni (see Pognon, *Les Coupes de Kouabir*, Paris, 1898) gives many details about Mani's teaching (also ed. without translation by Dr M. Lewin, Berlin, 1905).

(*b*) Greek and Latin. The earliest mention of the Manichaeans in the Graeco-Roman Empire is to be found in an edict of Diocletian (see Hänel, *Cod. Gregor.*, tit. xv.), which is held by some to be spurious, while others assign it to one or other of the years 287, 290, 296, 308 (so Mason, *The Persec. of Diocl.*, pp. 275 seq.). Eusebius gives a short account of the sect (*H. E.*, vii. 31). It was the *Acta Archelai*, however, that became the principal source on the subject of Manichaeism for Greek and Roman writers. These *Acta* are not indeed what they give themselves out for, viz. an account of a disputation held between Mani and the bishop Archelaus of Cascar, in Mesopotamia; but they nevertheless contain much that is trustworthy, especially regarding the doctrine of Mani, and they also include Manichaean documents. They consist of various distinct pieces, and originated in the beginning of the 4th century, probably at Edessa. They were translated as early as the first half of the same century from the Syriac (as is maintained by Jerome, *De vir. illust.*, 72; though this is doubted by modern scholars) into Greek, and soon afterwards into Latin. It is only this secondary Latin version that we possess (ed. by C. H. Beeson, Leipzig, 1906, under title *Hegemonius acta Archelai*); earlier editions, Zacagni (1698); Routh, *Reliquiae sac.*, vol. v. (1848); translated in Clark's *Ante-Nicene Library*, vol. xx.); small fragments of the Greek version have been preserved. Regarding the *Acta Archelai*, see Zittwitz in *Zeitschr. f. d. histor. Theol.* (1873) and Oblasinski, *Acta disp. Arch. et Manetis* (1874). In the form in which we now possess them, they are a compilation after the pattern of the *Clementine Homilies*, and have been subjected to manifold redactions. These *Acta* were used by Cyril of Jerusalem (*Catech.* 6), Epiphanius (*Haer.* 66), and a great number of other writers. All the Greek and Latin heresiologists have included the Manichaeans in their catalogues; but they seldom adduce any independent information regarding them (see Theodoret, *Haer. fab.* i. 26). Important matter is to be found in the resolutions of the councils from the 4th century onwards (see Mansi, *Acta concil.*, and Hefele, *Conciliengeschichte*, vols. i.-iii.), and also in the controversial writings of Titus of Bostra (6th century), Πρὸς Μανιχαίους (ed. Lagarde, 1859), and of Alexander of Lycopolis Λόγος πρὸς τὰς Μανιχαίου δόξας (ed. Combefis; transl. in *Ante-Nic. Lib.*, vol. xiv.). Of the Byzantines, the most worthy of mention are John of Damascus (*De haeres.* and *Dialog.*) and Photius (*cod.* 179 *Biblioth.*). The struggle with the Paulicians and the Bogomiles, who were often simply identified with the Manichaeans, again directed attention to the latter. In the West the works of Augustine are the great repertory for information on the subject of Manichaeism (*Contra epistolam Manichaei, quam vocant fundamenti*; *Contra Faustum Manichaeum*; *Contra Fortunatum*; *Contra Adimantum*; *Contra Secundinum*; *De actis cum Felice Manichaeo*; *De genesi c. Manichaeos*; *De natura boni*; *De duabus animabus*; *De utilitate credendi*; *De moribus eccl. cathol. et de moribus Manichaeorum*; *De haeres.*). The more complete the picture, however, which may here be obtained of Manichaeism, the more cautious must we be in making generalizations from it, for it is beyond doubt that Western Manichaeism adopted Christian elements which are wanting in the original and in the Oriental Manichaeism. The "Dispute of Paul the Persian with a Manichaean" in Migne *P.G.*, 88, col. 529–578 (first ed. by A. Mai) is shown by G. Mercati, *Studi e testi* (Rome, 1901) to be the *procès verbal* of an actual discussion held under Justinian at Constantinople in 527.

LITERATURE.—The most important works on Manichaeism are Beausobre, *Hist. critique de Manichée et du Manichéisme* (2 vols., 1734 seq.; the Christian elements in Manichaeism are here strongly, indeed too strongly, emphasized); Baur, *Das manich. Religionssystem* (1831; in this work Manichaean speculation is exhibited from a speculative standpoint); Flügel, *Mani* (1862; a very careful investigation on the basis of the *Fihrist*); Kessler, *Untersuchung zur Genesis des manich. Religionssystems* (1876); and the article "Mani, Manichäer," by the same writer in Herzog-Hauck's *R.E.*, xii. 193–228; Kessler, *Mani* (2 vols., Berlin, 1889, 1903); Ernest Rochat, *Essai sur Mani et sa doctrine* (Geneva, 1897); *Recherches sur le manichéisme: I. La cosmogonie manichéisme d'après Théodore Bar Khôui*, by Franz Cumont (Brussels, 1908); *II. Fragments syriaques d'ouvrages manichéens*, by Kugener and F. Cumont. *III. Les Formules grecques d'abjuration imposées aux manichéens*, by F. Cumont. The accounts of Mosheim, Lardner, Walch and Schröckh, as well as the monograph by Trechsel, *Ueber Kanon, Kritik und Exegese der Manichäer* (1832), may also be mentioned as still useful. The various researches which have been made regarding Parsism, the ancient Semitic religions, Gnosticism, &c., are of the greatest importance for the investigation of Manichaeism. (A. HA.; F. C. C.)

MANIFEST (Lat. *manifestus*, clear, open to view), in commercial law, a document delivered to the officer of customs by the captain of a ship before leaving port, giving a description of the shipped goods of every kind, and setting forth the marks, numbers and descriptions of the packages and the names of the consignors thereof. In England, by the Revenue Act 1884, s. 3, where goods are exported for which no bond is required, a manifest must be delivered to the officer of customs by the master or owner of the ship within six days after the final clearance, or a declaration in lieu thereof, the penalty in default being a sum not exceeding five pounds.

MANIHIKI (MANAHIKI, MONAHIKI), a scattered archipelago in the central Pacific Ocean, between 4° and 11° S., and 150° and 162° W., seldom visited, and producing only a little copra and guano. It may be taken to include the Caroline or Thornton Islands, Vostok and Flint to the east; Suvarov, Manihiki or Humphrey, and Tongareva or Penrhyn to the west, and Starbuck and Malden to the north, the whole thus roughly forming the three corners of a triangle. There are pearl and pearl-shell fisheries at Tongareva and Suvarov. The natives (about 1000) are Polynesians and nominally Christian. There are ancient stone buildings of former inhabitants on Malden Island. The islands were mostly discovered early in the 19th century, and were annexed by Great Britain mainly in 1888–1889.

MANIKIALA, a village of India, in Rawalpindi district of the Punjab. Pop. (1901), 734. It contains one of the largest *stupas* or Buddhist memorial shrines in N. India, and the one first known to Europeans, who early detected traces of Greek influence in the sculpture. The *stupa* was excavated by General Court in 1834, and has been identified by Sir A. Cunningham with the scene of Buddha's "body-offering."

MANILA, the capital city and principal port of the Philippine Islands, situated on the W. coast of the island of Luzon, on the E. shore of Manila Bay, at the mouth of the Pasig river, in lat. 14° 35′ 31″ N., and in long. 120° 58′ 8″ E. It is about 4890 m. W.S.W. of Honolulu, 6990 m. W.S.W. of San Francisco, 628 m. S.E. of Hong-Kong, and 1630 m. S. by W. of Yokohama. Pop. (1876), 93,595; (1887), 176,777; (1903), 219,928. Of the total population in 1903, 185,351 were of the brown race, 21,838 were of the yellow race, 7943 were of the white race, and 232 were of the black race (230 of those of this race were foreign-born), and 4564 were of mixed races; of the same total 131,659, or nearly 60% were males. The foreign-born in 1903 numbered 29,491, comprising 21,083 natives of China, 4300 natives of the United States of America, 2065 natives of Spain, and 721 natives of Japan. Nearly all of the brown race were native-born, and 80·6% of them were Tagalogs.

The city covers an area of about 20 sq. m. of low ground, through which flow the Pasig river and several *esteros*, or tide-water creeks. To the west is the broad expanse of Manila Bay, beyond which are the rugged Mariveles Mountains; to the eastward the city extends about half-way to Laguna de' Bay, a lake nearly as large as Manila Bay and surrounded on three sides by mountains. On the south bank of the Pasig and fronting the bay for nearly a mile is the "Ancient City," or Intramuros, enclosed by walls 2¼ m. long, with a maximum height of 25 ft., built about 1590. Formerly a moat flanked the city on the land sides, and a drawbridge at each of six gates was raised every night. But this practice was discontinued in 1852 and the moat was filled with earth in 1905. In the north-west angle of the walled enclosure stands Fort Santiago, which was built at the same time as the walls to defend the entrance to the river; the remaining space is occupied largely by a fine cathedral, churches, convents, schools, and government buildings. Outside the walls the modern city has been formed by the union of several towns whose names are still retained as the names of districts. The Pasig river is crossed by two modern steel cantilever bridges. Near the north-east angle of Intramuros is the Bridge of Spain, a stone structure across the Pasig, leading to Binondo, the principal shopping and financial district; here is the Escolta, the most busy thoroughfare of the city, and the Rosario, noted for its Chinese shops. Between Binondo and the bay is San Nicholas, with the United States custom-house and large shipping interests. North of San Nicholas is Tondo, the most densely populated district; in the suburbs, outside the fire limits, the greater part of the inhabitants live in native houses of bamboo frames roofed and sided with nipa palm, and the thoroughfares consist of narrow streets and navigable streams. Paco, south-west of Intramuros, has some large cigar factories, and a large cemetery where the dead are buried in niches in two concentric circular walls. Ermita and Malate along the bay in the south part of the city, San Miguel on the north bank of the river above Intramuros, and Sampaloc farther north, are the more attractive residential districts.

Most of the white inhabitants live in Ermita and Malate, or in San Miguel, where there are several handsome villas along the river front, among them that of the governor-general of the Philippines. The better sort of houses in Manila have two storeys, the lower one built of brick or stone and the upper one of wood, roofed with red Spanish tile or with corrugated iron; the upper storey contains the living-rooms, and the lower has servants' rooms, store-houses, stables, carriage-houses and poultry yards. On account of the warm climate the cornices are wide, the upper storey projects over the lower, and the outer walls are fitted with sliding frames. Translucent oyster shells are a common substitute for glass; and the walls are white-washed, but on account of the frequency of earthquakes are not plastered. More than one half of the dwellings in the city are mere shacks or nipa huts. Few of the public buildings are attractive or imposing. There are, however, some churches with graceful towers and beautiful façades and a few attractive monuments; among the latter are one standing on the Magellan Plaza (Plaza or Paseo de Magellanes) beside the Pasig, to the memory of Ferdinand Magellan, the discoverer of the islands; and another by A. Querol on the shore of the bay, to the memory of Don Miguel de Legaspi (d. 1572), the founder of the Spanish city, and of Andres de Urdaneta (1498–1568), the Augustinian friar who accompanied Legaspi to Cebu (but not to what is now Manila).

Many improvements have been made in and about the city since the American occupation in 1898. The small tram-cars drawn by native ponies have been replaced by a modern American electric street-railway service, and the railway service to and from other towns on the island of Luzon has been extended; in 1908, 267 m. were open to traffic and 400 m. were under construction. Connected with Manila by electric railway is Fort William McKinley, a U.S. army post in the hills five miles away, quartering about 3000 men. The scheme for dredging some of the *esteros* in order to make them more navigable and for filling in others has been in part executed. But the greatest improvement affecting transportation is the construction of a safe and deep harbour. Although Manila Bay is nearly landlocked, it is so large that in times of strong winds it becomes nearly as turbulent as the open sea, and it was formerly so shallow that vessels drawing more than 16 ft. could approach no nearer than two miles to the shore, where typhoons of the south-west monsoon not infrequently obliged them to lie several days before they could be unloaded. Two long jetties or breakwaters have now been constructed, about 350 acres of harbour area have been dredged to a depth of 30 ft., and two wharves of steel and concrete, one 600 ft. long and 70 ft. wide, and the other 650 ft. long and 110 ft. wide, were in process of construction in 1909. The Pasig river has been dredged up to the Bridge of Spain to a depth of 18 ft. and from the Bridge of Spain to Laguna de Bay to a depth of 6 ft. The construction of the harbour was begun about 1880 by the Spanish government, but the work was less than one-third completed when the Americans took possession. Among other American improvements were: an efficient fire department, a sewer system whereby the sewage by means of pumps is discharged into the bay more than a mile from the shore; a system of gravity waterworks (1908) whereby the city's water supply is taken from the Mariquina river about 23 m. from the city into a storage reservoir which has a capacity of 2,000,000,000 gallons and is 212 ft. above the sea; the extension of the Luneta, the principal pleasure-ground; a boulevard for several miles along the bay; a botanical garden; and new market buildings.

Climate.—Manila has a spring and summer hot season, an autumn and winter cooler season, a summer and autumn rainy season, and a winter and spring dry season. For the twenty years 1883–1902 the annual average of mean monthly temperatures was 26·8° C., the maximum being 27·4° in 1889 and 1897, and the minimum 26·2° in 1884. From May until October the prevailing wind is south-east, from November to January it is north, and from February to April it is east. July and August are the cloudiest months of the year; the average number of rainy days in each of those months being 21, and in February or March only 3. The annual average of rainy days is 138: 94 in the wet season (average precipitation for the six months, 1556·3 mm.) and 44 in the dry season (average precipitation for the six dry months, 382 mm.). Thunderstorms are frequent and occasionally very severe, between May and September; the annual average of thunderstorms for the decennium 1888–1897 was 505, the greatest frequency was in May (average 100·3) and in June (average 90·7); the severity of these storms may be imagined from the fact that in a half-hour between 5 and 6 p.m. on the 21st of May 1892 the fall (probably the maximum) was 60 mm. The air is very damp: for the period 1883–1902 the annual average of humidity was 79·4%, the lowest average for any one month was 66·6% in April 1896 (the average for the twenty Aprils was 70·7), and the highest average for any one month was 89·9 % for September 1897 (the average for the twenty Septembers was 85·5). The city is so situated as to be affected by shocks from all the various seismological centres of Luzon, especially those from the active volcano Taal, 35 m. south of the city. At the Manila observatory, about 1 m. south-east of the walled city, the number of perceptible earthquakes registered by seismograph between 1880 and 1897 inclusive was 221; the greatest numbers for any one year were 26 in 1882 and 23 in 1892, and the least, 5 in 1896 and 6 in 1889 and in 1894; the average number in each May was 1·44, in each July, 1·33, and in January and in February 0·72; the frequency is much greater in each of the spring summer months (except June, average 0·78) than in the months of autumn and winter.

Public Institutions.—The public school system of Manila includes, besides the common schools and Manila high school, the American school, the Philippine normal school (1901), the Philippine school of arts and trades (1901), the Philippine medical school (1907) and the Philippine school of commerce (1908). The Philippine government also maintains here a bureau of science which publishes the monthly *Philippine Journal of Science*, and co-operates with the Jesuits in maintaining, in Ermita, the Manila observatory (meteorological, seismological and astronomical), which is one of the best equipped institutions of the kind in the East. The royal and pontifical university of St Thomas Aquinas (generally known as the university of Santo Tomas) was founded in 1857 with faculties of theology, law, philosophy, science, medicine and pharmacy, and grew out of a seminary, for the foundation of which Philip II. of Spain gave a grant in 1585, and which opened in 1601; and of the Dominican college of St Thomas, dating from 1611. Other educational institutions are the (Dominican) San José medical and pharmaceutical college, San Juan de Letrán (Dominican), which is a primary and secondary school, the ateneo municipal, a corresponding secondary and primary school under the charge of the Jesuits, and the college of St Isabel, a girls' school. In 1908 there were thirty-four newspapers and periodicals published in the city, of which thirteen were Spanish, fourteen were English, two were Chinese, and five were Tagalog; the principal dailies were the *Manila Times*, *Cablenews American*, *El Comercio*, *El Libertas*, *El Mercantil*, *El Renacimiento* and *La Democracia*. There are several Spanish hospitals in Manila, in two of which the city's indigent sick are cared for at its expense; in connexion with another a reform school is maintained; and there are a general hospital, built by the government, a government hospital for contagious diseases, a government hospital for government employees, a government hospital for lepers, an army hospital, a free dispensary and hospital supported by American philanthropists, St Paul's hospital (Roman Catholic), University hospital (Protestant Episcopal), and the Mary Johnson hospital (Methodist Episcopal). There are several American Protestant churches in the city, notably a Protestant Episcopal cathedral and training schools for native teachers. In Bibilid prison, in the Santa Cruz district, nearly 80% of the prisoners of the archipelago are confined; it is under the control of the department of public instruction and its inmates are given an opportunity to learn one or more useful trades.

Trade and Industry.—Manila is important chiefly for its commerce, and to make it the chief distributing point for American goods consigned to Eastern markets the American government undertook the harbour improvements, and abolished the tonnage dues levied under Spanish rule. Manila is the greatest hemp market in the world; 110,399 tons, valued at $19,444,769, were exported from the archipelago in 1906, almost all being shipped from Manila. Other important exports are sugar, copra and tobacco. The imports represent a great variety of food stuffs and manufactured articles. In 1906 the the total value of the exports was $23,902,986 and the total value of the imports was $21,868,257. The coastwise trade is large. The principal manufactures are tobacco, cigars, cigarettes, malt liquors, distilled liquors, cotton fabrics, clothing, ice, lumber, foundry and machine shop products, carriages, waggons, furniture and boots and shoes. There is some ship and boat building. Lumber is sawed by steam power, and cotton mills in the Tondo district are operated by steam. In the foundries and machine shops small engines, boilers and church bells are made, and the government maintains an ice and cold-storage plant. With these exceptions manufacturing is in a rather primitive state. Another industry of importance, especially in the district of Tondo, is fishing, and the city's markets are well supplied with many varieties of choice fish.

Administration.—Manila is governed under a charter enacted in 1901 by the Philippine commission, and amended in 1903. This vests the legislative and administrative authority mainly in a municipal board of five members, of whom three are appointed by the governor of the Philippines by the advice and with the consent of the Philippine commission, and the others are the president of the advisory board and the city engineer. The administration is divided into eight departments: engineering and public works; sewer and waterworks construction; sanitation and transportation; assessments and collections; police, fire, law and schools. There are no elective offices, but there is an advisory board, appointed by the governor and consisting of one member from each of eleven districts; its recommendations the municipal board must seek on all important matters. The administration of justice is vested in a municipal court and in one court under justices of the peace and auxiliary justices; the administration of school affairs is vested in a special board of six members; and matters pertaining to health are administered by the insular bureau of health.

History.—The Spanish city of Manila (named from "nilad," a weed or bush which grew in the locality) was founded by Legaspi in 1571. The site had been previously occupied by a town under a Mahommedan chieftain, but this town had been burned before Legaspi gained possession, although a native settlement still remained, within the present district of Tondo. In 1572, while its fortifications were still slight, the Spanish city was attacked and was nearly captured by a force of Chinese pirates who greatly outnumbered the Spaniards. About 1590 the construction of the present walls and other defences was begun. At the beginning of the 17th century Manila had become the commercial metropolis of the Far East. To it came fleets from China, Japan, India, Malacca and other places in the Far East for an exchange of wares, and from it rich cargoes were sent by way of Mexico to the mother country in exchange for much cheaper goods. Before the close of the century, however, a decline began, from which there was but little recovery under Spanish rule. Several causes contributed to this, among them the waning of the power of Spain, an exclusive commercial policy, dishonest administration, hostilities with the Chinese, ravages of the Malay pirates, and the growth of Dutch commerce. On several occasions the city has been visited with destructive earthquakes; those of 1645 and 1863 were especially disastrous. In 1762, during war between England and Spain, an English force under Vice-Admiral Sir Samuel Cornish (d. 1770) and Lieut.-General Sir William Draper (1721–1787) breached the walls and captured the city, but by the Treaty of Paris (1763) it was returned to Spain. In 1837 the port of Manila was opened to foreign trade, and there was a steady but slow increase in prosperity up to about 1890. During this period, however, progress was hampered by vested interests, and the spirit of rebellion among the natives became increasingly threatening. About 1892 a large number of Filipinos in and near Manila formed a secret association whose object was independence and separation from Spain. In August 1896 members of this association began an attack; and late in December the movement was reinforced as a result of the execution in Manila of Dr José Rizal y Mercado (1861–1896), a Filipino patriot. It spread to the provinces, and was only in part suppressed when, in April 1898, the United States declared war against Spain. On the 1st of May an American fleet under Commodore George Dewey destroyed the Spanish fleet stationed in Manila Bay (see SPANISH-AMERICAN WAR). The smouldering Filipino revolt then broke out afresh and an American army under General Wesley Merritt (1836–   ) was sent from San Francisco to assist in capturing the city. The Spaniards, after making a rather weak defence, surrendered it on the 13th of August 1898. Trouble now arose between the Americans and the Filipinos under the leadership of Emilio Aguinaldo, for the latter wished to establish a government of their own. On the night of the 4th of February 1899 the Filipinos attacked the American army which was defending the city, but were repulsed after suffering a heavy loss. A military government, however, was maintained in the city until August 1901.

MANILA HEMP, the most valuable of all fibres for cordage, the produce of the leaf-stalks of *Musa textilis*, a native of the Philippine Islands. The plant, called *abacá* by the islanders, throws up a spurious stem from its underground rootstocks, consisting of a cluster of sheathing leaf-stalks, which rise to a height of from 15 to 25 ft. and spread out into a crown of huge undivided leaves characteristic of the various species of *Musa* (plantain, banana, &c.). From 12 to 20 clusters are developed on each rhizome. In its native regions the plant is rudely cultivated solely as a source of fibre; it requires little attention, and when about three years old develops flowers on a central stem, at which stage it is in the most favourable condition for yielding fibre. The stock is then cut down, and the sheathing stalks are torn asunder and reduced to small strips. These strips in their fresh succulent condition are drawn between a knife-edged instrument and a hard wooden block to which it is fixed. The knife is kept in contact with the block except when lifted to introduce the ribbons. Sufficient weight is suspended to the end of the knife to keep back all pith when the operator is drawing forward the ribbon between the block and knife. By repeated scraping in this way the soft cellular matter which surrounds the fibre is removed, and the fibre so cleaned has only to be hung up to dry in the open air, when, without further treatment, it is ready for use. Each stock yields, on an average, a little under 1 lb of fibre; and two natives cutting down plants and separating fibre will prepare not more than 25 lb per day. The fibre yielded by the outer layer of leaf-stalks is hard, fully developed and strong, and used for cordage, but the produce of the inner stalks is increasingly thin, fine and weak. The finer fibre is used by the natives, without spinning or twisting (the ends of the single fibres being knotted or gummed together), for making exceedingly fine, light and transparent yet comparatively strong textures, which they use as articles of dress and ornament. According to Warden, "muslin and grass-cloth are made from the finest fibres of Manila hemp, and some of them are so fine that a garment made of them may, it is said, be enclosed in the hollow of the hand." In Europe, especially in France, articles of clothing, such as shirts, veils, neckerchiefs and women's hats, are made from *abacá*. It is also used for matting and twines. It is of a light colour, very lustrous, and possesses great strength, being thus exceptionally suitable for the best class of ropes. It is extensively used for marine and other cordage. The hemp exported for cordage purposes is a somewhat woody fibre, of a bright brownish-white colour, and possessing great durability and strain-resisting power. The strength of Manila hemp compared with English hemp is indicated by the fact that a Manila rope 3½ in. in circumference and 2 fathoms long stood a strain of 4669 lb before giving way, while a similar rope of English hemp broke with 3885 lb. The fibre contains a very considerable amount of adherent pectinous matter, and in its so-called dry condition an unusually large proportion, as much as 12% of water. In a damp atmosphere the fibre absorbs moisture so freely that it has been found to contain not less than 40% of water, a circumstance which dealers in the raw fibre should bear in mind. From the old and disintegrated ropes is made the well-known manila paper. The plant has been introduced into tropical lands—the West Indies, India, Borneo, &c.—but only in the Philippines has the fibre been successfully produced as an article of commerce. It is distributed throughout the greater part of the Philippine Archipelago. The area of successful cultivation lies approximately between 6° and 15° N. and 121° and 126° E.; it may be successfully cultivated up to about 4000 ft. above sea-level. The provinces, or islands, where cultivation is most successful are those with a heavy and evenly distributed rainfall. H. T. Edwards, fibre expert to the Philippine bureau of agriculture, wrote in 1904:—

> "The opportunities for increasing the production of *abacá* in the Philippines are almost unlimited. Enormous areas of good *abacá* land are as yet untouched, while the greater part of land already under cultivation might yield a greatly increased product if more careful attention were given to the various details of cultivation. The introduction of irrigation will make possible the planting of *abacá* in many districts where it is now unknown. The perfection of a machine for the extraction of the fibre will increase the entire output by nearly one-third, as this amount is now lost by the wasteful hand-stripping process."

Hitherto, while numerous attempts have been made to extract the fibre with machinery, some obstacle has always prevented the general use of the process. The exports have increased with great rapidity, as shown by the following table:—

1870	31,426 tons.
1880	50,482 „
1890	67,864 „
1900	89,438 „
1904	121,637 „

In 1901 the value of the export was $14,453,410, or 62·3% of the total exports from the Philippines. The fibre is now so valuable that Manila hemp cordage is freely adulterated by manufacturers, chiefly by admixture of phormium (New Zealand flax) and Russian hemp.

MANILIUS, a Roman poet, author of a poem in five books called *Astronomica*. The author is neither quoted nor mentioned by any ancient writer. Even his name is uncertain, but it was probably Marcus Manilius; in the earlier MSS. the author is anonymous, the later give Manilius, Manlius, Mallius. The poem itself implies that the writer lived under Augustus or Tiberius, and that he was a citizen of and resident in Rome. According to R. Bentley he was an Asiatic Greek; according to F. Jacob an African. His work is one of great learning; he had studied his subject in the best writers, and generally represents the most advanced views of the ancients on astronomy (or rather astrology). He frequently imitates Lucretius, whom he resembles in earnestness and originality and in the power of enlivening the dry bones of his subject. Although his diction presents some peculiarities, the style is metrically correct. Firmicus, who wrote in the time of Constantine, exhibits so many points of resemblance with the work of Manilius that he must either have used him or have followed some work that Manilius also followed. As Firmicus says that hardly any Roman except Caesar, Cicero and Fronto had treated the subject, it is probable that he did not know the work of Manilius. The latest event referred to in the poem (i. 898) is the great defeat of Varus by Arminius in the Teutoburgiensis Saltus (A.D. 9). The fifth book was not written till the reign of Tiberius; the work appears to be incomplete, and was probably never published.

See editions by J. Scaliger (1579); R. Bentley (1739); F. Jacob (1846); A. G. Pingré (1786); and T. Breiter (Leipzig, 1907; and commentary 1909); of book i. by A. E. Housman (1903). On the subject generally see M. Bechert, *De emendandi Manilii Ratione* (1878) and *De M. M. Astronomicorum Poeta* (1891); B. Freier, *De M. Astronom. Aetate* (1880); A. Cramer, *De Manilii Elocutione* (very full; 1882); G. Lanson, *De Manilio Poeta*, with select bibliog. (1887); P. Monceaux, *Les Africains* (a study of the Latin literature of Africa; 1894); R. Ellis, *Noctes Manilianae* (1891); J. P. Postgate, *Silva Maniliana* (1897), chiefly on textual questions; P. Thomas, *Lucubrationes Manilianae* (1888), a collation of the Gemblacensis (Gembloux)MS.; F. Plessis, *La Poesie latine* (1909), pp. 477–483.

MANILIUS, GAIUS, Roman tribune of the people in 66 B.C. At the beginning of his year of office (Dec. 67) he succeeded in getting a law passed (*de libertinorum suffragiis*), which gave freedmen the privilege of voting together with those who had manumitted them, that is, in the same tribe as their patroni; this law, however, was almost immediately declared null and void by the senate. Both parties in the state were offended by the law, and Manilius endeavoured to secure the support of Pompey by proposing to confer upon him the command of the war against Mithradates with unlimited power (see POMPEY). The proposal was supported by Cicero in his speech, *Pro lege Manilia*, and carried almost unanimously. Manilius was later accused by the aristocratical party on some unknown charge and defended by Cicero. He was probably convicted, but nothing further is heard of him.

See Cicero's speech; Dio Cassius xxxvi. 25–27· Plutarch, *Pompey*, 30; Vell. Pat. ii. 33; art. ROME: *History*, § II.

MANIN, DANIELE (1804–1857), Venetian patriot and statesman, was born in Venice, on the 13th of May 1804. He was the son of a converted Jew, who took the name of Manin because that patrician family stood sponsors to him, as the custom then was. He studied law at Padua, and then practised at the bar of his native city. A man of great learning and a profound jurist, he was inspired from an early age with a deep hatred for Austria. The heroic but foolhardy attempt of the brothers Bandiera, Venetians who had served in the Austrian navy against the Neapolitan Bourbons in 1844, was the first event to cause an awakening of Venetian patriotism, and in 1847 Manin presented a petition to the Venetian congregation, a shadowy consultative assembly tolerated by Austria but without any power, informing the emperor of the wants of the nation. He was arrested on a charge of high treason (Jan. 18, 1848), but this only served to increase the agitation of the Venetians, who were beginning to know and love Manin. Two months later, when all Italy and half the rest of Europe were in the throes of revolution, the people forced Count Palffy, the Austrian governor, to release him (March 17). The Austrians soon lost all control of the city, the arsenal was seized by the revolutionists, and under the direction of Manin a civic guard and a provisional government were instituted. The Austrians evacuated Venice on the 26th of March, and Manin became president of the Venetian republic. He was already in favour of Italian unity, and though not anxious for annexation to Piedmont (he would have preferred to invoke French aid), he gave way to the will of the majority, and resigned his powers to the Piedmontese commissioners on the 7th of August. But after the Piedmontese defeats in Lombardy, and the armistice by which King Charles Albert abandoned Lombardy and Venetia to Austria, the Venetians attempted to lynch the royal commissioners, whose lives Manin saved with difficulty; an assembly was summoned, and a triumvirate formed with Manin at its head. Towards the end of 1848 the Austrians, having been heavily reinforced, reoccupied all the Venetian mainland; but the citizens, hard-pressed and threatened with a siege, showed the greatest devotion to the cause of freedom, all sharing in the dangers and hardships and all giving what they could afford to the state treasury. Early in 1849 Manin was again chosen president of the republic, and conducted the defence of the city with great ability. After the defeat of Charles Albert's forlorn hope at Novara in March the Venetian assembly voted "Resistance at all costs!" and granted Manin unlimited powers. Meanwhile the Austrian forces closed round the city; but Manin showed an astonishing power of organization, in which he was ably seconded by the Neapolitan general, Guglielmo Pepe. But on the 26th of May the Venetians were forced to abandon Fort Malghera, half-way between the city and the mainland; food was becoming scarce, on the 19th of June the powder magazine blew up, and in July cholera broke out. Then the Austrian batteries began to bombard Venice itself, and when the Sardinian fleet withdrew from the Adriatic the city was also attacked by sea, while certain demagogues caused internal trouble. At last, on the 24th of August 1849, when all provisions and ammunition were exhausted, Manin, who had courted death in vain, succeeded in negotiating an honourable capitulation, on terms of amnesty to all save Manin himself, Pepe and some others, who were to go into exile. On the 27th Manin left Venice for ever on board a French ship. His wife died at Marseilles, and he himself reached Paris broken in health and almost destitute, having spent all his fortune for Venice. In Paris he maintained himself by teaching and became a leader among the Italian exiles. There he became a convert from republicanism to monarchism, being convinced that only under the auspices of King Victor Emmanuel could Italy be freed, and together with Giorgio Pallavicini and Giuseppe La Farina he founded the *Società Nazionale Italiana* with the object of propagating the idea of unity under the Piedmontese monarchy. His last years were embittered by the terrible sufferings of his daughter, who died in 1854, and he himself died on the 22nd of September 1857, and was buried in Ary Scheffer's family tomb. In 1868, two years after the Austrians finally departed from Venice, his remains were brought to his native city and honoured with a public funeral. Manin was a man of the greatest honesty, and possessed genuinely statesmanlike qualities. He believed in Italian unity when most men, even Cavour, regarded it as a vain thing, and his work of propaganda by means of the National Society greatly contributed to the success of the cause.

See A. Errera, *Vita di D. Manin* (Venice, 1872); P. de la Farge, *Documents, &c., de D. Manin* (Paris, 1860); Henri Martin, *D. Manin* (Paris, 1859); V. Marchesi, *Settant' anni della storia di Venezia* (Turin) and an excellent monograph in Countess Martinengo Cesaresco's *Italian Characters* (London, 1901).

MANING, FREDERICK EDWARD (1812–1883), New Zealand judge and author, son of Frederick Maning, of Johnville, county Dublin, was born on the 5th of July 1812. His father emigrated to Tasmania in the ship "Ardent" in 1824 and took up a grant of land there. Young Maning served in the fatuous expedition which attempted to drive in the Tasmanian blacks by sweeping with an unbroken line of armed men across the island. Soon afterwards he decided to try the life of a trader among the wild tribes of New Zealand, and, landing in the beautiful inlet of Hokianga in 1833, took up his abode among the Ngapuhi. With them the tall Irish lad—he stood 6 ft. 3 in.—full of daring and good-humour and as fond of fun as of fighting, quickly became a prime favourite, was adopted into the tribe, married a chief's daughter, and became a "Pakeha-Maori" (foreigner turned Maori). With the profits of his trading he bought a farm of 200 acres on the Hokianga, for which, unlike most white adventurers of the time, he paid full value. When New Zealand was peacefully annexed in 1840, Maning's advice to the Maori was against the arrangement, but from the moment of annexation he became a loyal friend to the government, and in the wars of 1845–46 his influence was exerted with effect in the settlers' favour. Again, in 1860, he persuaded the Ngapuhi to volunteer to put down the insurrection in Taranaki. Finally, at the end of 1865, he entered the public service as a judge of the native lands court, where his unequalled knowledge of the Maori language, customs, traditions and prejudices was of solid value.

In this office he served until 1881, when ill-health drove him to resign, and two years later to seek surgical aid in London, where, however, he died of cancer on the 25th of July 1883. At his wish, his body was taken back to New Zealand and buried there. A bust of him is placed in the public library at Auckland. Maning is chiefly remembered as the author of two short books, *Old New Zealand* and *History of the War in the North of New Zealand against the Chief Heké*. Both books were reprinted in London in 1876 and 1884, with an introduction by the earl of Pembroke.

MANIPLE (Lat. *manipulus*, from *manus*, hand, and *plere*, to fill), a liturgical vestment of the Catholic Church, proper to all orders from the subdeacon upwards. It is a narrow strip of material, silk or half-silk, about a yard long, worn on the left fore-arm in such a way that the ends hang down to an equal length on either side. In order to secure it, it is sometimes tied on with strings attached underneath, sometimes provided with a hole in the lining through which the arm is passed. It is ornamented with three crosses, one in the centre and one at each end, that in the centre being obligatory, and is often elaborately embroidered. It is the special ensign of the office of subdeacon, and at the ordination is placed on the arm of the new subdeacon by the bishop with the words: "Take the maniple, the symbol of the fruit of good works."[1] It is strictly a "mass vestment," being worn, with certain exceptions (*e.g.* by a subdeacon singing the Gospel at the service of blessing the palms), only at Mass, by the celebrant and the ministers assisting.

The most common name for the maniple up to the beginning of the 11th century in the Latin Church was *mappula* (dim. of *mappa*, cloth), the Roman name for the vestment until the time of Innocent III. The designation *manipulus* did not come into general use until the 15th century. Father Braun (*Liturg. Gewandung*, p. 517) gives other early medieval names: *sudanum*, *fano*, *mantile*, all of them meaning "cloth" or "handkerchief." He traces the vestment ultimately to a white linen cloth of ceremony (*pallium linostinum*) worn in the 4th century by the Roman clergy over the left arm, and peculiar at that time to them. Its ultimate origin is obscure, but is probably traceable to some ceremonial handkerchiefs commonly carried by Roman dignitaries, *e.g.* those with which the magistrates were wont to signal the opening of the games of the circus. As late as the 9th century, indeed, the maniple was still a handkerchief, held folded in the left hand. By what process it became changed into a narrow strip is not known; the earliest extant specimen of the band-like maniple is that found in the grave of St Cuthbert (9th century); by the 11th century (except in the case of subdeacons, whose maniples would seem to have continued for a while to be cloths in practical use) the maniple had universally assumed its present general form and purely ceremonial character.

The maniple was originally carried in the left hand. In pictures of the 9th, 10th and 11th centuries it is represented as either so carried or as hung over the left fore-arm. By the 12th century the rule according to which it is worn over the left arm had been universally accepted. According to present usage the maniple is put on by priests after the alb and girdle; by deacons and subdeacons after the dalmatic or tunicle; by bishops at the altar after the *Confiteor*, except at masses for the dead, when it is assumed before the stole.[2]

In the East the maniple in its Western form is known only to the Armenians, where it is peculiar to subdeacons. This vestment is not derived from the Roman rite, but is properly a stole, which the subdeacons used to carry in the left hand. It is now laid over the subdeacon's left arm at ordination. The true equivalent of the maniple (in the Greek and Armenian rites only) is not, as has been assumed, the *epimanikion*, a sort of loose, embroidered cuff (see VESTMENTS), but the *epigonation*. This is a square of silk, stiffened with cardboard, surrounded by an embroidered border, and usually decorated in the middle with a cross or a sword (the "sword of the Spirit," which it is supposed to symbolize); sometimes, however, the space within the border is embroidered with pictures. It is worn only by bishops and the higher clergy, and derives its name from the fact that it hangs down over the knee (γόνυ). It is worn on the right side, under the *phelonion*, but when the *sakkos* is worn instead of the *phelonion*, by metropolitans, &c., it is attached to this. The *epigonation*, like the maniple, was originally a cloth held in the hand; a fact sufficiently proved by the ancient name ἐγχείριον (χείρ, hand), which it retained until the 12th century. For convenience' sake this cloth came to be suspended from the girdle on the right side, and is thus represented in the earliest extant paintings (see Braun, p. 552). The name *epigonation*, which appears in the latter half of the 12th century, probably marks the date of the complete conventionalizing of the original cloth into the present stiff embroidered square; but the earliest representations of the vestment in its actual form date from the 14th century, *e.g.* the mosaic of St Athanasius in the chapel of St Zeno in St Mark's at Venice.

See J. Braun, S. J., *Die liturgische Gewandung* (Freiburg im Breisgau, 1907), pp. 515-561, and the bibliography to VESTMENTS.

MANIPUR, a native state on the north-east frontier of India, in political subordination to the lieutenant-governor of Eastern Bengal and Assam. Area, 8456 sq. m. Pop. (1901), 284,465. It is bounded on the N. by the Naga country and the hills overlooking the Assam valley, on the W. by Cachar district, on the E. by Upper Burma, and on the S. by the Lushai hills. The state consists of a wide valley, estimated at about 650 sq. m., and a large surrounding tract of mountainous country. The hill ranges generally run north and south, with occasional connecting spurs and ridges of lower elevation between. Their greatest altitude is in the north, where they reach to upwards of 8000 ft. above sea-level. The principal geographical feature in the valley is the Logtak lake, an irregular sheet of water of considerable size, but said to be yearly growing smaller. The valley is watered by numerous rivers, the Barak being the most important. The hills are densely clothed with tree jungle and large forest timber. Some silk is produced and there are a few primitive manufacturing industries, *e.g.* of pottery. Rice and forest produce, however, are the principal exports. The road from Manipur to the Assam-Bengal railway at Dimapur is the principal trade route.

The kingdom of Manipur, or, as the Burmans call it, Kasse or Kathe, first emerges from obscurity as a neighbour and ally of the Shan kingdom of Pong, which had its capital at Mogaung. The valley appears to have been originally occupied by several tribes which came from different directions. Although their general facial characteristics are Mongolian, there is a great diversity of feature among the Manipuris, some of them showing a regularity approaching the Aryan type. In the valley the people are chiefly Hindus, that religion being of recent introduction. Their own name for themselves is Meithei, and their language is a branch of the Kuki-Chin family, spoken by 273,000 persons in all India in 1901. One of their peculiarities is the high position enjoyed by women, who conduct most of the trade of the valley. They have a caste system of their own, different from that of India, and chiefly founded on the system of *lallup*, or forced labour, which has been abolished by the British. Every male between the ages of seventeen and sixty was formerly obliged to place his services at the disposal of the state for a certain number of days each year, and to different classes of the people different employments were assigned. About four hundred Mahommedan families, descendants of settlers from Bengal, reside to the east of the capital. The aboriginal hillmen belong to one of the two great divisions of Nagas and Kukis, and are subdivided into innumerable clans and sections with slight differences in language, customs or dress. The state is noted for the excellence of its breed of ponies. The English game of polo was introduced from Manipur, where it forms a great national pastime.

The first relations of the British with Manipur date from 1762, when the raja solicited British aid to repel a Burmese invasion, and a treaty was entered into. The force was recalled, and little communication between the two countries took place until 1824, on the outbreak of the first Burmese War. British assistance was again invoked by the raja, and the Burmese were finally expelled from both the Assam and the Manipur valleys. Disputed successions have always been a cause of trouble. The raja, Chandra Kirtti Singh, died in 1886, and was succeeded by his eldest son, Sur Chandra Singh, who appointed his next brother, Kula Chandra Dhuya Singh, *jubraj*, or heir-apparent. In 1890 another brother, the *senapati*, or commander-in-chief, Tikendrajit Singh, dethroned the raja, and installed the *jubraj* as regent, the ex-raja retiring to Calcutta. In March 1891 the chief commissioner of Assam (Quinton) marched to Manipur with 400 Gurkhas, in order to settle the question of succession. His purpose was to recognize the new ruler, but to remove the *senapati*. After some futile negotiations, Quinton sent an ultimatum, requiring the surrender of the *senapati*, by the hands of the political resident, F. Grimwood, but no result followed. An attempt was then made to arrest the *senapati*, but after some sharp fighting, in which Lieut. Brackenbury was killed, he escaped; and the Manipuris then attacked the British residency with an overwhelming force. Quinton was compelled to ask for a parley, and he, Colonel Skene, Grimwood, Cossins and Lieut. Simpson, unarmed, went to the fort to negotiate. They were all there treacherously murdered, and when the news arrived the Gurkhas retreated to Cachar, Mrs Grimwood and the wounded being with them. This led to a military expedition, which did not encounter much resistance. The various columns, converging on Manipur, found it deserted; and the regent, *senapati*, and others were captured during May. After a formal trial the *senapati* and one of the generals of the rebellion were hanged and the regent was transported to the Andaman Islands. But it was decided to preserve the existence of the state, and a child of the ruling family, named Chura Chand, of the age of five, was nominated raja. He was sent to be educated in the Mayo College at Ajmere, and he afterwards served for two years in the imperial cadet corps. Meanwhile the administration was conducted under British supervision. The opportunity was seized for abolishing slavery and unpaid forced labour, a land revenue of Rs. 2 per acre being substituted in the valley and a house-tax in the hills. The boundaries of the state were demarcated, disarmament was carried out, and the construction of roads was pushed forward. In 1901 Manipur was visited by Lord Curzon, on his way from Cachar to Burma. In May 1907 the government of the state was handed over to Chura Chand, who was to be assisted by a council of six Manipuris, with a member of the Indian civil service as vice-president. At the same time it was announced that the government of India would support the raja with all its powers and suppress summarily all attempts to displace him. The revenue is £26,000. The capital is Imphal, which is really an overgrown village; pop. (1901), 67,093.

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[1] According to Father Braun this custom cannot be traced earlier than the 9th century. It forms no essential part of the ordination ceremony (*Liturg. Gewandung*, p. 548).

[2] For the evolution of these rules see Braun, *op. cit.* pp. 546 seq.

See Mrs Ethel St Clair Grimwood, *My Three Years in Manipur* (1891); *Manipur State Gazetteer* (Calcutta, 1905); T. C. Hodson, *The Meitheis* (1908).

MANISA (anc. *Magnesia ad Sipylum*), the chief town of the Saru-khan sanjak of the Aidin (Smyrna) vilayet of Asia Minor, situated in the valley of the Gediz Chai (Hermus), at the foot of Mt Sipylus, and connected by railway with Smyrna and Afium Kara-Hissar. Pop. about 35,000, half being Mussulman. Manisa is an important commercial centre, and contains interesting buildings dating from the times of the Seljuk and early Osmanli sultans, including mosques built by Murad II. and III. and a Mevlevi *Tekke* second only to that at Konia. It is the seat of a flourishing American mission. In 1204 Manisa was occupied by John Ducas, who when he became emperor made it the Byzantine seat of government. In 1305, after the inhabitants had massacred the Catalan garrison, Roger de Flor besieged it unsuccessfully. In 1313 the town was taken by Saru Khan and became the capital of the Turcoman emirate of that name. In 1398 it submitted to the Osmanli sultan Bayezid I., and in 1402 was made a treasure city by Timur. In 1419 it was the scene of the insurrection of the liberal reformer, Bedr ed-Din, which was crushed by Prince Murad, whose residence in the town as Murad II., after twice abdicating the throne, is one of the most romantic stories in Turkish history. In the 17th century Manisa became the residence of the greatest of the Dere Bey families, Kara Osman Oglu, Turcoman by origin, and possibly connected with the former emirs of Sarukhan, which seems to have risen to power by farming the taxes of a province which princes of the house of Othman had often governed and regarded with especial affection. The *liva* of Sarukhan was one of the twenty-two in the Ottoman Empire leased on a life tenure up to the time of Mahmud II. In the 18th century the family of Kara Osman Oglu (or Karasman) ruled *de facto* all west central Anatolia, one member being lord of Bergama and another of Aidin, while the head of the house held Manisa with all the Hermus valley and had greater power in Smyrna than the representative of the capitan pasha in whose province that city nominally lay. Outside their own fiefs the family had so much property that it was commonly said they could sleep in a house of their own at any stage from Smyrna to Baghdad. The last of its great beys was Haji Hussein Zadē, who was frequently called in to Smyrna on the petition of his friends, the European merchants, to assure tranquillity in the troublous times consequent on Napoleon's invasion of Egypt, and the British and Russian attacks on the Porte early in the 19th century. He always acquitted himself well, but having refused to bring his contingent to the grand vizier when on the march to Egypt in 1798, and awakened the jealousy of the capitan pasha, he was in continual danger. Exiled in 1812, he was subsequently restored to Manisa, and died there in 1821. His son succeeded after sanguinary tumults; but Mahmud II., who had long marked the family for destruction, was so hostile towards it, after he had got rid of the janissaries, that it had lost all but the shadow of power by 1830. Descendants survived in Manisa who retained a special right of granting title-deeds within the district, independent of the local administration. (D. G. H.)

MANISTEE, a city and the county-seat of Manistee county, Michigan, U.S.A., on the Manistee river (which here broadens into a small lake) near its entrance into Lake Michigan, about 114 m. W.N.W. of Grand Rapids. Pop. (1890), 12,812; (1900), 14,260 (4966 foreign-born); (1904, state census), 12,708; (1910), 12,381. It is served by the Père Marquette, the Manistee & Grand Rapids, the Manistee & North-Eastern, and the Manistee & Luther railways, and by steamboat lines to Chicago, Milwaukee and other lake ports. The channel between Lake Manistee and Lake Michigan has been considerably improved since 1867 by the Federal government. There is a United States life-saving station at the harbour entrance. The city has a county normal school, a school for the deaf and dumb, a domestic science and manual training school, a business college, and a Carnegie library. Manistee is a summer resort, with good trout streams and well-known brine-baths. One mile from the city limits, on Lake Michigan, is Orchard Beach, a bathing resort, connected with the city by electric railway; and about 9 m. north of Manistee is Portage Lake (about 2 m. long and 1 m. wide), a fishing resort and harbour of refuge (with a good channel from Lake Michigan), connected with the city by steamboat and railway. Manistee has large lumber interests, is the centre of an extensive fruit-growing region, and has various manufactures, including lumber and salt.[1] The total value of the factory product in 1904 was $3,256,601. The municipality owns and operates its waterworks. Manistee (the name being taken from a former Ottawa Indian village, probably on Little Traverse Bay, Mich.) was settled about 1849, and was chartered as a city in 1869, the charter of that year being revised in 1890.

MANITOBA, a lake of Manitoba province, Canada, situated between 50° 11′ and 51° 48′ N. and 97° 56′ and 99° 35′ W. It has an area of 1711 sq. m., a length of shore line of 535 m., and is at an altitude of 810 ft. above the sea. It has a total length of 119 m., a maximum width of 29 m., discharge of 14,833 cub. ft.

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[1] There is a very large salt block at Eastlake, 1 m. east of Manistee, and Filer City, a few miles south-east, is another source of supply.

per second, and has an average depth of 12 ft. Its shores are low, and for the most part swampy. The Waterhen river, which carries the discharge of Lake Winnipegosis, is the only considerable stream entering the lake. It is drained by the Little Saskatchewan river into Lake Winnipeg. It was discovered by De la Verendrye in 1739.

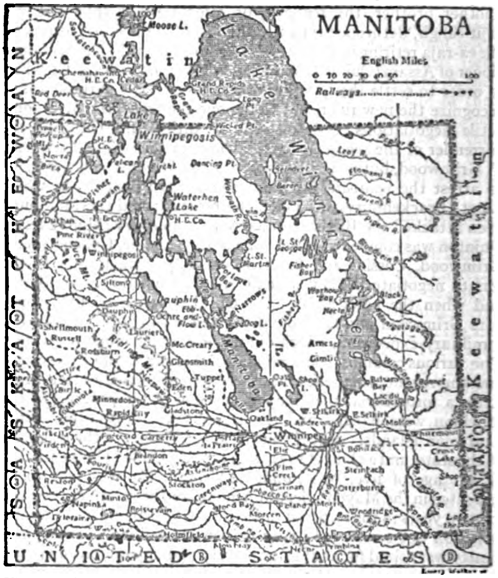
MANITOBA, one of the western provinces of the Dominion of Canada, situated midway between the Atlantic and the Pacific coasts of the Dominion, about 1090 m. due west of Quebec. It is bounded S. by the parallel 49° N., which divides it from the United States; W. by 101° 20′ W.; N. by 52° 50′ N.; and E. by the western boundary of Ontario. Manitoba formerly belonged to the Hudson's Bay Company, and after the transfer of its territory to Canada was admitted in 1870 as the fifth province of the Dominion. At that time the infant province had an area of 13,500 sq. m., and some 12,000 people, chiefly Indian half-breeds. In 1881 the limits were increased as above, and the province now contains upwards of 73,956 sq. m., extending 264 m. from north to south and upwards of 300 from east to west. The old district of Assiniboia, the result of the efforts in colonization by the earl of Selkirk in 1811 and succeeding years, was the nucleus of the province.

The name Manitoba sprang from the union of two Indian words, *Manito* (the Great Spirit), and *Waba* (the "narrows" of the lake, which may readily be seen on the map). This well-known strait was a sacred place to the Crees and Saulteaux, who, impressed by the weird sound made by the wind as it rushed through the narrows, as simple children of the prairies called them *Manito-Waba*, or the "Great Spirit's narrows." The name, arising from this unusual sound, has been by metonymy translated into "God's Voice." The word was afterwards contracted into its present form. As there is no accent in Indian words, the natural pronunciation of this name would be Măn-ĭ-tō-bă. On this account, the custom of both the French and English people of the country was for years before and for several years after 1870 to pronounce it Măn-ĭ-tō-bă, and even in some cases to spell it "Manitobah." After the formation of the province and the familiar use of the provincial name in the Dominion parliament, where it has occupied much attention for a generation, the pronunciation has changed, so that the province is universally known from ocean to ocean as Măn-ĭ-tō-bă.

Physical Features.—The drainage of Manitoba is entirely north-eastward to Hudson Bay. The three lakes—whose greatest lengths are 260, 122 and 119 m. respectively—are Winnipeg, Winnipegosis and Manitoba. They are all of irregular shape, but average respectively 30, 18 and 10 m. in width. They are fresh, shallow and tideless. Winnipegosis and Manitoba at high water, in spring-time, discharge their overflow through small streams into Winnipeg. The chief rivers emptying into Lake Winnipeg are the Winnipeg, the Red and the Saskatchewan. The Assiniboine river enters the Red river 45 m. from Lake Winnipeg, and at the confluence of the rivers ("The Forks") is situated the city of Winnipeg. The Winnipeg, which flows from the territory lying south-east of Lake Winnipeg, is a noble river some 200 m. long, which after leaving Lake of the Woods dashes with its clear water over many cascades, and traverses very beautiful scenery. At its falls from Lake of the Woods is one of the greatest and most easily utilized water-powers in the world, and from falls lower down the river electric power for the city of Winnipeg is obtained. The Red river is at intervals subject to freshets. In a century's experience of the Selkirk colonists there have been four "floods." The highest level of the site of the city of Winnipeg is said to have been under 5 ft. of water for several weeks in May and June in 1826, and 2½ ft. in 1852, not covered in 1861; only the lowest levels were under water in 1882. The extent of overflow has thus on each occasion been less. The loose soil on the banks of the river is every year carried away in great masses, and the channel has so widened as to render the recurrence of an overflow unlikely. The Saskatchewan, though not in the province, empties into Lake Winnipeg less than half a degree from the northern boundary. It is a mighty river, rising in the Rocky Mountains, and crossing eighteen degrees of longitude. Near its mouth are the Grand Rapids. Above these steamers ply to Fort Edmonton, a point upwards of 800 m. north-west of the city of Winnipeg. Steamers run from Grand Rapids, through Lake Winnipeg, up Red river to the city of Winnipeg, important locks having been constructed on the river at St Andrews.

The surface of Manitoba is somewhat level and monotonous. It is chiefly a prairie region, with treeless plains of from 5 to 40 m. extent, covered in summer with an exuberant vegetable growth, which dies every year. The river banks, however, are fringed with trees, and in the more undulating lands the timber belts vary from a few hundreds of yards to 5 or 10 m. in width, forming at times forests of no inconsiderable size. The chief trees of the country are the aspen (*Populus tremuloides*), the ash-leaved maple (*Negundo aceroides*), oak (*Quercus alba*), elm (*Ulmus Americana*), and many varieties of willow. The strawberry, raspberry, currant, plum, cherry and grape are indigenous.

Climate.—The climate of Manitoba, being that of a region of wide extent and of similar conditions, is not subject to frequent variations. Winter, with cold but clear and bracing weather, usually sets in about the middle of November, and ends with March. In April and May the rivers have opened, the snow has disappeared, and the opportunity has been afforded the farmer of sowing his grain. June is often wet, but most favourable for the springing crops; July and August are warm, but, excepting two or three days at a time, not uncomfortably so; while the autumn weeks of late August and September are very pleasant. Harvest generally extends from the middle of August to near the end of September. The chief crops of the farmer are wheat (which from its flinty hardness and full kernel is the specialty of the Canadian north-west), oats, barley and pease. Hay is made of the native prairie grasses, which grow luxuriantly. From the richness and mellowness of the soil potatoes and all tap-roots reach a great size. Heavy dews in summer give the needed moisture after the rains of June have ceased. The traveller and farmer are at times annoyed by the mosquito.



Area and Population.—The area is 73,956 sq. m., of which 64,066 are land and 9890 water. Pop. (1871), 18,995; (1881), 62,260; (1891), 152,506; (1901), 254,947 (138,332 males, 116,615 females); (1906), 365,688 (205,183 males and 160,505 females). The principal cities and towns are: Winnipeg (90,153), Brandon (10,408), Portage la Prairie (5106), St Boniface (5119), West Selkirk (2701), and Morden (1437). In 1901, 49,102 families inhabited 48,415 houses, and the proportion of the urban population to the rural was 27·5 to 72·5. Classified according to place of birth, the principal nationalities were as follows in 1901: Canada, 180,853; England, 20,392; Scotland, 8099; Ireland, 4537; other British possessions, 490; Germany, 2291; Iceland, 5403; Austria, 11,570; Russia and Poland, 8854; Scandinavia, 1772; United States, 6922; other countries, 4028. In 1901 the Indians numbered 5827; half-breeds, 10,372. Of the Indian half-breeds, one half are of English-speaking parentage, and chiefly of Orkney origin; the remainder are known as Metis or Bois-brûlés, and are descended from French-Canadian voyageurs. In 1875 a number of Russian Mennonites (descendants of the Anabaptists of the Reformation) came to the country. They originally emigrated from Germany to the plains of southern Russia, but came over to Manitoba to escape the conscription. They number upwards of 15,000. About 4000 French Canadians, who had emigrated from Quebec to the United States, have also made the province their home, as well as Icelanders now numbering 20,000. During the decade ending 1907 large reserves were settled with Ruthenians often known as Galicians, Poles and other peoples from central and northern Europe. Some 30,000 of these are found in the province. The remainder of the population is chiefly made up of English-speaking people from the other provinces of the Dominion, from the United States, from England and Scotland and the north of Ireland.

Religion.—Classified according to religion, the various denominations were, in 1901, as follows: Presbyterians, 65,310; Episcopalians, 44,874, Methodists, 49,909; Roman Catholics, 35,622; Baptists, 9098; Lutherans, 16,473; Mennonites, 15,222; Greek Catholics, 7898; other denominations, 9903; not specified, 638.

Government.—The province is under a lieutenant-governor, appointed for a term of five years, with an executive council of six members, responsible to the local legislature, which consists of forty-two members. It has four members in the Canadian Senate and ten in the House of Commons.

Education.—The dual system of education, established in 1871, was abolished in 1890, and the administrative machinery consolidated under a minister of the Crown and an advisory board. This act was amended in 1897 to meet the wishes of the Roman Catholic minority, but separate schools were not re-established; nor was the council divided into denominational committees. There are collegiate institutes for more advanced education at Winnipeg, Brandon and Portage la Prairie, with a total of 1094 pupils enrolled. There is also a normal school at Winnipeg for the training of teachers. Higher education is represented by the provincial university, which teaches science and mathematics, holds examinations, distributes scholarships, and grants degrees in all subjects. It has affiliated to it colleges of the Roman Catholic, Episcopalian, Presbyterian and Methodist denominations, with medical and pharmaceutical colleges. The arts colleges of the churches carry on the several courses required by the university, and send their students to the examinations of the university. A well-equipped agricultural college near Winnipeg is provided for sons and daughters of farmers.

Agriculture is the prevailing industry of Manitoba. Dairy-farming is rapidly increasing in importance, and creameries for the manufacture of butter and cheese are established in almost all parts of the province. Large numbers of horses, cattle, swine and poultry are reared. The growth of cereals is the largest department of agriculture followed.

The following statistics are interesting:—

	1883.	1890.	1894.	1901.
	Bushels.	Bushels.	Bushels.	Bushels.
Wheat . .	5,686,355	14,665,769	17,172,883	50,502,085
Oats . .	9,478,965	9,513,443	11,907,854	27,796,588
Barley . .	1,898,430	2,069,415	2,981,716	6,536,155
Flax . .	No statistics collected.		366,000	266,420
Rye . .	„	„	59,924	62,261
Peas . .	„	„	18,434	16,349
Potatoes . .	„	„	2,035,336	4,797,433
Other roots .	„	„	1,841,942	2,925,362

The enormous development of the wheat-growing industry is shown by these and the following statistics:—

Wheat inspected in Winnipeg.

1902	51,833,000 bushels
1903	40,396,650 „
1904	39,784,900 „
1905	55,849,840 „
1906	66,636,390 „

These figures do not include the wheat ground into flour and sent by way of British Columbia to Asia and Australia, nor the wheat retained by the farmers for seed. The Dominion government maintains an experimental farm of 670 acres at Brandon. The fisheries are all fresh-water, principally white-fish, pickerel and pike. Large quantities of fresh fish caught in lakes Winnipeg and Manitoba are exported to all parts of the United States.

Communications.—The region of the Red River and Assiniboine valleys was opened up by the fur traders, who came by the waterways from Lake Superior, and afterwards by the water communication with Hudson Bay. While these early traders used the canoe and the York boat,[1] yet the steam-boat played an important part in the early history of the region from 1868 till 1885, when access from the United States was gained by steamers down the Red River. The completion of the St Andrew's Rapids canal on Red River, and the Grand Rapids canal on the Saskatchewan river will again give an impetus to inland navigation on the tributaries of Lake Winnipeg. Lake Manitoba also affords opportunity for inland shipping.

The broad expanse of prairie-land in the western provinces of Canada is well suited for the cheap and expeditious building of railways. The first connexion with the United States was by two railways coming down the Red River valley. But the desire for Canadian unity led the Dominion to assist a transcontinental line connecting Manitoba with eastern Canada. The building of the Canadian Pacific railway through almost continuous rocks for 800 miles was one of the greatest engineering feats of modern times. Immediately on the formation of the Canadian Pacific railway company branch lines were begun at Winnipeg and there are eight radial lines running from this centre to all parts of the country. Winnipeg is thus connected with Montreal on the east, and Vancouver on the west, and is the central point of the Canadian Pacific system, having railway yards and equipment equalled by few places in America. In opposition to the Canadian Pacific railway a southern line was built from Winnipeg to the American boundary. This fell into the hands of the Northern Pacific railway, but was purchased by the promoters of the Canadian Northern railway. This railway has six radiating lines leaving the city of Winnipeg, and its main line connects Port Arthur on Lake Superior with Edmonton in the west. The Canadian Northern railway has a remarkable network of railways connecting Winnipeg with every corner of Manitoba. The Great Northern railway has also three branch lines in Manitoba and one of these has Winnipeg as its terminus. The grand Trunk Pacific railway, the great transcontinental line promoted by the Laurier government, passes through Manitoba north of the Canadian Pacific, coming from the east deflects southward to pass through Winnipeg, and then strikes northward in a direct line of easy gradients to find its way through the Rocky Mountains to its terminus of Prince Rupert on the north coast of British Columbia.

History.—The first white settlement in Manitoba was made by Pierre Gaultier de Varennes, Sieur de la Verendrye (d. 1749), who, gradually pushing westward from Lake Superior, reached Lake Winnipeg in 1733, and in the following year built a fort not far from the present Fort Alexander. In October 1738 he built another at Fort Rouge, at the junction of the Red and Assiniboine rivers, where is now the city of Winnipeg. After the British conquest of 1763 the west became the scene of a rapidly increasing fur trade, and for many years there was keen rivalry between the Hudson's Bay Company, with its headquarters in England, and the North-West Company of Montreal. French and Scottish farmers and fur-traders gradually settled along the Red River, and by their frequent marriages with the Indians produced a race of metis or half-breeds. From 1811 to 1818 Lord Selkirk's attempted colonization greatly increased the population; from the time of his failure till 1869 the settlers lived quietly under the mild rule of the Hudson's Bay Company. In that year the newly formed Dominion of Canada bought from the company its territorial and political rights. A too hasty occupation by Canadian officials and settlers led to the rebellion of the Metis under Louis Riel, a native leader. The rebellion was quieted and Sir Garnet Wolseley (now Lord Wolseley) was sent from Canada by the lake route, with several regiments of troops—regulars and volunteers. The Manitoba Act constituting the province was passed by the Canadian parliament in 1870. (See RED RIVER SETTLEMENT; and RIEL, LOUIS.)

The admixture of races and religions, and its position as the key to the great West, have ever since made Manitoba the storm centre of Canadian politics. In the charter granted by the Canadian parliament to the Canadian Pacific railway a clause giving it for twenty years control over the railway construction of the province led to a fierce agitation, till the clause was repealed in 1888. Till 1884 an equally fierce agitation was carried on against Ontario with regard to the eastern boundary of Manitoba. (See ONTARIO.) In both these disputes the provincial leader was the Hon. John Norquay, in whose veins ran a large admixture of Indian blood. In 1890 changes in the school system unfavourable to the Roman Catholic Church led to a constitutional struggle, to which was due the defeat of the Federal ministry in 1896. Since 1896 its rapid material progress has produced numerous economic problems and disputes, many of which are still unsolved.

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[1] A round-bottomed, strongly built boat, 30 to 36 ft. long, propelled by 8 men. It was devised by the Hudson's Bay Company for carrying freight, as a substitute for the less serviceable canoe, and was named after their York factory, the centre to which the traders brought down the furs for shipment to England and from which they took back merchandise and supplies to the interior of Rupert's Land.

(G Br.; W. L. G.)

MANITOU or MANITO (Algonquian Indian, "mystery," "supernatural"), among certain American Indian tribes, a spirit or genius of good or evil. The manitou is almost always an animal, each individual having one assigned him, generally by dream-inspiration, at the greatest religious act of his life—his first fast. This animal then becomes his fetish; its skin is carried as a charm, and representations of it are tattooed and painted on the body or engraved on the weapons.

MANITOWOC (Indian, "Spirit-land"), a city and the county-seat of Manitowoc county, Wisconsin, on the W. shore of Lake Michigan, 75 m. N. of Milwaukee. Pop. (1890), 7710; (1900), 11 786, of whom 2998 were foreign-born; (1910 census), 13,027. It is served by the Chicago & North-Western, and the Wisconsin Central railways; by ferry across the lake to Frankfort, Mich., and Ludington, Mich.; by the Ann Arbor and the Père Marquette railways; and by the Goodrich line of lake steamers. The city is finely situated on high ground above the lake at the mouth of the Manitowoc river. At Manitowoc are the county insane asylum and a Polish orphan asylum. The city has a training school for county teachers, a business college, two hospitals and a Carnegie library. There are ship-yards for the construction of both steel and wooden vessels, and several grain elevators. The value of the factory products increased from $1,935,442 in 1900 to $4,427,816 in 1905, or 128·8 per cent.—a greater increase than that of any other city in the state during this period. There is a good harbour, and the city has a considerable lake commerce in grain, flour, and dairy products. Jacques Vieau established here a post for the North-west Company of fur traders in 1795. The first permanent settlement was made about 1836, and Manitowoc was chartered as a city in 1870. In Manitowoc county, 18 m. south-west of the city of Manitowoc, is St Nazianz, an unorganized village near which in 1854 a colony or community of German Roman Catholics was established under the leadership of Father Ambrose Oswald, the primary object being to enable poor people by combination and co-operation to supply themselves with the comforts of life at minimum expense and have as much time as possible left for religious thought and worship. The title of the colony's land was vested in Father Oswald after the panic of 1857 until his death in 1874, when he devised the lands to "the colony founded by me." The colony had no legal existence at the time, but was then incorporated as the "Roman Catholic Religious Society of St Nazianz," and as such sued successfully for the bequest. Financially the colony was successful, but as there were some desertions and no new recruits after Father Oswald's death, there were few members by 1909. There are no longer any traces of communism, and the colony's property is actually held by an organization of the local Roman Catholic church.

MANIZALES, a city of Colombia and capital of the department of Cáldas (up to 1905 the northern part of Antioquia, 75 m. S. of Medellín, on the old trade route across the Cordillera between Honda, on the Magdalena, and the Cauca Valley. Pop. (1906, estimate), 20,000. The city is situated on a plateau of the western slope of the Cordillera, 6988 ft. above the sea. It is surrounded by rich mineral and agricultural districts.

MANKATO, a city and the county-seat of Blue Earth county, Minnesota, U.S.A., at the southern bend of the Minnesota river, where it is joined by the Blue Earth about 86 m. S.W. of Minneapolis. Pop. (1890), 8838; (1900), 10,599, of whom 2578 were foreign-born; (1910 census), 10,365 Mankato is served by the Chicago, St. Paul, Minneapolis & Omaha, the Chicago & North-Western (both "North-Western Lines"), the Chicago, Milwaukee & St Paul, and the Chicago Great-Western railways. The city has two fine parks, a Carnegie library, a Federal building, the Immanuel and St Joseph hospitals, two commercial colleges, and a state normal school (1868). The numerous lakes in the neighbourhood, particularly Lake Madison and Lake Washington, are widely known as summer resorts. Four miles west of the city is Minneopa state park (area, 60 acres), in which are Minneopa Falls (60 ft.) and a fine gorge; the park was established by the state in 1905–1906. Mankato has an extensive trade in dairy and agricultural products (especially grain), stone (a pinkish buff limestone is quarried in the vicinity), and forest products. The value of its factory products increased from $1,887,315 in 1900 to $3,422,117 in 1905, or 81·3%.

Mankato was settled about 1853, and was first chartered as a city in 1868. On or near the site of the city stood a village of the Mankato ("blue earth") band of the Mdewakanton Sioux, who derived their name from one of their chiefs, "Old Mankato." In this region occurred the Sioux uprising of 1862, and from this point operations were carried on which eventually resulted in the subjugation of the Indians and the hanging, at Mankato, in December 1862, of 38 leaders of the revolt. In the uprising the Mankato band was led by another chief named Mankato, who took part in the attack on Ft Ridgeley, Minn., in August, in the engagement on the 3rd of September at Birch Coolie, Minn., and in that on the 23rd of September at Wood Lake, where he was killed.

MANLEY, MARY DE LA RIVIERE (*c.* 1663–1724), English writer, daughter of Sir Roger Manley, governor of the Channel Islands, was born on the 7th of April 1663 in Jersey. She wrote her own biography under the title of *The Adventures of Rivella, or the History of the Author of the Atalantis* by "Sir Charles Lovemore" (1714). According to her own account she was left an orphan at the age of sixteen, and beguiled into a mock marriage with a kinsman who deserted her basely three years afterwards. She was patronized for a short time by the duchess of Cleveland, and wrote an unsuccessful comedy, *The Lost Lover* (1696); in freedom of speech she equalled the most licentious writers of comedy in that generation. Her tragedy, *The Royal Mischief* (1696) was more successful. From 1696 Mrs Manley was a favourite member of witty and fashionable society. In 1705 appeared *The Secret History of Queen Zarah and the Zarazians*, a satire on Sarah, duchess of Marlborough, in the guise of romance. This was probably by Mrs Manley, who, four years later, achieved her principal triumph as a writer by her *Secret Memoirs . . . . of Several Persons of Quality* (1709), a scandalous chronicle "from the New Atalantis, an island in the Mediterranean." She was arrested in the autumn of 1709 as the author of a libellous publication, but was discharged by the court of queen's bench on the 13th of February 1710. Mrs Manley sought in this scandalous narrative to expose the private vices of the ministers whom Swift, Bolingbroke and Harley combined to drive from office. During the keen political campaign in 1711 she wrote several pamphlets, and many numbers of the *Examiner*, criticizing persons and policy with equal vivacity. Later were published her tragedy *Lucius* (1717); *The Power of Love, in Seven Novels* (1720), and *A Stage Coach Journey to Exeter* (1725).

MANLIUS, the name of a Roman gens, chiefly patrician, but containing plebeian families also.

1. MARCUS MANLIUS CAPITOLINUS, a patrician, consul 392 B.C. According to tradition, when in 390 B.C. the besieging Gauls were attempting to scale the Capitol, he was roused by the cackling of the sacred geese, rushed to the spot and threw down the foremost assailants (Livy v. 47; Plutarch, *Camillus*, 27).

Several years after, seeing a centurion led to prison for debt, he freed him with his own money, and even sold his estate to relieve other poor debtors, while he accused the senate of embezzling public money. He was charged with aspiring to kingly power, and condemned by the comitia, but not until the assembly had adjourned to a place without the walls, where they could no longer see the Capitol which he had saved. His house on the Capitol (the origin of his surname) was razed, and the Manlii resolved that henceforth no patrician Manlius should bear the name of Marcus. According to Mommsen, the story of the saving of the Capitol was a later invention to explain his surname, and his attempt to relieve the debtors a fiction of the times of Cinna.

Livy vi. 14–20; Plutarch, *Camillus*, 36; Cicero, *De domo*, 38.

2. Titus Manlius Imperiosus Torquatus, twice dictator (353, 349 B.C.) and three times consul (347, 344, 340). When his father, L. Manlius Imperiosus (dictator 363), was brought to trial by the tribune M. Pomponius for abusing his office of dictator, he forced Pomponius to drop the accusation by threatening his life (Livy vii. 3–5). In 360, during a war with the Gauls, he slew one of the enemy, a man of gigantic stature, in single combat, and took from him a *torques* (neck-ornament), whence his surname. When the Latins demanded an equal share in the government of the confederacy, Manlius vowed to kill with his own hand the first Latin he saw in the senate-house. The Latins and Campanians revolted, and Manlius, consul for the third time, marched into Campania and gained two great victories, near Vesuvius, where P. Decius Mus (*q.v.*), his colleague, "devoted" himself in order to gain the day, and at Trifanum. In this campaign Manlius executed his own son, who had killed an enemy in single combat, and thus disobeyed the express command of the consuls.

Livy vii. 4, 10, 27, viii. 3; Cicero, *De off.* iii. 31.

3. Titus Manlius Torquatus, consul 235 B.C. and 224, censor 231, dictator 208. In his first consulship he subjugated Sardinia, recently acquired from the Carthaginians, when the temple of Janus was shut for the second time in Roman history (Livy i. 19). In 216 he opposed the ransoming of the Romans taken prisoners at Cannae; and in 215 he was sent to Sardinia and defeated a Carthaginian attempt to regain possession of the island.

Livy xxiii. 34; Polybius ii. 31.

4. Gnaeus Manlius Vulso, praetor 195, consul 189. He was sent to Asia to conclude peace with Antiochus III., king of Syria. He marched into Pamphylia, defeated the Celts of Galatia on Mt Olympus and drove them back across the Halys. In the winter, assisted by ten delegates sent from Rome, he settled the terms of peace with Antiochus, and in 187 received the honour of a triumph.

Polybius xxii. 16–25; Livy xxxviii. 12–28, 37–50; xxxix. 6.

MANN, HORACE (1796–1859), American educationist, was born in Franklin, Massachusetts, on the 4th of May 1796. His childhood and youth were passed in poverty, and his health was early impaired by hard manual labour. His only means for gratifying his eager desire for books was the small library founded in his native town by Benjamin Franklin and consisting principally of histories and treatises on theology. At the age of twenty he was fitted, in six months, for college, and in 1819, graduated with highest honours, from the Brown University at Providence, Rhode Island, having devoted himself so unremittingly to his studies as to weaken further his naturally feeble constitution. He then studied law for a short time at Wrentham, Massachusetts; was tutor in Latin and Greek (1820–1822) and librarian (1821–1823) at Brown University; studied during 1821–1823 in the famous law school conducted by Judge James Gould at Litchfield, Connecticut; and in 1823 was admitted to the Norfolk (Mass.) bar. For fourteen years, first at Dedham, Massachusetts, and after 1833 at Boston, he devoted himself, with great success, to his profession. Meanwhile he served, with conspicuous ailbity, in the Massachusetts House of Representatives from 1827 to 1833 and in the Massachusetts Senate from 1833 to 1837, for the last two years as president. It was not until he became secretary (1837) of the newly created board of education of Massachusetts, that he began the work which was soon to place him in the foremost rank of American educationists. He held this position till 1848, and worked with a remarkable intensity—holding teachers' conventions, delivering numerous lectures and addresses, carrying on an extensive correspondence, introducing numerous reforms, planning and inaugurating the Massachusetts normal school system, founding and editing *The Common School Journal* (1838), and preparing a series of *Annual Reports*, which had a wide circulation and are still considered as being "among the best expositions, if, indeed, they are not the very best ones, of the practical benefits of a common school education both to the individual and to the state" (Hinsdale). The practical result of his work was the virtual revolutionizing of the common school system of Massachusetts, and indirectly of the common school systems of other states. In carrying out his work he met with bitter opposition, being attacked particularly by certain school-masters of Boston who strongly disapproved of his pedagogical theories and innovations, and by various religious sectaries, who contended against the exclusion of all sectarian instruction from the schools. He answered these attacks in kind, sometimes perhaps with unnecessary vehemence and rancour, but he never faltered in his work, and, an optimist by nature, a disciple of his friend George Combe (*q.v.*), and a believer in the indefinite improvability of mankind, he was sustained throughout by his conviction that nothing could so much benefit the race, morally, intellectually and materially, as education. Resigning the secretaryship in 1848, he was elected to the national House of Representatives as an anti-slavery Whig to succeed John Quincy Adams, and was re-elected in 1849, and, as an independent candidate, in 1850, serving until March 1853. In 1852 he was the candidate of the Free-soilers for the governorship of Massachusetts, but was defeated. In Congress he was one of the ablest opponents of slavery, contending particularly against the Compromise Measures of 1850, but he was never technically an Abolitionist and he disapproved of the Radicalism of Garrison and his followers. From 1853 until his death, on the second of August 1859, he was president of the newly established Antioch College at Yellow Springs, Ohio, where he taught political economy, intellectual and moral philosophy, and natural theology. The college received insufficient financial support and suffered from the attacks of religious sectaries—he himself was charged with insincerity because, previously a Unitarian, he joined the Christian Connexion, by which the college was founded—but he earned the love of his students, and by his many addresses exerted a beneficial influence upon education in the Middle West.

A collected edition of Mann's writings, together with a memoir (1 vol.) by his second wife, Mary Peabody Mann, a sister of Miss E. P. Peabody, was published (in 5 vols. at Boston in 1867–1891) as the *Life and Works of Horace Mann*. Of subsequent biographies the best is probably Burke A. Hinsdale's *Horace Mann and the Common School Revival in the United States* (New York, 1898), in "The Great Educators" series. Among other biographies O. H. Lang's *Horace Mann, his Life and Work* (New York, 1893), Albert E. Winship's *Horace Mann, the Educator* (Boston, 1896), and George A. Hubbell's *Life of Horace Mann, Educator, Patriot and Reformer* (Philadelphia, 1910), may be mentioned. In vol. I. of the *Report* for 1895–1896 of the United States commissioner of education there is a detailed "Bibliography of Horace Mann," containing more than 700 titles.

MANNA, a concrete saccharine exudation obtained by making incisions on the trunk of the flowering or manna ash tree, *Fraxinus Ornus*. The manna ash is a small tree found in Italy, and extending to Switzerland, South Tirol, Hungary, Greece, Turkey and Asia Minor. It also grows in the islands of Sicily, Corsica and Sardinia. It blossoms early in summer, producing numerous clusters of whitish flowers. At the present day the manna of commerce is collected exclusively in Sicily from cultivated trees, chiefly in the districts around Capaci, Carini, Cinisi and Favarota, small towns 20 to 25 m. W. of Palermo, and in the townships of Geraci, Castelbuono, and other places in the district of Cefalù, 50 to 70 m. E. of Palermo. In the *frassinetti* or plantations the trees are placed about 7 ft. apart, and after they are eight years old, and the trunk at least 3 in. in diameter, the collection of manna is begun. This operation is performed in July or August during the dry weather, by making transverse incisions 1½ to 2 in. long, and about 1 in. apart, through the bark, one cut being made each day, the first at the bottom of the tree, another directly above the first, and so on. In succeeding years the process is repeated on the untouched sides of the trunk, until the tree has been cut all round and exhausted. It is then cut down, and a young plant arising from the same root takes its place. The finest or flaky manna appears to have been allowed to harden on the stem. A very superior kind, obtained by allowing the juice to encrust pieces of wood or straws inserted in the cuts, is called *manna a cannolo*. The fragments adhering to the stem, after the finest flakes have been removed are scraped off, and form the small or Tolfa manna of commerce. That which flows from the lower incisions is often collected on tiles or on a concave piece of the prickly pear (*Opuntia*), but is less crystalline and more glutinous, and is less esteemed.

Manna of good quality dissolves at ordinary temperatures in about 6 parts of water, forming a clear liquid. Its chief constituent is mannite or manna sugar, a hexatomic alcohol, $C_6H_8(OH)_6$, which likewise occurs, in much smaller quantity, in certain species of the brown seaweed, *Fucus*, and in plants of several widely separated natural orders. Mannite is obtained by extracting manna with alcohol and crystallizing the solution. The best manna contains 70 to 80%. It crystallizes in shining rhombic prisms from its aqueous solution and as delicate needles from alcohol. Manna possesses mildly laxative properties, and on account of its sweet taste is employed as a mild aperient for children. It is less used in England now than formerly, but is still largely consumed in South America. In Italy mannite is prepared for sale in the shape of small cones resembling loaf sugar in shape, and is frequently prescribed in medicine instead of manna.

The manna of the present day appears to have been unknown before the 15th century, although a mountain in Sicily with the Arabic name Gibelman, *i.e.* "manna mountain," appears to point to its collection there during the period that the island was held by the Saracens, 827-1070. In the 16th century it was collected in Calabria, and until recently was produced in the Tuscan Maremma, but none is now brought into commerce from Italy, although the name of Tolfa, a town near Civita Vecchia, is still applied to an inferior variety of the drug.

Various other kinds of manna are known, but none of these has been found to contain mannite. Alhagi manna (Persian and Arabic *tar-angubīn*, also known as terendschabin) is the produce of *Alhagi maurorum*, a small, spiny, leguminous plant, growing in Arabia, Asia Minor, Persia, Afghanistan, Baluchistan and northern India. This manna occurs in the form of small, roundish, hard, dry tears, varying from the size of a mustard seed to that of a coriander, of a light-brown colour, sweet taste, and senna-like odour. The spines and pods of the plant are often mixed with it. It is collected near Kandahar and Herat, and imported into India from Cabul and Kandahar. Tamarisk manna (Persian *gaz-angubīn*, tamarisk honey) exudes in June and July from the slender branches of *Tamarix gallica*, var. *mannifera*, in the form of honey-like drops, which, in the cold temperature of the early morning, are found in the solid state. This secretion is caused by the puncture of an insect, *Coccus manniparus*. In the valleys of the peninsula of Sinai, especially in the Wādy el-Sheikh, this manna (Arabic *man*) is collected by the Arabs and sold to the monks of St Catherine, who supply it to the pilgrims visiting the convent. It is found also in Persia and the Punjab, but does not appear to be collected in any quantity. This kind of manna seems to be alluded to by Herodotus (vii. 31). Under the same name of *gaz-angubīn* there are sold commonly in the Persian bazaars round cakes, of which a chief ingredient is a manna obtained to the south-west of Ispahan, in the month of August, by shaking the branches or scraping the stems of *Astragalus florulentus* and *A. adscendens*.[1] *Shir Khist*, a manna known to writers on materia medica in the 16th century, is imported into India from Afghanistan and Turkestan to a limited extent; it is the produce of *Cotoneaster nummularia* (*Rosaceae*), and to a less extent of *Atraphaxis spinosa* (*Polygonaceae*); it is brought chiefly from Herat.

Oak manna or *Gueze-elefi*, according to Hausknecht, is collected from the twigs of *Quercus Vallonia* and *Q. persica*, on which it is produced by the puncture of an insect during the month of August. This manna occurs in the state of agglutinated tears, and forms an object of some industry among the wandering tribes of Kurdistan. It is collected before sunrise, by shaking the grains of manna on to linen cloths spread out beneath the trees, or by dipping the small branches in hot water and evaporating the solution thus obtained. A substance collected by the inhabitants of Laristan from *Pyrus glabra* strongly resembles oak manna in appearance.

Australian or Eucalyptus manna is found on the leaves of *Eucalyptus viminalis*, *E. Gunnii*, var. *rubida*, *E. pulverulenta*, &c. The Lerp manna of Australia is of animal origin.

Briançon manna is met with on the leaves of the common Larch (*q.v.*), and *bide-khecht* on those of the willow, *Salix fragilis*; and a kind of manna was at one time obtained from the cedar.

The manna of the Biblical narrative, notwithstanding the miraculous circumstances which distinguish it from anything now known, answers in its description very closely to the tamarisk manna.

See Bentley and Trimen, *Medicinal Plants* (1880); Watt, *Dictionary of Economic Products of India*, under "Manna" (1891). For analyses see A. Ebert, *Abst. J.C.S.*, 1909, 96, p. 176.

MANNERS, CHARLES (1857-), English musician, whose real name was Southcote Mansergh, was born in London, son of Colonel Mansergh, an Irishman. He had a fine bass voice, and was educated for the musical profession in Dublin and at the Royal Academy of Music in London. He began singing in opera in 1881, and in 1882 had great success as the sentry in *Iolanthe* at the Savoy, following this with numerous engagements in opera both in England and America. He married the singer Fanny Moody, already a leading soprano on the operatic stage, in 1890; and in 1897 they formed the Moody-Manners opera company, which had a great success in the provinces and undertook seasons in London in 1902. Manners and his wife were assisted by some other excellent artists, and their enterprise had considerable influence on contemporary English music.

MANNERS-SUTTON, CHARLES (1755-1828), archbishop of Canterbury, was educated at Charterhouse and Cambridge. In 1785 he was appointed to the family living at Averham-with-Kelham, in Nottinghamshire, and in 1791 became dean of Peterborough. He was consecrated bishop of Norwich in 1792, and two years later received the appointment of dean of Windsor *in commendam*. In 1805 he was chosen to succeed Archbishop Moore in the see of Canterbury. During his primacy the old archiepiscopal palace at Croydon was sold and the country palace of Addington bought with the proceeds. He presided over the first meeting which issued in the foundation of the National Society, and subsequently lent the scheme his strong support. He also exerted himself to promote the establishment of the Indian episcopate. His only published works are two sermons, one preached before the Lords (London, 1794), the other before the Society for the Propagation of the Gospel (London, 1797). His brother, THOMAS MANNERS-SUTTON, 1st BARON MANNERS (1756-1842), was lord chancellor of Ireland. For his son Charles see CANTERBURY, 1st VISCOUNT.

MANNHEIM, a town of Germany, in the grand-duchy of Baden, lying on the right bank of the Rhine, at its confluence with the Neckar, 39 m. by rail N. of Karlsruhe, 10 m. W. of Heidelberg and 55 m. S. of Frankfort-on-Main. Pop. (1900), 141,131; (1905), 162,607 (of whom about 70,000 are Roman Catholics and 6000 Jews). It is perhaps the most regularly built town in Germany, consisting of twelve parallel streets intersected at right angles by others, which cut it up into 136 square sections of equal size. These blocks are distinguished, after the American fashion, by letters and numerals. Except on the south side all the streets debouch on the promenade, which forms a circle round the town on the site of the old ramparts. Outside this ring are the suburbs Schwetzinger-Vorstadt to the south and Neckar-Vorstadt to the north, others being Lindenhof, Mühlau, Neckarau and Käferthal. Mannheim is connected by a handsome bridge with Ludwigshafen, a rapidly growing commercial and manufacturing town on the left bank of the Rhine, in Bavarian territory. The Neckar is spanned by two bridges.

Nearly the whole of the south-west side of the town is occupied by the palace (1720-1759), formerly the residence of the elector palatine of the Rhine. It is one of the largest buildings of the kind in Germany, covering an area of 15 acres, and having a frontage of about 600 yards. It has 1500 windows. The left wing was totally destroyed by the bombardment of 1795, but has since been restored. The palace contains a picture gallery and collections of natural history and antiquities, and in front of it are two monumental fountains and a monument to the emperor William I. The large and beautiful gardens at the back form the public park of the town. Among the other prominent buildings are the theatre, the arsenal, the synagogue, the "Kaufhaus," the town-hall (*Rathaus*, 1771) and the observatory. A newer building is the fine municipal Festhalle with magnificent rooms. The only noteworthy churches are the Jesuit church (1737–1760), the interior of which is lavishly decorated with marble and painting; the Koncordienkirche and the Schlosskirche. In front of the theatre are statues of Schiller, August Wilhelm Iffland the actor, and Wolfgang Heribert von Dalberg (1750–1806), intendant of the theatre in the time of Schiller. Mannheim is the chief commercial town on the upper Rhine, and yields in importance to Cologne alone among the lower Rhenish towns. It stands at the head of the effective navigation on the Rhine, and is not only the largest port on the upper course of that stream, but is the principal emporium for south Germany for such commodities as cereals, coal, petroleum, timber, sugar and tobacco, with a large trade in hops, wine and other south German produce. Owing to the rapid increase in the traffic, a new harbour at the mouth of the Neckar was opened in 1898. The industries are equal in importance to the transit trade, and embrace metal-working, ironfounding and machine building, the manufacture of electric plant, celluloid, automobiles, furniture, cables and chemicals, sugar refining, cigar and tobacco making, and brewing.

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[1] See *Bombay Lit. Tr.*, vol. i. art. 16, for details as to the *gazangubīn*. A common Persian sweetmeat consists of wheat-flour kneaded with manna into a thick paste.

Mannheim is the seat of the central board for the navigation of the Rhine, of a high court of justice, and of the grand ducal commissioner for north Baden.

History.—The name of Mannheim was connected with its present site in the 8th century, when a small village belonging to the abbey of Lorsch lay in the marshy district between the Neckar and the Rhine. To the south of this village, on the Rhine, was the castle of Eicholzheim, which acquired some celebrity as the place of confinement assigned to Pope John XXIII. by the council of Constance. The history of modern Mannheim begins, however, with the opening of the 17th century, when the elector palatine Frederick IV. founded a town here, which was peopled chiefly with Protestant refugees from Holland. The strongly fortified castle which he erected at the same time had the unfortunate result of making the infant town an object of contention in the Thirty Years' War, during which it was five times taken and retaken. In 1688 Mannheim, which had in the meantime recovered from its former disasters, was captured by the French, and in 1689 it was burned down. Ten years later it was rebuilt on an extended scale, and provided with fortifications by the elector John William. For its subsequent importance it was indebted to the elector Charles Philip, who, owing to ecclesiastical disputes, transferred his residence from Heidelberg to Mannheim in 1720. It remained the capital of the Palatinate for nearly sixty years, being especially flourishing under the elector Charles Theodore. In 1794 Mannheim fell into the hands of the French, and in the following year it was retaken by the Austrians after a severe bombardment, which left scarcely a single building uninjured. In 1803 it was assigned to the grand duke of Baden, who caused the fortifications to be razed. Towards the end of the 18th century Mannheim attained great celebrity in the literary world as the place where Schiller's early plays were performed for the first time. It was at Mannheim that Kotzebue was assassinated in 1819. During the revolution in Baden in 1849 the town was for a time in the hands of the insurgents, and was afterwards occupied by the Prussians.

See Feder, *Geschichte der Stadt Mannheim* (1875–1877, 2 vols., new ed. 1903); Pichler, *Chronik des Hof-und National Theaters in Mannheim* (Mannheim, 1879); Landgraf, *Mannheim und Ludwigshafen* (Zürich, 1890); *Die wirthschaftliche Bedeutung Mannheims*, published by the Mannheim Chamber of Commerce (Mannheim, 1905); the *Forschungen zur Geschichte Mannheims und der Pfalz*, published by the *Mannheimer Altertumsvereis* (Leipzig, 1898); and the annual *Chronik der Hauptstadt Mannheim* (1901 seq.).

MANNING, HENRY EDWARD (1808–1892), English Roman Catholic cardinal, was born at Totteridge, Hertfordshire, on the 15th of July 1808,[1] being the third and youngest son of William Manning, a West India merchant, who was a director of the Bank of England and governor, 1812–1813, and who sat in Parliament for some thirty years, representing in the Tory interest Plympton Earle, Lymington, Evesham, and Penryn consecutively. His mother, Mary, daughter of Henry Leroy Hunter, of Beech Hill, Reading, was of a family said to be of French extraction. Manning's boyhood was mainly spent at Coombe Bank, Sundridge, Kent, where he had for companions Charles and Christopher Wordsworth, afterwards bishops of St Andrews and of Lincoln. He was educated at Harrow, 1822–1827, Dr G. Butler being then the head master, but obtained no distinction beyond being in the cricket eleven in 1825. He matriculated at Balliol College, Oxford, in 1827, and soon made his mark as a debater at the Union, where Gladstone succeeded him as president in 1830. At this date he was ambitious of a political career, but his father had sustained severe losses in business, and in these circumstances Manning, having graduated with first-class honours in 1830, obtained the year following, through Viscount Goderich, a post as supernumerary clerk in the colonial office. This, however, he resigned in 1832, his thoughts having been turned towards a clerical career under Evangelical influences, which affected him deeply throughout life. Returning to Oxford, he was elected a fellow of Merton College, and was ordained; and in 1833 he was presented to the rectory of Lavington-with-Graffham in Sussex by Mrs Sargent, whose granddaughter Caroline he married on the 7th of November 1833, the ceremony being performed by the bride's brother-in-law, Samuel Wilberforce, afterwards bishop of Oxford and of Winchester. Manning's married life was of brief duration. His young and beautiful wife was of a consumptive family, and died childless (July 24, 1837). The lasting sadness that thus early overshadowed him tended to facilitate his acceptance of the austere teaching of the Oxford Tracts; and though he was never an acknowledged disciple of Newman, it was due to the latter's influence that from this date his theology assumed an increasingly High Church character, and his printed sermon on the "Rule of Faith" was taken as a public profession of his alliance with the Tractarians. In 1838 he took a leading part in the Church education movement, by which diocesan boards were established throughout the country; and he wrote an open letter to his bishop in criticism of the recent appointment of the ecclesiastical commission. In December of that year he paid his first visit to Rome, and called on Dr Wiseman in company with W. E. Gladstone. In January 1841 Shuttleworth, bishop of Chichester, appointed him archdeacon, whereupon he began a personal visitation of each parish within his district, completing the task in 1843. In 1842 he published a treatise on *The Unity of the Church*, and his reputation as an eloquent and earnest preacher being by this time considerable, he was in the same year appointed select preacher by his university, thus being called upon to fill from time to time the pulpit which Newman, as vicar of St Mary's, was just ceasing to occupy. Four volumes of his sermons appeared between the years 1842 and 1850, and these had reached the 7th, 4th, 3rd and 2nd editions respectively in 1850, but were not afterwards reprinted. In 1844 his portrait was painted by Richmond, and the same year he published a volume of university sermons, in which, however, was not included the one on the Gunpowder Plot. This sermon had much annoyed Newman and his more advanced disciples, but it was a proof that at that date Manning was loyal to the Church of England as Protestant. Newman's secession in 1845 placed Manning in a position of greater responsibility, as one of the High Church leaders, along with Pusey and Keble and Marriott; but it was with Gladstone and James Hope (afterwards Hope-Scott) that he was at this time most closely associated. In the spring of 1847 he was seriously ill, and that autumn and the following winter he spent abroad, chiefly in Rome, where he saw Newman "wearing the Oratorian habit and dead to the world." He had public and private audiences with the pope on the 9th of April and the 11th of May 1848, but recorded next to nothing in his diary concerning them, though numerous other entries show an eager interest in everything connected with the Roman Church, and private papers also indicate that he recognized at this time grave defects in the Church of England and a mysterious attractiveness in Roman Catholicism, going so far as to question whether he might not one day be a Roman Catholic himself. Returning to England, he protested, but with moderation, against the appointment of Hampden as bishop of Hereford, and continued to take an active part in the religious education controversy. Through the influence of Samuel Wilberforce, he was offered the post of sub-almoner to Queen Victoria, always recognized as a stepping-stone to the episcopal bench, and his refusal of it was honourably consonant with all else in his career as an Anglican dignitary, in which he united pastoral diligence with an asceticism that was then quite exceptional. In 1850 the decision of the privy council, that the bishop of Exeter was bound to institute the Rev. G. C. Gorham to the benefice of Brampford Speke in spite of the latter's acknowledged disbelief in the doctrine of baptismal regeneration, brought to a crisis the position within the Church of England of those who believed in that Church as a legitimate part of the infallible *Ecclesia docens*. Manning made it clear that he regarded the matter as vital, though he did not act on this conviction until no hope remained of the decision being set aside or practically annulled by joint action of the bishops. In July he addressed to his bishop an open letter on "The Appellate Jurisdiction of the Crown in Matters Spiritual," and he also took part in a meeting in London which protested against the decision. In the autumn of this year (1850) was the great popular outcry against the "Papal aggression" (see WISEMAN), and Manning, feeling himself unable to take part in this protest, resigned, early in December his benefice and his archdeaconry; and writing to Hope-Scott, who a little later became a Roman Catholic with him, stated his conviction that the alternative was "either Rome or licence of thought and will." He was received into the Roman Catholic Church by Father Brownbill, S.J., at the church in Farm Street, on Passion Sunday, the 6th of April 1851. On the following Sunday he was confirmed and received to communion by Cardinal Wiseman, who also, within ten weeks of his reception, ordained him priest. Manning thereupon proceeded to Rome to pursue his theological studies, residing at the college known as the "Academy for Noble Ecclesiastics," and attending lectures by Perrone and Passaglia among others. The pope frequently received him in private audience, and in 1854 conferred on him the degree of D.D. During his visits to England he was at the disposal of Cardinal Wiseman, who through him, at the time of the Crimean War, was enabled to obtain from the government the concession that for the future Roman Catholic army chaplains should not be regarded as part of the staff of the Protestant chaplain-general. In 1857 the pope, *proprio motu*, appointed him provost (or head of the chapter) of Westminster, and the same year he took up his residence in Bayswater as superior of a community known as the "Oblates of St Charles," an association of secular priests on the same lines as the institute of the Oratory, but with this difference, that they are by their constitution at the beck and call of the bishop in whose diocese they live. The community was thus of the greatest service to Cardinal Wiseman, whose right-hand man Manning thenceforward became. During the eight years of his life at Bayswater he was most active in all the duties of the priesthood, preaching, hearing confessions, and receiving converts; and he was notably zealous to promote in England all that was specially Roman and papal, thus giving offence to old-fashioned Catholics, both clerical and lay, many of whom were largely influenced by Gallican ideas, and had with difficulty accepted the restoration of the hierarchy in 1850. In 1860 he delivered a course of lectures on the pope's temporal power, at that date seriously threatened, and shortly afterwards he was appointed a papal domestic prelate, thus becoming a "Monsignor," to be addressed as "Right Reverend." He was now generally recognized as the able and effective leader of the Ultramontane party among English Roman Catholics, acting always, however, in subordination to Cardinal Wiseman; and on the latter's death (Feb. 15, 1865) it was felt that, if Manning should succeed to the vacant archbishopric, the triumph of Ultramontanism would be secured. Such a consummation not being desired by the Westminster chapter, they submitted to the pope three names, and Manning's was not one of them. Great efforts were made to secure the succession for the titular archbishop Errington, who at one time had been Wiseman's coadjutor with that right reserved to him, but who had been ousted from that position by the pope acting under Manning's influence. In such circumstances Pius IX. could hardly do otherwise than ignore Errington's nomination, as he also ignored the nomination of Clifford, bishop of Clifton, and of Grant, bishop of Southwark; and, by what he humorously described as "the Lord's own *coup d'état*," he appointed Manning to the archiepiscopal see. Consecrated at the pro-cathedral at Moorfields (since destroyed) by Dr Ullathorne, bishop of Birmingham (June 8, 1865), and enthroned there (Nov. 6), after receiving the *pallium* in Rome, Manning began his work as archbishop by devoting himself especially to the religious education of the poor and to the establishment of Catholic industrial and reformatory schools. He steadily opposed whatever might encourage the admission of Catholics to the national universities, and so put his foot down on Newman's project to open a branch house of the Oratory at Oxford with himself as superior. He made an unsuccessful and costly effort to establish a Catholic university at Kensington, and he also made provision for a diocesan seminary of strictly ecclesiastical type. Jealous of the exclusive claims of the Roman Church, he procured a further condemnation at Rome of the "Association for the Promotion of the Unity of Christendom," which advocated prayers for the accomplishment of a kind of federal union between the Roman, Greek and Anglican Churches, and in a pastoral letter he insisted on the heretical assumption implied in such an undertaking. He also worked for the due recognition of the dignity of the secular or pastoral clergy, whose position seemed to be threatened by the growing ascendancy of the regulars, and especially of the Jesuits, whom, as a practically distinct organization within the Church, he steadily opposed. In addition to his diocesan synods, he presided in 1873 over the fourth provincial synod of Westminster, which legislated on "acatholic" universities, church music, mixed marriages, and the order of a priest's household, having previously taken part, as theologian, in the provincial synods of 1853 and 1859, with a hand in the preparation of their decrees. But it was chiefly through his strenuous advocacy of the policy of defining papal infallibility at the Vatican council (1869–1870) that Manning's name obtained world-wide renown. In this he was instant in season and out of season. He brought to Rome a petition in its favour from his chapter at Westminster, and during the progress of the council he laboured incessantly to overcome the opposition of the "inopportunists." And he never ceased to regard it as one of the chief privileges of his life that he had been able to take an active part in securing the definition, and in having heard with his own ears that doctrine proclaimed as a part of divine revelation. In 1875 he published a reply to Gladstone's attack on the Vatican decrees; and on the 15th of March in that year he was created cardinal, with the title of SS. Andrew and Gregory on the Coelian. He was present at the death of Pius IX. (Feb. 7, 1878); and in the subsequent conclave, while some Italian cardinals were prepared to vote for his election to fill the vacant chair, he himself supported Cardinal Pecci, afterwards known as Leo XIII. With him, however, Manning found less sympathy than with his predecessor, though Manning's advocacy of the claims of labour attracted Leo's attention, and influenced the encyclical which he issued on the subject. After the Vatican council, and more especially after the death of Pius IX., Manning devoted his attention mainly to social questions, and with these his name was popularly associated during the last fifteen years of his life. From 1872 onwards he was a strict teetotaller, not touching alcohol even as a medicine, and there was some murmuring among his clergy that his teaching on this subject verged on heresy. But his example and his zeal profoundly influenced for good the Irish poor forming the majority of his flock; and the "League of the Cross" which he founded, and which held annual demonstrations at the Crystal Palace, numbered nearly 30,000 members in London alone in 1874. He sat on two royal commissions, the one on the housing of the working classes (1884), and the other on primary education (1886); and in each case the report showed evident marks of his influence, which his fellow-commissioners recognized as that of a wise and competent social reformer. In the cause of labour he was active for many years, and in 1872 he set an example to the clergy of all the churches by taking a prominent part in a meeting held in Exeter Hall on behalf of the newly established Agricultural Labourers' Union, Joseph Arch and Charles Bradlaugh being among those who sat with him on the platform. In later years his strenuous advocacy of the claims of the working classes, and his declaration that "every man has a right to work or to bread" led to his being denounced as a Socialist. That he was such he denied more than once (Lemire, *Le Cardinal Manning et son action sociale*, Paris, 1893, p. 210), nor was he ever a Socialist in principle; but he favoured some of the methods of Socialism, because they alone seemed to him practically to meet the case of that pressing poverty which appealed to his heart. He took a leading part in the settlement of the dockers' strike in the autumn of 1889, and his patient and effectual action on this and on similar occasions secured for him the esteem and affection of great numbers of working men, so that his death on the 14th of January 1892, and his funeral a week later, were the occasion for a remarkable demonstration of popular veneration. The Roman Catholic Cathedral at Westminster is his joint memorial with his predecessor, Cardinal Wiseman.

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[1] Purcell's assertion that the year of his birth was 1807 rests on no trustworthy evidence.

Whatever may have been the value of Manning's services to the Roman Catholic Church in England in bringing it, as he did, up to a high level of what in earlier years was commonly denounced as Ultramontanism, it is certain that by his social action, as well as by the earnestness and holiness of his life, he greatly advanced, in the minds of his countrymen generally, their estimate of the character and value of Catholicism. Pre-eminently he was a devout ecclesiastic, a "great priest"; and his sermons, both Anglican and Catholic, are marked by fervour and dignity, by a conviction of his own authoritative mission as preacher, and by an eloquent insistence on considerations such as warm the heart and bend the will rather than on such as force the intellect to assent. But many of his instincts were those of a statesman, a diplomatist, a man of the world, even of a business man; and herein lay, at least in part, the secret of his influence and success. Intellectually he did not stand in the front rank. He was neither a philosopher nor a literary genius. Among his many publications, written, it is only fair to admit, amidst the urgent pressure of practical work, there is barely a page or even a sentence that bears the stamp of immortality. But within a somewhat narrower field he worked with patience, industry, and self-denying zeal; his ambition, which seemed to many personal, was rather the outcome of his devotion to the cause of the Church; and in the later years of his life especially he showed that he loved righteousness and hated iniquity, and that he realized as clearly as any one that the service of God was incomplete without the service of man.

The publication in 1896 of Manning's *Life*, by Purcell, was the occasion for some controversy on the ethics of biography. Edward Purcell was an obscure Catholic journalist, to whom Manning, late in life, had entrusted, rather by way of charitable bequest, his private diaries and other confidential papers. It thus came to pass that in Purcell's voluminous biography much that was obviously never intended for the public eye was, perhaps inadvertently, printed, together with a good deal of ungenerous comment. The facts disclosed which mainly attracted attention were: (1) that Manning, while yet formally an Anglican, and while publicly and privately dissuading others from joining the Roman Catholic Church, was yet within a little convinced that it was his own duty and destiny to take that step himself; (2) that he was continually intriguing at the back-stairs of the Vatican for the furtherance of his own views as to what was desirable in matters ecclesiastical; (3) that his relations with Newman were very unfriendly; and (4) that, while for the most part he exhibited towards his own clergy a frigid and masterful demeanour, he held privately very cordial relations with men of diverse religions or of no theological beliefs at all. And certainly Manning does betray in these autobiographical fragments an unheroic sensitiveness to the verdict of posterity on his career. But independent critics (among whom may specially be named François de Pressensé) held that Manning came well through the ordeal, and that Purcell's *Life* had great value as an unintentionally frank revelation of character. (A. W. Hu.)

MANNY, SIR WALTER DE MANNY, Baron de (d. 1372), soldier of fortune and founder of the Charterhouse, younger son of Jean de Mauny, known as Le Borgne de Mauny, by his wife Jeanne de Jenlain, was a native of Hainaut, from whose counts he claimed descent. Manny—the name is thus spelt by most English writers—was a patron and friend of Froissart, in whose chronicles his exploits have a conspicuous and probably an exaggerated place. He appears to have first come to England as an esquire of Queen Philippa in 1327, and he took a distinguished part in the Scottish wars of Edward III. In 1337 he was placed in command of an English fleet, and in the following year accompanied Edward to the continent, where in the campaigns of the next few years he proved himself one of the boldest and ablest of the English king's military commanders. He was summoned to parliament as a baron by writ from the 12th of November 1347 to the 8th of January 1371. In 1359 he was made a knight of the Garter; and at various times he received extensive grants of land both in England and in France. He was frequently employed by King Edward in the conduct of diplomatic negotiations as well as in military commands. He was one of those charged with the safe custody of the French king John when a prisoner at Calais in 1360; in 1369 he was second in command under John of Gaunt in his invasion of France.

But Manny is chiefly remembered for his share in the foundation of the Charterhouse in London. In 1349 he bought some acres of land near Smithfield, which were consecrated as a burying-place where large numbers of the victims of the Black Death were interred; and here he built a chapel, from which the place obtained the name of "Newchurchhaw." The chapel and ground were bought from Manny by the bishop of London, Michael de Northburgh, who died in 1361 and by his will bequeathed a large sum of money to found there a Carthusian convent. It is not clear whether this direction was ever carried out; for in 1371 Manny obtained letters patent from King Edward III. permitting him to found, apparently on the same site, a Carthusian monastery called "La Salutation Mère Dieu," where the monks were to pray for the soul of Northburgh as well as for the soul of Manny himself. The bishop's bequest may have contributed to the building and endowment of the house; or possibly, as seems to be implied by a bull granted by Urban VI, in 1378, there were originally two kindred establishments owing their foundation to Northburgh and Manny respectively. At all events Manny, who died early in 1372, left instructions that he was to be buried in the church of the Carthusian monastery founded by himself. About 1335 he married Margaret, daughter and heiress of Thomas Plantagenet, earl of Norfolk, son of King Edward I., whose first husband had been John, Lord Segrave. This lady, who outlived Manny by many years, was countess of Norfolk in her own right, and she was created duchess of Norfolk in 1397. Manny left no surviving son. His daughter Anne, Baroness de Manny in her own right, married John Hastings, 2nd earl of Pembroke; and on the death of her only son unmarried in 1389, the barony of Manny became extinct.

See *Œuvres de Froissart, I. Chroniques*, edited by Baron Kervyn de Lettenhove (Brussels, 1867–1877), and the Globe edition of *Froissart's Chronicles* (Eng. trans., London, 1895); G. F. Beltz, *Memorials of the Most Noble Order of the Garter* (London, 1841); *Chronicon Angliae 1323–1388*, edited by E. Maunde Thompson (Rolls series 64, London, 1874); Philip Bearcroft, *An Historical Account of Thomas Sutton and of his Foundation in Charterhouse* (London, 1737).

MANNYNG, ROBERT (Robert of Brunne) (*c.* 1264–1340?), English poet, was a native of Brunne, now Bourne, in

Lincolnshire. About 6 m. from Bourne was the Gilbertine monastery of Sempringham, founded by Sir Gilbert de Sempringham in 1139. The foundation provided for seven to thirteen canons, with a number of lay brothers and a community of nuns. No books were allowed to the lay brothers and nothing could be written in the monastery without the prior's consent. Mannyng entered this house in 1288, when, according to the rules, he must have been at least 24 years of age, if, as is supposed, he was a lay brother. He says he was at Cambridge with Robert de Bruce and his two brothers, Thomas and Alexander, but this does not necessarily imply that he was a fellow-student. There was a Gilbertine monastery at Cambridge, and Mannyng may have been there on business connected with his order. When he wrote *Handlyng Synne* he had been (ll. 63-76) fifteen years in the priory, beginning to write in "englysch rime in 1303." Thirty-five years later he began his *Story of Inglande*, and had removed (ll. 139, &c.) to the monastery of Sixille (now Sixhills), near Market Rasen, in north Lincolnshire.

Handlyng Synne, a poem of nearly 13,000 lines, is a free translation, with many additions and amplifications, from William of Waddington's *Manuel des Pechiez*. It is a series of metrical homilies on the Ten Commandments, the Seven Deadly Sins and the Seven Sacraments, illustrated by a number of amusing stories from various sources. The *Cursor Mundi* had turned religious history into something not very different from a romance of chivalry, and in the stories of *Handlyng Synne* the influence of the *fabliaux* is not far to seek. Mannyng wrote in the English tongue not for learned but for "lewd" men, "that talys and ryme wyl blethly here," to occupy the leisure hours during which they might otherwise fall into "vylanye, dedly synne or other folye." Each of his twenty-four topics has its complement of stories. He tells of the English observance of Saturday afternoon as holy to the Virgin, and has much to say of popular amusements, which become sins when they keep people away from church. Tournaments in particular are fertile occasions of all the deadly sins; and mystery plays, except those of the birth and resurrection of Christ performed in the churches, also lead men into transgression. He inveighs against the oppression of the poor by the rich, reproves those who, weary of matins or mass, spend their time in church "jangling," telling tales, and wondering where they will get the best ale, and revives the legend of the dancers at the church door during mass who were cursed by the priest and went on dancing for a twelvemonth without cessation. He loved music himself, and justified this profane pleasure by the example of Bishop Grosseteste, who lodged his harper in the chamber next his own; but he holds up as a warning to gleemen the fate of the minstrel who sang loud while the bishop said grace, and was miserably killed by a falling stone in consequence. The old monk's keen observation makes the book a far more valuable contribution to history than his professed chronicle. It is a storehouse of quaint stories and out-of-the-way information on manners and customs.

His chronicle, *The Story of Inglande*, was also written for the solace and amusement of the unlearned when they sit together in fellowship (ll. 6-10). The earlier half is written in octosyllabic verse, and begins with the story of the Deluge. The genealogy of Locrine, king of Britain, is traced back to Noah, through Aeneas, and the chronicler relates the incidents of the Trojan war as told by Dares the Phrygian. From this point he follows closely the *Brut* of Wace. He loved stories for their own sake, and found fault with Wace for questioning the miraculous elements in the legend of Arthur. In the second half of his chronicle, which is less simple in style, he translates from the French of Pierre de Langtoft. He writes in rhyming alexandrines, and in the latter part of the work uses middle rhymes. Mannyng's *Chronicle* marks a change in national sentiment. Though he regards the Norman domination as a "bondage," he is loud in his praises of Edward I., "Edward of Inglond."

The linguistic importance of Mannyng's work is very great. He used very few of those Teutonic words which, though still in use, were eventually to drop out of the language, and he introduced a great number of French words destined to be permanently adopted in English. Moreover, he employed comparatively few obsolete inflexions, and his work no doubt furthered the adoption of the Midland dialect as the acknowledged literary instrument. T. L. Kington-Oliphant (*Old and Middle English*, 1878) regards his work as the definite starting point of the New English which with slight changes was to form the language of the Book of Common Prayer.

A third work, usually ascribed to Mannyng, chiefly on the ground of its existing side by side with the *Handlyng Synne* in the Harleian and Bodleian MSS., is the *Medytacyuns of the Soper of oure lorde Jhesu, And also of hys passyun And eke of the peynes of hys swete modyr, Mayden marye*, a free translation of St Bonaventura's *De coena et passione Domini*. . . .

Robert of Brunne's *Chronicle* exists in two MSS.: Petyt MS. 511, written in the Northern dialect, in the Inner Temple library; and Lambeth MS. 131 in a Midland dialect. The first part was edited *The Story of England* . . . (1887) for the Rolls Series, with an introductory essay by F. J. Furnivall; the second part was published by Thomas Hearne as *Peter Langtoft's Chronicle* . . . (1725). Peter Langtoft's French version was edited by Thomas Wright for the "Rolls Series" in 1866. Of *Handlyng Synne* there are complete MSS. in the Bodleian library (MS. 415) and in the British Museum (Harleian MS. 1701), and a fragment in the library of Dulwich College (MS. 24). It was edited, with Waddington's text in parallel columns, by F. J. Furnivall for the Roxburghe Club (1862), and for the Early English Text Society (1901-1903). The *Meditacyun* was edited from the Bodleian and Harleian MSS. by J. Meadow Cooper for the same society (1875). See also Gerhard Hellmers, *Ueber die Sprache Robert Mannyngs of Brunne und über die Autorschaft der ihm zugeschriebenen Meditations* . . . (Göttingen, 1885), which contains an analysis of the dialectic peculiarities of Mannyng's work; O. Boerner, "Die Sprache Robert Mannyngs" . . . in *Studien zur engl. Philologie* (vol. xii., Halle, 1904) and Oskar Preussner, *Robert Mannyng of Brunne's Übersetzung von Pierre de Langtofts Chronicle* (Breslau, 1891). All accounts of his life are based on his own work. For the Sempringham priory see Dugdale, *Monasticon* vi. 947 seq., and Miss Rose Graham's *S. Gilbert of Sempringham and the Gilbertines* (1901).

MANŒUVRES, MILITARY. Manœuvres may be defined as the higher training for war of troops of all arms in large bodies, and have been carried out in most countries ever since the first formation of standing armies. In England no manœuvres or camps of exercise appear to have been held till the beginning of the 19th century, when Sir John Moore trained the famous Light Brigade at Shorncliffe camp. In France, however, under Louis XIV., large camps of instruction were frequently held, the earliest recorded being that of 18,000 troops at Compiègne in 1666; and these were continued at intervals under his successor. At these French camps much time was devoted to ceremonial, and the manœuvres performed were of an elementary description. Still their effect upon the training of the army for war was far-reaching, and bore fruit in the numerous wars in the first half of the 18th century. Moreover, experiments were made with proposed tactical systems and technical improvements, as in the case of the contest between *l'ordre mince* and *l'ordre profonde* (see INFANTRY) between 1785 and 1790. Other countries followed suit, but it was reserved for Frederick the Great to inaugurate a system of real manœuvres and to develop on the training-ground the system of tactics which bore such good fruit in his various campaigns. The numbers of troops assembled were large; for example, at Spandau in 1753, when 36,000 men carried out manœuvres for twelve days. The king laid the greatest stress on these exercises, and took immense pains to turn to account the experience gained in his campaigns. Great secrecy was observed, and before the Seven Years' War no stranger was allowed to be present. The result of all this careful training was shown in the Seven Years' War, and after it the Prussian manœuvres gained a reputation which they have maintained to this day. But with the passing away of the great king they became more and more pedantic, and the fatal results were shown in 1806. After the Napoleonic wars yearly manœuvres became the custom in every large Continental army. Great Britain alone thought she could dispense with them, perhaps because of the constant practical training her troops and officers received in the various Indian and colonial wars;

and it was not till 1853 that, by the advice of the Prince Consort, a body of troops were gathered together for a camp of exercise on Chobham Common, and that eventually a standing camp of exercise was evolved out of the temporary camp formed during the Crimean War at Aldershot.

Most continental armies have, since the great successes of the Germans in 1870, copied more or less their system of military training; hence it is appropriate to consider their methods first. The whole training of the army is based on a yearly programme of gradual progression, from the joining of the recruits in October to the training by squads, companies, battalions and regiments, the latter finishing their field training about the middle of August, when the manœuvre period begins. First of all, the brigades go through five working days of drills on flat ground, to get them under the hand of their commanders and prepare them for manœuvres. Then follow ten working days of manœuvres in new and varied ground, of which four are "brigade," four "divisional" and two "corps" manœuvres, in each case the unit named being divided into two portions of all arms, which manœuvre against one another. Each year two or more army corps carry out manœuvres before the emperor, working against one another. The chief feature of the German manœuvres is the free hand allowed to leaders of sides. Of course, for reasons of supply and transport, it is necessary to keep the troops within a certain area, but the general and special ideas[1] are so framed that, while retaining their own initiative, the leaders of sides have to give such orders as will suit the arrangements made by the director of manœuvres for supply. The faculty of quartering troops on private individuals to any extent, and the fact of the troops being provided with portable tent equipment, give great latitude to the German leaders in their choice of quarters for troops, and so increase the similitude of manœuvres to war. The Austrian and Italian manœuvres are a close copy of the German, but those of the French present the peculiarity of a certain amount of prearrangement, especially at grand manœuvres, when it is frequently laid down beforehand which side is to be victorious. Thus a series of pictures of war is presented, but the manœuvres are hardly a test of the skill of the rival leaders. But, just as in recent years in France this practice has been modified, so also the entire liberty given to commanders in the German manœuvres in 1906–7 had to be curtailed in the following years owing to the strain of forced marches which it entailed on the troops.

In Russia the climatic and social conditions, and the distribution of the army, necessitate a quite peculiar system. The troops leave their barracks and move into standing camps, generally in May, and in these for about three months their training up to that in battalions is carried out on the drill ground. Camps of mixed units are then formed for a month, and from them, but always over the same ground, the manœuvres of regiments, brigades and divisions are performed. Then follow the so-called mobile manœuvres, which last for ten days or a fortnight. Of all European manœuvres these are perhaps the nearest approach to war, for the sides start a great distance apart, and ample time is allowed for cavalry reconnaissance. Besides, the Russian soldier does not require elaborate arrangements for supply; hence the director is not so tied down by consideration of this matter as in other armies. A political colour is sometimes given to such large assemblages of troops, especially when the manœuvres take place in frontier districts.

In England the military authorities have long been hampered in the organization of manœuvres by the necessity of carrying them out on very limited portions of government land or on areas lent as a favour by, or hired from, private individuals. There has been no want of recognition by the military authorities of the necessity for, and value of, manœuvres, and the training at the camps of instruction has been supplemented as far as possible by small manœuvres on such portions of country as could be made available. But, with the exception of spasmodic efforts in 1871 and 1872, it was not until 1897 that the government allowed itself to be convinced by its military advisers, and passed a Military Manœuvres Act, by which certain districts could be "proclaimed" for purposes of manœuvres, and troops in consequence could traverse all ground. In 1898 the first manœuvres under this Act were held in Wilts and Dorset, and were intended to be repeated at fixed intervals in future years. In addition, every effort was made to add to the existing permanent training grounds for troops, and ground was acquired on Salisbury Plain with the intention of developing it into a second Aldershot. But the training on those well-known grounds, excellent as it is in itself as a preparation, is not "manœuvres," and never can do away with the necessity for them, with a more or less free hand given to the leaders over fresh country.

Much misconception prevails as to the nature and limitation of the military instruction to be imparted at manœuvres. Manœuvres are a school for the leaders, in a less degree for the led, and consequently the minor details of instruction must be completed, and the troops fully trained as units, before they can take part in them with advantage. The time during which large bodies of troops can be kept together for manœuvres is too short, and the expense too great, to justify time being spent on exercises which might as well be carried out in the ordinary stations or at the great training camps. Therefore it may be laid down as a principle that manœuvres, properly so-called, should be begun with units not smaller than a brigade of infantry on each side, with a due proportion of the other arms attached. It is useful if these can precede the manœuvres of larger bodies, as the training is then progressive and the result more satisfactory.[2]

The choice of ground is of great importance. Its extent should be proportionate to the force to be employed and the nature of the instruction to be imparted. It should not be too hilly nor yet too flat, but both descriptions should be judiciously combined; and regard must be had to the water supply and the road and railway net for the convenience of the supply service. Once the ground has been selected, the general and special ideas must be so framed that the troops are thereby confined to the chosen ground without seeming to tie the hands of the leaders of sides. It is of great advantage if the same idea can be maintained throughout each series of operations, as thereby the interest of all concerned and the likeness to actual warfare are increased; and, if possible, the "state of war" should be continuous also. Within the limits of the special idea, the utmost latitude should be left to leaders; but if the orders of one or both sides seem to render a collision unlikely, the director should so modify the special idea as to compel one or other to re-cast his orders in such a way that contact is brought about. Such interference will scarcely be necessary after the first issues of orders in each series. In war the number of marching days vastly outnumbers those of fighting, but in manœuvres this must not be allowed; tactical instruction is what is desired, and a manœuvre day in which none is imparted is not fully utilized. It is not necessary that all the troops should be engaged, but at least the advanced bodies must come into contact, and the rest must carry out marches as on active service. Each action should be fought to its end, "Cease firing" being sounded when the crisis has been reached; and on a decision being given by the director, one side should retire and the fight be broken off in a proper military manner. The troops should place outposts each day, and act in all respects as if on active service.

The quartering and supply of troops are the chief difficulties in the arrangement of manœuvres, and afford ample opportunity for the practising of the officers and departments responsible for these matters. In England, where in peace it is not possible to billet troops on private individuals, quartering must be replaced by encampments or bivouacs, and the selection of ground for them affords invaluable practice. If possible, their position should be selected to conform to the military situation; but if it is found necessary, for reasons of water or food supply, to withdraw troops to positions other than such as they would occupy in real warfare, time should be allowed them on the following day to regain the positions they would otherwise have occupied. It is next to impossible, for various reasons, financial and other, to organize the food supply in manœuvres as it would be in war. Sufficient transport *cadres* cannot be kept up in peace, and consequently recourse must be had to hired transport, which cannot be treated as a military body. Again, food cannot be requisitioned, and local purchase at the time cannot be trusted to; so dépôts of supplies must be formed beforehand in the manœuvres area, which more or less tie the hands of the supply service. Still, with a judicious choice of the points at which these are formed, much may be done to approximate to service conditions, and the more nearly these are realized the more instructive for the supply will the manœuvres become.

Finally, a word must be said as to the umpire staff, which represents the bullets. The most careful selection of officers for this important duty is necessary, and they must have sufficient authority and be in sufficient number to make their influence everywhere felt. Their principal object should be to come to a decision quickly, so as to prevent the occurrence of unreal situations; and by constant intercommunication they must ensure uniformity in their decisions, and so maintain continuity of the action all over the manœuvres battlefield. (J. M. Gr.)

MANOMETER (Gr. *μανός*, thin or loose; *μέτρον*, a measure), an instrument for measuring the pressures exerted by gases or vapours. An alternative name is pressure gauge, but this term may conveniently be restricted to manometers used in connexion with steam-boilers, &c. The principle of hydrostatics suggest the most common forms. Suppose we have a U tube (fig. 1), containing a liquid: if the pressures on the surfaces of the liquid be equal, then the surfaces will be at the same height. If, on the other hand, the pressure in one limb be greater than the pressure in the other, the surfaces will be at different heights. the difference being directly proportional to the difference of pressures and inversely as the specific gravity of the liquid used.

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[1] The "general idea" is a document, communicated to both sides, containing such general information of the war—the supposed frontiers, previous battles, &c.—as would be matters of common knowledge. The "special idea" of each side comprises the instructions upon which it is acting.

[2] Manœuvres incidentally afford an excellent opportunity of testing new patterns of equipment, transport or other matériel under conditions approximating to those of active service.

Two forms are in use: (1) the "open-tube," in which the pressure in one limb is equal to the atmospheric pressure, and (2) the "closed-tube," in which the experimental pressure is balanced against the liquid column and the air compressed into the upper part of a closed limb of the tube. In the "open tube" form (fig. 1) the pressure on the surface a is equal to the pressure on the surface at b (one atmosphere) *plus* the hydrostatic pressure exerted by the liquid column of height ab. The liquid commonly used is mercury. If a scale be placed behind the limbs of the tube, so that the difference ab can be directly determined, then the pressure in a is at once expressible as $P + ab$ in millimetres or inches of mercury, where P is the atmospheric pressure, known from an ordinary barometric observation. In the "closed tube" form (fig. 2) the calculation is not so simple, for the variation of pressure on the mercury surface in the closed limb has to be taken into account. Suppose the length of the air column in the closed limb be h when the mercury is at the same height in both tubes. Applying the experimental pressure to the open end, if this be greater than atmospheric pressure the mercury column will rise and the air column diminish in the closed limb. Let the length of the air column be h', then its pressure is h/h' atmospheres. The difference in height of the mercury columns in the two limbs is $2(h-h')$, and the pressure in the open limb is obviously equal to that of a column of mercury of length $2(h-h')$, *plus* h/h' atmospheres. These instruments are equally serviceable for determining pressures less than one atmosphere. In laboratory practice, *e.g.* when it is required to determine the degree of exhaust of a water pump, a common form consists of a vertical glass tube having its lower end immersed in a basin of mercury, and its upper end connected by means of an intermediate vessel to the exhaust. The mercury rises in the tube, and the difference between the barometric height and the length of the mercury column gives the pressure attained.

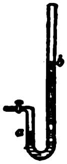

FIG. 1.

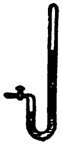

FIG. 2.

MANOR. Any definition of a manor, in land tenure, must take note of two elements—economic and political. The manor has an estate for its basis, although it need not coincide with an estate, but may be wider. It is also a political unit, a district formed for purposes of government, although the political functions made over to it may greatly vary. As a lordship based on land tenure, the manor necessarily comprises a ruler and a population dependent on him, and the characteristic trait of such dependence consists not in ownership extending over persons, as in slave-holding communities, nor in contractual arrangements, as in a modern economic organization, but in various forms and degrees of subjection, chiefly regulated by custom. In the sense mentioned the manor is by no means a peculiarly English institution; it occurs in every country where feudalism got a hold. Under other names we find it not only in France, Germany, Italy, Spain, but also, to a certain extent, in the Byzantine Empire, Russia, Japan, &c. It is especially representative of an aristocratic stage in the development of European nations. When tribal notions and arrangements ceased to be sufficient for upholding their commonwealths, when social and political life had to be built up on the basis of land-tenure, the type of manorial organization came forward in natural course. It was closely connected with natural economy, and was suited to a narrow horizon of economic wants and political requirements. At the same time it provided links for a kind of national federation of military estates. We shall only speak of the course of manorial evolution in France and Germany, because this presents the clearest expression of the fundamental principles of manorial life and the best material for comparison with English facts.

One problem common to the entire European world has to be considered from the very beginning. Does the manor date from the Roman Empire, or not? Can its chief features be traced in Roman institutions? There can be no doubt that at the end of the Roman period certain traits are noticeable which might, under favourable conditions, develop into a manorial combination. Great estates with political functions, populations subjected to the political lordship of landowners, appear in the closing centuries of the empire, and have to be reckoned with as precursors of medieval manorial life. The original organization of the ancient world was built up on the self-government of cities and on the sharp distinction between citizens and slaves. Both features were gradually modified by the Roman Empire. Self-government was atrophied by bureaucratic interference; the economy based on the exploitation of slaves began to give way before relations in which the elements of freedom and serfdom were oddly mixed. During the last centuries of its existence the Western Empire became more and more a conglomerate of barbaric and half-civilized populations, and it is not strange that the characteristic germs of feudalism began to show themselves within its territory as well as outside it. As far as political institutions are concerned, we notice that the central power, after claiming an absolute sway over its subjects, is obliged more and more to lean on private forces in order to maintain itself. One of its favourite resources in the 4th and 5th centuries consists in making great landowners responsible for the good behaviour of their tenants and even of their less important neighbours. The *saltus*, the great domain, is occasionally recognized as a separate district exempt from the ordinary administration of the city, subordinated to its owner in respect of taxes and police. Even in ordinary estates (*fundi*) there is a tendency to make the landowner responsible for military conscription, for the presentation of criminals to justice. On the other hand the incumbents of ecclesiastical offices are nominated in accordance with the wishes of patrons among the landowners; in the administration of justice the influence of this same class makes itself felt more and more. Nor are signs of a convergent evolution wanting on the economic side. Slaves are used more and more as small householders provided with rural tenements and burdened with rents and services. Free peasant farmers holding by free agreement get more and more reduced to a status of half-free settlers occupying their tenancies on the strength of custom and traditional ascription to the glebe. Eventually this status is recognized as a distinct class by imperial legislation. Ominous symptoms of growing political disruption and of an aristocratic transformation of society were visible everywhere at the close of the empire. Yet there could be no talk of a manorial system as long as the empire and the commercial intercourse protected by it continued to exist.

The fall of the empire hastened the course of evolution. It brought into prominence barbaric tribes who were unable to uphold either the political power or the economic system of the Romans. The Germans had from old certain manorial features in the constitution of their government and husbandry. The owner of a house had always been possessed of a certain political power within its precincts, as well as within the fenced area surrounding it: the peace of the dwelling and the peace of the hedged-in yard were recognized by the legal customs of all the German tribes. The aristocratic superiority of warriors over all classes engaged in base peaceful work was also deeply engraved in the minds of the fighting and conquering tribes. On the other hand the downfall of complicated forms of civilization and civil intercourse rendered necessary a kind of subjection in which tributary labourers were left to a certain extent to manage their own affairs. The Germanic conqueror was unable to move slaves about like draughts: he had no scope for a complicated administration of capital and work. The natural outcome was to have recourse to serfdom with its convenient system of tribute and services.

But, as in the case of the Roman Empire, the formation of regular manors was held back for a time in the early Germanic monarchies by the lingering influence of tribal organization. In the second period of medieval development in continental Europe, in the Carolingian epoch, the features of the estate as a political unit are more sharply marked. Notwithstanding the immense efforts of Charles Martel, Pippin and Charlemagne to strengthen the tottering edifice of the Frankish Empire, public authority had to compromise with aristocratic forces in order to ensure regular government. As regards military organization this is expressed in the recognition of the power of *seniores*, called upon to lead their vassals in the host; as regards jurisdiction, in the increase of the numbers of commended freemen who seek to interpose the powerful patronage of lay and secular magnates between themselves and the Crown. Great estates arose not only on the lands belonging to the king, but on that of churches and of lay potentates, and the constitution of these estates, as described for instance in the Polyptique of St Germain des Près or in the "Brevium exempla ad describendas res ecclesiasticas et fiscales" (*Capitularia*, ed. Boretius, i. 250), reminds us forcibly of that of later feudal estates. They contain a home-farm, with a court and a *casa indominicata*, or manor-house, some holdings (*mansi*) of free men (*ingenuiles*), of serfs (*serviles*), and perhaps of half-free people (*lidiles*). The rents and services of this dependent population are stated in detail, as in later custumals, and there is information about the agricultural implements, the stores and stock on the home-farm. Thus the economic basis of the manor exists in more or less complete order, but it cannot be said as yet to form the prevailing type of land tenure in the country. Holdings of independent free men and village organizations of ancient type still surround the great estates, and in the case of ecclesiastical possessions we are often in a position to watch their gradual extension at the expense of the neighbouring free settlers, by way of direct encroachment, and by that of surrender and commendation on the part of the weaker citizens. Another factor which plays a great part in the gradual process of infeudation is the rise of private jurisdictions, which falls chiefly into the 10th and 11th centuries. The struggle against Northmen, Magyars and Slavs gave a crowning touch to the process of localization of political life and of the aristocratic constitution of society.

In order to describe the full-grown continental manor of the 11th century it is better to take French examples than German, Italian or Spanish. Feudalism in France attained the greatest extension and utmost regularity, while in other European countries it was hampered and intermixed with other institutional features. The expression best corresponding to the English "manor," in the sense of an organized district, was *seigneurie*. *Manoir* is in use, and is, of course, a French word corresponding to *manerium*, but it meant strictly "mansion" or chief homestead in France. *Baronie* is another term which might be employed in some instances as an equivalent of the English manor, but, in a sense, it designates only one species of a larger genus, the estate of a full baron in contrast to a mere knight's fee, as well as to a principality. Some of the attributes of a baron are, however, typical, as the purest expression of manorial rights, and may be used in a general characterization of the latter.

The *seigneurie* may be considered from three points of view—as a unit of administration, as an economic unit, and as a union of social classes.

(*a*) In principle the disruption of political life brought about by feudalism ought to have resulted in the complete administrative independence of the manor. *Chaque baron est souverain dans sa baronie* is a proverb meant to express this radical view of manorial separatism. As a matter of fact this separatism was never completely realized, and even at the time of the greatest prevalence of feudalism the little sovereigns of France were combined into a loose federation of independent fiefs. Still, the proverb was not a mere play of words, and it took a long time for the kings of France to break in potentates, like the little Sire de Coucy in the immediate vicinity of Paris, who sported in his crest the self-complacent motto: *Je ne suis ni comte, ni marquis, je suis le sire de Coucy*. The institutional expression of this aspect of feudalism in the life of the *seigneurie* was the jurisdiction combined with the latter. The principal origin of this jurisdiction was the dismemberment of royal justice, the acquisition by certain landowners of the right of holding royal pleas. The assumption of authority over public tribunals of any kind was naturally considered as equivalent to such a transmission of royal right. But other sources may be noticed also. It was assumed by French feudal law that in all cases when land was granted by a *seigneur* in subinfeudation the recipients would be bound to appear as members of a court of tenants for the settlement of conflicts in regard to land. A third source may be traced in the extension of the patrimonial justice of a person over his serfs and personal dependents to the classes of free and half-free population connected with the *seigneurie* in one way or another. There arose in consequence of these assumptions of jurisdiction a most bewildering confusion of tribunals and judicial rights. It happened sometimes that the question as to who should be the judge in some particular contest was decided by matter-of-fact seizure—the holder of pleas who was the first on the spot to proclaim himself judge in a case was deemed entitled to jurisdiction. In other cases one *seigneur* held the pleas in a certain place for six days in the week, while some competitor of his possessed jurisdiction during the seventh. A certain order was brought into this feudal chaos by the classification of judiciary functions according to the four categories of high, middle, low and tenurial justice. The scope of the first three subdivisions is sufficiently explained by their names; the fourth concerned cases arising from subinfeudation. As a rule the baron or *seigneur* sat in justice with a court of assessors or peers, but the constitution of such courts varied a great deal. They represented partly the succession of the old popular courts with their *scabini*, partly courts of vassals and tenants. In strict feudal law an appeal was allowed from a lower to a higher court only in a case of a denial of justice (*dénie de justice*), not in error or revision of sentence. This rule was, however, very often infringed, and gave way ultimately before the restoration of royal justice.

(*b*) The economic fabric of the French *seigneurie* varied greatly, according to localities. In the north of France it was not unlike that of the English manor. The capital messuage, or castle, and the home-farm of the lord, were surrounded by dependent holdings, *censives*, paying rent, and villein tenements burdened with services. Between these tenancies there were various ties of neighbourhood and economic solidarity recalling the open-field cultivation in England and Germany. When the harvest was removed from the open strips they returned to a state of undivided pasture in which the householders of the village exercised rights of common with their cattle. Wild pasture and woods were used more or less in the same fashion as in England (*droit de pacage de vaine pâture*). The inhabitants often formed courts and held meetings in order to settle the by-laws, and to adjudicate as to trespasses and encroachments (*courts colongères*). In the south, individual property was more prevalent and the villagers were not so closely united by ties of neighbourhood. Yet even there the dependent households were arranged into *mansi* or *colonicae*, subjected to approximately equal impositions in respect of rents and services. In any case the characteristic dualism of manorial life, the combined working of a central home-farm, and of its economic satellites providing necessary help in the way of services, and contributing towards the formation of manorial stores, is quite as much a feature of French as of English medieval husbandry.

(*c*) The social relations between the manorial lord and his subjects are marked by various forms of the exploitation of the latter by the former. Apart from jurisdictional profits, rents and agricultural services, dues of all kinds are exacted from the rural population. Some of these dues have to be traced to servile origins, although they were evidently gradually extended to groups of people who were not descended from downright serfs but had lapsed into a state of considerable subjection. The *main morte* of rustic tenants meant that they had no goods of their own, but held movable property on sufferance without the right of passing it on to their successors. As a matter of fact, sons were admitted to inheritance after their fathers, and sometimes succession was extended to other relatives, but the person taking inheritance paid a heavy fine for entering into possession, or gave up a horse, an ox, or some other especially valuable piece of property. The *formariage* corresponded to the English *merchetum*, and was exacted from rustics on the marriage of their daughters. Although this payment assumed very different shapes, and sometimes only appeared in case consorts belonged to different lords, it was considered a badge of serfdom. *Chevage* (*capitagium*) might be exacted as a poll-tax from all the unfree inhabitants of a *seigneurie*, or, more especially, from those who left it to look for sustenance abroad. The power of the lord as a landowner was more particularly expressed in his right of pre-emption (*retrait seigneurial*), and in taxes on alienation (*lods et ventes*). As a person wielding political authority, a kind of sovereignty, the lord enjoyed divers rights which are commonly attributed to the state—the right of coining money, of levying direct taxes and toll (*tallagium*, *tolneta*) and of instituting monopolies. These latter were of common occurrence, and might take the shape, for instance, of forcing the inhabitants to make use of the lord's mill (*moulin banal*), or of his oven (*four banal*), or of his bull (*taureau banal*).

In Germany the history of the manorial system is bound up with the evolution of the *Grundherrschaft* (landlordship), as opposed to *Gutsherrschaft* (estate-ownership). The latter need not include any elements of public authority and aristocratic supremacy: the former is necessarily connected with public functions and aristocratic standing. The centre of the *Grundherrschaft* was the *Hof*, the court or hall of the lord, from which the political and economic rights of the lord radiated.

The struggle of the military aristocracy and of ecclesiastical institutions with common freedom was more protracted than in France or England; the lordships very often took the shape of disparate rights over holdings and groups of population scattered over wide tracts of country and intermixed with estates and inhabitants subjected to entirely different authority. Therefore the aspect of German manorialism is more confused and heterogeneous than that of the French or English systems. One remarkable feature of it is the consistent separation of criminal justice from other kinds of jurisdiction on Church property. Episcopal sees and abbeys delegated their share of criminal justice to lay magnates in the neighbourhood (*Vogtei*), and this division of power became a source of various conflicts and of many entangled relations. The main lines of German manorialism are not radically different from those of France and England. The communal element, the *Dorfverband*, is usually more strongly developed than in France, and assumes a form more akin to the English township. But there were regions, *e.g.* Westphalia, where the population had settled in separate farms (*Hofsystem*), and where the communal solidarity was reduced to a union for administrative purposes and for the use of pasture.

It need hardly be added that every step in the direction of more active economic intercourse and more efficient public authority tended to lessen the influence of the manorial system in so far as the latter was based on the localization of government, natural husbandry and aristocratic authority.

See Fustel de Coulanges, *Histoire des institutions de la France*, especially the volumes " L' Alleu et le domaine rural " and " L'Invasion germanique "; Beaudouin, Les Grands domaines dans l'empire romain " (*Nouvelle revue de droit français et étranger*, 1898); J. Flach, *Les Origines de l'ancienne France*, I., II., III. (1886); Paul Viollet, *Histoire des institutions de la France*, I., II. (1890, 1898); A. Luchaire, *Manuel des institutions françaises* (1892); G. Waitz, *Deutsche Verfassungsgeschichte*, I.–VIII. (1865–1883); K. T. von Inama-Sternegg, *Deutsche Wirtschaftsgeschichte*, I., II. (1879–1891); K. Lamprecht, *Deutsches Wirthschaftsleben*, I.–IV. (1885); A. Meitzen, *Ansiedelungen, Wanderungen und Agrarwesen der Völker Europas*, I.–IV. (1895 ff.); W. Wittich, *Die Grundherrschaft in Nordwestdeutschland* (1896); G. F. von Maurer, *Geschichte der Mark-, Dorf- und Hofverfassung in Deutschland*; and F. Seebohm, *The English Village Community* (1883). (P. Vi.)

The Manor in England.—It will be most convenient to describe a typical English manor in its best known period, the 13th century, and to indicate briefly the modifications of the type which varying conditions may produce. Topographically such a manor consisted partly of the houses of the inhabitants more or less closely clustered together, and surrounded by arable land divided into large fields, two or three in number. Each of these fields was divided again into shots or furlongs, and each of the shots was broken up into cultivated strips a pole wide, each containing an acre, separated by narrow balks of turf. There were also certain meadows for supplying hay; and beyond the cultivated land lay the wood and waste of the manor. Portions of arable or meadow land might be found apart from the organization of the remainder; the lord of the manor might have a park, and each householder a garden, but the land of the manor was the open fields, the meadows and the wastes or common. The condition of the inhabitants of such a manor is as complex as its geography.

Rights of Lord and Tenants.

At the head of the society came the lord of the manor, with his hall, court, or manor-house, and the land immediately about it, and his demesne both in the fields and in the meadow land. The arable demesne consisted of certain of the acre strips lying scattered over the various furlongs; his meadow was a portion assigned to him each year by the custom of the manor. He had also rights over the surrounding waste paramount to those enjoyed by the other inhabitants. Part of his demesne land would be granted out to free tenants to hold at a rent or by military or other service; part would be in the lord's own hands, and cultivated by him. Each part so granted out will carry with it a share in the meadow land and in the profits of the waste. These rights of the free tenants over the waste limited the lord's power over it. He could not by enclosure diminish their interest in it. The statute of Merton in 1236 and the second statute of Westminster in 1285 marked the utmost limit of enclosure allowed in the 13th century. Below the lord and the free tenants came the villeins, natives, bondmen, or holders of *virgates* or yard-lands, each holding a house, a fixed number of acre strips, a share of the meadow and of the profits of the waste. The number of strips so held was usually about thirty; but virgates of fifteen acres or even eighty are not unknown. In any one manor, however, the holdings of all the villeins were equal.

Rights of Villeins.

Normally the holder of a virgate was unfree; he had no rights in the eye of the law against his lord, who was protected from all suits by the *exceptio villenagii*; he could not without leave quit the manor, and could be reclaimed by process of law if he did; the strict contention of law deprived him of all right to hold property; and in many cases he was subject to certain degrading incidents, such as *merchet* (*merchetum*), a payment due to the lord upon the marriage of a daughter, which was regarded as a special mark of unfree condition. But there are certain limitations to be made. Firstly, all these incidents of tenure, even merchet, might not affect the personal status of the tenant; he might still be free, though holding by an unfree tenure; secondly, even if unfree, he was not exposed to the arbitrary will of his lord but was protected by the custom of the manor as interpreted by the manor court. Moreover, he was not a slave, he was not bought and sold apart from his holding. The hardship of his condition lay in the services due from him. As a rule a villein paid for his holding in money, in labour and in kind. In money he paid, firstly, a small fixed rent called rent of assize; and, secondly, dues under various names, partly in lieu of services commuted into money payments, and partly for the privileges and profits enjoyed by him on the waste of the manor. In labour he paid more heavily. Week by week he had to come with his own plough and oxen to plough the lord's demesne; when ploughing was done he had to harrow, to reap the crops, to thresh and carry them, or do whatever might be required of him, until his allotted number of days' labour in the year was done. Beyond this his lord might request of him extra days in harvest or other seasons of emergency, and these requests could not be denied. Further, all the carriage of the manor was provided by the villeins, even to places as much as a hundred miles away from the manor. The mending of the ploughs, hedging, ditching, sheepshearing and other miscellaneous work also fell upon him, and it is sometimes hard to see what time remained to him to work upon his own holding. In kind he usually rendered honey, eggs, chickens and perhaps a ploughshare, but these payments were almost always small in value.

Cotters.

Another class of inhabitants remains to be mentioned—the cotters. These are the poor of the manor, who hold a cottage and garden, or perhaps one acre or half an acre in the fields. They were unfree in condition, and in most manors their services were modelled upon those of the villeins. From their ranks were usually drawn the shepherd of the manor, the bee-keeper and other minor officials of the manor.

A complicated organization necessarily involves administrators. Just as the services of the tenants and even their names vary from manor to manor, so does the nature of the staff. Highest in rank came the steward; he was attached to no manor in particular, but controlled a group, travelling from one to another to take accounts, to hold the courts, and generally represent the lord.

Staff.

Under him are the officers of the several manors. First came the bailiff or beadle, the representative of the lord in the manor; his duty was to collect the rents and services, to gather in the lord's crops and account for the receipts and expenditure of the manor. Closely connected with him was the " messor " or reaper; in many cases, indeed, "reaper" seems to have been only another name for the bailiff. But the villeins were not without their own officer, the provost or reeve. His duty was to arrange the distribution of the services due from the tenants, and, as their representative, to assist the bailiff in the management of the manor. Sometimes the same man appears to have united both offices, and we find the reeve accounting to the lord for the issues of the manor.

To these important officials may be added a number of smaller ones, the shepherd, the swineherd, the beekeeper, the cowherd, the ploughman and so on, mostly selected from the cotters, and occupying their small holdings by the services expressed in their titles. The number varies with the constitution and needs of each estate, and they are often replaced by hired labour.

Manor Court.

The most complicated structure in the system is the manor court. The complication is, indeed, partly the work of lawyers interpreting institutions they did not understand by formulae not adapted to describe them. But beyond this there remain the facts that the court was the meeting-point of the lord and the tenants both free and unfree, that any question touching on the power and constitution of the court was bound to affect the interests of the lord and the tenants, and that there was no external power capable of settling such questions as did arise. Amid this maze a few clear lines can be laid down. In the first place, so far as the 13th century goes, all the discussion that has collected about the terms court leet, court baron and court customary may be put aside; it relates to questions which in the 13th century were only just emerging. The manor court at that date exercised its criminal, civil, or manorial jurisdiction as one court; its names may differ, the parties before it may be free or unfree, but the court is the same. Its president was the lord's steward; the bailiff was the lord's representative and the public prosecutor; and the tenants of the manor, both free and unfree, attended at the court and gave judgment in the cases brought before it. To modern ears the constitution sounds unfamiliar. The president of the court settled the procedure of the court, carried it out, and gave the final sentence, but over the law of the court he had no power. All that is comprised in the word "judgment" was settled by the body of tenants present at the court. This attendance was, indeed, compulsory, and absence subjected to a fine any tenant owing and refusing the service known as "suit of court." It may be asked who in these courts settled questions of fact. The answer must be that disputed questions of fact could only be settled in one way, by ordeal; and that in most manorial courts the method employed was the wager of law. The business of the court may be divided into criminal, manorial and civil. Its powers under the first head depended on the franchises enjoyed by the lord in the particular manor; for the most part only petty offences were triable, such as small thefts, breaches of the assize of bread and ale, assaults, and the like; except under special conditions, the justice of great offences remained in the king. But offences against the custom of the manor, such as bad ploughing, improper taking of wood from the lord's woods, and the like, were of course the staple criminal business of the court. Under the head of manorial business the court dealt with the choice of the manorial officers, and had some power of making regulations for the management of the manor; but its most important function was the recording of the surrenders and admittances of the villein tenants. Into the history and meaning of this form of land transfer it is not necessary to enter here. But it must be noted that the conveyance of a villein's holding was effected by the vendor surrendering his land to the lord, who thereupon admitted the purchaser to the holding. The same procedure was employed in all cases of transfer of land, and the transaction was regularly recorded upon the rolls of the court among the records of all the other business transacted there. Finally, the court dealt with all suits as to land within the manor, questions of dower and inheritance, and with civil suits not connected with land. But it need hardly be said that in an ordinary rural manor very few of these would occur.

It will be clear on consideration that the manor court as here described consisted of conflicting elements of very different origin and history. Founded partly on express grants of franchises, partly on the inherent right of a feudal lord to hold a court for his free tenants, partly on the obscure community traceable among the unfree inhabitants of the manor, it is incapable of strict legal definition. All these elements, moreover, contain in themselves reasons for the decay which gradually came over the system. The history of the decay of the manorial jurisdictions in England has not yet been written. On the one hand were the king's courts, with new and improved processes of law; on the other hand the gradual disintegration which marks the history of the manor during the 14th and 15th centuries. The criminal jurisdiction was the first to disappear, and was closely followed by the civil jurisdiction over the free tenants; and in modern times all that is left is the jurisdiction over the customary tenants and their holdings, and that in an attenuated form.

A few words must be given to the legal theories of the 15th century on the manor court. It would seem to have become the law that to the existence of the manor two courts were necessary—a court customary for customary tenants, and a court baron for free tenants. In the court customary the lord's steward is the judge; in the court baron the freeholders are the judges. If the freeholders in the manor diminish to less than two in number the court baron cannot be held, and the manor perishes. Nor can it be revived by the grant of new freehold tenures, because under the statute of *Quia Emptores* such new freeholders would hold not of the lord of the manor, but of his lord. The customary tenants and the court customary may survive, but the manor is only a reputed manor. Of the 13th century all this is untrue, but even at that date the existence of free tenants was in a measure essential to the existence of the manor court. If there were none the jurisdiction of the court over free tenants of course collapsed; but in addition to this the lord also lost his power of exercising the highest criminal franchises, even if he otherwise possessed them; he could, for instance, no longer hang a murderer on his own gallows. Perhaps it may be said that to the exercise of the feudal power and of the royal franchises the presence of free tenants was necessary. But it is clear that no such condition was necessary to the existence of the manor.

Apart from the change in the court of the manor, the most important thread in its history is the process which converted the villein into the copyholder. Here again the subject is imperfectly explored, and part of it is still subject to controversy. In the strict view of contemporary lawyers the holding of the villein tenant of the 13th century was at the will of the lord, and the king's courts of law would not protect him in his possession. If, however, the villein were a tenant on the king's ancient demesne his condition was improved. The writs of *monstraverunt* and the little writ of right close protected him from the improper exaction of services and from ejection by the lord. But in ordinary manors there was no such immunity. That ejection was common cannot be believed, but it was legally possible; and it was not until the well-known decision of Danby, C.J., and Bryan, C.J., in 7 Edw. IV., that the courts of law would entertain an action of trespass brought against his lord by a customary tenant. From that date the courts, both of law and equity, begin to intervene; and the records of the Courts of Star Chamber and Requests show that in the Tudor period equitable suits brought by tenants against their lords are not infrequent. Side by side with the alteration in the legal condition of the manor there went on an economic change. The labour rents and other services slowly disappeared, and were replaced by money payments. The field divisions gave way before inclosures, effected sometimes by the lords and sometimes by the tenants. Change in legal and agricultural practice went on side by side, and finally the manor ceased to be an important social form, and became only a peculiar form of land tenure and the abode of antiquarian curiosities.

See G. L. von Maurer, *Einleitung in die Geschichte der Hof-, Mark-, Dorf- und Stadtverfassung in Deutschland* (Erlangen, 1856); G. Nasse, *Zur Geschichte der mittelälterlichen Feldgemeinschaft in England* (Bonn, 1869); H. S. Maine, *Village Communities in the East and West* (Cambridge, 1872); F. Seebohm, *The English Village Community* (1883); W. J. Ashley, *English Economic History*, pts. i. ii. (1888–1893); F. W. Maitland, *Select Pleas in Manorial Courts* (London, Selden Society, 1888); P. Vinogradoff, *Villainage in England* (Cambridge, 1892); *The Growth of the Manor* (1905) and *English Society in the 11th Century* (1908); A. Meitzen, *Siedelung und Agrarwesen der Westgermanen und Ostgermanen* (Berlin, 1896); W. Cunningham, *Growth of English Industry and Commerce* (Cambridge, 1896); F. Pollock and F. W. Maitland, *History of English Law* (Cambridge, 1896); F. W. Maitland, *Doomsday Book and Beyond* (Cambridge, 1897); and C. M. Andrews, *The Old English Manor* (1892).

(C. G. Cr.)

MANOR-HOUSE (Lat. *manerium*; Fr. *manoir*), in architecture, the name given to the dwelling-house of the lord of the manor. The manor-house was generally arranged for defence against robbers and thieves and was often surrounded by a moat with drawbridge, but was not provided with a keep or with towers or lofty curtain walls so as to stand a siege. The early buildings were comparatively small, square in plan, comprising a hall with one or two adjacent chambers; at a later period wings were added, thus forming three sides of a quadrangle, like the house designed by John Thorpe as his residence, the plan of which is among his drawings in the Soane Museum. One of the most ancient examples is the manor-house built by Richard Cœur de Lion at Southampton as a rendezvous when he was about to cross into France. This consisted of a hall and chapel on the first floor, with cellars on the ground floor; the walls of this structure, with the chimney-piece, are still in existence. The distinction between the "manor-house" and "castle" is not always very clearly defined; in France such buildings as the castles of Aydon (Northumberland) and of Stokesay (Shropshire) would be regarded as manor-houses in that they were built as country houses and not as fortresses, like Coucy and Pierrefonds; some of the smaller castles in France were, in the 16th century, transformed into manor-houses by the introduction of windows on the second floors of their towers and the partial destruction of their curtain walls, as in the manor-houses of Sedières (Corrèze), Nantouillet and Compiègne; and in the same century, as at Chenonceaux, Blois and Chambord, though angle towers and machicolated parapets still formed part of the design, they were considered to be purely decorative features. The same is found in England; thus in Thornbury and Hurstmonceaux castles, and in Cowdray House, the fortifications were more for show than for use. There is an interesting example of a French manor-house near Dieppe, known as the Manoir-d'Ango, built in 1525, of which a great portion still exists, where the proprietor Ango received François I., so that it must have been of considerable size.

In England the principal examples of which remains exist are the manor-houses of Appleton, Berkshire, with a moat; King John's house at Warnford (Hampshire); Boothby Ragnell, Lincolnshire, with traces of moat; Godmersham, Kent; Little Wenham Hall, Suffolk, built partly in brick and flint, and one of the earliest in which the bricks, probably imported from Flanders, are found; Charney Hall, Berkshire (T-shaped in plan in two storeys); Longthorpe House, near Peterborough; Stokesay, Shropshire, already referred to; Cottesford, Oxfordshire; Woodcroft, Northamptonshire; Acton Burnell, Shropshire; Old Soar, Plaxtol, Kent, in two storeys, the ground storey vaulted and used as cellar and storehouse, and the upper floor with hall, solar and chapel. The foundation of all these dates from the 13th century. Ightham Mote, Kent, portions of which, with the moat, date from the 14th century, is one of the best preserved manor-houses; then follow Norborough Hall, Northamptonshire; Creslow manor-house, Bucks, with moat; Sutton Courtenay, Berkshire; the Court Lodge, Great Chart, Kent; Stanton St Quentin, Great Chalfield, and South Wraxhall, all in Wilts; Meare manor-house, Somerset; Ockwell, Berks; Kingfield manor-house, Derbyshire; Kirby Muxloe, Leicestershire; Stoke Albany, Northamptonshire; and, in the 16th century, Large Marney Hall, Essex (1520); Sutton Place, Surrey (1530); the Vyne, Hampshire, already influenced by the first Renaissance. In the 17th and 18th centuries the manor-house is generally rectangular in plan, and, though well and solidly built, would seem to have been erected more with a view to internal comfort than to exterior embellishments. There is one other type of manor-house, which partakes of the character of the castle in its design, and takes the form of a tower, rectangular or square, with angle turrets and in several storeys; in France it is represented by the manor-houses of St Medard near Bordeaux and Camarsae (Dordogne), and in England by Tattershall Castle, Lincolnshire and Middleton Tower, Norfolk, both being in brick. (R. P. S.)

MANRESA, a town of north-eastern Spain, in the province of Barcelona, on the river Cardoner and the Barcelona-Lérida railway. Pop. (1900), 23,252. Manresa is the chief town of the highlands watered by the Cardoner and upper Llobregat, which meet below the town, and are also connected by a canal 18 m. long. Two bridges, one built of stone and dating from the Roman period, the other constructed of iron in 1804, unite the older and larger part of Manresa with the modern suburbs on the right bank of the river. The principal buildings are the collegiate church of Santa Maria de la Séo, the Dominican monastery, and the church of San Ignazio, built over the cavern (*cueva santa*) where Ignatius de Loyola spent most of the year 1522 in penitentiary exercises and the composition of his *Exercitia spiritualia*. Santa Maria is a fine example of Spanish Gothic, and consists, like many Catalan churches, of nave and chancel, aisles and ambulatory, without transepts. One of its chief treasures is an exquisite 15th-century Florentine altar-frontal, preserved in the sacristy. The Dominican monastery, adjoining the *cueva santa*, commands a magnificent view of the Montserrat (*q.v.*), and is used for the accommodation of the pilgrims who yearly visit the cavern in thousands. Manresa has important iron-foundries and manufactures of woollen, cotton and linen goods, ribbons, hats, paper, soap, chemicals, spirits and flour. Building-stone is quarried near the town.

Manresa is probably the *Munorisa* of the Romans, which was the capital of the Jacetani or Jaccetani, an important tribe of the south-eastern Pyrenees. A large portion of the town was burned by the French in 1811.

MANRIQUE, GÓMEZ (1412?–1490?), Spanish poet, soldier, politician and dramatist, was born at Amusco. The fifth son of Pedro Manrique, *adelantado mayor* of León, and nephew of Santillana (*q.v.*), Gómez Manrique was introduced into public life at an early age, took a prominent part against the constable Álvaro de Luna during the reign of John II., went into opposition against Miguel Lucas de Iranzo in the reign of Henry IV., and declared in favour of the infanta Isabel, whose marriage with Ferdinand he promoted. Besides being a distinguished soldier, he acted as a moderating political influence and, when appointed *corregidor* of Toledo, was active in protecting the converted Jews from popular resentment. His will was signed on the 31st of May 1490, and he is known to have died before the 16th of February 1491. He inherited the literary taste of his uncle Santillana, and was greatly esteemed in his own age; but his reputation was afterwards eclipsed by that of his nephew Jorge Manrique (*q.v.*), whose *Coplas* were continually reproduced. Gómez Manrique's poems were not printed till 1885, when they were edited by Antonio Paz y Melia. They at once revealed him to be a poet of eminent merit, and it seems certain that his *Consejos*, addressed to Diego Arias de Avila, inspired the more famous *Coplas* of his nephew. His didactic verses are modelled upon those of Santillana, and his satires are somewhat coarse in thought and expression; but his place in the history of Spanish literature is secure as the earliest Spanish dramatist whose name has reached posterity. He wrote the *Representación del nascimiento de Nuestro Señor*, a play on the Passion, and two *momos*, or interludes, played at court.

MANRIQUE, JORGE (1440?–1478), Spanish poet and soldier, was born probably at Paredes de Nava. The fourth son of Rodrigo Manrique, count de Paredes, he became like the rest of his family a fervent partisan of Queen Isabel, served with great distinction in many engagements, and was made *comendador* of Montizón in the order of Santiago. He was killed in a skirmish near the fortress of Garci-Muñoz in 1478, and was buried in the church attached to the convent of Uclés. His love-songs, satires, and acrostic verses are merely ingenious compositions in the taste of his age; he owes his imperishable renown to a single poem, the *Coplas por la muerte de su padre*, an elegy of forty stanzas on the death of his father, which was apparently first printed in the *Cancionero llamado de Fray Inigo de Mendosa* about the year 1482. There is no foundation for the theory that Manrique drew his inspiration from an Arabic poem by Abu 'l-Bakā Sālih ar-Rundi; the form of the *Coplas* is influenced by the *Consejos* of his uncle, Gómez Manrique, and the matter derives from the Bible, from Boethius and from other sources readily accessible. The great sonorous commonplaces on death are vitalized by the intensely personal grief of the poet, who lent a new solemnity and significance to thoughts which had been for centuries the common property of mankind. It was given to Jorge Manrique to have one single moment of sublime expression, and this isolated achievement has won him a fame undimmed by any change of taste during four centuries.

The best edition of the *Coplas* is that issued by R. Foulché-Delbosc in the *Bibliotheca hispanica*; the poem has been admirably translated by Longfellow. Manrique's other verses were mostly printed in Hernando del Castillo's *Cancionero general* (1511).

MANSE (Med. Lat. *mansa*, *mansus* or *mansum*, from *manere*, to dwell, remain), originally a dwelling-house together with a portion of land sufficient for the support of a family. It is defined by Du Cange (*Glossarium*, *s.v. Mansus*) as . . . *certam agri portionem quae coleretur et in qua coloni aedes esset*. The term was particularly applied, in ecclesiastical law, to the house and glebe to which every church was entitled by common right, the rule of canon law being *sancitum est ut unicuique ecclesiae unus mansus integer absque ullo servitio tribuatur* (Phillimore, *Eccles. Law*, 1895, ii. 1125). The word is now chiefly used for the residence of a minister of the Established Church of Scotland; to this every minister of a rural parish is entitled, and the landed proprietors must build and keep it up. "Manse" is also loosely used for the residence of a minister of various Free Church denominations (see GLEBE).

MANSEL, HENRY LONGUEVILLE (1820–1871), English philosopher, was born at Cosgrove, Northamptonshire (where his father, also Henry Longueville Mansel, fourth son of General John Mansel, was rector), on the 6th of October 1820. He was educated at Merchant Taylors' School and St John's College, Oxford. He took a double first in 1843, and became tutor of his college. He was appointed reader in moral and metaphysical philosophy at Magdalen College in 1855, and Waynflete professor in 1859. He was a great opponent of university reform and of the Hegelianism which was then beginning to take root in Oxford. In 1867 he succeeded A. P. Stanley as professor of ecclesiastical history, and in 1868 he was appointed dean of St Paul's. He died on the 31st of July 1871.

The philosophy of Mansel, like that of Sir William Hamilton, was mainly due to Aristotle, Kant and Reid. Like Hamilton, Mansel maintained the purely formal character of logic, the duality of consciousness as testifying to both self and the external world, and the limitation of knowledge to the finite and "conditioned." His doctrines were developed in his edition of Aldrich's *Artis logicae rudimenta* (1849)—his chief contribution to the reviving study of Aristotle—and in his *Prolegomena logica: an Inquiry into the Psychological Character of Logical Processes* (1851, 2nd ed. enlarged 1862), in which the limits of logic as the "science of formal thinking" are rigorously determined. In his Bampton lectures on *The Limits of Religious Thought* (1858, 5th ed. 1867; Danish trans. 1888) he applied to Christian theology the metaphysical agnosticism which seemed to result from Kant's criticism, and which had been developed in Hamilton's *Philosophy of the Unconditioned*. While denying all knowledge of the supersensuous, Mansel deviated from Kant in contending that cognition of the ego as it really is is itself a fact of experience. Consciousness, he held—agreeing thus with the doctrine of "natural realism" which Hamilton developed from Reid—implies knowledge both of self and of the external world. The latter Mansel's psychology reduces to consciousness of our organism as extended; with the former is given consciousness of free will and moral obligation. A summary of his philosophy is contained in his article "Metaphysics" in the 8th edition of the *Encyclopaedia Britannica* (separately published, 1860). Mansel wrote also *The Philosophy of the Conditioned* (1866) in reply to Mill's criticism of Hamilton; *Letters, Lectures, and Reviews* (ed. Chandler, 1873), and *The Gnostic Heresies* (ed. J. B. Lightfoot, 1875, with a biographical sketch by Lord Carnarvon). He wrote a commentary on the first two gospels in the *Speaker's Commentary*.

See J. W. Burgon, *Lives of Twelve Good Men* (1888–1889); James Martineau, *Essays, Reviews and Addresses* (London, 1891), iii. 117 seq.; A. W. Benn, *History of Rationalism* (1906), ii. 100–112; Masson, *Recent British Philosophy* (3rd ed., London, 1877), pp. 252 seq.; Sir Leslie Stephen in *Dict. Nat. Biog.*

MANSFELD, the name of an old and illustrious German family which took its name from Mansfeld in Saxony, where it was seated from the 11th to the 18th century One of its earliest members was Hoyer von Mansfeld (d 1115), a partisan of the emperor Henry V. during his struggles with the Saxons; he fought for Henry at Warnstädt and was killed in his service at Welfesholz. Still more famous was Albert, count of Mansfeld (1480–1560), an intimate friend of Luther and one of the earliest and staunchest supporters of the Reformation. He helped to crush the rising of the peasants under Thomas Munzer in Thuringia in 1525; he was a member of the league of Schmalkalden, and took part in all the movements of the Protestants against Charles V. With Albert was associated his brother Gebhard, and another member of the family was Johann Gebhard, elector of Cologne from 1558 to 1562. A scion of another branch of the Mansfelds was Peter Ernst, Fürst von Mansfeld (1517–1604), governor of Luxemburg, who unlike his kinsmen was loyal to Charles V. He went with the emperor to Tunis and fought for him in France. He was equally loyal to his son, Philip II. of Spain, whom he served at St Quentin and in the Netherlands. He distinguished himself in the field and found time to lead a body of troops to aid the king of France against the Huguenots. In this capacity he was present in 1569 at the battle of Moncontour, where another member of his family, Count Wolrad of Mansfeld (d. 1578) was among the Huguenot leaders. The Mansfeld family became extinct in 1780 on the death of Josef Wenzel Nepomuk, prince of Fondi, the lands being divided between Saxony and Prussia.

See L. F. Niemann, *Geschichte der Grafen von Mansfeld* (Aschersleben, 1834).

MANSFELD, ERNST, GRAF VON (*c.* 1580–1626), German soldier, was an illegitimate son of Peter Ernst, Fürst von Mansfeld, and passed his early years in his father's palace at Luxemburg. He gained his earliest military experiences in Hungary, where his half-brother Charles (1543–1595,) also a soldier of renown, held a high command in the imperial army. Later he served under the Archduke Leopold, until that prince's ingratitude, real or fancied, drove him into the arms of the enemies of the house of Habsburg. Although remaining a Roman Catholic he allied himself with the Protestant princes, and during the earlier part of the Thirty Years' War he was one of their foremost champions. He was despatched by Charles Emmanuel, duke of Savoy, at the head of about 2000 men to aid the revolting Bohemians when war broke out in 1618. He took Pilsen, but in the summer of 1619 he was defeated at Zablat; after this he offered his services to the emperor Ferdinand II. and remained inactive while the titular king of Bohemia, Frederick V., elector palatine of the Rhine, was driven in headlong rout from Prague. Mansfeld, however, was soon appointed by Frederick to command his army in Bohemia, and in 1621 he took up his position in the Upper Palatinate, successfully resisting the efforts made by Tilly to dislodge him. From the Upper he passed into the Rhenish Palatinate. Here he relieved Frankenthal and took Hagenau; then, joined by his master, the elector Frederick, he defeated Tilly at Wiesloch in April 1622 and plundered Alsace and Hesse. But Mansfeld's ravages were not confined to the lands of his enemies; they were ruinous to the districts he was commissioned to defend. At length Frederick was obliged to dismiss Mansfeld's troops from his service. Then joining Christian of Brunswick the count led his army through Lorraine, devastating the country as he went, and in August 1622 defeating the Spaniards at Fleurus. He next entered the service of the United Provinces and took up his quarters in East Friesland, capturing fortresses and inflicting great hardships upon the inhabitants. A mercenary and a leader of mercenaries, Mansfeld often interrupted his campaigns by journeys made for the purpose of raising money, or in other words of selling his services to the highest bidder, and in these diplomatic matters he showed considerable skill. About 1624 he paid three visits to London, where he was hailed as a hero by the populace, and at least one to Paris. James I. was anxious to furnish him with men and money for the recovery of the palatinate, but it was not until January 1625 that Mansfeld and his army of "raw and poor rascals" sailed from Dover to the Netherlands. Later in the year, the Thirty Years' War having been renewed under the leadership of Christian IV., king of Denmark, he re-entered Germany to take part therein. But on the 25th of April 1626 Wallenstein inflicted a severe defeat upon him at the bridge of Dessau. Mansfeld, however, quickly raised another army, with which he intended to attack the hereditary lands of the house of Austria, and pursued by Wallenstein he pressed forward towards Hungary, where he hoped to accomplish his purpose by the aid of Bethlem Gabor, prince of Transylvania. But when Gabor changed his policy and made peace with the emperor, Mansfeld was compelled to disband his troops. He set out for Venice, but when he reached Rakowitza he was taken ill, and here he died on the 29th of November 1626. He was buried at Spalato.

See F. Stieve, *Ernst von Mansfeld* (Munich, 1890); R. Reuss, *Graf Ernst von Mansfeld im böhmischen Kriege* (Brunswick, 1865); A. C. de Villermont, *Ernest de Mansfeldt* (Brussels, 1866); L. Graf Uetterodt zu Schaffenberg, *Ernst Graf zu Mansfeld* (Gotha, 1867); J. Grossmann, *Des Grafen Ernst von Mansfeld letzte Pläne und Thaten* (Breslau, 1870); E. Fischer, *Des Mansfelders Tod* (Berlin, 1873); S. R. Gardiner, *History of England*, vols. iv. and v. (1901); J. L. Motley, *Life and Death of John of Barneveld* (ed. 1904; vol. ii.).

MANSFIELD, RICHARD (1857–1907), American actor, was born on the 24th of May 1857, in Berlin, his mother being Madame [Erminia] Rudersdorff (1822–1882), the singer, and his father, Maurice Mansfield (d. 1861), a London wine merchant. He first appeared on the stage at St George's Hall, London, and then drifted into light opera, playing the Major-General in *The Pirates of Penzance*, and the Lord High Executioner in *The Mikado*, both in the English provinces and in America. In 1883 he joined A.M. Palmer's Union Square theatre company in New York, and made a great hit as Baron Chevrial in *A Parisian Romance*. He appeared successfully in several plays adapted from well-known stories, and his rendering (1887) of the doubled title-parts in R. L. Stevenson's *Strange Case of Dr Jekyll and Mr Hyde* created a profound impression. It was with this play that he made his London reputation during a season (1888) at the Lyceum theatre, by invitation of Henry Irving. He produced Richard III. the next year at the Globe. Among his other chief successes were *Prince Karl*, *Cyrano de Bergerac* and *Monsieur Beaucaire*. He was one of the earliest to produce G. Bernard Shaw's plays in America, appearing in 1894 as Bluntschli in *Arms and the Man*, and as Dick Dudgeon in *The Devil's Disciple* in 1897. As a manager and producer of plays Mansfield was remarkable for his lavish staging. He died in New London, Connecticut, on the 30th of August 1907.

See the lives by Paul Wilstach (1908) and William Winter (1910).

MANSFIELD, WILLIAM MURRAY, 1st Earl of (1705–1793), English judge, was born at Scone in Perthshire, on the 2nd of March 1705. He was a younger son of David Murray, 5th Viscount Stormont (*c.* 1665–1731), the dignity having been granted in 1621 by James I. to his friend and helper, Sir David Murray (d. 1631), a Scottish politician of some note. Lord Stormont's family was Jacobite in its politics, and his second son James (*c.* 1690–1728), being apparently mixed up in some of the plots of the time joined the court of the exiled Stuarts and in 1721 was created earl of Dunbar by James Edward, the Old Pretender.

William Murray was educated at Perth grammar school and Westminster School, of which he was a king's scholar. Entering Christ Church, Oxford, he graduated in 1727. A friend of the family, Lord Foley, provided the funds for his legal training, and he became a member of Lincoln's Inn on his departure from Oxford, being called to the bar in 1730. He was a good scholar and mixed with the best literary society, being an intimate friend of Alexander Pope. His appearance in some important Scottish appeal cases brought him into notice, and in Scotland at least he acquired an immense reputation by his appearance for the city of Edinburgh when it was threatened with disfranchisement for the affair of the Porteous mob. His English practice had as yet been scanty, but in 1737 a single speech in a jury trial of note placed him at the head of the bar, and from this time he had all he could attend to. In 1738 he married Lady Elizabeth Finch, daughter of the earl of Winchelsea. His political career began in 1742 with his appointment as solicitor-general. During the next fourteen years he was one of the most conspicuous figures in the parliamentary history of the time. By birth a Jacobite, by association a Tory, he was nevertheless a Moderate, and his politics were really dominated by his legal interests. Although holding an office of subordinate rank, he was the chief defender of the government in the House of Commons, and during the time that Pitt was in opposition had to bear the brunt of his attacks. In 1754 he became attorney-general, and for the next two years acted as leader of the House of Commons under the administration of the duke of Newcastle. But in 1756, when the government was evidently approaching its fall, an unexpected vacancy occurred in the chief justiceship of the king's bench, and he claimed the office, being at the same time raised to the peerage as Baron Mansfield.

From this time the chief interest of his career lies in his judicial work, but he did not wholly dissever himself from politics. He became by a singular arrangement, only repeated in the case of Lord Ellenborough, a member of the cabinet, and remained in that position through various changes of administration for nearly fifteen years, and, although he persistently refused the chancellorship, he acted as Speaker of the House of Lords while the Great Seal was in commission. During the time of Pitt's ascendancy he took but little part in politics, but while Lord Bute was in power his influence was very considerable, and seems mostly to have been exerted in favour of a more moderate line of policy. He was on the whole a supporter of the prerogative, but within definite limits. Macaulay terms him, justly enough, "the father of modern Toryism, of Toryism modified to suit an order of things in which the House of Commons is the most powerful body in the state." During the stormy session of 1770 he came into violent collision with Chatham and Camden in the questions that arose out of the Middlesex election and the trials for political libel; and in the subsequent years he was made the subject of the bitter attacks of Junius, in which his early Jacobite connexions, and his apparent leanings to arbitrary power, were used against him with extraordinary ability and virulence. In 1776 he was created earl of Mansfield. In 1783, although he declined to re-enter the cabinet, he acted as Speaker of the House of Lords during the coalition ministry, and with this his political career may be said to have closed. He continued to act as chief justice until his resignation in June 1788, and after five years spent in retirement died on the 20th of March 1793. He left no family, but his title had been re-granted in 1792 with a direct remainder to his nephew David Murray, 7th Viscount Stormont (1727–1796). The 2nd earl was ambassador to Vienna and then to Paris; he was secretary of state for the southern department from 1779 to 1782, and lord president of the council in 1783, and again from 1794 until his death. In 1906 his descendant Alan David Murray (b. 1864) became 6th earl of Mansfield.

Lord Mansfield's great reputation rests chiefly on his judicial career. The political trials over which he presided, although they gave rise to numerous accusations against him, were conducted with singular fairness and propriety. He was accused with especial bitterness of favouring arbitrary power by the law which he laid down in the trials for libel which arose out of the publications of Junius and Horne Tooke, and which at a later time he reaffirmed in the case of the dean of St Asaph (see Libel). But we must remember that his view of the law was concurred in by the great majority of the judges and lawyers of that time, and was supported by undoubted precedents. In other instances, when the government was equally concerned, he was wholly free from suspicion. He supported Lord Camden's decision against general warrants, and reversed the outlawry of Wilkes. He was always ready to protect the rights of conscience, whether they were claimed by Dissenters or Catholics, and the popular fury which led to the destruction of his house during the Gordon riots was mainly due to the fact that a Catholic priest, who was accused of saying Mass, had escaped the penal laws by his charge to the jury. His chief celebrity, however, is founded upon the consummate ability with which he discharged the civil duties of his office. He has always been recognized as the founder of English mercantile law. The common law as it existed before his time was wholly inadequate to cope with the new cases and customs which arose with the increasing development of commerce. The facts were left to the jury to decide as best they might, and no principle was ever extracted from them which might serve as a guide in subsequent cases. Mansfield found the law in this chaotic state, and left it in a form that was almost equivalent to a code. He defined almost every principle that governed commercial transactions in such a manner that his successors had only to apply the rules he had laid down. His knowledge of Roman and foreign law, and the general width of his education, freed him from the danger of relying too exclusively upon narrow precedents, and afforded him a storehouse of principles and illustrations, while the grasp and acuteness of his intellect enabled him to put his judgments in a form which almost always commanded assent. A similar influence was exerted by him in other branches of the common law; and although, after his retirement, a reaction took place, and he was regarded for a while as one who had corrupted the ancient principles of English law, these prejudices passed rapidly away, and the value of his work in bringing the older law into harmony with the needs of modern society has long been fully recognized.

See Holliday's *Life* (1797); Campbell's *Chief Justices*; Foss's *Judges*; Greville's *Memoirs, passim*; Horace Walpole's *Letters*; and other memoirs and works on the period.

MANSFIELD, a market town and municipal borough in the Mansfield parliamentary division of Nottinghamshire, England, on the small river Mann or Maun; the junction of several branches of the Midland railway, by which it is 142 m. N.N.W. from London. Pop. (1891), 13,094; (1901), 15,250. Area, 7068 acres. The church of St Peter is partly Early Norman; and partly Perpendicular. There is a grammar school founded by Queen Elizabeth in 1561, occupying modern buildings. Twelve almshouses were founded by Elizabeth Heath in 1693, and to these six were afterwards added. There are a number of other charities. The industries are the manufacture of lace, thread, boots and machinery, iron-founding and brewing. In the neighbourhood, as at Mansfield Woodhouse to the north, there are quarries of limestone, sandstone and freestone. The town is governed by a mayor, 6 aldermen and 18 councillors. During the heptarchy Mansfield was occasionally the residence of the Mercian kings, and it was afterwards a favourite resort of Norman sovereigns, lying as it does on the western outskirts of Sherwood Forest. By Henry VIII. the manor was granted to the earl of Surrey. Afterwards it went by exchange to the duke of Newcastle, and thence to the Portland family. The town obtained a fair from Richard II. in 1377. It became a municipal borough in 1891.

MANSFIELD, a city and the county-seat of Richland county, Ohio, U.S.A., about 65 m. S.W. of Cleveland. Pop. (1890), 13,473; (1900), 17,640, of whom 1781 were foreign-born; (1910 census), 20,768. It is served by the Pennsylvania (Pittsburg, Ft Wayne & Chicago division), the Erie, and the Baltimore & Ohio railways. It is built on an eminence (1150 ft.), and has two public parks, a substantial court-house, a soldiers' and sailors' memorial building, a public library, a hospital and many fine residences. It is the seat of the Ohio state reformatory. Mansfield has an extensive trade with the surrounding agricultural country, but its largest interests are in manufactures. The total factory product in 1905 was valued at $7,353,578. There are natural gas wells in the vicinity. The waterworks and the sewage disposal plant are owned and operated by the municipality. Mansfield was laid out in 1808, and was named in honour of Lieut.-Colonel Jared Mansfield (1759–1830), United States surveyor of Ohio and the North-west Territory in 1803–1812, and professor of natural and experimental philosophy at West Point from 1812 to 1828. Mansfield was incorporated as a village in 1828 and was first chartered as a city in 1857. It was the home of John Sherman from 1840 until his death.

MANSION (through O. Fr. *mansion*, mod. *maison*, from Lat. *mansio*, dwelling-place, stage on a journey; *manere*, to remain), a term applied in early English use to the principal house of the lord of a manor. By the Settled Land Act 1890, § 10, subsec. 2, repealing § 15 of the act of 1882, " the principal mansion house . . . on any settled land shall not be sold or exchanged or leased by the tenant for life without the consent of the trustees of the settlement or an order of the court." The principles guiding an English court of law for making or refusing such an order are laid down in *In re the Marquess of Ailesbury's Settled Estate* (1892), 1 Ch. 506, 546; A.C. 356. In general usage, the term " mansion " is given to any large and important house in town or country; and " mansion house " to the official residence, when provided, of the mayor of a borough, particularly to that of the lord mayors of London and Dublin. From the general meaning of a conspicuously large dwelling-place comes the modern employment of the term " mansions," in London and elsewhere, for large buildings composed of " flats."

MANSLAUGHTER (O. Eng., *mannslaeht*, from *mann*, man, and *slaeht*, act of slaying, *sleán*, to slay, properly to smite; cf. Ger. *schlagen*, *Schlacht*, battle), a term in English law signifying " unlawful homicide without malice aforethought " (Stephen, *Digest of the Criminal Law*, Art. 223). The distinction between manslaughter and murder and other forms of homicide is treated under HOMICIDE.

MANSON, GEORGE (1850–1876), Scottish water-colour painter, was born in Edinburgh on the 3rd of December 1850. When about fifteen he was apprenticed as a woodcutter with W. & R. Chambers, with whom he remained for over five years, diligently employing all his spare time in the study and practice of art, and producing in his morning and evening hours water-colours of much delicacy and beauty. In 1871 he devoted himself exclusively to painting. His subjects were derived from humble Scottish life—especially child-life, varied occasionally by portraiture, by landscape, and by views of picturesque architecture. In 1873 he visited Normandy, Belgium and Holland; in the following year he spent several months in Sark; and in 1875 he resided at St Lô, and in Paris, where he mastered the processes of etching. Meanwhile in his water-colour work he had been adding more of breadth and power to the tenderness and richness of colour which distinguished his early pictures, and he was planning more complex and important subjects. But his health had been gradually failing, and he was ordered to Lympstone in Devonshire, where he died on the 27th of February 1876.

A volume of photographs from his water-colours and sketches, with a memoir by J. M. Gray, was published in 1880. For an account of Manson's technical method as a wood engraver see P. G. Hamerton's *Graphic Arts*, p. 311.

MANṢŪR (Arab. " victorious "), a surname (*laqab*) assumed by a large number of Mahommedan princes. The best known are: (1) ABŪ JA'FAR IBN MAHOMMED, second caliph of the Abbasid house, who reigned A.D. 754–775 (see CALIPHATE: § C, §2); (2) ABŪ TĀHIR ISMA'IL IBN AL-QĀIM, the third Fatimite caliph of Africa (946–953) (see FATIMITES); (3) ABŪ YŪSUF YA 'QŪB IBN YŪSUF, often described as Jacob Almanzor, of the Moorish dynasty of the Almohades, conqueror of Alfonso III. in the battle of Alarcos (1195); (4) IBN ABĪ 'ĀMIR MAHOMMED, commonly called Almanzor by European writers, of an ancient but not illustrious Arab family, which had its seat at Torrox near Algeciras. The last-named was born A.D. 939, and began life as a lawyer at Cordova. In 967 he obtained a place at the court of Ḥakam II., the Andalusian caliph, and by an unusual combination of the talents of a courtier with administrative ability rapidly rose to distinction, enjoying the powerful support of Ṣubḥ, the favourite of the caliph and mother of his heir Hishām. The death of Ḥakam (976) and the accession of a minor gave fresh scope to his genius, and in 978 he became chief minister. The weak young caliph was absorbed in exercises of piety, but at first Manṣūr had to share the power with his father-in-law Ghālib, the best general of Andalusia, and with the mother of Hishām. At last a rupture took place between the two ministers. Ghālib professed himself the champion of the caliph and called in the aid of the Christians of Leon; but Manṣūr, anticipating the struggle, had long before remodelled the army and secured its support. Ghālib fell in battle (981); a victorious campaign chastised the Leonese; and on his return to Cordova the victor assumed his regal surname of *al-Manṣūr billah*, and became practically sovereign of Andalusia. The caliph was a mere prisoner of state, and Manṣūr ultimately assumed the title as well as the prerogatives of king (996). Unscrupulous in the means by which he rose to power, he wielded the sovereignty nobly. His strict justice and enlightened administration were not less notable than the military prowess by which he is best known. His arms were the terror of the Christians, and raised the Moslem power in Spain to a pitch it had never before attained. In Africa his armies were for a time hard pressed by the revolt of Zīrī, viceroy of Mauretania, but before his death this enemy had also fallen. Mansūr died at Medinaceli on the 10th of August 1002, and was succeeded by his son Mozaffar.

MANSURA, the capital of the province of Dakahlia, Lower Egypt, near the west side of Lake Menzala, and on the Cairo-Damietta railway. Pop. (1907), 40,279. It dates from 1221, and is famous as the scene of the battle of Mansura, fought on the 8th of February 1250, between the crusaders commanded by the king of France, St Louis, and the Egyptians. The battle was drawn, but it led to the retreat of the crusaders on Damietta, and to the surrender of St Louis. Mansura has several cotton-ginning, cotton, linen and sail-cloth factories.

MANT, RICHARD (1776–1848), English divine, was born at Southampton on the 12th of February 1776, and was educated at Winchester and Trinity College, Oxford. He was elected fellow of Oriel in 1798, and after taking orders held a curacy at Southampton (1802), and then the vicarage of Coggeshall, Essex (1810). In 1811 he was Bampton lecturer, in 1816 was made rector of St Botolph's, and in 1820 bishop of Killaloe and Kilfenoragh (Ireland). In 1823 he was translated to Down and Connor, to which Dromore was added in 1842. In connexion with the Rev. George D'Oyly he wrote a commentary on the whole Bible. Other works by him were the *Psalms in an English Metrical Version* (1842) and a *History of the Church of Ireland* (1839–1841; 2 vols.).

MANTEGAZZA, PAOLO (1831–1910), Italian physiologist and anthropologist, was born at Monza on the 31st of October 1831. After spending his student-days at the universities of Pisa and Milan, he gained his M.D. degree at Pavia in 1854. After travelling in Europe, India and America, he practised as a doctor in the Argentine Republic and Paraguay. Returning to Italy in 1858 he was appointed surgeon at Milan Hospital and professor of general pathology at Pavia. In 1870 he was nominated professor of anthropology at the Instituto di Studii Superiori, Florence. Here he founded the first Museum of Anthropology and Ethnology in Italy, and later the Italian Anthropological Society. From 1865 to 1876 he was deputy for Monza in the Italian parliament, subsequently being elected to the senate. He became the object of bitter attacks on the ground of the extent to which he carried the practice of vivisection. His published works include *Fisiologia del dolore* (1880); *Fisiologia dell' amore* (1896); *Elementi d' igiene* (1875); *Fisonomia e mimica* (1883); *Le Estasi umane* (1887).

MANTEGNA, ANDREA (1431–1506), one of the chief heroes in the advance of painting in Italy, was born in Vicenza, of very humble parentage. It is said that in his earliest boyhood Andrea was, like Giotto, put to shepherding or cattle-herding; this is not likely, and can at any rate have lasted only a very short while, as his natural genius for art developed with singular precocity, and excited the attention of Francesco Squarcione, who entered him in the gild of painters before he had completed his eleventh year.

Squarcione, whose original vocation was tailoring, appears to have had a remarkable enthusiasm for ancient art, and a proportionate faculty for acting, with profit to himself and others, as a sort of artistic middleman; his own performances as a painter were merely mediocre. He travelled in Italy, and perhaps in Greece also, collecting antique statues, reliefs, vases, &c., forming the largest collection then extant of such works, making drawings from them himself, and throwing open his stores for others to study from, and then undertaking works on commission for which his pupils no less than himself were made available. As many as one hundred and thirty-seven painters and pictorial students passed through his school, established towards 1440, which became famous all over Italy. Mantegna was, as he deserved to be, Squarcione's favourite pupil. Squarcione adopted him as his son, and purposed making him the heir of his fortune. Andrea was only seventeen when he painted, in the church of S. Sofia in Padua, a Madonna picture of exceptional and recognized excellence. He was no doubt fully aware of having achieved no common feat, as he marked the work with his name and the date, and the years of his age. This painting was destroyed in the 17th century.

As the youth progressed in his studies, he came under the influence of Jacopo Bellini, a painter considerably superior to Squarcione, father of the celebrated painters Giovanni and Gentile, and of a daughter Nicolosia; and in 1454 Jacopo gave Nicolosia to Andrea in marriage. This connexion of Andrea with the pictorial rival of Squarcione is generally assigned as the reason why the latter became alienated from the son of his adoption, and always afterwards hostile to him. Another suggestion, which rests, however, merely on its own internal probability, is that Squarcione had at the outset used his pupil Andrea as the unavowed executant of certain commissions, but that after a while Andrea began painting on his own account, thus injuring the professional interests of his chief. The remarkably definite and original style formed by Mantegna may be traced out as founded on the study of the antique in Squarcione's atelier, followed by a diligent application of principles of work exemplified by Paolo Uccello and Donatello, with the practical guidance and example of Jacopo Bellini in the sequel.

Among the other early works of Mantegna are the fresco of two saints over the entrance porch of the church of S. Antonio in Padua, 1452, and an altar-piece of St Luke and other saints for the church of S. Giustina, now in the Brera Gallery in Milan, 1453. It is probable, however, that before this time some of the pupils of Squarcione, including Mantegna, had already begun that series of frescoes in the chapel of S. Cristoforo, in the church of S. Agostino degli Eremitani, by which the great painter's reputation was fully confirmed, and which remain to this day conspicuous among his finest achievements.[1] The now censorious Squarcione found much to carp at in the earlier works of this series, illustrating the life of St James; he said the figures were like men of stone, and had better have been coloured stone-colour at once. Andrea, conscious as he was of his own great faculty and mastery, seems nevertheless to have felt that there was something in his old preceptor's strictures; and the later subjects, from the legend of St Christopher, combine with his other excellences more of natural character and vivacity. Trained as he had been to the study of marbles and the severity of the antique, and openly avowing that he considered the antique superior to nature as being more eclectic in form, he now and always affected precision of outline, dignity of idea and of figure, and he thus tended towards rigidity, and to an austere wholeness rather than gracious sensitiveness of expression. His draperies are tight and closely folded, being studied (as it is said) from models draped in paper and woven fabrics gummed. Figures slim, muscular and bony, action impetuous but of arrested energy, tawny landscape, gritty with littering pebbles, mark the athletic hauteur of his style. He never changed, though he developed and perfected, the manner which he had adopted in Padua; his colouring, at first rather neutral and undecided, strengthened and matured. There is throughout his works more balancing of colour than fineness of tone. One of his great aims was optical illusion, carried out by a mastery of perspective which, though not always impeccably correct, nor absolutely superior in principle to the highest contemporary point of attainment, was worked out by himself with strenuous labour, and an effect of actuality astonishing in those times.

Successful and admired though he was in Padua, Mantegna left his native city at an early age, and never afterwards resettled there; the hostility of Squarcione has been assigned as the cause. The rest of his life was passed in Verona, Mantua and Rome—chiefly Mantua; Venice and Florence have also been named, but without confirmation.

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[1] His fellow-workers were Bono of Ferrara, Ansuino of Forlì, and Niccolò Pizzolo, to whom considerable sections of the fresco-paintings are to be assigned. The acts of St James and St Christopher are the leading subjects of the series. St James Exorcizing may have been commenced by Pizzolo, and completed by Mantegna. The Calling of St James to the Apostleship appears to be Mantegna's design, partially carried out by Pizzolo; the subjects of St James baptizing, his appearing before the judge, and going to execution, and most of the legend of St Christopher, are entirely by Mantegna.

It may have been in 1459 that he went to Verona; and he painted, though not on the spot, a grand altar-piece for the church of S. Zeno, a Madonna and angels, with four saints on each side. The Marquis Lodovico Gonzaga of Mantua had for some time been pressing Mantegna to enter his service; and the following year, 1460, was perhaps the one in which he actually established himself at the Mantuan court, residing at first from time to time at Goito, but, from December 1466 onwards, with his family in Mantua itself. His engagement was for a salary of 75 lire (about £30) a month, a sum so large for that period as to mark conspicuously the high regard in which his art was held. He was in fact the first painter of any eminence ever domiciled in Mantua. He built a stately house in the city, and adorned it with a multitude of paintings. The house remains, but the pictures have perished. Some of his early Mantuan works are in that apartment of the Castello which is termed the Camera degli Sposi—full compositions in fresco, including various portraits of the Gonzaga family, and some figures of genii, &c. In 1488 he went to Rome at the request of Pope Innocent VIII., to paint the frescoes in the chapel of the Belvedere in the Vatican; the marquis of Mantua (Federigo) created him a cavaliere before his departure. This series of frescoes, including a noted "Baptism of Christ," was ruthlessly destroyed by Pius VI. in laying out the Museo Pio-Clementino. The pope treated Mantegna with less liberality than he had been used to at the Mantuan court; but on the whole their connexion, which ceased in 1490, was not unsatisfactory to either party. Mantegna then returned to Mantua, and went on with a series of works—the nine tempera-pictures, each of them 9 ft. square, of the "Triumph of Caesar"—which he had probably begun before his leaving for Rome, and which are now in Hampton Court. These superbly invented and designed compositions, gorgeous with all splendour of subject-matter and accessory, and with the classical learning and enthusiasm of one of the master-spirits of the age, have always been accounted of the first rank among Mantegna's works. They were sold in 1628 along with the bulk of the Mantuan art treasures, and were not, as is commonly said, plundered in the sack of Mantua in 1630. They are now greatly damaged by patchy repaintings. Another work of Mantegna's later years was the so-called "Madonna della Vittoria," now in the Louvre. It was painted in tempera about 1495, in commemoration of the battle of Fornovo, which Ginfrancesco Gonzaga found it convenient to represent to his lieges as an Italian victory, though in fact it had been a French victory; the church which originally housed the picture was built from Mantegna's own design. The Madonna is here depicted with various saints, the archangel Michael and St Maurice holding her mantle, which is extended over the kneeling Gianfrancesco Gonzaga, amid a profusion of rich festooning and other accessory. Though not in all respects of his highest order of execution, this counts among the most obviously beautiful and attractive of Mantegna's works—from which the qualities of beauty and attraction are often excluded, in the stringent pursuit of those other excellences more germane to his severe genius, tense energy passing into haggard passion.

Vasari eulogizes Mantegna for his courteous, distinguished and praiseworthy deportment, although there are indications of his having been not a little litigious in disposition. With his fellow-pupils at Padua he had been affectionate; and for two of them, Dario da Trevigi and Marco Zoppo, he retained a steady friendship. That he had a high opinion of himself was natural, for no artist of his epoch could produce more manifest vouchers of marked and progressive attainment. He became very expensive in his habits, fell at times into difficulties, and had to urge his valid claims upon the marquis's attention. After his return to Mantua from Rome his prosperity was at its height, until the death of his wife. He then formed some other connexion, and became at an advanced age the father of a natural son, Giovanni Andrea; and at the last, although he continued launching out into various expenses and schemes, he had serious tribulations, such as the banishment from Mantua of his son Francesco, who had incurred the marquis's displeasure. Perhaps the aged master and connoisseur regarded as barely less trying the hard necessity of parting with a beloved antique bust of Faustina. Very soon after this transaction he died in Mantua, on the 13th of September 1506. In 1517 a handsome monument was set up to him by his sons in the church of S. Andrea, where he had painted the altar-piece of the mortuary chapel.

Mantegna was no less eminent as an engraver, though his history in that respect is somewhat obscure, partly because he never signed or dated any of his plates, unless in one single disputed instance, 1472. The account which has come down to us is that Mantegna began engraving in Rome, prompted by the engravings produced by Baccio Baldini of Florence after Sandro Botticelli; nor is there anything positive to invalidate this account, except the consideration that it would consign all the numerous and elaborate engravings made by Mantegna to the last sixteen or seventeen years of his life, which seems a scanty space for them, and besides the earlier engravings indicate an earlier period of his artistic style. It has been suggested that he began engraving while still in Padua, under the tuition of a distinguished goldsmith, Niccolò. He engraved about fifty plates, according to the usual reckoning; some thirty of them are mostly accounted indisputable—often large, full of figures, and highly studied. Some recent connoisseurs, however, ask us to restrict to seven the number of his genuine extant engravings—which appears unreasonable. Among the principal examples are "Roman Triumphs" (not the same compositions as the Hampton Court pictures), "A Bacchanal Festival," "Hercules and Antaeus," "Marine Gods," "Judith with the Head of Holophernes," the "Deposition from the Cross," the "Entombment," the "Resurrection," the "Man of Sorrows," the "Virgin in a Grotto." Mantegna has sometimes been credited with the important invention of engraving with the burin on copper. This claim cannot be sustained on a comparison of dates, but at any rate he introduced the art into upper Italy. Several of his engravings are supposed to be executed on some metal less hard than copper. The technique of himself and his followers is characterized by the strongly marked forms of the design, and by the oblique formal hatchings of the shadows. The prints are frequently to be found in two states, or editions. In the first state the prints have been taken off with the roller, or even by hand-pressing, and they are weak in tint; in the second state the printing press has been used, and the ink is stronger.

The influence of Mantegna on the style and tendency of his age was very marked, and extended not only to his own flourishing Mantuan school, but over Italian art generally. His vigorous perspectives and trenchant foreshortenings pioneered the way to other artists: in solid antique taste, and the power of reviving the aspect of a remote age with some approach to system and consistency, he distanced all contemporary competition. He did not, however, leave behind him many scholars of superior faculty. His two legitimate sons were painters of only ordinary ability. His favourite pupil was known as Carlo del Mantegna; Caroto of Verona was another pupil, Bonsignori an imitator. Giovanni Bellini, in his earlier works, obviously followed the lead of his brother-in-law Andrea.

The works painted by Mantegna, apart from his frescoes, are not numerous; some thirty-five to forty are regarded as fully authenticated. We may name, besides those already specified—in the Naples Museum, "St Euphemia," a fine early work; in Casa Melzi, Milan, the "Madonna and Child with Chanting Angels" (1461); in the Tribune of the Uffizi, Florence, three pictures remarkable for scrupulous finish; in the Berlin Museum, the "Dead Christ with two Angels"; in the Louvre, the two celebrated pictures of mythic allegory—"Parnassus" and "Minerva Triumphing over the Vices"; in the National Gallery, London, the "Agony in the Garden," the "Virgin and Child Enthroned, with the Baptist and the Magdalen," a late example; the monochrome of "Vestals," brought from Hamilton Palace; the "Triumph of Scipio" (or Phrygian Mother of the Gods received by the Roman Commonwealth), a tempera in chiaroscuro, painted only a few months before the master's death; in the Brera, Milan, the "Dead Christ, with the two Maries weeping," a remarkable *tour de force* in the way of foreshortening, which, though it has a stunted appearance, is in correct technical perspective as seen from all points of view. With all its exceptional merit, this is an eminently ugly picture. It remained in Mantegna's studio unsold at his death, and was disposed of to liquidate debts.

Not to speak of earlier periods, a great deal has been written concerning Mantegna of late years. See the works by Maud Crutwell (1901), Paul Kristeller (1901), H. Thode (1897), Paul Yriarte (1901), Julia Cartwright, *Mantegna and Francia* (1881). (W. M. R.)

MANTELL, GIDEON ALGERNON (1790–1852), English geologist and palaeontologist, was born in 1790 at Lewes, Sussex. Educated for the medical profession, he first practised in his native town, afterwards in 1835 in Brighton, and finally at Clapham, near London. He found time to prosecute researches on the palaeontology of the Secondary rocks, particularly in Sussex—a region which he made classical in the history of discovery. While he was still a country doctor at Lewes his eminence as a geological investigator was fully recognized on the publication of his work on *The Fossils of the South Downs* (1822). His most remarkable discoveries were made in the Wealden formations. He demonstrated the fresh-water origin of the strata, and from them he brought to light and described the remarkable Dinosaurian reptiles known as *Iguanodon*, *Hylaeosaurus*, *Pelorosaurus* and *Regnosaurus*. For these researches he was awarded the Wollaston medal by the Geological Society and a Royal medal by the Royal Society. He was elected F.R.S. in 1825. Among his other contributions to the literature of palaeontology was his description of the Triassic reptile *Telerpeton elginense*. Towards the end of his life Dr Mantell retired to London, where he died on the 10th of November 1852. His eldest son, Walter Baldock Durrant Mantell (1820–1895), settled in New Zealand, and there attained high public positions, eventually being secretary for Crown-lands. He obtained remains of the *Notornis*, a recently extinct bird, and also brought forward evidence to show that the moas were contemporaries of man.

In addition to the works above mentioned Dr Mantell was author of *Illustrations of the Geology of Sussex* (4to, 1827); *Geology of the South-east of England* (1833); *The Wonders of Geology*, 2 vols. (1838; ed. 7, 1857); *Geological Excursions round the Isle of Wight, and along the Adjacent Coast of Dorsetshire* (1847; ed. 3, 1854); *Petrifactions and their Teachings* (1851); *The Medals of Creation* (2 vols., 1854).

MANTES-SUR-SEINE, a town of northern France, capital of an arrondissement in the department of Seine-et-Oise on the left bank of the Seine, 34 m. W.N.W. of Paris by rail. Pop. (1906), 8113. The chief building in Mantes is the celebrated church of Notre-Dame which dates in the main from the end of the 12th century. A previous edifice was burnt down by William the Conqueror together with the rest of the town, at the capture of which he lost his life in 1087; he is said to have bequeathed a large sum for the rebuilding of the church. The plan, which bears a marked resemblance to that of Notre-Dame at Paris, includes a nave, aisles and choir, but no transepts. Three portals open into the church on the west, the two northernmost, which date from the 12th century, being decorated with fine carving; that to the south is of the 14th century and still more ornate. A fine rose-window and an open gallery, above which rise the summits of the western towers, occupy the upper part of the façade. In the interior, chapels dating from the 13th and 14th centuries are of interest. The tower of St Maclou (14th century), relic of an old church and the hôtel de ville (15th to 17th centuries), are among the older buildings of the town, and there is a fountain of the Renaissance period. Modern bridges and a medieval bridge unite Mantes with the opposite bank of the Seine on which the town of Limay is built. The town has a sub-prefecture and a tribunal of first instance. Mantes was occupied by the English from 1346 to 1364, and from 1416 to 1449.

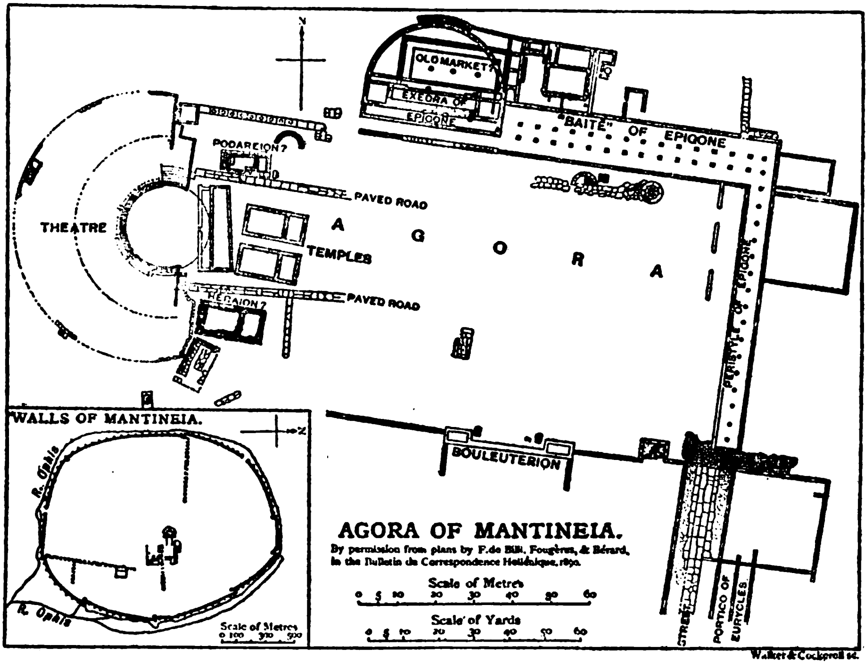
MANTEUFFEL, EDWIN, Freiherr von (1809–1885), Prussian general field marshal, son of the president of the superior court of Magdeburg, was born at Dresden on the 24th of February 1809. He was brought up with his cousin, Otto von Manteuffel (1805–1882), the Prussian statesman, entered the guard cavalry at Berlin in 1827, and became an officer in 1828. After attending the War Academy for two years, and serving successively as aide-de-camp to General von Müffling and to Prince Albert of Prussia, he was promoted captain in 1843 and major in 1848, when he became aide-de-camp to Frederick William IV., whose confidence he had gained during the revolutionary movement in Berlin. Promoted lieutenant-colonel in 1852, and colonel to command the 5th Uhlans in 1853, he was sent on important diplomatic missions to Vienna and St Petersburg. In 1857 he became major-general and chief of the military cabinet. He gave hearty support to the prince regent's plans for the reorganization of the army. In 1861 he was violently attacked in a pamphlet by Karl Twesten (1820–1870), a Liberal leader, whom he wounded in a duel. He served as lieutenant-general (to which rank he was promoted on the coronation of William I., Oct. 18, 1861) in the Danish war of 1864, and at its conclusion was appointed civil and military governor of Schleswig. In the Austrian War of 1866 he first occupied Holstein and afterwards commanded a division under Vogel von Falkenstein in the Hanoverian campaign, and succeeded him, in July, in command of the Army of the Main (see Seven Weeks' War). His successful operations ended with the occupation of Würzburg, and he received the order *pour le mérite*. He was, however, on account of his monarchist political views and almost bigoted Roman Catholicism, regarded by the parliament as a reactionary, and, unlike the other army commanders, he was not granted a money reward for his services. He then went on a diplomatic mission to St Petersburg, where he was *persona grata*, and succeeded in gaining Russia's assent to the new position in north Germany. On returning he was gazetted to the colonelcy of the 5th Dragoons. He was appointed to the command of the IX. (Schleswig-Holstein) army corps in 1866. But having formerly exercised both civil and military control in the Elbe duchies he was unwilling to be a purely military commander under one of his late civil subordinates, and retired from the army for a year. In 1868, however, he returned to active service. In the Franco-German War of 1870–71 he commanded the I. corps under Steinmetz, distinguishing himself in the battle of Colombey-Neuilly, and in the repulse of Bazaine at Noisseville (see Franco-German War; and Metz). He succeeded Steinmetz in October in the command of the I. army, won the battle of Amiens against General Farre, and occupied Rouen, but was less fortunate against Faidherbe at Pont Noyelles and Bapaume. In January 1871 he commanded the newly formed Army of the South, which he led, in spite of hard frost, through the Côte d'Or and over the plateau of Langres, cut off Bourbaki's army of the east (80,000 men), and, after the action of Pontarlier, compelled it to cross the Swiss frontier, where it was disarmed. His immediate reward was the Grand Cross of the order of the Iron Cross, and at the conclusion of peace he received the Black Eagle. When the Southern Army was disbanded Manteuffel commanded first the II. army, and, from June 1871 until 1873, the army of occupation left in France, showing great tact in a difficult position. On leaving France at the close of the occupation, the emperor promoted Manteuffel to the rank of general field marshal and awarded him a large grant in money, and about the same time Alexander II. of Russia gave him the order of St Andrew. After this he was employed on several diplomatic missions, was for a time governor of Berlin, and in 1879, perhaps, as was commonly reported, because he was considered by Bismarck as a formidable rival, he was appointed governor-general of Alsace-Lorraine; and this office he exercised—more in the spirit, some said, of a Prussian than of a German official—until his death at Carlsbad, Bohemia, on the 17th of June 1885.

See lives by v. Collas (Berlin, 1874), and K. H. Keck (Bielefeld and Leipzig, 1890).

MANTINEIA, or Mantinea, an ancient city of Arcadia, Greece, situated in the long narrow plain running north and south, which is now called after the chief town Tripolitsa. Tegea was in the same valley, about 10 m. S. of Mantineia, and the two cities continually disputed the supremacy of the district. In every great war we find them ranged on opposite sides, except when superior force constrained both. The worship and mysteries of Cora at Mantineia were famous. The valley in which the city lies has no opening to the coast, and the water finds its way, often only with much care and artificial aid, through underground passages (*katavothra*) to the sea. It is bounded on the west by Mount Maenalus, on the east by Mount Artemision.

Mantineia is mentioned in the Homeric catalogue of ships, but in early Greek times existed only as a cluster of villages inhabited by a purely agricultural community. In the 6th century it was still insignificant as compared with the neighbouring city of Tegea, and submitted more readily to Spartan overlordship. The political history of Mantineia begins soon after the Persian wars, when its five constituent villages, at the suggestion of Argos, were merged into one city, whose military strength forthwith secured it a leading position in the Peloponnesus. Its policy was henceforth guided by three main considerations. Its democratic constitution, which seems to have been entirely congenial to the population of small freeholders, and its ambition to gain control over the Alpheus watershed and both the Arcadian high roads to the isthmus, frequently estranged Mantineia from Sparta and threw it into the arms of Argos. But the chronic frontier disputes with Tegea, which turned the two cities into bitter enemies, contributed most of all to determine their several policies. About 469 B.C. Mantineia alone of Arcadian townships refused to join the league of Tegea and Argos against Sparta. Though formally enrolled on the same side during the Peloponnesian War the two cities used the truce of 423 to wage a fierce but indecisive war with each other. In the time following the peace of Nicias the Mantineians, whose attempts at expansion beyond Mount Maenalus were being foiled by Sparta, formed a powerful alliance with Argos, Elis and Athens (420), which the Spartans, assisted by Tegea, broke up after a pitched battle in the city's territory (418). In the subsequent years Mantineia still found opportunity to give the Athenians covert help, and during the Corinthian War (394–387) scarcely disguised its sympathy with the anti-Spartan league. In 385 the Spartans seized a pretext to besiege and dismantle Mantineia and to scatter its inhabitants among four villages. The city was reconstituted after the battle of Leuctra and under its statesman Lycomedes played a prominent part in organizing the Arcadian League (370). But the long-standing jealousy against Tegea, and a recent one against the new foundation of Megalopolis, created dissensions which resulted in Mantineia passing over to the Spartan side. In the following campaign of 362 Mantineia, after narrowly escaping capture by the Theban general Epaminondas, became the scene of a decisive conflict in which the latter achieved a notable victory but lost his own life. After the withdrawal of the Thebans from Arcadia Mantineia failed to recover its pre-eminence from Megalopolis, with which city it had frequent disputes. In contrast with the Macedonian sympathies of Megalopolis Mantineia joined the leagues against Antipater (322) and Antigonus Gonatas (266). A change of constitution, imposed perhaps by the Macedonians, was nullified (about 250) by a revolution through which democracy was restored. About 235 B.C. Mantineia entered the Achaean League, from which it had obtained protection against Spartan encroachments, but soon passed in turn to the Aetolians and to Cleomenes III. of Sparta. A renewed defection, inspired apparently by aversion to the aristocratic government of the Achaeans and jealousy of Megalopolis, was punished in 222 by a thorough devastation of the city, which was now reconstituted as a dependency of Argos and renamed Antigoneia in honour of the Achaeans' ally Antigonus Doson. Mantineia regained its autonomous position in the Achaean League in 192, and its original name during a visit of the emperor Hadrian in A.D. 133. Under the later Roman Empire the city dwindled into a mere village, which since the 6th century bore the Slavonic name of Goritza. It finally became a prey to the malaria which arose when the plain fell out of cultivation, and under Turkish rule disappeared altogether.

(M. O. B. C.)



AGORA OF MANTINEIA.

By permission from plans by F. de Bill, Fougères, & Bérard, in the Bulletin de Correspondence Hellénique, 1890.

The site was excavated by M. Fougères, of the French School at Athens, in 1888. The plan of the agora and adjacent buildings has been recovered, and the walls have been completely investigated. The town was situated in an unusual position for a Greek city, on a flat marshy plain, and its walls form a regular ellipse about 2½ m. in circumference. When the town was first formed in 470 B.C. by the "synoecism" of the neighbouring villages, the river Ophis flowed through the midst of it, and the Spartan king Agesipolis dammed it up below the town and so flooded out the Mantineians and sapped their walls, which were of unbaked brick. Accordingly, when the city was rebuilt in 370 B.C., the river Ophis was divided into two branches, which between them encircled the walls; and the walls themselves were constructed to a height of about 3 to 6 feet of stone, the rest being of unbaked brick. These are the walls of which the remains are still extant. There are towers about every 80 ft.; and the gates are so arranged that the passage inwards usually runs from right to left, and so an attacking force would have to expose its right or shieldless side. Within the walls the most conspicuous landmark is the theatre, which, unlike the majority of Greek theatres, consists entirely of an artificial mound standing up from the level plain. Only about a quarter of its original height remains. Its *scena* is of rather irregular shape, and borders one of the narrow ends of the agora. Close to it are the foundations of several temples, one of them sacred to the hero Podares. The agora is of unsymmetrical form; its sides are bordered by porticoes, interrupted by streets, like the primitive agora of Elis as described by Pausanias, and unlike the regular agoras of Ionic type. Most of these porticoes were of Roman period —the finest of them were erected, as we learn from inscriptions, by a lady named Epigone: one, which faced south, had a double colonnade, and was called the Βαίτη: close to it was a large exedra. The foundations of a square market-hall of earlier date were found beneath this. On the opposite side of the agora was an extensive Bouleuterion or senate-house. Traces remain of paved roads both within the agora and leading out of it; but the whole site is now a deserted and feverish swamp. The site is interesting for comparison with Megalopolis; the nature of its plan seems to imply that its main features must survive from the earlier "synoecism" a century before the time of Epaminondas.

See Strabo viii. 337; Pausanias viii. 8; Thucyd. iv. 134, v.; Xenophon, *Hellenica*, iv.-vii.; Diodorus xv. 85–87; Polybius ii. 57 sqq., vi. 43; D. Worenka, *Mantineia* (1905); B. V. Head, *Historia numorum* (Oxford, 1887), pp. 376–377; G. Fougères in *Bulletin de correspondance hellénique* (1890), id. *Mantinée et l'Arcadie orientale* (Paris, 1898). Consult also TEGEA; ARCADIA.

Five battles are recorded to have been fought near Mantineia; 418, 362 (see above), 295 (Demetrius Poliorcetes defeats Archidamus of Sparta), 242 (Aratus beats Agis of Sparta), 207 (Philopoemen beats Machanidas of Sparta). The battles of 362 and 207 are discussed at length by J. Kromayer, *Antike Schlachtfelder in Griechenland* (Berlin, 1903), 27–123, 281–314; *Wiener Studien* (1905), pp. 1–16. (E. GR.)

MANTIS, an insect belonging to the order *Orthoptera*. Probably no other insect has been the subject of so many and widespread legends and superstitions as the common "praying mantis," *Mantis religiosa*, L. The ancient Greeks endowed it with supernatural powers (*μάντις*, a diviner); the Turks and Arabs hold that it prays constantly with its face turned towards Mecca; the Provençals call it *Prega-Diou* (*Prie-Dieu*); and numerous more or less similar names—preacher, saint, nun, mendicant, soothsayer, &c.—are widely diffused throughout southern Europe. In Nubia it is held in great esteem, and the Hottentots, if not indeed worshipping the local species (*M. fausta*), as one traveller has alleged, at least appear to regard its alighting upon any person both as a token of saintliness and an omen of good fortune.

Yet these are "not the saints but the tigers of the insect world." The front pair of limbs are very peculiarly modified—the coxa being greatly elongated, while the strong third joint or femur bears on its curved underside a channel armed on each edge by strong movable spines. Into this groove the stout tibia is capable of closing like the blade of a penknife, its sharp, serrated edge being adapted to cut and hold. Thus armed, with head raised upon the much-elongated and semi-erect prothorax, and with the half-opened fore-limbs held outwards in the characteristic devotional attitude, it rests motionless upon the four posterior limbs waiting for prey, or occasionally stalks it with slow and silent movements, finally seizing it with its knife-blades and devouring it. Although apparently not daring to attack ants, these insects destroy great numbers of flies, grasshoppers and caterpillars, and the larger South-American species even attack small frogs, lizards and birds. They are very pugnacious, fencing with their sword-like limbs "like hussars with sabres," the larger frequently devouring the smaller, and the females the males. The Chinese keep them in bamboo cages, and match them like fighting-cocks.

The common species fixes its somewhat nut-like egg capsules on the stems of plants in September. The young are hatched in early summer, and resemble the adults, but are without wings.

The green coloration and shape of the typical mantis are procryptic, serving to conceal the insect alike from its enemies and prey. The passage from leaf to flower simulation is but a step which, without interfering with the protective value of the coloration so far as insectivorous foes are concerned, carries with it the additional advantage of attracting flower-feeding insects within reach of the raptorial limbs. This method of allurement has been perfected in certain tropical species of *Mantidae* by the development on the prothorax and raptorial limbs of laminate expansions so coloured on the under side as to resemble papilionaceous or other blossoms, to which the likeness is enhanced by a gentle swaying kept up by the insect in imitation of the effect of a lightly blowing breeze. As instances of this may be cited *Idolum diabolicum*, an African insect, and *Gongylus gongyloides*, which comes from India. Examples of another species (*Empusa eugena*) when standing upon the ground deceptively imitate in shape and hue a greenish white anemone tinted at the edges with rose; and Bates records what appears to be a true case of aggressive mimicry practised by a Brazilian species which exactly resembles the white ants it preys upon.

Praying Mantis (*Mantis religiosa*).

MANTIS-FLY, the name given to neuropterous insects of the family *Mantispidae*, related to the ant-lions, lace-wing flies, &c., and named from their superficial resemblance to a *Mantis* owing to the length of the prothorax and the shape and prehensorial nature of the anterior legs. The larva, at first campodeiform, makes its way into the egg-case of a spider or the nest of a wasp to feed upon the eggs or young. Subsequently it changes into a fat grub with short legs. When full grown it spins a silken cocoon in which the transformation into the pupa is effected. The latter escapes from its double case before moulting into the mature insect.

MANTLE, a long flowing cloak without sleeves, worn by either sex. Particularly applied to the long robe worn over the armour by the men-at-arms of the middle ages, the name is still given to the robes of state of kings, peers, and the members of an order of knights. Thus the "electoral mantle" was a robe of office worn by the imperial electors, and the Teutonic knights were known as the *orde alborum mantellorum* from their white mantles. As an article of women's dress a mantle now means a loose cloak or cape, of any length, and made of silk, velvet, or other rich material. The word is derived from the Latin *mantellum* or *mantelum*, a cloak, and is probably the same as, or another form of, *mantelium* or *mantele*, a table-napkin or table-cloth, from *manus*, hand, and *tela*, a cloth. A late Latin *mantum*, from which several Romance languages have taken words (cf. Ital. *manto*, and Fr. *mante*), must, as the *New English Dictionary* points out, be a "back-formation," and this will explain the diminutive form of the Spanish *mantilla*. From the old French *mantel* came the English compounds "mantel-piece," "mantel-shelf," for the stone or wood beam which serves as a support for the structure above a fire-place, together with the whole framework, whether of wood, stone, &c., that acts as an ornament of the same (see CHIMNEYPIECE). The modern French form *manteau* is used in English chiefly as a dressmaker's term for a woman's mantle. "Mantua," much used in the 18th century for a similar garment, is probably a corruption of *manteau*, due to silk or other materials coming from the Italian town of that name, and known by the trade name of "mantuas." The Spanish *mantilla* is a covering for the head and shoulders of white or black lace or other material, the characteristic head-dress of women in southern and central Spain. It is occasionally seen in the other parts of Spain and Spanish countries, and also in Portugal.

"Mantle" is used in many transferred senses, all with the meaning of "covering," as in zoology, for an enclosing sac or integument; thus it is applied to the "tunic" or layer of connective-tissue forming the body-wall of ascidians enclosing muscle-fibres, blood-sinuses and nerves (see TUNICATA). The term is also used for a meshed cap of refractory oxides employed in systems of incandescent lighting (see LIGHTING). The verb is used for the creaming or frothing of liquids and of the suffusing of the skin with blood. In heraldry "mantling," also known as "panache," "lambrequin" or "contoise," is an ornamental appendage to an escutcheon, of flowing drapery, forming a background (see HERALDRY).

MANTON, THOMAS (1620–1677), English Nonconformist divine, was born at Laurence Lydiard, Somerset, in 1620, and was educated at Hart Hall, Oxford. Joseph Hall, bishop of Norwich, ordained him deacon: he never took priest's orders, holding that "he was properly ordained to the ministerial office." He was one of the clerks at the Westminster Assembly, one of Cromwell's chaplains and a "trier," and held livings at Stoke Newington (1645) and St Paul's, Covent Garden (1656). He disapproved of the execution of Charles I. In 1658 he assisted Baxter to draw up the "Fundamentals of Religion." He helped to restore Charles II. and became one of his chaplains, refusing the deanery of Rochester. In 1662 he lost his living under the Act of Uniformity and preached in his own rooms and in other parts of London. For this he was arrested in 1670.

His works are best known in the collected edition by J. C. Ryle (22 vols. 1870–1875).

MAN-TRAPS, mechanical devices for catching poachers and trespassers. They have taken many forms, the most usual being like a large rat-trap, the steel springs being armed with teeth which met in the victim's leg. Since 1827 they have been illegal in England, except in houses between sunset and sunrise as a defence against burglars.

MANTUA (Ital. *Mantova*), a fortified city of Lombardy, Italy, the capital of the province of Mantua, the see of a bishop, and the centre of a military district, 25 m. S.S.W. of Verona and 100 m. E.S.E. of Milan by rail. Pop. (1906), 31,783. It is situated 88 ft. above the level of the Adriatic on an almost insular site in the midst of the swampy lagoons of the Mincio. As the belt of marshy ground along the south side can be laid under water at pleasure, the site of the city proper, exclusive of the considerable suburbs of Borgo di Fortezza to the north and Borgo di San Giorgio to the east, may still be said to consist, as it formerly did more distinctly, of two islands separated by a narrow channel and united by a number of bridges. On the west side lies Lago Superiore, on the east side Lago Inferiore —the boundary between the two being marked by the *Argine del Mulino*, a long mole stretching northward from the north-west angle of the city to the citadel.

On the highest ground in the city rises the cathedral, the interior of which was built after his death according to the plans of Giulio Romano; it has double aisles, a fine fretted ceiling, a dome-covered transept, a bad baroque façade, and a large unfinished Romanesque tower. Much more important architecturally is the church of St Andrea, built towards the close of the 15th century, after plans by Leon Battista Alberti, and consisting of a single, barrel-vaulted nave 350 ft. long by 62 ft. wide. It has a noble façade with a deeply recessed portico, and a brick campanile of 1414. The interior is decorated with 18th-century frescoes, to which period the dome also belongs. Mantegna is buried in one of the side chapels. S. Sebastiano is another work of Alberti's. The old ducal palace—one of the largest buildings of its kind in Europe—was begun in 1302 for Guido Bonaccolsi, and probably completed in 1328 for Ludovico Gonzaga; but many of the accessory apartments are of much later date, and the internal decorations are for the most part the work of Giulio Romano and his pupils. There are also some fine rooms of the early 19th century. Close by are the Piazza dell' Erbe and the Piazza Sordello, with Gothic palaces. The Castello di Corte here, the old castle of the Gonzagas (1395–1406), erected by Bartolino da Novara, the architect of the castle of Ferrara, now contains the archives, and has some fine frescoes by Mantegna with scenes from the life of Ludovico Gonzaga. Outside of the city, to the south of Porta Pusterla, stands the Palazzo del Te, Giulio's architectural masterpiece, erected for Frederick Gonzaga in 1523–1535; of the numerous fresco-covered chambers which it contains, perhaps the most celebrated is the Sala dei Giganti, where, by a combination of mechanical with artistic devices, the rout of the Titans still contending with artillery of uptorn rocks against the pursuit and thunderbolts of Jove appears to rush downwards on the spectator. The architecture of Giulio's own house in the town is also good.

Mantua has an academy of arts and sciences (*Accademia Vergiliana*), occupying a fine building erected by Piermarini, a public library founded in 1780 by Maria Theresa, a museum of antiquities dating from 1779, many of which have been brought from Sabbioneta, a small residence town of the Gonzagas in the late 16th century, a mineralogical museum, a good botanical garden, and an observatory. There are ironworks, tanneries, breweries, oil-mills and flour-mills in the town, which also has printing, furriery, doll-making and playing-card industries. As a fortress Mantua was long one of the most formidable in Europe, a force of thirty to forty thousand men finding accommodation within its walls; but it had two serious defects—the marshy climate told heavily on the health of the garrison, and effective sorties were almost impossible. It lies on the main line of railway between Verona and Modena; and is also connected by rail with Cremona and with Monselice, on the line from Padua to Bologna, and by steam tramway with Brescia and other places.

S. Maria delle Grazie, standing some 5 m. outside the town, was consecrated in 1399 as an act of thanksgiving for the cessation of the plague, and has a curious collection of *ex voto* pictures (wax figures), and also the tombs of the Gonzaga family.

Mantua had still a strong Etruscan element in its population during the Roman period. It became a Roman municipium, with the rest of Gallia Transpadana; but Martial calls it little Mantua, and had it not been for Virgil's interest in his native place, and in the expulsion of a number of the Mantuans (and among them the poet himself) from their lands in favour of Octavian's soldiers, we should probably have heard almost nothing of its existence. In 568 the Lombards found Mantua a walled town of some strength; recovered from their grasp in 590 by the exarch of Ravenna, it was again captured by Agilulf in 601. The 9th century was the period of episcopal supremacy, and in the 11th the city formed part of the vast possessions of Bonifacio, marquis of Canossa. From him it passed to Geoffrey, duke of Lorraine, and afterwards to the countess Matilda, whose support of the pope led to the conquest of Mantua by the emperor Henry IV. in 1090. Reduced to obedience by Matilda in 1113, the city obtained its liberty on her death, and instituted a communal government of its own, *salva imperiali justitia*. It afterwards joined the Lombard League; and the unsuccessful attack made by Frederick II. in 1236 brought it a confirmation of its privileges. But after a period of internal discord Ludovico Gonzaga attained to power (1328), and was recognized as imperial vicar (1329);

and from that time till the death of Ferdinando Carbo in 1708 the Gonzagas were masters of Mantua (see GONZAGA). Under Gian Francesco II., the first marquis, Ludovico III., Gian Francesco III. (whose wife was Isabella d'Este), and Federico II., the first duke of Mantua, the city rose rapidly into importance as a seat of industry and culture. It was stormed and sacked by the Austrians in 1630, and never quite recovered. Claimed in 1708 as a fief of the empire by Joseph I., it was governed for the greater part of the century by the Austrians. In June 1796 it was besieged by Napoleon; but in spite of terrific bombardments it held out till February 1797. A three days' bombardment in 1799 again placed Mantua in the hands of the Austrians; and, though restored to the French by the peace of Lunéville (1801), it became Austrian once more from 1814 till 1866. Between 1849 and 1859, when the whole of Lombardy except Mantua was, by the peace of Villafranca, ceded to Italy, the city was the scene of violent political persecution.

See Gaet. Susani, *Nuovo prospetto delle pitture, &c., di Mantova* (Mantua, 1830); Carlo d'Arco, *Delle arti e degli artefici di Mantova* (Mantua, 1857); and *Storia di Mantova* (Mantua, 1874).

MANU (Sanskrit, "man"), in Hindu mythology, the first man, ancestor of the world. In the Satapatha-Brahmana he is represented as a holy man, the chief figure in a flood-myth. Warned by a fish of the impending disaster he built a ship, and when the waters rose was dragged by the fish, which he harnessed to his craft, beyond the northern mountains. When the deluge ceased, a daughter was miraculously born to him and this pair became the ancestors of the human race. In the later scriptures the fish is declared an incarnation of Brahma. See SANSKRIT LITERATURE; INDIAN LAW (*Hindu*).

MANUAL, *i.e.* belonging to the hand (Lat. *manus*), a word chiefly used to describe an occupation which employs the hands, as opposed to that which chiefly or entirely employs the mind. Particular uses of the word are: "sign-manual," a signature or autograph, especially one affixed to a state document; "manual-exercise," in military usage, drill in the handling of the rifle; "manual alphabet," the formation of the letters of the alphabet by the fingers of one or both hands for communication with the deaf and dumb; and "manual acts," the breaking of the bread, and the taking of the cup in the hands by the officiating priest in consecrating the elements during the celebration of the Eucharist. The use of the word for tools and implements to be used by the hand, as distinct from machinery, only survives in the "manual fire-engine." From the late Latin use of *manuale* as a substantive, meaning "handbook," comes the use of the word for a book treating a subject in a concise way, but more particularly of a book of offices, containing the forms to be used in the administration of the sacraments other than the Mass, but including communion out of the Mass, also the forms for churching, burials, &c. In the Roman Church such a book is usually called a *rituale*, "manual" being the name given to it in the English Church before the Reformation. The keyboard of an organ, as played by the hands, is called the "manual," in distinction from the "pedal" keys played by the feet.

MANUCODE, from the French, an abbreviation of *Manucodiata*, and the Latinized form of the Malay *Manukdewata*, meaning, says Crawfurd (*Malay and Engl. Dictionary*, p. 97), the "bird of the gods," and a name applied for more than two hundred years apparently to birds-of-paradise in general. In the original sense of its inventor, Montbeillard (*Hist. nat. oiscaux*, iii. 163), *Manucode* was restricted to the king bird-of-paradise and three allied species; but in English it has curiously been transferred[1] to a small group of species whose relationship to the *Paradiseidae* has been frequently doubted, and must be considered uncertain. These manucodes have a glossy steel-blue plumage of much beauty, but are distinguished from other birds of similar coloration by the outer and middle toes being united for some distance, and by the extraordinary convolution of the trachea, in the males at least, with which is correlated the loud and clear voice of the birds. The convoluted portion of the trachea lies on the breast, between the skin and the muscles, much as is found in the females of the painted snipes (*Rostratula*), in the males of the curassows (*Cracidae*), and in a few other birds, but wholly unknown elsewhere among the *Passeres*. The manucodes are peculiar to the Papuan sub-region (including therein the peninsula of Cape York), and comprehend, according to R. B. Sharpe (*Cat. B. Brit. Museum*, iii. 164), two genera, for the first of which, distinguished by the elongated tufts on the head, he adopts R. P. Lesson's name *Phonygama*, and for the second, having no tufts, but the feathers of the head crisped, that of *Manucodia*; and W. A. Forbes (*Proc. Zool. Soc.* 1882, p. 349) observed that the validity of the separation was confirmed by their tracheal formation. Of *Phonygama* Sharpe recognizes three species, *P. keraudreni* (the type) and *P. jamesi*, both from New Guinea, and *P. gouldi*, the Australian representative species; but the first two are considered by D. G. Elliot (*Ibis*. 1878, p. 56) and Count Salvadori (*Ornitol. della Papuasia*, ii. 510) to be inseparable. There is a greater unanimity in regard to the species of the so-called genus *Manucodia* proper, of which four are admitted—*M. chalybeata* or *chalybea* from north-western New Guinea, *M. comriei* from the south-eastern part of the same country, *M. atra* of wide distribution within the Papuan area, and *M. jobiensis* peculiar to the island which gives it a name. Little is known of the habits of these birds, except that they are, as already mentioned, remarkable for their vocal powers, which, in *P. keraudreni*, Lesson describes (*Voy. de la Coquille*, "Zoologie," i. 638) as enabling them to pass through every note of the gamut. (A. N.)

MANUEL I., COMNENUS (*c.* 1120–1180), Byzantine emperor (1143–1180), the fourth son of John II., was born about 1120. Having distinguished himself in his father's Turkish war, he was nominated emperor in preference to his elder surviving brother. Endowed with a fine physique and great personal courage, he devoted himself whole-heartedly to a military career. He endeavoured to restore by force of arms the predominance of the Byzantine empire in the Mediterranean countries, and so was involved in conflict with his neighbours on all sides. In 1144 he brought back Raymond of Antioch to his allegiance, and in the following year drove the Turks out of Isauria. In 1147 he granted a passage through his dominions to two armies of crusaders under Conrad III. of Germany and Louis VII. of France; but the numerous outbreaks of overt or secret hostility between the Franks and the Greeks on their line of march, for which both sides were to blame, nearly precipitated a conflict between Manuel and his guests. In the same year the emperor made war upon Roger of Sicily, whose fleet captured Corfu and plundered the Greek towns, but in 1148 was defeated with the help of the Venetians. In 1149 Manuel recovered Corfu and prepared to take the offensive against the Normans. With an army mainly composed of mercenary Italians he invaded Sicily and Apulia, and although the progress of both these expeditions was arrested by defeats on land and sea, Manuel maintained a foothold in southern Italy, which was secured to him by a peace in 1155, and continued to interfere in Italian politics. In his endeavour to weaken the control of Venice over the trade of his empire he made treaties with Pisa and Genoa; to check the aspirations of Frederic I. of Germany he supported the free Italian cities with his gold and negotiated with pope Alexander III. In spite of his friendliness towards the Roman church Manuel was refused the title of "Augustus" by Alexander, and he nowhere succeeded in attaching the Italians permanently to his interests. None the less in a war with the Venetians (1172–74), he not only held his ground in Italy but drove his enemies out of the Aegean Sea. On his northern frontier Manuel reduced the rebellious Serbs to vassalage (1150–52) and made repeated attacks upon the Hungarians with a view to annexing their territory along the Save. In the wars of 1151–53 and 1163–68 he led his troops into Hungary but failed to maintain himself there; in 1168, however, a decisive victory near Semlin enabled him to conclude a peace by which Dalmatia and other frontier strips were ceded to him. In 1169 he sent a joint expedition with King Amalric of Jerusalem to Egypt, which retired after an ineffectual attempt to capture Damietta. In 1158–59 he fought with success against Raymond of Antioch and the Turks of Iconium, but in later wars against the latter he made no headway. In 1176 he was decisively beaten by them in the pass of Myriokephalon, where he allowed himself to be surprised in line of march. This disaster, though partly retrieved in the campaign of the following year, had a serious effect upon his vitality; henceforth he declined in health and in 1180 succumbed to a slow fever.

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[1] *Manucodiata* was used by M. J. Brisson (*Ornithologie*, ii. 130) as a generic term equivalent to the Linnaean *Paradisea*. In 1783 Boddaert, when assigning scientific names to the birds figured by Daubenton, called the subject of one of them (*Pl. enlum.* 634) *Manucodia chalybea*, the first word being apparently an accidental curtailment of the name of Brisson's genus to which he referred it. Nevertheless some writers have taken it as evidence of an intention to found a new genus by that name, and hence the importation of *Manucodia* into scientific nomenclature, and the English form to correspond.

In spite of his military prowess Manuel achieved but in a slight degree his object of restoring the East Roman empire. His victories were counterbalanced by numerous defeats, sustained by his subordinates, and his lack of statesmanlike talent prevented his securing the loyalty of his subjects. The expense of keeping up his mercenary establishment and the sumptuous magnificence of his court put a severe strain upon the financial resources of the state. The subsequent rapid collapse of the Byzantine empire was largely due to his brilliant but unproductive reign. Manuel married, firstly, a sister-in-law of Conrad III. of Germany; and secondly, a daughter of Raymond of Antioch. His successor, Alexis II., was a son of the latter.

See John Cinnamus, *History of John and Manuel* (ed. 1836, Bonn); E. Gibbon, *The Decline and Fall of the Roman Empire* (ed. Bury, London, 1896), v. 229 sqq., vi. 214 sqq.; G. Finlay, *History of Greece* (ed. 1877, Oxford), iii. 143–197; H. v. Kap-Herr, *Die abendländische Politik Kaiser Manuels* (Strassburg, 1881). (M. O. B. C.)

MANUEL II. PALAEOLOGUS (1350–1425), Byzantine emperor from 1391 to 1425, was born in 1350. At the time of his father's death he was a hostage at the court of Bayezid at Brusa, but succeeded in making his escape; he was forthwith besieged in Constantinople by the sultan, whose victory over the Christians at Nicopolis, however (Sept. 28, 1396), did not secure for him the capital. Manuel subsequently set out in person to seek help from the West, and for this purpose visited Italy, France, Germany and England, but without material success; the victory of Timur in 1402, and the death of Bayezid in the following year were the first events to give him a genuine respite from Ottoman oppression. He stood on friendly terms with Mahommed I., but was again besieged in his capital by Murad II. in 1422. Shortly before his death he was forced to sign an agreement whereby the Byzantine empire undertook to pay tribute to the sultan.

Manuel was the author of numerous works of varied character—theological, rhetorical, poetical and letters. Most of these are printed in Migne, *Patrologia graeca*, clvi.; the letters have been edited by E. Legrand (1893). There is a special monograph, by B. de Xivrey (in *Mémoires de l'Institut de France*, xix. (1853), highly commended by C. Krumbacher, whose *Geschichte der byzantinischen Litteratur* (1897) should also be consulted.

MANUEL I. (d. 1263), emperor of Trebizond, surnamed the Great Captain (ὁ *στρατηγικώτατος*), was the second son of Alexius I., first emperor of Trebizond, and ruled from 1228 to 1263. He was unable to deliver his empire from vassalage, first to the Seljuks and afterwards to the Mongols. He vainly negotiated for a dynastic alliance with the Franks, by which he hoped to secure the help of Crusaders.

MANUEL II., the descendant of Manuel I., reigned only a few months in 1332–1333. Manuel III. reigned from 1390 to 1417, but the only interest attaching to his name arises from his connexion with Timur, whose vassal he became without resistance.

See G. Finlay, *History of Greece* (ed. 1877, Oxford), iv. 338–340, 340–341, 386: Ph. Fallmerayer, *Geschichte des Kaisertums Trapezunt* (Munich, 1827), i. chs. 8, 14, ii. chs. 4, 5; T. E. Evangelides, *'Ιστορία τῆς Τραπεζοῦντος* (Odessa, 1898), 71–73, 87–88, 126–132.

MANUEL, EUGENE (1823–1901), French poet and man of letters, was born in Paris, the son of a Jewish doctor, on the 13th of July 1823. He was educated at the École Normale, and taught rhetoric for some years in provincial schools and then in Paris. In 1870 he entered the department of public instruction, and in 1878 became inspector-general. His works include: *Pages intimes* (1866), which received a prize from the Academy; *Poèmes populaires* (1874); *Pendant la guerre* (1871), patriotic poems, which were forbidden in Alsace-Lorraine by the German authorities; *En voyage* (1881), poems; *La France* (4 vols., 1854–1858); a school-book written in collaboration with his brother-in-law, Lévi Alavarès; *Les Ouvriers* (1870), a drama dealing with social questions, which was crowned by the Academy; *L'Absent* (1873), a comedy; *Poésies du foyer et de l'école* (1889), and editions of the works of J. B. Rousseau (1852) and André Chénier (1884). He died in Paris in 1901.

His *Poésies complètes* (2 vols., 1899) contained some fresh poems; to his *Mélanges en prose* (Paris, 1905) is prefixed an introductory note by A. Cahen.

MANUEL, JACQUES ANTOINE (1775–1827), French politician and orator, was born on the 10th of December 1775. When seventeen years old he entered the army, which he left in 1797 to become a lawyer. In 1814 he was chosen a member of the chamber of representatives, and in 1815 he urged the claim of Napoleon's son to the French throne and protested against the restoration of the Bourbons. After this event he actively opposed the government, his eloquence making him the foremost orator among the members of the Left. In February 1823 his opposition to the proposed expedition into Spain to help Ferdinand VII. against his rebellious subjects produced a tumult in the Assembly. Manuel was expelled, but he refused to accept this sentence, and force was employed to remove him. He died on the 20th of August 1827.

MANUEL, LOUIS PIERRE (1751–1793), French writer and Revolutionist, was born at Montargis (Loiret). He entered the Congregation of the Christian Doctrine, and became tutor to the son of a Paris banker. In 1783 he published a pamphlet, called *Essais historiques, critiques, littéraires, et philosophiques*, for which he was imprisoned in the Bastille. He embraced the revolutionary ideas, and after the taking of the Bastille became a member of the provisional municipality of Paris. He was one of the leaders of the *émeutes* of the 20th of June and the 10th of August 1792, played an important part in the formation of the revolutionary commune which assured the success of the latter *coup*, and was made *procureur* of the commune. He was present at the September massacres and saved several prisoners, and on the 7th of September 1792 was elected one of the deputies from Paris to the convention, where he was one of the promoters of the proclamation of the republic. He suppressed the decoration of the Cross of St Louis, which he called a stain on a man's coat, and demanded the sale of the palace of Versailles. His missions to the king, however, changed his sentiments; he became reconciled to Louis, courageously refused to vote for the death of the sovereign, and had to tender his resignation as deputy. He retired to Montargis, where he was arrested, and was guillotined in Paris on the 17th of November 1793. Besides the work cited above and his political pamphlets, he was the author of *Coup d'œil philosophique sur le règne de St Louis* (1786); *L'Année française* (1788); *La Bastille dévoilée* (1789); *La Police de Paris dévoilée* (1791); and *Lettres sur la Révolution* (1792). In 1792 he was prosecuted for publishing an edition of the *Lettres de Mirabeau à Sophie*, but was acquitted.

MANUEL DE MELLO, DOM FRANCISCO (? 1611–1666), Portuguese writer, a connexion on his father's side of the royal house of Braganza, was a native of Lisbon. He studied the Humanities at the Jesuit College of S. Antão, where he showed a precocious talent, and tradition says that at the age of fourteen he composed a poem in *ottava rima* to celebrate the recovery of Bahia from the Dutch, while at seventeen he wrote a scientific work, *Concordancias mathematicas*. The death of his father, Dom Luiz de Mello, drove him early to soldiering, and having joined a contingent for the Flanders war, he found himself in the historic storm of January 1627, when the pick of the Portuguese fleet suffered shipwreck in the Bay of Biscay. He spent much of the next ten years of his life in military routine work in the Peninsula, varied by visits to the court of Madrid, where he contracted a friendship with the Spanish poet Quevedo and earned the favour of the powerful minister Olivares. In 1637 the latter despatched him in company with the conde de Linhares on a mission to pacify the revolted city of Evora, and on the same occasion the duke of Braganza, afterwards King John IV. (for whom he acted as confidential agent at Madrid), employed him to satisfy King Philip of his loyalty to the Spanish crown. In the following year he suffered a short imprisonment in Lisbon. In 1639 he was appointed colonel of one of the regiments raised for service in Flanders, and in June that year he took a leading part in defending Corunna against a French fleet commanded by the archbishop of Bordeaux, while in the following August he directed the embarcation of an expeditionary force of 10,000 men when Admiral Oquendo sailed with seventy ships to meet the French and Dutch. He came safely through the naval defeat in the channel suffered by the Spaniards at the hands of Van Tromp, and on the outbreak of the Catalonian rebellion became chief of the staff to the commander-in-chief of the royal forces, and was selected to write an account of the campaign, the *Historia de la guerra de Cataluña*, which became a Spanish classic. On the proclamation of Portuguese independence in 1640 he was imprisoned by order of Olivares, and when released hastened to offer his sword to John IV. He travelled to England, where he spent some time at the court of Charles I., and thence passing over to Holland assisted the Portuguese ambassador to equip a fleet in aid of Portugal, and himself brought it safely to Lisbon in October 1641. For the next three years he was employed in various important military commissions and further busied himself in defending by his pen the king's title to his newly acquired throne. An intrigue with the beautiful countess of Villa Nova, and her husband's jealousy, led to his arrest on the 19th of November 1644 on a false charge of assassination, and he lay in prison about nine years. Though his innocence was clear, the court of his Order, that of Christ, influenced by his enemies, deprived him of his *commenda* and sentenced him to perpetual banishment in India with a heavy money fine, and the king would not intervene to save him. Owing perhaps to the intercession of the queen regent of France and other powerful friends, his sentence was finally commuted into one of exile to Brazil. During his long imprisonment he finished and printed his history of the Catalonian War, and also wrote and published a volume of Spanish verses and some religious treatises, and composed in Portuguese a volume of homely philosophy, the *Carta de Guia de Casados* and a *Memorial* in his own defence to the king, which Herculano considered "perhaps the most eloquent piece of reasoning in the language." During his exile in Brazil, whither he sailed on the 17th of April 1655, he lived at Bahia, where he wrote one of his *Epanaphoras de varia historia* and two parts of his masterpiece, the *Apologos dialogaes*. He returned home in 1659, and from then until 1663 we find him on and off in Lisbon, frequenting the celebrated *Academia dos Generosos*, of which he was five times elected president. In the last year he proceeded to Parma and Rome, by way of England, and France, and Alphonso VI. charged him to negotiate with the Curia about the provision of bishops for Portuguese sees and to report on suitable marriages for the king and his brother. During his stay in Rome he published his *Obras morales*, dedicated to Queen Catherine, wife of Charles II. of England, and his *Cartas familiares*. On his way back to Portugal he printed his *Obras metricas* at Lyons in May 1665, and he died in Lisbon the following year.

Manuel de Mello's early Spanish verses are tainted with Gongorism, but his Portuguese sonnets and *cartas* on moral subjects are notable for their power, sincerity and perfection of form. He strove successfully to emancipate himself from foreign faults of style, and by virtue of his native genius, and his knowledge of the traditional poetry of the people, and the best Quinhentista models, he became Portugal's leading lyric poet and prose writer of the 17th century. As with Camoens, imprisonments and exile contributed to make Manuel de Mello a great writer. His *Letters*, addressed to the leading nobles, ecclesiastics, diplomats and literati of the time, are written in a conversational style, lighted up by flashes of wit and enriched with apposite illustrations and quotations. His commerce with the best authors appears in the *Hospital das lettras*, a brilliant chapter of criticism forming part of the *Apologos dialogaes*. His comedy in *redondilhas*, the *Auto do Fidalgo Aprendiz*, is one of the last and quite the worthiest production of the school of Gil Vicente, and may be considered an anticipation of Molière's *Le Bourgeois gentilhomme*.

There is no uniform edition of his works, but a list of them will be found in his *Obras morales*, and the various editions are set out in Innocencio da Silva's *Diccionario bibliographico portuguez*. See *Dom Francisco Manuel de Mello, his Life and Writings*, by Edgar Prestage (Manchester, 1905), "D. Francisco Manuel de Mello, documentos biographicos" and "D. Francisco Manuel de Mello, obras autographas e ineditas," by the same writer, in the *Archivo historico portuguez* for 1909. Manuel de Mello's prose style is considered at length by G. Cirot in *Mariana historien* (Bordeaux, 1905), pp. 378 seq. (E. Pr.)

MANUL (*Felis manul*), a long-haired small wild cat from the deserts of Central Asia, ranging from Tibet to Siberia. The coat is long and soft, pale silvery grey or light buff in hue, marked with black on the chest and upper parts of the limbs, with transverse stripes on the loins and rings on the tail of the same hue. The Manul preys upon small mammals and birds. A separate generic name, *Trichaelurus*, has been proposed for this species by Dr K. Satunin.

MANURES AND MANURING. The term "manure" originally meant that which was "worked by hand" (Fr. *manœuvre*), but gradually came to apply to any process by which the soil could be improved. Prominent among such processes was that of directly applying "manure" to the land, manure in this sense being what we now call "farmyard manure" or "dung," the excreta of farm animals mixed with straw or other litter. Gradually, however, the use of the term spread to other materials, some of home origin, some imported, some manufactured by artificial processes, but all useful as a means of improving the fertility of the soil. Hence we have two main classes of manures: (*a*) what may be termed "natural manures," and (*b*) "artificial manures." Manures, again, may be divided according to the materials from which they are made—*e.g.* "bone manure," "fish manure," "wool manure," &c.; or according to the constituents which they mainly supply—*e.g.* "phosphatic manures," "potash manures," "nitrogenous manures," or there may be numerous combinations of these to form mixed or "compound" manures. Whatever it be, the word "manure" is now generally applied to anything which is used for fertilizing the soil. In America the term "fertilizers" is more generally adopted, and in Great Britain the introduction of the "Fertilizers and Feeding Stuffs Act" has effected a certain amount of change in the same direction. The modern tendency to turn attention less to the consideration of manurial applications given to land and more to the physical and mechanical changes introduced thereby in the soil itself, would seem to be carrying the word "manure" back more to its original meaning.

The subject of manures and their application involves a prior consideration of plant life and its requirements. The plant, growing in the soil, and surrounded by the atmosphere, derives from these two sources its nourishment and means of growth through the various stages of its development.

Chemical analysis has shown that plants are composed of water, organic or combustible matters, and inorganic or mineral matters. Water constitutes by far the greater part of a living plant; a grass crop will contain about 75% of water, a turnip crop 89 or 90%. The organic or combustible matters are those which are lost, along with the water, when the plant is burnt; the inorganic or mineral matters are those which are left behind as an "ash" after the burning. The combustible matter is composed of six elements: carbon, hydrogen, oxygen, nitrogen, sulphur and a little phosphorus. About one-half of the combustible matter of plants is carbon. Along with hydrogen and oxygen the carbon forms the cellulose, starch, sugar, &c., which plants contain, and with these same elements and sulphur the carbon forms the albuminoids of plants. The inorganic or mineral matters comprise a comparatively small part of the plant, but they contain, as essential constituents of plant life, the following elements: potassium, calcium, magnesium, iron, phosphorus and sulphur. In addition, other, but not essential, elements are found in the ash *e.g.* sodium, silicon and chlorine, together with small quantities of manganese and other rarer elements.

The above constituents that have been classed as "essential," are necessary for the growth of the plant, and absence of any one will involve failure. This has been shown by growing plants in water dissolved in which are salts of the elements present in plants. By omitting in turn one or other of the elements aforesaid it is found that the plants will not grow after they have used up the materials contained in the seed itself. These elements are accordingly termed "essential," and it therefore becomes necessary to inquire how they are to be supplied.

The atmosphere is the great storehouse of organic plant food. The leaves take up, through their stomata, the carbonic acid and other gases of the atmosphere. The carbonic acid, under the influence of light, is decomposed in the chlorophyll cells, oxygen is given off and carbon is assimilated, being subsequently built up into the various organic bodies forming the plant's structure. It would seem, too, that plants can take up a small quantity of ammonia by their leaves, and also water to some extent, but the free or uncombined nitrogen of the air cannot be directly assimilated by the leaves of plants.

From the soil, on the other hand, the plant obtains, by means of its roots, its mineral requirements, also sulphur and phosphorus, and nearly all its nitrogen and water. Carbon, too, in the case of fungi, is obtained from the decayed vegetable matter in the soil. The roots are able not only to take up soluble salts that are presented to them, but they can attack and render soluble the solid constituents of the soil, thus transforming them into available plant food. In this way important substances, such as phosphoric acid and potash, are supplied to the plant, as also lime. Roots can further supply themselves with nitrogen in the form of nitrates, the ammonia and other nitrogenous bodies undergoing ready conversion into nitrates in the soil. These various mineral constituents, being now transferred to the plant, go to form new tissue, and ultimately seed, or else accumulate in the sap and are deposited on the older tissue.

Whether the nitrogen of the air can be utilized by plants or not has been long and strenuously discussed, Boussingault first, and then Lawes, Gilbert and Pugh, maintaining that there was no evidence of this utilization. But it was always recognized that certain plants, clover for example, enriched the land with nitrogen to an extent greater than could be accounted for by the mere supply to them of nitrates in the soil. Ultimately Hellriegel supplied the explanation by showing that, at all events, certain of the Leguminosae, by the medium of swellings or "nodules" on their roots, were able to fix the atmospheric nitrogen in the soil, and to convert it into nitrates for the use of the plant. This was found to be the result of the action of certain organisms within the nodules themselves, which in turn fed upon the carbohydrates of the plant and were thus living in a state of "symbiosis" with it. So far, however, this has not been shown to be the case with any other plants than the Leguminosae, and, though it is asserted by some that many other plants can take up the nitrogen of the air directly through their leaves, there is no clear evidence as yet of this.

We must now consider how the different requirements of the plant in regard to the elements necessary to maintain its life and to build up its structure affect the question of manuring.

Under conditions of natural growth and decay, when no crops are gathered in, or consumed on the land by live stock, the herbage, on dying down and decaying, returns to the atmosphere and the soil the elements taken from them during life; but, under cultivation, a succession of crops deprives the land of the constituents which are essential to healthy and luxuriant growth. Without an adequate return to the land of the matters removed in the produce, its fertility cannot be maintained for many years. In newly opened countries, where old forests have been cleared and the land brought under cultivation, the virgin soil often possesses at first a high degree of fertility, but gradually its productive power decreases from year to year. Where land is plentiful and easy to be obtained it is more convenient to clear fresh forest land than to improve more or less exhausted land by the application of manure, labour and skill. But in all densely peopled countries, and where the former mode of cultivation cannot be followed, it is necessary to resort to artificial means to restore the natural fertility of the land and to maintain and increase its productiveness. That continuous cropping without return of manure ends in deterioration of the soil is well seen in the case of the wheat-growing areas in America. Crops of wheat were taken one after another, the straw was burned and nothing was returned to the land; the produce began to fall off and the cultivators moved on to fresh lands, there to meet, in time, with the same experience; and now that the available land has been more or less intensely occupied, or that new land is too far removed for ready transport of the produce, it has been found necessary to introduce the system of manuring, and America now manufactures and uses for herself large quantities of artificial and other manures.

That the same exhaustion of soil would go on in Great Britain, if unchecked by manuring, is known to every practical farmer, and, if evidence were needed, it is supplied by the renowned Rothamsted experiments of Lawes and Gilbert, on a heavy land, and also by the more recent Woburn experiments of the Royal Agricultural Society of England, conducted on a light sandy soil. The following table will illustrate this point, and show also how under a system of manuring the fertility is maintained:—

TABLE I.—Showing Exhaustion of Land by continuous Cropping without Manure, and the maintenance of fertility through manuring. (Rothamsted 50 years; Woburn 30 years.)

1. Rothamsted (heavy land).

Crop.	Plot.	Treatment.	Average yield of corn per acre.						
			8 years, 1844–1851.	10 years, 1852–1861.	10 years, 1862–1871.	10 years, 1872–1881.	10 years, 1882–1891.	10 years, 1892–1901.	Average of 50 years, 1852–1901.
			Bush.	Bush.	Bush.	Bush.	Bush.	Bush.	Bush.
Wheat	3	Unmanured continuously	17·2	15·9	14·5	10·4	12·6	12·3	13·1
	2	Farm-yard manure yearly. . . .	28·0	34·2	37·5	28·7	38·2	39·2	35·6
Barley	7–2	Unmanured continuously	—	22·4	17·5	13·7	12·7	10·0	15·3
	1–0	Farm-yard manure yearly. . . .	—	45·0	51·5	50·2	47·6	44·3	47·7

2. Woburn (light land).

Crop.	Plot	Treatment.	Average yield of corn per acre.			
			10 years, 1877–1886.	10 years, 1887–1896.	10 years, 1897–1906.	Average of 30 years, 1877–1906.
			Bush.	Bush.	Bush.	Bush.
Wheat	7	Unmanured continuously	17·4	14·5	10·8	14·2
	11b	Farm-yard manure yearly. . . .	26·7	27·8	24·0	26·2
Barley	7	Unmanured continuously	23·0	18·1	13·3	18·1
	11b	Farm-yard manure yearly. . . .	40·0	39·9	36·6	38·8

Whereas on the heavier and richer land of Rothamsted the produce of unmanured wheat has fallen in 58 years from 17·2 bushels to 12·3 bushels, on the lighter and poorer soil of Woburn it has fallen in 30 years from 17·4 bushels to 10·8 bushels; barley has in 50 years at Rothamsted gone from 22·4 bushels to 10 bushels, whilst at Woburn (which is better suited for barley) it has fallen in 30 years from 23 bushels to 13·3 bushels. At both Rothamsted and Woburn the application of farm-yard manure has kept the produce of wheat and barley practically up to what it was at the beginning, or even increased it. Similar conclusions can be drawn from the use of artificial manures at each of the experimental stations named, exemplifying the fact that with suitable manuring crops of wheat or barley can be grown years after year without the land undergoing deterioration, whereas if left unmanured it gradually declines in fertility. Practical proof has further been given of this in the well-known "continuous corn-growing" system pursued, in his regular farming, by Mr John Prout of Sawbridgeworth, Herts, and subsequently by his son, Mr W. A. Prout, since the year 1862. By supplying, in the form of artificial manures, the necessary constituents for his crops, Mr Prout was enabled to grow year after year, with only an occasional interval for a clover crop and to allow of cleaning the land, excellent crops of wheat, barley and oats, and without, it may be added, the use of farm-yard manure at all.

In considering the economical use of manures on the land regard must be had to the following points: (1) the requirements of the crops intended to be cultivated; (2) the physical condition of the soil; (3) the chemical composition of the soil; and (4) the composition of the manure. Briefly stated, the guiding principle of manuring economically and profitably is to meet the requirements of the crops intended to be cultivated, by incorporating with the soil, in the most efficacious states of combination, the materials in which it is deficient, or which the various crops usually grown on the farm do not find in the land in a sufficiently available condition to ensure an abundant harvest. Soils vary greatly in composition, and hence it will be readily understood that in one locality or on one particular field a certain manure may be used with great benefit, while in another field the same manure has little or no effect upon the produce.

For plant life to thrive certain elements are necessary, viz. carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, among the organic or combustible matters, and among the inorganic or mineral matters, potassium, calcium, magnesium, iron, phosphorus and sulphur. We must now examine the extent to which these necessary elements occur in either of the two great storehouses, the atmosphere and the soil, and how their removal in the form of crops may be made up for by the use of manures, so that the soil may be maintained in a state of fertility. Further, we must consider what functions these elements perform in regard to plant life, and, lastly, the forms in which they can best be applied for the use of crops.

Of carbon, hydrogen and oxygen there is no lack, the atmosphere providing carbonic acid in abundance, and rain giving the elements hydrogen and oxygen, so that these are supplied from natural sources. Iron, magnesium and sulphur also are seldom or never deficient in soils, and do not require to be supplemented by manuring. Accordingly, the elements for which there is the greatest demand by plants, and which the soil does not provide in sufficiency, are nitrogen, phosphorus, potassium, and, possibly, calcium. Manuring, apart from the physical and mechanical advantages which it confers upon soils, practically resolves itself, therefore, into the supply of nitrogen, phosphorus and potassium, and it is with the supply of these that we shall accordingly deal in particular.

1. *Nitrogen.*—Though we are still far from knowing what are the exact functions which nitrogen fulfils in plant life, there is no doubt as to the important part which it plays in the vegetable growth of the plant and in the formation of stem and leaf. Without a sufficiency of nitrogen the plant would be stunted in growth. Its growth, indeed, may be said to be measured by the supply of nitrogen, for while mineral constituents like phosphoric acid and potash are only taken up to the extent that the plant can use them *i.e.* according to its rate of growth, this actual growth itself would seem to be determined by the extent of the nitrogen supply. This it is which causes the ready response given to a crop by the application of some quickly-acting nitrogenous material like nitrate of soda, and which is marked by the dark-green colour produced and the pushing-on of the growth. Similarly, this use of nitrogen, by prolonging growth, defers maturity, while over-use of nitrogen tends to produce increase of leaf and lateness of ripening. Along with this growth of the vegetative portions, and seen, in the case of corn crops, mainly in the straw, there is a corresponding decrease, from the use of nitrogen in excess, in the quality of the grain. In corn a smaller grain and lesser weight per bushel are the result of over-nitrogen manuring. The composition of the grain is likewise affected, becoming more nitrogenous. With crops, however, where rapid green growth is required, nitrogen effects the purpose well, though here, too, over-manuring with nitrogen will tend to produce rankness and coarseness of growth. Experiments at Rothamsted and elsewhere, as well as everyday practice of the farm, bear testimony to the paramount importance of nitrogen-supply, and to the crops it is capable of raising. This applies not only to corn crops of all kinds, but to root crops, grass, potatoes, &c. Leguminous crops alone seem to have no need of it. In view of this practical experience, Liebig's "mineral theory"—according to which he laid down that plants only needed to have mineral constituents, such as phosphoric acid, potash and lime, supplied to them—reads strangely nowadays. The use of mineral manures without nitrogen other than that already present in the soil or supplied in rain has been shown, alike at Rothamsted and Woburn, to produce crops of wheat and barley little better than those from unmanured land. The lack of nitrogen in ordinary cultivated soils is much more marked than is that of mineral constituents, and consequently even with the application of nitrogen alone (as by the use of nitrate of soda or sulphate of ammonia), good crops have been grown for a large number of years. This has been shown both at Rothamsted and at Woburn. On the other hand, experiments at these stations have demonstrated that better and more lasting results are obtained by the judicious use of nitrogenous materials in conjunction with phosphates and potash.

The form in which nitrogen is taken up by plants is mainly, if not wholly, that of nitrates, which are readily-soluble salts. Ammonia and other nitrogenous bodies undergo in the soil, through the agency of nitrifying organisms present in it (*Bacterium nitrificans*, &c.), rapid conversion into nitrates, and as such are easily assimilable by the plant. Similarly, they are the constituents which are most readily removed in drainage, and hence the adequate supply of nitrogen for the plant's use is a constant problem in agriculture. Experiments on the rate of removal of nitrates from the soil by drainage showed that every inch of rain passing through the drains caused a loss of 2½ lb of nitrogen per acre (Voelcker and Frankland). At the same time, soils, as Way showed, have the power of absorbing, in different degrees, ammonia from its solution in water, and when salts of ammonia are passed through soils the ammonia alone is absorbed, the acids passing, generally in combination with lime, into the drainage.

Other experiments at Rothamsted on drainage showed that, though large quantities of ammonia salts were applied to the land, the drainage water contained merely traces of ammonia, but, on the other hand, nitrates in quantity, thus proving that it is as nitrates, and not as ammonia, that plants mainly, if not entirely, take up their nitrogenous food.

From these investigations it follows that much more nitrogen must be added to the land than would be needed to produce a given increase in the crop. Nitrogen, then, being so all-important, the question is, where is it to come from? We have seen that the leaves take up only minute quantities of ammonia, comparatively small amounts are supplied in the rain, dew, snow, &c.,[1] and in the case of Leguminosae alone have we any evidence of plants being able to provide themselves with nitrogen from atmospheric sources. Some few organisms present in fertile soils, *e.g.* *Azotobacter chroococcum*, have also the power, under certain conditions, of fixing the free nitrogen of the atmosphere without the intervention of a "host," but all these sources would be very inadequate to meet the demands of an intensive cultivation. An ordinary fertile arable soil will not show, on analysis, much more than ·15% of nitrogen, and it is evident that the great source of supply of the needed nitrogen must be the direct manuring of the soil with materials containing nitrogen. These materials will be considered in detail later.

2. *Phosphorus.*—This is the most important mineral element which has to be supplied to the soil by the agency of manuring. It occurs in ordinary fertile soils to the extent of only about ·15%, reckoned as phosphoric acid, and though its absence in sufficiency is not so marked or so soon shown under prolonged cultivation as is that of nitrogen, yet the fact that it is needed by all classes of crops, and that its application in manurial form is attended with great benefits, makes its supply one of great importance. From the time that Liebig, in 1840, suggested the treatment of bones with sulphuric acid in order to make them more readily available for the use of crops, and that

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[1] The amount of nitrogen thus deposited annually was found at Rothamsted to be 7·21 lb per acre.

the late Sir John Lawes (in 1843) began the dissolving of mineral phosphates for the purpose of manufacturing superphosphate, the "artificial manure" trade took its rise, and ever since then the whole globe has been exploited for the purpose of obtaining the raw phosphatic materials which form the base of the artificial manures of the past and of the present day. The functions which phosphoric acid fulfils in plant life would appear to be connected rather with the maturing of the plant than with the actual growth of the structure. Phosphates are found concentrated in those parts of the plant where cell growth and reproduction are most active. More especially is this the case with the seed in which phosphates are present in greatest quantity. While nitrogen delays maturity, phosphoric acid has just the opposite effect, and cereal crops not sufficiently supplied with it ripen much more tardily than do others. Moreover, the grain is formed more early when phosphatic manures have been given than when they are withheld. Phosphates increase the proportion of corn to straw, and, as regards the grain itself, they render it less nitrogenous, richer in phosphates, and altogether improve its quality.

While these are the principal functions of phosphates, they also exercise an influence on the young plant in its early stages. This is well seen in the almost universal practice of applying superphosphate to the young turnip or swede crop in order to push it beyond the attack of "fly." Undoubtedly phosphates in readily available form stimulate the young seedling, enabling it to develop root growth, and, later on, causing the plant to "tiller out" well. Phosphoric acid occurs in the soil bound up with the oxides of iron and alumina, or, it may be, with lime, and the extent to which it may become useful to plants will depend largely upon the readiness with which it becomes available. For the purpose of ascertaining this different analytical methods have been suggested, the best known one being that of B. Dyer, in which a 1% solution of citric acid is used as a solvent. As a result of experimenting with Rothamsted soils of known capability it has been put forward that if a soil shows, by this treatment, less than ·01% of phosphoric acid it is in need of phosphatic manuring.

Experiments carried on for many years at Rothamsted and Woburn have clearly established the beneficial effects of phosphatic manuring on corn crops, for though no material increase marks the application of mineral manures in the absence of nitrogen, yet the results when phosphates and nitrogen are used together are very much greater than when nitrogen alone has been applied; and this is true as regards not only the better ripening and quality of the grain, but also as regards the actual crop increase.

With root crops phosphates are almost indispensable; and, owing to the limited power which these crops have of utilizing the phosphoric acid in the soil, the supply of a readily available phosphatic manure like superphosphate is of the highest importance.

The assimilation of phosphoric acid goes on in a cereal crop after the time of flowering and to a later date than does that of nitrogen and potash, and it is ultimately stored in the seed. Soils possess a retentive power for phosphoric acid which enables the latter to be conserved and not removed to any extent by drainage. This function is exercised mainly by the presence of oxide of iron. Alumina acts in a similar way. In the case of soils that contain clay only traces of phosphoric acid are found in the drainage water.

3. *Potassium.*—The element third in importance, which requires to be supplied by manuring, is potassium, or, as it is generally expressed, potash. This in its functions resembles phosphoric acid somewhat, being concerned rather with the mature development of the plant than with its actual increase of growth. Like phosphoric acid, potash is found concentrated throughout the plant in the early stages of its growth, but, unlike it, is in the case of a cereal crop all taken up by the time of full bloom, whereas with phosphoric acid the assimilation continues later. Potash would appear to have an intimate connexion with the quality of crops, and to be favourable to the production of seed and fruit rather than to stem and leaf development. Certain crops, such as vegetables, fruit, hops, as well as root crops generally, make special demands upon potash supply, and, as checking the tendency to over-development of leaf, &c., induced by nitrogenous manures when used alone, potash has great practical importance. Potash appears to be bound up in a special way with the process of assimilation, for it has been clearly shown that whenever potash is deficient the formation of the carbohydrates, such as sugar, starch and cellulose, does not go on properly. Hellriegel and Wilfarth showed by experiment the dependence of starch formation on an adequate supply of potash. Cereal grains remained small and undeveloped when potash was withheld, because the formation of starch did not go on. The same effect has been strikingly shown in the Rothamsted experiments with mangels, a plot receiving potash salts as manure giving a crop of roots nearly 2½ times as heavy as that grown on a plot which has received no potash. In this case the increase is due almost entirely to the sugar and other carbohydrates elaborated in the leaves, and not to any increase of mineral constituents.

The effect of potash on maturity is somewhat uncertain, inasmuch as in the case of grain crops it would appear to delay maturity and to hasten it in that of root crops.

The influence of potash on particular crops is very marked. On clovers and other leguminous crops it is highly beneficial, while on grass land it is of particular importance as inducing the spread of clovers and other leguminous herbage. This is well seen in the Rothamsted grass experiments, where with a mineral manure containing potash one-half of the herbage is leguminous in nature, whereas the same manure without potash gives only 15% of leguminous plants. Similarly, where nitrogen is used by itself and no potash given there are no leguminous plants at all to be found. Potash occurs in an ordinary fertile soil to the extent of about ·20%; a sandy soil will have less, a clay soil may have considerably more. Potash, however, is mostly bound up in the soil in the form of insoluble silicates, and these are often in a far from available form, but require cultivation, the use of lime and other means for getting them acted on by the air and moisture, and so liberating the potash. According to B. Dyer's method of ascertaining the availability of potash in soils, the amount of potash soluble in a 1% citric acid solution should be about ·005%, otherwise the addition of potash manures will be a requisite. In the case of soils containing much lime a larger quantity would, no doubt, be needed.

Potash, like phosphoric acid, is readily retained by soils, and so is not subject to any considerable losses by drainage. This retention is exercised by the ferric-oxide and alumina in soils, but still more so by the double silicates, and to some extent also by the humus of the soil. Potash will be liberated from its salts by the action of lime in the soil, the lime taking the place of the potash. Lime is, therefore, of much importance in setting free fresh stores of potash. Soda salts also, when in considerable excess, are able to liberate potash from its compounds, and to this is probably due, in many cases, the beneficial action attending the use of common salt.

4. *Calcium.*—Though calcium, or lime, is found in sufficiency in most cultivated soils, there are, nevertheless, soils in which lime is clearly deficient and where that deficiency has shown itself in practice. Moreover, so comparatively easy is the removal of lime from the soil by drainage, and so important is the part which lime plays in liberating potash from its compounds, and in helping to retain bases in the soil so that they are not lost in drainage, that the significance of lime cannot be ignored. Further, the availability of both potash and phosphoric acid in the soil has been found to be much increased by the presence of lime. Lime, as carbonate of calcium, is also necessary for the process of nitrification to go on in the soil. Some sandy soils, and even some clays, contain so little lime as to call for the direct supply of lime as an addition to the soil. When this is the case nothing can adequately take the place of lime, and in this sense lime may be called a "manure." In the majority of cases, however, the practice of liming or chalking, which was a common one in former times, was resorted to mainly because of the ameliorating effects it produced on the land, both in a mechanical and in a physical direction. Thus, on clay soil it flocculates the particles, rendering the soil less tenacious of moisture, improving the drainage and making the soil warmer. Nor must the directly chemical results be overlooked, for in addition to those already mentioned, of liberating plant food (chiefly potash and phosphoric acid), retaining bases, and aiding nitrification, lime acts in a special way as regards the sourness or "acidity" which is sometimes produced in land when lime is deficient. In soils that are acid through the accumulation of humic acid nitrification does not go on, and bacterial life is repressed. The addition of lime has the effect of "sweetening" the land, and of restoring its bacterial activity. This acidity is also seen in the occurrence of the disease known as "finger and toe" in turnips, the fungus producing this being one that thrives in an acid soil. It is only found in soils poor in lime, and the only remedy for it is liming. The growth of weeds like spurry, marigold, sorrel, &c., is also a sign of land being wanting in lime. The most striking instance of this "soil acidity" is that afforded by the Woburn experiments, where, on a soil originally poor in lime, the soil has, through the continuous use of ammonia salts, been impoverished of its lime to such an extent that it has become quite sterile and is distinctly acid in character. The application of lime, however, to such a soil has had the effect of quite restoring its fertility.

The amount of lime which soils contain is a very variable one, chalk soils being very rich in lime, whereas sandy and peaty soils are generally very poor in it. If the amount of lime in a soil falls below 1% of carbonate of lime on the dried soil, the soil will sooner or later require liming.

5. *Magnesium.*—This is not known to be deficient in soils, although an essential element in them, and it is seldom directly applied as a manurial ingredient. Some natural potash salts, such as kainit, contain magnesia salts in considerable quantity; but their influence is not known to be of beneficial nature, though, like common salt, magnesia salts will, doubtless, render some of the potash in the soil available. At the same time magnesia salts are not without their influence on crops, and experiments have been undertaken at the Woburn experimental farm and elsewhere to determine the nature of this influence. Carbonate of magnesia has been tried in connexion with potato-growing, and, it is said, with good results.

6. *Iron.*—Iron is another essential ingredient of soil that is found in abundance and does not call for special application in manurial

form. Iron is essential for the formation of chlorophyll in the leaves, and its presence is believed also to be beneficial for the development of colour in flowers, and for producing flavour in fruits and in vines especially. Ferrous sulphate has, partly with this view, and partly for its fungus-resisting properties, been suggested as a desirable constituent of manures. The function performed by ferric oxide in the soil of retaining phosphoric acid, potash and ammonia has been already alluded to.

7. *Sulphur.*—This, the last of the "essential" elements, is seldom specially employed in manurial form. There would appear to be no lack of it for the plant's supply, and it is little required except for the building-up, with carbon, hydrogen, oxygen and nitrogen, of the albuminoids. There are few artificial manures which do not contain considerable amounts of sulphur, notably superphosphate. Sulphate of lime (gypsum) is sometimes applied to the land direct as a way of giving lime; this is employed in the case of clover and hops principally.

Having thus dealt with the essential ingredients which plants must have, and which may require to be supplied to them in the form of additional manures, we may briefly pass over the other constituents found in plants, which may, or may not, be given as manures.

8. *Sodium.*—This is a widely distributed element. The influence of common salt (chloride of sodium) in liberating, when used in large excess, potash from the silicates in which it is combined in the soil has been already referred to, and in this way common salt and also nitrate of soda (the two forms in which soda salts are used as manures) may have some benefit. The principal purpose for which common salt, however, is used, is that of retaining moisture in the land. It is specially useful in a dry season, or for succulent crops such as cabbage, kale, &c., or again for plants of maritime origin (such as mangels), which thrive near the sea shore.

9. *Silicon.*—All soils contain silica in abundance. Though silica forms so large a part of the ash of plants and is especially abundant in the straw of cereals, there is no evidence that it is required in plant life. Popularly, it is believed to "stiffen" the stems of cereals and grasses, but plants grown without it will do perfectly well. It would, however, appear that soluble silica does play some part in enabling phosphoric acid to be better assimilated by the plant. Silicates, however, have not justified their use as direct fertilizers.

10. *Chlorine.*—A certain amount of chlorine is brought down in the rain, and chlorides are also used in the form of common salt, with the effect, as aforesaid, of liberating potash from silicates, when given in excess, but there is no evidence as to any particular part which the chlorine itself plays.

11. *Manganese*, &c.—Manganese occurs in minute quantities in most plants, and it, along with lithium (found largely in the tobacco-plant), caesium, titanium, uranium and other rare elements, may be found in soils. Experiments at the Woburn pot-culture station and elsewhere, point to stimulating effects on vegetation produced by the action of minute doses of salts of these elements, but, so far, their use as manurial ingredients need not be considered in practice.

12. *Humus.*—Though not an element, or itself essential, this body, which may be described as decayed vegetable matter, is not without importance in plant life. Of it, farmyard manure is to a large extent composed, and many "organic manures," as they are termed, contain it in quantity. Dead leaves, decayed vegetation, the stubble of cereal crops and many waste materials add humus to the land, and this humus, by exposure to the air, is always undergoing further changes in the soil, opening it out, distributing carbonic acid through it, and supplying it, in its further decomposition, with nitrogen. The principal effects of humus on the soil are of a physical character, and it exercises particular benefit through its power of retaining moisture. Humus, however, has a distinct chemical action, in that it forms combinations with iron, calcium and ammonia. It thus becomes one of the principal sources of supply of the nitrogenous food of plants, and a soil rich in humus is one rich in nitrogen. The nitrogen in humus is not directly available as a food for plants, but many kinds of fungi and bacteria are capable of converting it into ammonia, from which, by the agency of nitrifying organisms, it is turned into nitrates and made available for the use of plants. Humus is able to retain phosphoric acid, potash, ammonia and other bases. So important were the functions of humus considered at one time that on this Thaer built his "humus theory," which was, in effect, that, if humus was supplied to the soil, plants required nothing more. This was based, however, on the erroneous belief that the carbon, of which the bulk of the plant consists, was derived from the humus of the soil, and not, as we now know it to be, from the carbonic acid of the atmosphere. This theory was in turn replaced by the "mineral theory" of Liebig, and then both of them by the "nitrogen theory" of Lawes and Gilbert.

We pass next to review, in the light of the foregoing, the manures in common use at the present day.

Manures, as already stated, may be variously classified according to the materials they are made from, the constituents which they chiefly supply, or the uses to which they are put. But, except with certain few manures, such as nitrate of soda, sulphate of ammonia and potash salts, which are used purely for one particular purpose, it is impossible to make any definite classification of manures, owing to the fact that the majority of them serve more than one purpose, and contain more than one fertilizing constituent of value. It is only on broad lines, therefore, that any division can be framed. Between so-called "natural" manures like farm-yard manure, seaweed, wool waste, shoddy, bones, &c., which undergo no particular artificial preparation, and maufactured manures like superphosphate, dissolved bones, and other artificially prepared materials, there may, however, be a distinction drawn, as also between these and such materials as are imported and used without further preparation, *e.g.* nitrate of soda, kainit, &c. On the whole, the best classification to attempt is that according to the fertilizing constituents which each principally supplies, and this will be adopted here, with the necessary qualifications.

I.—NITROGENOUS (WHOLLY OR MAINLY) MANURES

These divided themselves into: (*a*) Natural nitrogenous manures; (*b*) imported or manufactured manures.

a. NATURAL NITROGENOUS MANURES

Under this heading come—farm-yard manure; seaweed; refuse cakes and meals; wool dust and shoddy; hoofs and horns; blood; soot; sewage sludge.

Farm-yard Manure.—This is the most important, as well as the most generally used, of all natural manures. It consists of the solid and liquid excreta of animals that are fed at the homestead, together with the material used as litter. The composition of farm-yard manure will vary greatly according to the conditions under which it is produced. The principal determining factors are (1) the nature and age of the animals producing it, (2) the food that is given them, (3) the kind and quantity of litter used, (4) whether it be made in feeding-boxes, covered yards or open yards, (5) the length of time and the way in which it has been stored. The following analysis represents the general composition of well-made farm-yard manure, in which the litter used is straw:—

Water	75·42
*Organic matter	16·52
Oxide of iron and alumina	·36
Lime	2·28
Magnesia	·14
Potash	·48
Soda	·08
†Phosphoric acid	·44
Sulphuric acid	·12
Chlorine	·02
Carbonic acid, &c.	1·38
Silica	2·76
	100·00

*Containing nitrogen = ·59%, which is equal to ammonia . . . . ·72%

†Equal to phosphate of lime . . . . . ·96

Put broadly, farm-yard manure will contain from 65 to 80% of water, from ·45 to ·65% of nitrogen, from ·4 to ·8% of potash, and from ·2 to ·5% of phosphoric acid.

This analysis shows that farm-yard manure contains all the constituents, without exception, which are required by cultivated crops in order to bring them to perfection, and hence it may be called a "perfect" manure. Dung, it may be observed, contains a great variety of organic and inorganic compounds of various degrees of solubility, and this complexity of composition—difficult, if not impossible, to imitate by art—is one of the circumstances which render farm-yard manure a perfect as well as a universal manure.

The excrements of different kinds of animals vary in composition, and those of the same animal will vary according to the nature and quantity of the food given, the age of the animal, and the way it is generally treated. Thus, a young animal which is growing, needs food to produce bone and muscle, and voids poorer dung than one which is fully grown and only has to keep up its condition. Similarly, a milking-cow will produce poorer dung than a fattening bullock. Again, cake-feeding will produce a richer manure than feeding without cake. Straw is the most general litter used, but peat-moss litter, sawdust, &c., may be used, and they will affect the quality of the manure to some extent. Peat-moss is the best absorbent and has a higher manurial value than straw Box-fed manure, and that made in covered yards will suffer much less loss than that made in an open yard. Lastly, manure kept in a heap covered with earth will be much richer than that left in an uncovered heap. The solid and liquid excrements differ much in composition, for, while the former contain principally phosphoric acid, lime, magnesia, and silica and comparatively little nitrogen, the urine is almost destitute of phosphoric acid, and abounds in alkaline salts (including salts of potash) and in nitrogenous organic matters, among which are urea and uric acid, and which on decomposition yield ammonia. Unless, therefore, the two kinds of excrements are mixed, a perfect manure supplying all the needs of the plant is not obtained; care must accordingly be taken to absorb all the urine by the litter. Farm-yard manure, it is well known, is much affected by the length of time and the way in which it has been kept. Fresh dung is soluble in water only to a limited extent, and, in consequence, it acts more slowly on vegetation, and the action lasts longer than when dung is used which has been kept some time; fresh dung is therefore generally used in autumn or winter, and thoroughly rotten dung in spring, when an immediate forcing effect is required.

The changes which farm-yard manure undergoes on keeping, have been made the subject of much inquiry. In Germany, Maercker and Schneidewind; in France, Muntz and Girard; and in England, Voelcker, Wood, Russell and others, have investigated these losses, coming to very similar conclusions concerning them. Perhaps the most complete set of experiments is one conducted at the Woburn experimental station and extending over three years (1899–1901). The dung was cake-fed manure made in feeding-boxes from which no drainage issued, and, after removal, it was kept in a heap, covered with earth. Hence it was made under as good conditions as possible; but, even then, the losses—after deduction for live-weight increase of the animals—were found to be 15% of the total nitrogen of the food, during the making, and 34% (or a further 19%) during storing and by the time the manure came to be put on the land. Accordingly, under ordinary farm conditions it is quite clear that only about 50% of the nitrogen of the food given is recovered in the dung that goes on the land. This is the figure which Lawes and Gilbert suggested in the practical application of their Tables of Compensation for Unexhausted Manure Value.

During the fermentation of dung a large proportion of the non-nitrogenous organic matters disappear in the forms of carbonic acid and water, while another portion is converted into humic acids which fix the ammonia gradually produced from the nitrogenous constituents of the solid and liquid excreta. The mineral matters remain behind entirely in the rotten dung, if care be taken to prevent loss by drainage. For proper decomposition, both air and moisture are requisite, while extreme dryness or too much water will arrest the due fermentation of the mass.

Well-fermented dung is more concentrated and consequently more efficacious than fresh farm-yard manure. Neither fresh nor rotten dung contains any appreciable quantity of volatile ammonia, and there is no advantage from applying gypsum, dilute acid, superphosphate, kainit, or other substances recommended as fixers of ammonia. If dung is carted into the field and spread out at once in thin layers it will suffer comparatively little loss. But if dung be kept for a length of time in shallow heaps, or in open straw-yards and exposed to rain, it loses by drainage a considerable proportion of its most valuable soluble fertilizing constituents. Experiments with farm-yard manure kept in an open yard showed that, after twelve months' exposure to the weather, nearly all the soluble nitrogen and 78·2% of the soluble mineral matters were lost by drainage (A. Voelcker). To prevent this loss, farmyard manure, as had been pointed out, should, whenever possible, be carted into the field, spread out at once, and ploughed in at the convenience of the farmer. It is, however, not always practicable to apply farm-yard manure just at the time it is made, and, as the manure heap cannot be altogether dispensed with, it is necessary to see how the manure may best be kept. The best dung is that made in regular pits or feeding-boxes. In them the urine is thoroughly absorbed, and, the manure being more compact through the constant treading, air enters less freely and the decomposition goes on less rapidly, the volatile matters, in consequence, not being so readily lost. External agents, such as rain, wind, sun, &c., do not affect the manure as they would in the case of open yards. Next best to box-fed manure is that made in covered yards, then that in sheds, and lastly that in open yards. When removed from the box or yard, the manure should be put in a heap upon a floor of clay or well-beaten-down earth, and then be covered with earth. When kept in an open yard, care should be taken not to let spoutings of buildings lead on to it, and if there be a liquid-manure tank, this might be pumped out over the manure again when the latter is too dry.

The advantages of farm-yard manure consist, not only in its supplying all the constituents of plant food, but also in the improved physical condition of the soil which results from its application, inasmuch as the land is thereby kept porous, and air is allowed free access. While, however, farm-yard manure has these advantages, experience has shown that artificial manures, properly selected so as to meet the requirements of the crops intended to be grown on the particular land, may be employed to greater advantage. In farm-yard manure about two-thirds of the weight is water and one-third dry matter; a large bulk thus contains only a small proportion of fertilizing substances, and expense is incurred for carriage of much useless matter when dung has to be carted to distant fields. When a plentiful supply of good farm-yard manure can be produced on the farm or bought at a moderate price in the immediate neighbourhood, it is economy to use it either alone or in conjunction with artificial manures; but when food is dear and fattening does not pay, or farm-yard manure is expensive to buy, it will be found more economical to use artificial manures. This has obtained confirmation from the experience of Mr Prout, at Sawbridgeworth, Herts, where since 1866, successive crops of corn have been grown, and entirely with the use of artificial manures.

The real difficulty with farm-yard manure is to get enough of it, and, if it were available in sufficiency, it would be safe to say that farmers generally would not require to go farther in regard to the manuring of any of the crops of the farm. Moreover, experiments at Rothamsted and Woburn have shown of how "lasting" a character farm-yard manure is, its influence having told for some 15 to 20 years after its application had ceased.

Light land is benefited by farm-yard manure through its supplying to the soil organic matter, and imparting to it "substance" whereby it becomes more consolidated and is better able to retain the manurial ingredients given to it. By improving the soil's moisture-holding capacity, moreover, "burning" of the land is prevented.

With heavy clay soils the advantages are that these are kept more open in texture, drainage is improved, and the soil rendered easier of working. On light land, well-rotted manure is best to apply; and in spring, whereas on heavy land freshly-made, "long," manure is best, and should be put on in autumn or winter.

Farm-yard manure, where the supply is limited, is mostly saved for the root-crop, which, however, generally needs a little superphosphate to start it, as farm-yard manure is not sufficiently rich in this constituent. It serves a great purpose in retaining the needed moisture in the soil for the root crop.

For potato-growing, for vegetables, and in market-gardening, farm-yard manure is almost indispensable. On grass-land and on clover-ley it is also very useful, and in the neighbourhood of large towns is employed greatly for the production of hay.

For corn crops also, and especially for wheat on heavy land, farm-yard manure is much used, and, in a dry season in particular, shows excellent results, though experiments at Rothamsted and Woburn have shown that, on heavy and light land alike, heavier crops of wheat and barley can be produced in average seasons by artificial manures.

Seaweed.—Along the sea-coast seaweed is collected, put in heaps and allowed to rot, being subsequently used on the land, just as farm-yard manure is. According to the nature of the weed and its water-contents, it may have from ·3 to 1% of nitrogen, or more, with potash in some quantity.

Green-manuring.—Though properly belonging to cultivation rather than to manuring, and acting chiefly as a means of improving the condition of the soil, the practice of green-manuring carries with it manurial benefits also, in that it supplies humus and nitrogen to the soil, and provides a substitute for farm-yard manure. The ploughing-in of a leguminous green-crop which has collected nitrogen from the atmosphere should result in a greater accumulation of nitrogen for a succeeding corn-crop, and thus supply the cheapest form of manuring. Green-manuring is most beneficial on light land, poor in vegetable matter.

Manure Cakes, Malt Dust, Spent Hops, &c.—Many waste materials of this kind are used because of their supplying, in the form of nitrogenous organic matter, nitrogen for crop uses. The nitrogen in these is of somewhat slow-acting, but lasting, nature. In addition to nitrogen, some of these materials, *e.g.* rape cake, cotton cake and castor cake, contain appreciable amounts of phosphoric acid and potash. Rape cake, or "land cake," as it is called in Norfolk, is used considerably for wheat. It is also believed to be a preventive of wireworm, and so is often employed for potatoes and root-crops. Rape-seed from which the oil has been extracted by chemical means, and which is called "rape refuse," is made use of in hop-gardens as a slowly acting supplier of nitrogen. It will contain 4 to 5% of nitrogen with 3 to 4% of phosphates. Damaged cotton and other feeding-cakes, no longer fit for feeding, are ground into meal and put on the land. Castor cake is directly imported for manurial purposes, and will have up to 5% of nitrogen with 4 to 5% of phosphates. Spent hops, malt dust and other waste materials are similarly used. The principal use of these materials is on light land, and to give bulk to the soil while supplying nitrogen in suitable form.

Wool-dust, Shoddy, &c.—The clippings from wool, the refuse from cloth factories, silk, fur and hair waste, carpet clippings and similar waste materials are comprised in this category. They are valuable purely for their nitrogen, and should be purchased according to their nitrogen-contents. They are favourite materials with hop-growers and fruit-farmers, whose experience leads them to prefer a manure which supplies its nitrogen in organic form, and which acts continuously, if not too readily. It is the custom in hop-lands to manure the soil annually with large quantities of these waste materials till it has much fertility stored up in it for succeeding crops. According to its nature, wool-dust or shoddy may contain anything from 3% of nitrogen up to 14%.

Leather is another waste material of the same class, but the process of tanning it has undergone makes its nitrogen but very slowly available and it is avoided, in consequence, as a manure.

There have been several processes started with the object of rendering leather more useful as a manure.

Hoofs and Horns.—The clippings and shavings from horn factories are largely used by some hop-growers, and, though very slow in their action, they will contain 14 to 15% of nitrogen. They are sometimes very finely ground and sold as "keronikon," chiefly for use in compound artificial manures.

Dried Blood is another purely nitrogenous material, which however seldom finds its way to the farmer, being used up eagerly by the artificial manure maker. It will contain from 12 to 14% of nitrogen. It is obtained by simply evaporating down the blood obtained from slaughter-houses. It is the most rapidly acting of the organic nitrogenous materials enumerated, and, when obtainable, is a favourite manure with fruit-growers, being also used for root and vegetable growing.

Soot is an article of very variable nature. It owes its manurial value mainly to the ammonia salts it contains, and a good sample will have about 4% of ammonia. It is frequently adulterated, being mixed with ashes, earth, &c. Flue sweepings of factory chimneys are sometimes sold as soot, but possess little value. Besides the ammonia that soot contains, there would undoubtedly seem to be a value attaching to the carbonaceous matter. Soot is a favourite top-dressing for wheat on heavy land, and is efficacious in keeping off slugs, &c. Speaking generally, the lighter a sample of soot is the more likely is it to be genuine.

Sewage Manure.—Where methods of dealing with the solid matters of sewage are in operation, it frequently happens that these matters are dried, generally with the aid of lime, and sold locally. Occasionally they are prepared with the addition of other fertilizing materials and made up as special manures. It may be taken for granted that sewage refuse by itself is not worth transporting to any distance. When made up with lime, the "sludge," as it is generally termed, is often useful because of the lime it contains. But, on the whole, the value of such preparations has been greatly exaggerated. Where land is in need of organic matter, or where it is desirable to consolidate light land by the addition of material of this class, sludge may, however, have decided value on mechanical and physical grounds, but such land requires to be near at hand.

b. Imported or Manufactured Nitrogenous Manures.

These are nitrate of soda; sulphate of ammonia; calcium cyanamide; calcium nitrate.

Nitrate of Soda.—This is the best known and most generally used of purely nitrogenous manures. It comes from the rainless districts of Chile and Peru, from which it was first shipped about the year 1830. By 1899 the export had reached to 1,344,550 tons. It is uncertain what its origin is, but it is generally believed to be the deposit from an ancient sea which was raised by volcanic eruption and its waters evaporated. Another theory puts it as the deposit from the saline residues of fresh-water streams. The crude deposit is termed *caliche*, and from this (which contains common salt and sulphates of soda, potash and lime) the nitrate is crystallized out and obtained as a salt containing 95 to 96% pure nitrate of soda. It is sold on a basis of 95% pure, and is but little subject to adulteration.

As a quickly acting nitrogenous manure nitrate of soda has no equal, and it is in great demand as a top-dressing for corn crops, also for roots. On grass-land, if used alone, it tends to produce grass but to exterminate leguminous herbage. Its tendency with corn crops is to produce, if used in quantity, inferiority of quality in grain. It can be employed in conjunction with superphosphate and other artificial manures, though it should not be mixed with them long before the mixture is to be put on. It is a very soluble salt, and the nitrogen being in the form of nitrates, it can be readily taken up by plants. On the other hand, it is readily removed from the soil by drainage, and its effects last only for a single season. Owing to its solubility, it requires to be used in much larger amount than the crop actually will take up. On a heavy soil it has a bad influence if used repeatedly and in quantity, causing the land to "run," and making the tilth bad. Though, doubtless, exhaustive to the soil, when used alone, there is no evidence yet of nitrate of soda causing land to "run out," as has been shown to be the case with sulphate of ammonia. One cwt. to the acre is a common dressing for corn crops, but for mangels it has been used to advantage up to 4 cwt. per acre. As a top-dressing for corn crops it differs little in its crop-results from its rival sulphate of ammonia, but in a dry season it answers better, owing to its more ready solubility and quicker action, whereas in a wet season sulphate of ammonia does better.

Sulphate of Ammonia.—This is the great competitor with nitrate of soda, and, like the latter, is useful purely as a nitrogenous manure. It is obtained in the manufacture of gas and as a by-product in the distillation of shale, &c., as also from coke ovens. By adding sulphuric acid to the ammoniacal liquor distilled over from the coal, &c., the salt is crystallized out. It is seldom adulterated, and, as sold in commerce, generally contains 24 to 25% of ammonia. It is not quite so readily soluble as nitrate of soda; it does not act quite so quickly on crops, but is less easily removed from the soil by drainage, leaving also a slight amount of residue for a second crop. It is nearly as efficacious as a top-dressing for corn crops as is nitrate of soda, and for some crops, *e.g.* potatoes, it is considered superior. It may also be used like nitrate of soda for root crops. On grass-land its effect in increasing gramineous but reducing leguminous herbage is similar to that of nitrate of soda, but with corn crops it has not the same deteriorating influence on the quality of grain. It can be mixed quite well with superphosphate and other artificial manures, and is therefore a common form in which nitrogen is supplied in compound manures. It does not produce the bad effect on the tilth of certain soils that nitrate of soda does, but it is open to the objection that, if used continually on soil poor in lime, it will gradually exhaust the soil and leave it in an acid condition, so that the soil is unable to bear crops again until fertility is restored by the addition of lime. A usual dressing of sulphate of ammonia is 1 cwt. per acre.

Calcium Cyanamide.—This is a new product which represents the earliest result of the utilization, in a commercial form, of atmospheric nitrogen as a manurial substance. It is obtained by passing nitrogen gas over the heated calcium carbide obtained in the electric furnace, the nitrogen then uniting with the carbide to form calcium cyanamide. The product contains from 19 to 20% of nitrogen, and, though still under trial as a nitrogenous manure, it bids fair to form a valuable source of supply, especially should the natural deposits of nitrate of soda become exhausted. The cost of production limits its manufacture to places where electrical power can be cheaply generated. In its action it would seem to resemble most closely sulphate of ammonia.

Calcium Nitrate.—This is another product of the utilization of atmospheric nitrogen as a manurial agent. Nitrogen and oxygen are made to combine within the electric arc and the nitric acid produced is then combined with lime, forming nitrate of lime. Nitrate of lime contains, as put on the market, about 13% of nitrogen. In its action it should be very similar to nitrate of soda, with, possibly, some added benefit to certain soils by reason of the lime it contains. Like cyanamide, it is still in the experimental stage as regards its agricultural use, and can only be produced where electric power is cheaply obtainable.

Neither material is altogether free from objection, the cyanamide heating when mixed with other manures and even with soil, and being liable to give off acetylene gas owing to the presence of calcium carbide, whereas the calcium nitrate is a salt which on exposure to a moist atmosphere readily deliquesces.

II.—PHOSPHATIC MANURES

Under the heading of manures that are used purely for their phosphatic benefit to the soil are superphosphate and basic slag.

Superphosphate.—This is the typical phosphatic manure, and is the base of the numerous artificial manures used on the farm. Superphosphate is made by dissolving raw phosphatic minerals in sulphuric acid (oil of vitriol), the tribasic phosphate of lime which these contain being converted into the so-called "soluble phosphate," sulphate of lime being formed at the same time. The first impetus to the manufacture of superphosphate was given by Liebig, when he suggested, in 1840, the treatment of bones with oil of vitriol in order to make them act more quickly in the soil. Lawes subsequently, in 1843, applied this to mineral phosphates, using phosphorite, first of all, and the great manufacture of mineral superphosphate then began. Coprolites, as found in Cambridgeshire, Suffolk, Bedfordshire and elsewhere were the raw materials at first employed in the United Kingdom. But gradually the demand for the new manure became so great that distant parts of the world were searched to bring in the raw material for conversion into superphosphate. Many new sources of supply have been worked, and many worked out or abandoned in favour of better and richer phosphates. Among these were the crystalline apatites of Canada and Norway, French, Spanish and German (Lahn) phosphates, and, at a later period, Carolina (land and river), Florida, Tennessee, Somme, Belgian, Algerian and Tunisian phosphates. In addition to these came other materials which, in their origin, were really of the nature of guano, being bird deposits the ammoniacal matters of which were gradually washed out. The mineral matters remained and altered the composition of the original rock on which the guano was deposited, thus forming rich deposits of phosphate of lime. Such were the phosphates obtained from many of the islands of the West Indies and South Pacific, and known under such various names as Sombrero, Curaçao, Aruba, Malden Island, Megillones, Baker Island, Fanning Islands, Lacepedes Islands, &c. guanos. Few of these are now worked, but their place has been largely taken by the rich deposits of Ocean Island and Christmas Island, which are of similar origin. The principal supplies of phosphatic minerals at the present time come from Florida, Algeria, Tunis, Ocean Island and Christmas Island. Other phosphates imported are Redonda and Alta Vela phosphates, but these consist mainly of phosphate of alumina, and are not used for superphosphate manufacture but for phosphorus production.

Coprolites, as formerly used, contained from 50 to 60% of phosphate of lime, but they are not worked now, the richer sources, which are also better adapted for superphosphate manufacture, having taken their place. The amount of oxide of iron and alumina in raw phosphates is of great importance, as phosphates containing these bodies are liable to cause superphosphate to "go back" or form what is called "reverted" phosphate, the percentage of "soluble phosphate" being reduced thereby. For this reason many of the older supplies have been replaced by newer and better ones. Florida rock phosphate of high grade contains 75 to 78% of phosphate of lime, and Florida land pebble phosphate about 70%. Algerian and Tunisian phosphates have from 55 to 65% of phosphate of lime, and are very free from iron and alumina, this fitting them especially for superphosphate making. Tennessee phosphate has about 70% of phosphate, Somme and Belgian phosphates 40 to 50%, while Ocean Island and Christmas Island phosphates are of very high grade and yield over 80 and up to 86% of phosphate of lime. Superphosphate is made by finely grinding the raw phosphate and mixing it with oil of vitriol (chamber acid); what actual product is formed is a matter of some uncertainty, but it is a phosphate soluble in water, and believed to be mono-calcic phosphate. This is the true "soluble phosphate," but in commercial transactions it is universal to express the amount in terms of the original tribasic phosphate which has been rendered soluble. Ordinary grades of mineral superphosphate give from 25 to 27% of soluble phosphate and higher grades 30 to 35%. On reaching the soil, the soluble phosphate becomes precipitated by the calcium and iron compounds in the soil. But it is precipitated in a very fine form of division, in which it is readily attacked by the plant roots. Superphosphate is used practically for all crops, including cereals, clover and other leguminous crops. Its use tends to early maturity in a crop. Its value for giving a start to root crops is particularly recognized, and root crops generally are dependent on it, as they have little power of utilizing the phosphoric acid in the soil itself. On land poor in lime superphosphate must be used with caution owing to its acid nature, and in such cases an undissolved phosphate is preferable. The quantity in which it is applied ranges from 2 and 3 cwt. per acre to 5 cwt. It suffers but little loss through drainage, and will exercise an influence on crops beyond the year of application.

Basic Slag.—This other principal phosphatic manure is of more recent origin, and is an undissolved phosphate. It is the waste product of steel-making where the Thomas-Gilchrist or "basic" process of manufacture has been employed. This process is used with ores containing much phosphorus, the removal of which is necessary in steel-manufacture. The "converters" which hold the molten iron are lined with lime and magnesia, and the impurities of the iron form a "slag" with these materials. For a long time the slag was regarded as a waste product, but ultimately it was found that, by grinding it very finely, it had distinct agricultural value, and now its use is universal. Basic slag is of various grades, containing 12 to 20% of phosphoric acid, which is believed to exist in the form of a tetracalcic phosphate. This phosphate is found to be readily attacked by a weak solution of citric acid, and this probably accounts for the comparative ease with which plants can utilize the phosphate. With it is also a good deal of lime, and the presence of this undoubtedly, in many cases, accounts partly for the benefits that follow the use of basic slag. It should be very finely ground; a common standard is that 80 to 90% should pass through a sieve having 10,000 meshes to the square inch.

The principal use of basic slag is on grass-land, especially where the soil is heavy or clayey. Its effect on such land in causing white clover to appear is in many cases most remarkable, and without doubt, much poor, cold grass-land has been immensely benefited by its use. It is also employed for root crops; but its effect on these, as on cereals, is not so marked as on grass-land. On light land its benefit is not nearly so great or universal as on heavier land.

III.—Manures containing Nitrogen and Phosphates

These may be classified as follows: (*a*) Natural manures—bones, fish and meat guanos, Peruvian guano, bats' guano; (*b*) Manufactured manures—dissolved bones, compound manures.

a. Natural Manures

Bones.—The value and use of these in agriculture has long been known, as also the comparative slowness of their action, which latter induced Liebig to suggest their treatment with sulphuric acid. Natural bones will contain from 45 to 50% of phosphate of lime with 4 to 4½% of nitrogen. It is usual to boil bones lightly after collection, in order to remove the adhering particles of flesh and the fat. If steamed under pressure the nitrogenous matter is to a great extent extracted, yielding glue, size, gelatine, &c., and the bones—known then in agriculture as "steamed bones"—will contain from 55 to 60% of phosphate of lime with 1 to 1½% of nitrogen. Bones are also imported from India, and these are of a very hard and dry nature. Bones are principally used for root crops, and to some extent on grass-land. The more finely they are ground the quicker is their action, but they are a slow-acting manure, which remains some years in the land. Mixed with superphosphate, bone meal forms an excellent manure for roots, and obviates the difficulty of using superphosphate on land poor in lime. Steamed bones, sometimes ground into flour, are much used in dairy pastures.

Fish and Meat Guanos.—The term "guano," though generally applied to these manures, is wrongly so used, for they are in no sense guano (meaning thereby the droppings of sea birds). They are really fish or meat refuse, being generally the dried fish-offal or the residue from meat-extract manufacture. They vary much in composition, according to their origin, some being highly nitrogenous (11 to 12% nitrogen) and comparatively low in phosphate of lime, and others being more highly phosphatic (30 to 40% phosphate of lime) with lower nitrogen. These materials are to some extent used for root and vegetable crops, and chiefly for hop-growing, but they go largely also to the artificial manure maker.

Peruvian Guano.—This material, though once a name to conjure with, has now not much more than an academic interest, owing to the rapid exhaustion of the supplies. It is true guano, *i.e.* the deposit of sea birds, and was originally found on islands off the coast of Peru. Peruvian guano was first discovered in 1804 by A. von Humboldt, and the wonderful results attending its use gave an enormous impulse to its exportation. The Chincha Islands yielded the finest qualities of guano, this giving up to 14 and 15% of nitrogen. Gradually the Chincha Islands deposits became worked out, and other sources, such as the Pabellon de Pica, Lobos, Guanape and Huanillos deposits were worked in turn. In many instances the guano had suffered from washing by rain or by decomposition, or in other cases the bare rock was reached and the shipments contained some considerable quantity of this rocky matter, so that the highly nitrogenous guanos were no longer forthcoming and deposits more phosphatic in character took their place. Gradually the shipments fell off, and with them the great reputation of the guano as a manure. On some of the islands the birds, after having been driven off, have returned and fresh deposits are being formed. On the west coast of Africa also some new deposits have been found, and a certain amount of guano comes from Ichaboe Island; but the trade will never be what it once was. Occasional shipments come from the Ballista Islands, giving from 10 to 11% of nitrogen with 11 to 12% of phosphoric acid, and lower-grade guanos (7% of nitrogen and 16% of phosphoric acid) are arriving from Guanape, while from Lobos de Tierra comes a still lower grade.

The particular feature that marked guano was that it contained both its nitrogenous and phosphatic ingredients in forms in which they could be very readily assimilated by plants. Moreover, the occurrence of the nitrogenous and phosphatic matters in different forms of combination gave to them a special value, and one that could not be exactly imitated in artificial manures. The nitrogenous matters, *e.g.*, exist as urates, carbonates, oxalates and phosphates of ammonia, and a particular nitrogenous body termed "guanine" is also found. Guano contains much alkaline salts, and is, from its containing alike phosphates, nitrogen and potash in suitable forms and quantity, an exceedingly well balanced manure. In agriculture it is used for corn crops, and also for root crops, potatoes and hops. It is esteemed for barley, as tending to produce good quality. For vegetable and market-garden crops that require forcing guano is also still in demand. The more phosphatic kinds are sometimes treated with sulphuric acid, and constitute "Dissolved Peruvian Guano."

Bats' Guano.—In caves in New Zealand, parts of America, South Africa and elsewhere, are found deposits formed by bats, and these are used to some extent as a manure, though they have no great commercial value.

b. Manufactured Manures

Dissolved Bones.—These are bones treated with oil of vitriol, as in superphosphate manufacture. By this treatment bones become much more readily available, and are used to a considerable extent, more especially for root crops. Their composition varies with the method of manufacture and the extent to which they are dissolved. Speaking generally, they will have from 11 to 19% of soluble phosphate, with 20 to 24% of insoluble phosphates, and if pure should contain 3% of nitrogen. When mixed with superphosphate in varying amount, or if made with steamed and not raw bone, they are generally known under the indefinite name of "bone manure."

Compound Manures.—To this class belong the manures of every description which it is the aim of the artificial manure manufacturer to compound for particular purposes or to suit particular soils or crops. The base of all these is, as a rule, mineral superphosphate or else dissolved bones, or the two together, and with these are mixed numerous different manurial substances calculated to supply definite amounts of nitrogen, potash, &c. Such manures, the trade in which is a very large one, are variously known as "corn manure," "turnip manure," "grass manure" and the like, and much care is bestowed on their compounding and on their preparation in good condition to allow of their ready distribution over the land.

IV.—Potash Manures

These, with few exceptions, are natural products from the potash mines of Stassfurt (Prussia). Until the discovery of these deposits, in 1861, the use of potash as a fertilizing constituent was very limited, being confined practically to the employment of wood ashes. At the present time a small quantity of potash salts—principally carbonate of potash—is obtained from sugar refinery and other manufacturing processes, but the great bulk of the potash supply comes from the German mines. In these the different natural salts occur in different layers and in conjunction with layers of rock-salt, carbonate of lime and other minerals, from which they have to be separated out and undergo subsequently a partial purification by re-crystallization.

The principal potash salts used in agriculture are—(1) sulphate of potash, which is about 90% pure; (2) kainit, an impure form of sulphate of potash, and containing much common salt and magnesia salts, and giving about 12% of potash (K_2O); (3) muriate of potash, which is used to a great extent in agriculture, and contains 75 to 90% of muriate of potash; and (4) potash manure salts, a mixture of different salts and containing from 20 to 30% of potash.

Potash is much esteemed in agriculture, more especially on light land (which is frequently deficient in it) and on peaty soils, and for use with root crops and potatoes in particular. For fruit and vegetable growing and for flowers potash manures are in constant request. Clay land, as a rule, is not benefited by their use, these oils containing generally an abundance of potash. Along with basic slag, potash salts have been frequently used for grass on light land with advantage.

V.—Miscellaneous Manures.

There are, in addition to the foregoing, certain materials which in a limited sense only can be called "manures," but the influences of which are mostly seen in the mechanical and physical improvements which they effect in soil. Such are salt, and also lime in its different forms.

Salt.—The action of salt in liberating potash from the soil has been explained. As a manure it is sometimes used along with nitrate of soda as a top-dressing for corn crops, in the belief that it stiffens the straw. For root crops also, and mangels in particular, it is employed; also for cabbage and other vegetables.

Lime.—The use of this is almost solely to be considered as a soil improvement, and not as that of a manure. Sulphate of lime (gypsum) is, however, occasionally used as a dressing for clover, and also for hops. The fact that superphosphate itself contains a considerable amount of sulphate of lime renders the special application of gypsum unnecessary, as a rule.

As compared with "natural" manures, like farm-yard manure, artificial manures have the disadvantage that they, unlike it, do not improve the physical condition of the soil. Artificial manures have, however, the advantage over farm-yard manure that they can supply in a small compass, and even if used in small quantity, the needed nitrogen, phosphoric acid and potash, &c., which crops require, and which farm-yard manure has but in small proportion. They, further, present the expensive fertilizing matters in a concentrated form, and by their application save expense in labour.

(J. A. V.*)

MANUSCRIPT, a term applied to any document written by the human hand (Lat. *manū scriptum*) with the aid of pen, pencil or other instrument which can be used with cursive facility, as distinguished from an inscription engraved with chisel or graver, worked laboriously. By usage the word has come to be employed in a special sense to indicate a written work of the ancient world or of the middle ages; collections of such "ancient manuscripts" being highly prized and being stored for preservation in public libraries. Down to the time of the invention of printing, and until the printed book had driven it out of the field, the manuscript was the vehicle for the conservation and dissemination of literature, and discharged all the functions of the modern book. In the present article a description is given of the development of the ancient manuscript, particularly among the Greeks and Romans, leading on to the medieval manuscripts of Europe, and bringing down the history of the latter to the invention of printing; the history of the printed volume is dealt with in the article Book (*q.v.*).

Materials.—The handbooks on palaeography describe in full the different materials which have been employed from remote time to receive writing, and may be referred to for minuter details. To dispose, in the first place, of the harder materials that have been put under requisition, we find metals both referred to by writers and actually represented by surviving examples. Thin leaves of gold or silver were recommended for the inscription of charms in particular. Leaden plates were in common use for incantations; the material was cheap and was supposed to be durable. On such plates were scratched the *dirae* or solemn devotions of obnoxious persons to the infernal deities; many examples have survived. As an instance of the use of soft substance afterwards hardened may be cited the practice by the Babylonians and Assyrians of writing, or rather of puncturing, their cuneiform characters on clay tablets while moist, which were afterwards dried in the heat of the sun or baked in the oven. Potsherds, or *ostraka*, were employed for all kinds of temporary purposes. Thousands of them have been found in Egypt inscribed with tax receipts and ephemeral drafts and memoranda, children's dictation lessons, &c. Analogous to the clay documents of western Asia are the tablets coated with wax in vogue among the Greeks and Romans, offering a surface not to be inscribed with the pen but to be scratched with the sharp pointed *stilus*. These will be described more fully below. With them we class the wooden boards, generally whitened with a coating of paint or composition and adapted for the pen, which were common in Egypt, and were specially used for educational purposes. Such boards were also employed for official notices in Athens in the 4th century B.C.

Of the more pliant, and therefore generally more convenient, substances there were many, such as animal skins and vegetable growths. Practically we might confine our attention to three of them: papyrus, parchment or vellum, and paper, the employment of which, each in turn, as a writing material became almost universal. But there are also others which must be mentioned.

In a primitive state of society leaves of plants and trees strong enough for the purpose might be taken as a ready-made material to receive writing. Palm leaves are used for this purpose to the present day in parts of India; and the references in classical authors to leaves as early writing material among the Greeks and Romans cannot be dismissed as entirely fanciful.

The bark of trees, and particularly the inner bark of the lime-tree, *φιλύρα*, *tilia*, was employed. The fact that the Latin word *liber*, bark, eventually meant also a book, would be sufficient proof that that material was once in common literary use, even if it were not referred to by writers.

Linen, too, was a writing material among the early Romans, as it was also among the Etruscans, and as it had been to some extent among the Egyptians.

Skins of animals, tanned, have doubtless served as a writing material from the very earliest period of the use of letters. The Egyptians occasionally employed this material. Instances of the use of leather in western Asia are recorded by ancient authors, and from Herodotus we learn that the Ionian Greeks applied to the rolls of the later-imported papyrus the title *διφθέραι*, skins, by which they had designated their writing material of leather. The Jews, also, to the present day hold to the ancient Eastern custom and inscribe the law upon skin rolls.

But generally these materials were superseded in the old world by the famous Egyptian writing material manufactured from the papyrus plant, which gradually passed beyond the boundaries of its native land and was imported at a remote period into other countries. Into Greece and into Rome it was introduced at so early a time that practically it was the vehicle for classical literature throughout its course. A description of the manufacture and use of this material will be found under Papyrus. Here it need only be noted that papyrus is associated in Greek and Roman literature with the roll form of the ancient manuscript, as will be more fully explained below, and that it was the supersession of this material by parchment or vellum which led to the change of shape to the book form.

The introduction of the new material, parchment or vellum, was not a revival of the use of animal skins as followed by the old world. The skins were now not tanned into leather, but were prepared by a new process to provide a material, thin, strong, flexible, and smooth of surface on both faces. This improved process was the secret of the success of the new material in ousting the time-honoured papyrus from its high position. The common story, as told by Pliny, that Eumenes II. of Pergamum (197–158 B.C.), seeking to extend the library of his capital, was opposed by the jealousy of the Ptolemies, who forbade the export of papyrus, hoping thus to check the growth of a rival library, and that he was thus compelled to have recourse to skins as a writing material, at all events points to Pergamum as the chief centre of trade in the material, *περγαμηνή*, *charta pergamena*. The old terms *διφθέραι*, *membranae*, applied originally to the older leather, were transferred to the newly improved substance. In describing MSS. written on this material, by common consent the term parchment has in modern times given place to that of vellum, properly applicable only to calfskin, but now generally used in reference to a medieval skin-book of any kind. Parchment is a title now usually reserved for the hard sheepskin or other skin material on which law deeds are engrossed. (See Parchment.)

Vellum had a long career as a writing material for the literature of the early centuries of our era and of the middle ages. But in its turn it eventually gave place to paper (*q.v.*). As early as the 13th century paper, an Asiatic invention, was making its way into Europe and was adopted in the Eastern Empire as a material for Greek literature side by side with vellum. It soon afterwards began to appear in the countries of southern Europe. In the course of the 14th century the use of it became fairly established, and in the middle of the century a number of paper manuscripts were produced along with those on vellum, particularly in Italy. Finally, in the 15th century paper became the common material for the manuscript book. The new paper, however, made no further change in the form of the manuscript. It possessed exactly the same qualities, as a writing material, as vellum: it could be inscribed on both sides; it could be made up into quires and bound in the codex form; and it had the further advantage of being easily manufactured in large quantities, and therefore of being comparatively cheap.

The Forms of the Manuscript Book.—In describing the development of the manuscript book in the ancient world, and subsequently in the middle ages, we have to deal with it in two forms. The common form of the book of the ancient world was the *roll*, composed of one continuous sheet of material and inscribed only on one side. This form had a long career. In Egyptian literature it can be traced back for thousands of years. In Greek literature it may be assumed to have been in vogue from the earliest times; actual examples have survived of the latter part of the 4th and beginning of the 3rd centuries B.C. As to its early use in Latin literature we cannot speak so definitely; but Rome followed the example of Greece in letters, and therefore no doubt also in the material shape of literary productions. Both in Greek and Latin literature the roll lasted down to the early centuries of the Christian era. It was superseded by the *codex*, the manuscript in book form (in the modern sense of the word book), composed of separate leaves stitched together into quires and made available to receive writing on both sides of the material. This form is still in vogue as the modern printed book, and probably will never be superseded. But the codex in this developed shape was only an evolution from the early waxen tablets of the Greeks and Romans, two or more of which, hinged together, formed the primitive codex which suggested the later form. Therefore it will be necessary to include the description of the tablets with that of the later codex.

The Roll.

The ordinary terms in use among the Greeks for a book (that is, a roll) were *βίβλος* (another, form of *βύβλος*, papyrus) and its diminutive *βιβλίον*, which included the idea of a written book. The corresponding Latin terms were *liber* and *libellus*; *volumen* was a rolled-up roll. A roll of material uninscribed was *χάρτης*, *charta*, or *τόμος* (originally a *cutting* of papyrus), applicable also to a roll containing a portion or division of a large work which extended to more than one roll. A work contained within the compass of a single roll was a *μονόβιβλος*, or *μονόβιβλον*. The term *τεῦχος* seems also to have meant a single roll, but it was also applied at a later time to indicate a work contained in several rolls.

In writing the text of a work, the scribe might choose to make use of separate sheets of papyrus, *κολλήματα*, *schedae*, and then join them to one another consecutively so as to make up the roll; or he might purchase from the stationers a *scapus*, or ready-made roll of twenty sheets at most; and if this length were not sufficient, he might add other sheets or *scapi*, and thus make a roll of indefinite length. But proverbially a great book was a great evil, and, considering the inconvenience of unrolling a long roll, not only for perusal, but, still more so, for occasional reference, the practice of subdividing lengthy works into divisions of convenient size, adapted to the capacity of moderate-sized rolls, must have come into vogue at a very early period.

It was the practice to write on one side only of the papyrus; to write on both front and back of a roll would obviously be a clumsy and irritating method. Works intended for the market were never *opisthograph*. Of course the blank backs of written rolls which had become obsolete might be turned to account for personal or temporary purposes, as we learn not only from references in classical authors but also from actual examples. The most interesting extant case of an opisthograph papyrus is the copy of Aristotle's *Constitution of Athens* in the British Museum, which is written on the back of a farmer's accounts, of the end of the 1st century—but only for private use. It being the rule, then, to confine the writing to one side of the material, that is, to the inner surface of the made-up roll, that surface was more carefully prepared and smoothed than the other; and, further, the joints of the several sheets were so well made that they offered no obstacle to the action of the pen. Still further, care was taken that this, the *recto* surface of the material, should be that in which the shreds of papyrus of which it was composed lay horizontally, so that the pen might move freely along the fibres; the shreds of the *verso* side, on the other hand, being in vertical position. This point is of some importance, as, in cases where two different handwritings are found on the two sides of a papyrus, it may be usually assumed that the one on the *recto* surface is the earlier.

The text was written in columns, *σελίδες*, *paginae*, the width of which seems not to have been prescribed, but which for calligraphic effect were by preference made narrow, sufficient margins being left at head and foot. The average width of the columns in the best extant papyri ranges from two to three-and-a-half inches. The written lines were parallel with the length of the roll, so that the columns stood, so to say, with the height of the rolled-up roll, and were disclosed consecutively as the roll was unwound. Ruling with lead to guide the writing is mentioned by writers, but it does not appear that the practice was generally followed. The number of lines in the several columns of extant papyri is not constant, nor is the marginal boundary of the beginnings of the lines, for the accuracy of which a ruled vertical line would have proved useful, ordinarily kept even. No doubt in practice the horizontal fibres of the material were found to afford a sufficient guide for the lines of writing.

If the title of the work was to be given, the scribe appears to have written it ordinarily at the end of the text. But something more was needed. To be obliged to unroll a text to the end, in order to ascertain the name of the author, would be the height of inconvenience. Its title was therefore sometimes written at the head of the text. It appears also that at an early period it was inscribed on the outside of the roll, so as to be visible as the roll lay in a chest or on the shelf. But a more general practice was to attach to the top edge of the roll a label or ticket, *σίλλυβος*, or *σίττυβος*, *titulus*, *index*, which hung down if the roll lay on the shelf, or was conveniently read if the roll stood along with others in the ordinary cylindrical roll-box, *κίστη*, *κιβωτός*, *cista*, *capsa*. One such label made of papyrus has survived and is in the British Museum.

The scribe would not commence his text at the very beginning, nor would he carry it quite down to the end, of the roll. He would leave blank a sufficient length of material at either extremity, where the roll would naturally be most exposed to wear and tear by handling in unrolling and re-rolling; and, further, the extreme vertical edges might each be strengthened by the addition of a strip of papyrus so as to form a double thickness of material.

According to the particulars given by classical authors, the roll would be finished off somewhat elaborately; but the details described by them must be taken to apply to the more expensive productions of the book trade, corresponding with the full-bound volumes of our days. In practice, a large proportion of working copies and ordinary editions must have been dealt with more simply. Firstly, the roll should be rolled up round a central stick, of wood or bone, called the *ὀμφαλός*, *umbilicus*, to which the last sheet of the papyrus may or may not have been attached. But as a matter of fact no rolling-sticks have been found in company with extant papyri, and it has therefore been suggested that they were not attached to the material but were rolled in loose, and were therefore liable to drop out. In some instances, as in the rolls found at Herculaneum, a central core of papyrus instead of a stick was thought sufficient. The edges, *frontes*, of the roll, after it had been rolled up, were shorn and were rubbed smooth with pumice, and they were sometimes coloured. A valuable roll might be protected with a vellum wrapper, *φαινόλης*, *paenula*, stained with colour; and, further, it might be secured with ornamental thongs. The central stick might also be adorned with knobs or "horns," plain or coloured. This seems to be the natural explanation of the *κέρατα*, or *cornua*, mentioned by the ancient writers. Finally, the title-label described above was attached to the completed roll, now ready for the book-market.

In the perusal of a work the reader held the roll upright and unrolled it gradually with the right hand; with the left hand he rolled up in the reverse direction what he had read. Thus, when he had finished, the roll had become reversed, the beginning of the text being now in the centre of the roll and the end of it being outside. The roll was "explicitus ad umbilicum," or "ad sua cornua." It had therefore now to be unrolled afresh and to be re-rolled into its normal shape—a troublesome process which the lazy man shirked, and which the careful man accomplished by making the revolutions with his two hands while he held the revolving material steady under his chin.

Although the codex or manuscript in book-form began to make its way in Greek and Roman literature as early as the 1st century of our era, the roll maintained its position as the recognized type of literary document down to the 3rd, and even into the 4th, century, when it was altogether superseded. We shall proceed to describe the codex after giving some account of the waxen, or, to speak more correctly, the waxed, tablet, its precursor in the book-form.

The Waxen Tablet.

The ordinary waxen tablet in use among the Greeks and Romans was a small oblong slab of wood, beech, fir, and especially box, the surface of which on one or both sides, with the exception of the surrounding margins which were left intact in order to form a frame, was sunk to a slight depth and was therein coated with a thin layer of wax, usually black. The tablet thus presented the appearance of a child's school-slate of the present day. Such tablets were single, double, triple, or of several pieces or leaves. In Greek they were called *πίναξ*, *πινακίς*, *δέλτος*, *δελτίον*.: in Latin *cera*, *tabula*, *tabella*, &c. Two or more put together and held together by rings or thongs acting as hinges formed a *caudex* or *codex*, literally a stock of wood, which a set of tablets might resemble, and from which they might actually be made by cleaving the wood. A codex of two leaves was called *δίθυροι*, *δίπτυχα*, *diptycha*; of three, *τρίπτυχα*, *triptycha*: and so on. The triptych appears to have been most generally used. A general term was also *libellus*.

Tablets served for the ordinary minor affairs of life: for memoranda, literary and other notes and drafts, school exercises, accounts, &c. The writing incised with the stilus could be easily obliterated by smoothing the wax, and the *tabula rasa* was thus rendered available for a fresh inscription. But tablets were also employed for official purposes, when documents had to be protected from unauthorized scrutiny or from injury. Thus they were the receptacles for wills, conveyances, and other legal transactions; and in such cases they were closed against inspection by being bound round with threads which were covered by the witnesses' seals.

Small tablets, *codicilli*, *pugillares*, often of more valuable material, such as ivory, served for correspondence among other purposes; very small specimens are mentioned as *vitelliani*, for the exchange of love-letters.

A certain number of Greek waxen tablets have been recovered, chiefly from Egypt, but none of them is very early. They are generally of the 3rd century, and are mostly inscribed with school exercises. The largest and most perfect extant codex is one in the British Museum (Add. MS. 33,270), perhaps of the 3rd century, being made up of nine leaves, measuring nearly 9 by 7 in., and inscribed with documents in shorthand.

Of Latin tablets we are fortunate in having a fairly large number of examples. Exclusive of a few isolated specimens, they are the result of two important finds. Twenty-four tablets containing the records of a burial club, A.D. 131–167, were recovered between 1786 and 1855 from some ancient mining works in Dacia. In 1875 as many as 127 tablets, containing deeds connected with sales by auction and payment of taxes, A.D. 15–62, were found in the ruins of Pompeii. These specimens have afforded the means of ascertaining the mechanical arrangement of waxen tablets when adopted for legal instruments among the Romans. Most of them are triptychs, severally cloven from single blocks of wood. Subject to some variations, the triptych was usually arranged as follows. Of the six sides or pages of the codex, pages 1 and 6 (the outside pages) were of plain wood; pages 2, 3, 5 were waxed; and page 4, which had a groove cut across the middle was sometimes of plain wood, sometimes waxed. The authentic deed was inscribed with the stilus on the waxed pages 2 and 3; and the first two leaves were then bound round with three twisted threads which passed down the groove so as to close the deed from inspection. On page 4 the witnesses' names were then inscribed (in ink if the page was plain; with the stilus if waxed), and their seals were impressed in the groove, thus securing the threads. In addition to the protection afforded to the seals from casual injury by their position in the groove, the third leaf acted as a cover to them. On page 5 an abstract or duplicate of the deed, as required by law, was inscribed. The arrangement of the Dacian tablets differed in this respect, that page 4 was waxed, and that the duplicate copy was begun on that page in the space on the left of the groove, that on the right being reserved for the names of the witnesses. In the case of one of the Pompeian tablets the threads and seals still remain.

The survival of the use of tablets to a late time should be noted. St Augustine refers to his tablets, and St Hilary of Arles also mentions their employment for the purpose of correspondence; there is a record of a letter written *in tabellâ* as late as A.D. 1148. They were very commonly used throughout the middle ages in all the west of Europe. Specimens inscribed with money accounts of the 13th and 14th centuries have survived in France, and similar documents of the 14th and 15th centuries are to be found in several of the municipal archives of Germany. Reference to their use in England occurs in literature, and specimens of the 14th or 15th century are said to have been dug up in Ireland. In Italy their employment is both recorded and proved by actual examples of the 13th and 14th centuries. With the beginning of the 16th century they seem to have practically come to an end, although a few survivals of the custom of writing on wax have lingered to modern times.

The Codex.

As already stated, the *codex*, or MS. in book-form, owed its existence to the substitution of vellum for papyrus as the common writing material for Greek and Roman literature. The fact that vellum was a tough material capable of being inscribed on both sides, that writing, particularly if freshly written, could be easily washed off or erased from it, and that the material could thus be made available for second use, no doubt contributed largely to its ready adoption. In Rome in the 1st century B.C. it was used, like the waxen tablets for notes, drafts, memoranda, &c.; and vellum tablets began to take the place of the *cerae*. References are not wanting in the classical writers to its employment for such temporary purposes. To what extent it was at first pressed into the service of literature and used in the preparation of books for the market must remain uncertain. But in the first three centuries of our era it may be assumed that vellum codices were not numerous. The papyrus roll still held its position as the *liber* or book of literature. Yet we learn from the poems of Martial that in his day the works of some of the best classical authors were to be had on vellum. From the way in which, in his *Apophoreta*, he has contrasted as exchangeable gifts certain works written respectively on papyrus and on vellum, it has been argued that vellum at that time was a cheap material, inferior to papyrus, and only used for roughly written copies. Up to a certain point this may be true, but the fact that the earliest great vellum Greek codices of the Bible and of Latin classical authors, dating back to the 4th century, are composed of very finely prepared material would indicate a perfection of manufacture of long standing.

But, apart from the references of writers, we have the results of recent excavations in Egypt to enable us to form a more correct judgment on the early history of the vellum codex. There have been found a certain number of inscribed leaves and fragments of vellum of early date which without doubt originally formed part of codices or MSS. in book-form. It is true that they are not numerous, but from the character of the writing certain of them can be individually assigned to the 3rd, to the 2nd, and even to the 1st century. We may then take it for an established fact that the codex form of MS. was gradually thrusting its way into use in the first centuries of our era.

The convenience of the codex form for easy reference was also a special recommendation in its favour. There can be little doubt that such compilations as public registers must at once have been drawn up in the new form. The jurists also were quick to adopt it, and the very title "codex" has been attached to great legal compilations, such as those of Theodosius and Justinian. Again, the book-form was favoured by the early Christians. The Bible, the book which before all others became the great work of reference in their hands, could only be consulted with convenience and despatch in the new form. A single codex could hold the contents of a work which formerly must have been distributed through many volumes in roll-form. The term *σωμάτιον*, which was one of the names given to a codex, was expressive of its capacity. Turning again to discoveries in Egypt, it appears that in the early centuries the codex-form had become so usual among the Christians in that land that even the native material, papyrus, the recognized material for the roll, was now also made up by them into leaved books. The greater number of papyri of the 3rd century containing Christian writings, fragments of the Scriptures, the "Sayings of Our Lord," and the like, are in book-form. On the other hand, the large majority of the non-Christian papyri of the same period keep to the old roll-form. Thus the codex becomes at once identified with the new religion, while the papyrus roll to the last is the chosen vehicle of pagan literature.

In the 4th century the struggle between the roll and the codex for supremacy in the literary field was finished, and the victory of the codex was achieved. Henceforward the roll-form remained in use for records and legal documents, and in certain instances for liturgies; and for such purposes it survives to the present day. But so completely was it superseded in literature by the codex that even when papyrus, the material once identified with the roll-form, was used as it sometimes was down to the 6th and 7th centuries and later, it was made up into the leaved codex, not only in Egypt but also in western Europe.

Quires.

The shape which the codex usually assumed in the early centuries of the middle ages was the broad quarto. The quires or gatherings of which the book was formed generally consisted, in the earliest examples, of four sheets folded to make eight leaves (*τετράς* or *τετράδιον*, *quaternio*), although occasionally quinterns, or quires of five sheets (ten leaves), were adopted. Sexterns, or quires of six sheets (twelve leaves), came into use at a later period. In making up the quires, care was generally taken to lay the sheets of vellum in such a way that hair-side faced hair-side, and flesh-side faced flesh-side; so that, when the book was opened, the two pages before the reader had the same appearance, either the yellow tinge of the hair-side, or the fresh whiteness of the flesh-side. In Greek MSS. the arrangement of the sheets was afterwards reduced to a system; the first sheet was laid with the flesh-side downwards, so that that side began the quire; yet in so early an example as the Codex Alexandrinus the first page of a quire is the hair-side. In Latin MSS. also the hair-side appears generally to have formed the first page. When paper came into general use for codices in the 15th century, it was not an uncommon practice to give the paper quires additional strength by an admixture of vellum, a sheet of the latter material forming the outer leaves, and sometimes the middle leaves also, of the quire. The quire mark, or "signature," was usually written at the foot of the last page, but in some early instances (*e.g.* the Codex Alexandrinus) it appears at the head of the first page of each quire. The numbering of the separate leaves in a quire, in the fashion followed by early printers, came in in the 14th century. Catch-words to connect the quires appear first in the 11th century and are not uncommon in the 12th century.

Ruling.

No exact system was followed in ruling the guiding lines on the pages of the codex. In the case of papyri it was enough to mark with the pencil the vertical marginal lines to bound the text, if indeed even this was considered needful (see above); the fibres of the papyrus were a sufficient guide for the lines of writing. On vellum it became necessary to rule lines to keep the writing even. These lines were at first drawn with a blunt point, almost invariably on the hair (or outer) side of the skin, and strongly enough to be in relief on the flesh (or inner) side. Marginal lines were drawn to bound the text laterally; but the ruled lines which guided the writing were not infrequently drawn right across the sheet. Each sheet should be ruled separately; but two or more sheets were often laid and ruled together, the lines being drawn with so much force that the lower sheets also received the impressions. In rare instances lines are found ruled on both sides of the leaf, as in some parts of the Codex Alexandrinus. In this same MS. and in other early codices the ruling was not always drawn for every line of writing, but was occasionally spaced so that the writing ran between the ruled lines as well as on them. The lines were evenly spaced by means of guiding pricks made at measured intervals with a compass or rotary instrument down the margins; in some early MSS. these pricks run down the middle of the page. Ruling with the plummet or lead-point is found in the 11th century and came into ordinary use in the 12th century; coloured inks, *e.g.* red and violet, were used for ornamental ruling in the 15th century.

Columns.

Mechanical Arrangement of Writing in MSS.—It has already been stated above that in the papyrus rolls the text was written in columns. They stood with convenient intervals between them and with fair margins at top and bottom. The length of the lines was to some extent governed by the nature of the text. If it was a poetical work, the metrical line was naturally the line of the column, unless, as sometimes was the case, the verse was written continuously as prose. For prose works a narrow column was preferred. It is noticeable that the columns in papyri have a tendency to lean to the right instead of being perpendicular—an indication that it was not the practice to rule marginal lines. In codices the columnar arrangement was also largely followed, and the number of columns in a page was commonly two. There are instances, however, of a larger number. The Codex Sinaiticus of the Bible has four columns to the page; and the Codex Vaticanus, three columns. And the tricolumnar arrangement occurs every now and then in later MSS.

Text without separation of Words.

In both Greek and Latin literary MSS. of early date the writing runs on continuously without separation of words. This practice however, may be regarded as rather artificial, as in papyri written in non-literary hands and in Latin deeds also, contemporary with these early literary MSS., there is a tendency to separation. In a text thus continuously written occasional ambiguities necessarily occurred, and then a dot or apostrophe might be inserted between words to aid the reader. Following the system of separation of words which appears in ancient inscriptions, wherein the several words are marked off by single, double, or treble dots or points, the words of the fragmentary poem on the battle of Actium found at Herculaneum are separated by single points, probably to facilitate reading aloud; monosyllables or short prepositions and conjunctions, however, being left unseparated from the words immediately following them—a system which is found in practice at a later time. But such marks of separation are not to be confounded with similar marks of punctuation whereby sentences are marked off and the sense of the text is made clear. Throughout the career of the uncial codices down to the 6th century, continuity of text was maintained. In the 7th century there is some evidence of separation of words, but without system. In early Latin minuscule codices partial separation in an uncertain and hesitating manner went on to the time of the Carolingian reform. In early Irish and English MSS., however, separation is more consistently practised. In the 9th and 10th centuries long words tend to separation, but short words, prepositions and conjunctions, still cling to the following word. It was not till the 11th century that the smaller words at length stood apart, and systematic separation of words was established. In Greek minuscule codices of the 10th century a certain degree of separation takes place; yet a large proportion of words remain linked together, and they are even incorrectly divided. Indeed a correct system of distinct separation of words in Greek texts was never thoroughly established even as late as the 15th century.

Paragraphs.

But while distinction of words was disregarded in early literary texts, distinction of important pauses in the sense was recognized from the first. The papyrus of the *Persae* of Timotheus of Miletus, the oldest MS. of a Greek classic in existence, of the end of the 4th century B.C., is written in independent paragraphs. This is a natural system, the simplicity of which has caused it to be the system of modern times. But, in addition, the Greek scribe also separated paragraphs by inserting a short horizontal stroke, παράγραφος, between them at the commencement of the lines of writing. It should be noted that this stroke indicated the close of a passage, and therefore belonged to the paragraph just concluded, and did not stand for an initial sign for the new paragraph which followed. The dividing stroke was also used to mark off the different speeches of a play. Besides the stroke, a wedge-shaped sign or tick might be used. But to make every paragraph stand distinctly by itself would have entailed a certain loss of space. If the concluding line were short, there would remain a long space unfilled. Therefore, when this occurred, it became customary to leave only a short space blank to mark the termination of the paragraph, and then to proceed with the new paragraph in the same line, the παράγραφος at the same time preventing possible ambiguity. The next step was to project the first letter of the first full line of the new paragraph slightly into the margin, as a still further distinction; and lastly to enlarge it. The enlargement of the letter gave it so much prominence that the dividing stroke could then be dispensed with, and in this form the new paragraph was henceforward indicated in Greek MSS., it being immaterial whether the enlarged letter was the initial or a medial letter of a word. As early as the 5th century there is evidence that the παράγραφος was losing its meaning with the scribes, for in the Codex Alexandrinus of the Bible it is not infrequently found in anomalous positions, particularly above the initial letters of different books, as if it were a mere ornament.

In Latin MSS. there was no such fixed system of marking off paragraphs as that just described. A new paragraph began with a new line, or a brief space in a line separated the conclusion of a paragraph from the beginning of the next one. It was only by the ultimate introduction of large letters, as the initial letters of the several sentences and paragraphs, and by the establishment of a system of punctuation, in the modern sense of the word, that a complete arrangement of the text was possible into sentences and paragraphs in accordance with its sense.

Punctuation.

From the earliest times an elementary system of punctuation by points is found in papyri. Thus the papyrus of the *Curse of Artemisia*, at Vienna, which is at least as early as the 3rd century B.C., and in one or two other ancient examples, a double point, resembling the modern colon, separates sentences. But more commonly a single point, placed high in the line of writing, is employed. This single punctuation was reduced to a system by the Alexandrian grammarians, its invention being ascribed to Aristophanes of Byzantium, 260 B.C. The point placed high on a level with the top of the letters had the value of a full-stop; in the middle of the line of writing, of a comma; and low down on the line, of a semicolon. But these distinctions were not observed in the MSS. In the early vellum codices both the high and the middle point are found. In medieval MSS. other signs, coming nearer to our modern system, make their appearance. In Latin MSS. by the 7th century the high point has the value of the modern comma, the semicolon appears with its present value, and a point emphasized with additional signs, such as a second point or point and dash, marks a full-stop. In the Carolingian period the comma appears, as well as the inverted semicolon holding a position between our comma and semicolon.

Division of Words at the End of a Line.

Another detail which required the scribe's attention in writing his text was the division of the last word in a line, when for want of room a portion of it had to be carried over into the next line. It was preferable, indeed, to avoid such division, and in the papyri as well as in the codices letters might be reduced in size and huddled together at the end of the line with this view. In the early codices too it was a common practice to link letters together in monogrammatic form, such as the common verbal terminations *ur*, *unt*, and thus save space. But when the division of a word was necessary, it was subject to certain rules. According to the Greek practice the division was ordinarily made after a vowel, as ἔτυ|χον (even monosyllables might be so treated, as οὐ|κ). But in the case of double consonants the division fell after the first of them, as ἵπ|πος: and, when the first of two or more consonants was a liquid or nasal the division followed it, as ὀφθαλ|μός, μαν|θάνω. When a word was compounded with a preposition, the division usually followed the preposition, as προσ|εῖπον, but not infrequently the normal practice of dividing after a vowel prevailed, as προ|σεῖπον. In Latin the true syllabic division was followed, but occasionally the scribes adopted the Greek system and divided after a vowel.

Colometry.

A modification of the practice of writing the text continuously was allowed in the case of certain works. Rhetorical texts, such as the orations of Demosthenes and Cicero, and the text of the Bible, might be broken up into short clauses or sense-lines, apparently with the view of assisting reading aloud. Instances of MSS. so written are still extant. This system, to which the name of "colometry" has been given, is the arrangement by *cola* and *commata* referred to by St Jerome in his preface to Isaiah. It will be found more fully explained under the heading of STICHOMETRY; where also is described the mechanical computation of the length of a text by measured lines, for the purpose or calculating the pay of the scribe.

Titles and Colophons.

The title of a MS., both in roll-form and in codex-form, was frequently written at the end of the text, but even at an early date it stood in some instances at the beginning; and the latter practice in course of time prevailed, although even in the 15th century the title was sometimes reserved for the close of the MS. In this latter position it might stand alone or be accompanied by other particulars concerning the MS., such as the length of the work, the date of writing, the name of the scribe, &c., all combined in a final paragraph called the colophon. For distinction, title and colophon might be written in red, as might also the first few lines of the text. This method of rubrication was a very early practice, appearing even in ancient Egyptian papyri. Such rubrics and titles and colophons were at first written in the same character as the text; afterwards, when the admixture of different kinds of writing was allowed, capitals and uncials were used at discretion. Running titles or head-lines are found in some of the earliest Latin MSS. in the same characters as the text, but of a small size.

Quotations.

Quotations were usually indicated by ticks or arrow-heads in the margin, serving the purpose of the modern inverted commas. Sometimes the quoted words were arranged as a sub-paragraph or indented passage. In commentaries of later date, the quotations from the work commented upon were often written in a different style from the text of the commentary itself.

Accentuation, &c.—Accentuation was not systematically applied to Greek MSS. before the 7th century, but even in the literary papyri it appears occasionally. In the latter instances accents were applied specially to assist the reader, and they seem to have been used more frequently in texts which may have presented greater difficulties than usual. For example, they are found fairly plentifully in the papyrus of Bacchylides of the 1st century B.C. In the less well-written papyri they are fewer in number; and papyri written in non-literary hands are practically devoid of them. Accents have been frequently added to the ancient texts of Homer, as in the Harris and Bankes papyri, but apparently long after the date of the writing. They were not used in the early uncial MSS. Breathings also appear occasionally in the papyri. The rough and the smooth breathings are found in the form of the two halves of the H (Ⱶ) in the Bacchylides papyrus; in other papyri they are in rectangular form, never rounded like an apostrophe; in fact rounded breathings do not come into general use until the 12th century. Other signs resembling accents are used occasionally in Greek MSS. For example, a short accent or horizontal stroke was employed to indicate a single-letter word, and an apostrophe was sometimes used to separate words in order to prevent ambiguity and was placed after words ending in κ, χ, ξ, ρ, and after proper names not having a Greek termination.

Accents were seldom employed by Latin scribes. In early Irish and English MSS., in particular, an acute accent is occasionally found over a monosyllabic word or one consisting of a single letter. In the 9th and 10th centuries a curious occasional practice obtained among the correctors of the texts of expressing the aspirate by the Greek half-eta symbol ⊢, instead of writing the letter *h* in the ordinary way—perhaps only an affectation.

Corrections.—For obliteration or removing pen strokes from the surface of the material the sponge was used in ancient times. While the writing was still fresh, the scribe could easily wash off the ink by this means; and for a fragile material, such as papyrus, he could well use no other. On vellum he might use sponge or knife. But after a MS. had left his hands it would undergo revision at the hands of a corrector, who had to deal with the text in a different manner. He could no longer conveniently apply the sponge. On hard material he might still use the knife to erase letters or words or sentences. But he could also use his pen for such purposes. Thus we find that a very early system of indicating erasure was the placing of dots or minute strokes above the letters to be thus "expunged." The same marks were also (and generally at later periods) placed under the letters; in rare instances they stood inside them. It need scarcely be said that letters were also struck out with strokes of the pen or altered into others, and that letters and words were interlined. A long sentence, however, which could not be admitted between the lines, was entered in the margin, and its place in the text indicated by corresponding reference marks, such as *hd., hs.* = *hic deest, hoc supra* or *hic scribas*, &c.

Abbreviations and Contractions.—The practice of shortening words in writing has played an important part in the history of the ancient and the medieval manuscript. Two reasons have disposed men to follow this practice: firstly, the desire to avoid the labour of writing over and over again words or portions of words of common occurrence which can be readily understood in a shortened form as when written in full; and, secondly, the necessity of saving space at a time when it was an object to make the most of the writing material to hand. To meet the former requirement, a simple and limited method alone was needed; to satisfy the second, a more elaborate system was necessary. The most natural method of reducing the length of a word is to suppress as much as possible of its termination, consistently with intelligibility, that is, by simple *abbreviation*. But if space of any appreciable value is to be saved in a page of writing, a system is necessary for eliminating letters from the body of the word as well as curtailing the termination, that is, a system of *contraction* as well as abbreviation; and, in addition, the employment of arbitrary signs, analogous to shorthand, will serve still further to condense the text. An elaborate system of contraction of this nature was naturally only fully developed after very long practice. Both in Greek and in Latin MSS. from the 9th to the 15th century such a system was in full force.

Different kinds of literature were, according to their nature, more or less abbreviated and contracted. From early times such curtailment was more freely employed in works written in technical language, such as works on law or grammar or mathematics, wherein particular words are more liable to repetition, than in MSS. of general literature. The oldest system of abbreviation is that in which a single letter (nearly always the initial letter) or at most two or three letters represent the whole word. This system we know was in common use among both Greek and Latin writers, and ancient inscriptions afford plentiful examples. It is well adapted for the brief expression of the common words and phrases in works of a technical nature (as for example such a phrase as C D E R N E = *cujus de ea re notio est*); but for general literature it is of little use, and practically has been restricted to express proper names and numerals.

Abbreviations in Greek MSS.

When abbreviations were employed only with the view of speed in writing, it is obvious that they would occur more frequently in the ephemeral documents of daily life than in carefully written literary works intended for the book-market. Hence they are not to be found in Greek papyri of the latter class. On the other hand in literary papyri written in non-literary script they naturally occur just as they would in contemporary common documents. As early as the 3rd and 2nd centuries B.C. the ordinary method of abbreviation was to omit the termination or latter portion of the word and to mark the omission by a short horizontal stroke or dash; or the letter which immediately preceded the omission was written above the line as a key to the reading, as $\tau\epsilon^{\lambda}$ for *τέλος*. Such a system obviously might be extended indefinitely at the discretion of the writer. But in addition, at quite an early period, symbols and monogrammatic forms for particular words must have been developed, for they are found in common use in cursive papyri. A notable instance of their employment in a full degree occurs in the papyrus of Aristotle's *Constitution of Athens*, of the 1st century.

Like the well-written literary papyri, the early vellum uncial codices of the Bible, being inscribed with calligraphic formality, avoided in principle the use of abbreviations. But by the 4th to the 6th century, the period when they were chiefly produced, the contraction or abbreviation of certain words and terminations had, it seems, become so fixed by usage that the contracted forms were adopted in the texts. They are $\overline{\mathrm{ΘC}}$ = *θεός*, $\overline{\mathrm{IC}}$ = *Ἰησοῦς*, $\overline{\mathrm{XC}}$ = *χριστός*, $\overline{\mathrm{ΠΝΑ}}$ = *πνεῦμα*, $\overline{\mathrm{CΗΡ}}$ = *σωτήρ*, $\overline{\mathrm{ΚC}}$ = *κύριος*, $\overline{\mathrm{CΤΡΟC}}$ = *σταυρός*, $\overline{\mathrm{ΠΗΡ}}$ = *πατήρ*, $\overline{\mathrm{ΜΗΡ}}$ = *μήτηρ*, $\overline{\mathrm{ΥC}}$ = *υἱός*, $\overline{\mathrm{ΑΝΟC}}$ = *ἄνθρωπος*, $\overline{\mathrm{ΟΥΝΟC}}$ = *οὐρανός*, Κ = *καί*, Τ = *ται*, $\hat{\mathrm{Μ}}$ = *μου, μοι*, &c. Final N, especially at the end of a line, was dropped, and its place occupied by the horizontal stroke, as $\mathrm{T\overline{O}}$

But while this limited system was used in biblical, and also in liturgical MSS., in profane literature a greater licence was recognized. For example, in a fragment of a mathematical work at Milan, of the 7th century, we find instances of abbreviation by dropping terminations, just as in the earlier papyri, and, in addition, contracted particles and prepositions are numerous. Technical works, in fact, inherited the system instituted in the early papyri written in non-literary or cursive hands; and this system, undergoing continual development, had a larger scope when the cursive writing was cast into a literary form and became the literary minuscule script of the middle ages. From the 9th century onwards a fully developed system of abbreviation and contraction was practised in Greek MSS., comprising the early system of the papyri, the special contractions of the early biblical MSS., and also a large number of special symbols, derived in great measure from tachygraphical signs.

In the early Greek minuscule MSS. contractions are not very frequent in the texts; but in the marginal glosses, where it was an object to save space, they are found in great numbers as early as the 10th century. The MS. of Nonnus, of A.D. 972, in the British Museum (Wattenb. and Von Vels., *Exempla*, 7) is an instance of a text contracted to a degree that almost amounts to tachygraphy. In the 12th, 13th and 14th centuries texts were fully contracted; and as the writing became more cursive contraction-marks were more carelessly applied, until, in the 15th century, they degenerated into mere flourishes.

Abbreviations in Latin MSS.

As far back as material is available for comparison, it appears that abbreviations and contractions in Latin MSS. followed the same lines as those in Greek MSS. We have no very early papyri written in Latin as we have in Greek to show us what the practice of Roman writers was in the 3rd and 2nd and early 1st centuries B.C.; but there can be little doubt that in that remote time there was followed in Latin writing a system of abbreviation similar to that in Greek, that is, by curtailment of terminations, and that in ephemeral documents written in cursive characters such abbreviation was allowed more freely than in carefully written literary works. The early system of representing words by their initial letters has already been referred to. It was in common use, as we know, in the inscriptions on coins and monuments, and to some extent in the texts of Roman writers. But the ambiguity which must have always accompanied such a system of single-letter abbreviations, or *sigla*, naturally induced an improvement by expressing a word by two or more of its letters. Hence was developed the more regular syllabic system of the Romans, by which the leading letters of the several syllables were written, as EG = *ergo*, $\mathrm{H\overline{R}}$ = *heres*, $\mathrm{S\overline{T}}$ = *satis*. At a later time Christian writers secured greater exactness by expressing the final letter of a contracted word, as $\bar{d}s$ = *deus*, $d\bar{o}$ = *deo*, *scs* = *sanctus*. Further, certain marks and signs, many derived from shorthand symbols, came into use to indicate inflections and terminations; or the terminating letter or a leading letter to indicate the termination might be written above the line, as Q^{o} = *quo*, V^{m} = *verum*, N^{o} = *noster*, S^{t} = *sint*. This practice became capable of greater development later on. Among the special signs are ÷ = *est*, ł = *vel*, $\bar{n}$ = *non*, p' = *pre*, ꝑ = *per*, ꝓ = *pro*, ꝰ = termination *us*. The letter *q* with distinctive strokes applied in different positions represented the often recurring relative and other short words, as *quod*, *quia*.

In Latin Biblical uncial MSS. the same restrictions on abbreviations were exercised as in the Greek. The sacred names and titles $\overline{\mathrm{DS}}$ = *deus*, $\overline{\mathrm{DMS}}$, $\overline{\mathrm{DNS}}$ = *dominus*, $\overline{\mathrm{SCS}}$ = *sanctus*, $\overline{\mathrm{SPS}}$ = *spiritus*, and others appear in the oldest codices. The contracted terminations Q· = *que*, B· = *bus*, and the omission of final *m*, or (more rarely) final *n*, are common to all Latin MSS. of the earliest period. There is a peculiarity about the contracted form of our Saviour's name that it is always written by the Latin scribes in letters imitating the Greek $\overline{\mathrm{IHC}}$, $\overline{\mathrm{XPC}}$, $\overline{ihc}$, $\overline{xpc}$, and $\overline{ihs}$, $\overline{xps}$.

The full development of the medieval system of abbreviation and contraction was effected at the time when the Carolingian schools were compelling the reform of the handwriting of western Europe. Then came a freer practice of abbreviation by suppression of terminations and the latter portions of words, the omission of which was indicated by the ordinary signs, the horizontal or oblique stroke or the apostrophe; then came also a freer practice of contraction by omitting letters and syllables from the middle as well as the end of words, as $\mathrm{o\overline{i}o}$, *omnino*, $\mathrm{pr\overline{b}}$, *presbyter*; and then from the practice of writing above the line a leading letter of an omitted syllable, as $\mathrm{int}^{\mathrm{a}}$ = *intra*, t^{r} = *tur*, conventional signs, with special significations, were also gradually developed. Such growths are well illustrated in the change undergone by the semicolon, which was attached to the end of a word to indicate the omission of the termination, as b; = *bus*, q; = *que*, deb; = *debet*, and which in course of time became converted into a *z*, a form which survives in our ordinary abbreviation, viz. (*i.e.* vi; = *videlicet*). The different forms of contraction were common to all the nations of western Europe. The Spanish scribes, however, attached different values to certain of them. For example, in Visigothic MSS., $\overline{qm}$, which elsewhere represented *quoniam*, may be read as *quum*; and ꝓ, which elsewhere = *pro*, is here = *per*. Nor must the use of arbitrary symbols for special words be forgotten. These are generally adaptations of the shorthand signs known as Tironian notes. Such are K = *autem*, ÷ = *est*, Ə = *ejus*, ħ = *enim*, ⁊ = *et*, ᵿ and u̇ = *ut*, which were employed particularly in early MSS. of English and Irish origin.

By the 11th century the system of Latin contractions had been reduced to exact rules; and from this time onwards it was universally practised. It reached its culminating point in the 13th century, the period of increasing demand for MSS., when it became more than ever necessary to economize space. After this date the exact formation of the signs of contractions was less strictly observed, and the system deteriorated together with the decline of handwriting. In conclusion, it may be noticed that in MSS. written in the vernacular tongues contractions are more rarely used than in Latin texts. A system suited to the inflexions and terminations of this language could not be readily adapted to other languages so different in grammatical structure.

Palimpsests, &c.—Palimpsest MSS., that is, MSS. written upon material from which older writing has been previously removed by washing or scraping, are described in a separate article (PALIMPSEST). The ornamentation of MSS. is fully dealt with under the headings ILLUMINATED MSS., and MINIATURES.

Writing Implements.—In conclusion, a few words may be added respecting the writing implements employed in the production of MSS. The reed, *κάλαμος*, *calamus*, was adapted for tracing characters either on papyrus or vellum. By the ancient Egyptians, and also probably by the early Greek scribes in Egypt, it was used with a soft brush-like point, rather as a paint-brush than as a pen. The Greek and Roman scribes used the reed cut to a point and slit like the quill-pen; and it survived as a writing implement into the middle ages. For scratching letters on the waxen tablet the sharp pointed bodkin, *στῦλος*, *γραφεῖον*, *stilus*, *graphium*, was necessary, made of iron, bronze, ivory, or other suitable material, with a knobbed or flattened butt-end wherewith corrections could be made by smoothening the wax surface (hence *vertere stilum*, to correct). Although there is no very early record of the use of quills as pens, it is obvious that, well adapted as they are for the purpose and to be had everywhere, they must have been in request even in ancient times as they afterwards were in the middle ages. Bronze pens, fashioned exactly on the model of the quill-pen, that is in form of a tube ending in a slit nib (sometimes even with a nib at each end), of late Roman manufacture, are still in existence. A score of them are to be found scattered among public and private museums. The ruler for guiding ruled lines was the *κανών*, *canon*, *regula*; the pencil was the *μόλυβδος*, *plumbum*, the plummet; the pricker for marking the spacing out of the ruled lines was the *διαβάτης*, *circinus*, *punctorium*; the pen-knife, *γλύφανον*, *σμίλη*, *scalprum*; the erasing-knife, *rasorium*, *novacula*.

Inks.—Inks of various colours were employed from early times. The ink of the early papyri is a deep glossy black; in the Byzantine period it deteriorates. In the middle ages black ink is generally of excellent quality; it tends to deteriorate from the 14th century. But its quality varies in different countries at different periods. Red ink, besides being used for titles and colophons, also served for contrast, as, for example, in glosses. In the Carolingian period entire MSS. were occasionally written in red ink. Other coloured inks—green, violet and yellow—are also found, at an early date. Gold and silver writing fluids were used in the texts of the ancient purple vellum MSS., and writing in gold was reintroduced under Charlemagne for codices of ordinary white vellum. It was introduced into English MSS. in the 10th century.

AUTHORITIES.—H. Geraud, *Essai sur les livres dans l'antiquité* (1840); E. Egger, *Histoire du livre depuis ses origines jusqu'à nos jours* (1880); T. Birt, *Das antike Buchwesen* (1882) and *Die Buchrolle in der Kunst* (1907); W. Wattenbach, *Das Schriftwesen im Mittelalter* (1896); K. Dziatzko, *Untersuchungen über ausgewählte Kapitel des antiken Buchwesens* (1900); J. W. Clark, *The Care of Books* (1901); W. Schubart, *Das Buch bei den Griechen und Römern* (1907); and generally the authorities quoted in the article PALAEOGRAPHY. See also TEXTUAL CRITICISM. (E. M. T.)

MANUTIUS, the Latin name of an Italian family (Mannucci, Manuzio), famous in the history of printing as organizers of the Aldine press.

1. ALDUS MANUTIUS (1450–1515). Teobaldo Mannucci, better known as Aldo Manuzio, the founder of the Aldine press, was born in 1450 at Sermoneta in the Papal States. He received a scholar's training, studying Latin at Rome under Gasparino da Verona, and Greek at Ferrara under Guarino da Verona. In 1482 he went to reside at Mirandola with his old friend and fellow-student, the illustrious Giovanni Pico. There he stayed two years, prosecuting his studies in Greek literature. Before Pico removed to Florence, he procured for Aldo the post of tutor to his nephews Alberto and Lionello Pio, princes of Carpi. Alberto Pio supplied Aldo with funds for starting his printing press, and gave him lands at Carpi. It was Aldo's ambition to secure the literature of Greece from further accident by committing its chief masterpieces to type. Before his time four Italian towns had won the honours of Greek publications: Milan, with the grammar of Lascaris, Aesop, Theocritus, a Greek Psalter, and Isocrates, between 1476 and 1493; Venice, with the *Erotemata* of Chrysoloras in 1484; Vicenza, with reprints of Lascaris's grammar and the *Erotemata*, in 1488 and 1490; Florence, with Alopa's Homer, in 1488. Of these works, only three, the Milanese Theocritus and Isocrates and the Florentine Homer, were classics. Aldo selected Venice as the most appropriate station for his labours. He settled there in 1490, and soon afterwards gave to the world editions of the *Hero and Leander* of Musaeus, the *Galeomyomachia*, and the Greek Psalter. These have no date; but they are the earliest tracts issued from his press, and are called by him "Precursors of the Greek Library."

At Venice Aldo gathered an army of Greek scholars and compositors around him. His trade was carried on by Greeks, and Greek was the language of his household. Instructions to typesetters and binders were given in Greek. The prefaces to his editions were written in Greek. Greeks from Crete collated MSS., read proofs, and gave models of calligraphy for casts of Greek type. Not counting the craftsmen employed in merely manual labour, Aldo entertained as many as thirty of these Greek assistants in his family: His own industry and energy were unremitting. In 1495 he issued the first volume of his Aristotle. Four more volumes completed the work in 1497–1498. Nine comedies of Aristophanes appeared in 1498. Thucydides, Sophocles and Herodotus followed in 1502; Xenophon's *Hellenics* and Euripides in 1503; Demosthenes in 1504. The troubles of Italy, which pressed heavily on Venice at this epoch, suspended Aldo's labours for a while. But in 1508 he resumed his series with an edition of the minor Greek orators; and in 1509 appeared the lesser works of Plutarch. Then came another stoppage. The league of Cambray had driven Venice back to her lagoons, and all the forces of the republic were concentrated on a struggle to the death with the allied powers of Europe. In 1513 Aldo reappeared with Plato, which he dedicated to Leo X. in a preface eloquently and earnestly comparing the miseries of warfare and the woes of Italy with the sublime and tranquil objects of the student's life. Pindar, Hesychius, and Athenaeus followed in 1514.

These complete the list of Aldo's prime services to Greek literature. But it may be well in this place to observe that his successors continued his work by giving Pausanias, Strabo, Aeschylus, Galen, Hippocrates and Longinus to the world in first editions. Omission has been made of Aldo's reprints, in order that the attention of the reader might be concentrated on his labours in editing Greek classics from MSS. Other presses were at work in Italy; and, as the classics issued from Florence, Rome or Milan, Aldo took them up, bestowing in each case fresh industry upon the collation of codices and the correction of texts. Nor was the Aldine press idle in regard to Latin and Italian classics. The *Asolani* of Bembo, the collected writings of Poliziano, the *Hypnerotomachia Poliphili*, Dante's *Divine Comedy*, Petrarch's poems, a collection of early Latin poets of the Christian era, the letters of the younger Pliny, the poems of Pontanus, Sannazzaro's *Arcadia*, Quintilian, Valerius Maximus, and the *Adagia* of Erasmus were printed, either in first editions, or with a beauty of type and paper never reached before, between the years 1495 and 1514. For these Italian and Latin editions Aldo had the elegant type struck which bears his name. It is said to have been copied from Petrarch's handwriting, and was cast under the direction of Francesco da Bologna, who has been identified by Panizzi with Francia the painter.

Aldo's enthusiasm for Greek literature was not confined to the printing-room. Whatever the students of this century may think of his scholarship, they must allow that only vast erudition and thorough familiarity with the Greek language could have enabled him to accomplish what he did. In his own days Aldo's learning won the hearty acknowledgment of ripe scholars. To his fellow workers he was uniformly generous, free from jealousy, and prodigal of praise. While aiming at that excellence of typography which renders his editions the treasures of the book-collector, he strove at the same time to make them cheap. We may perhaps roughly estimate the current price of his pocket series of Greek, Latin and Italian classics, begun in 1501, at 2s. per volume of our present money. The five volumes of the Aristotle cost about £8. His great undertaking was carried on under continual difficulties, arising from strikes among his workmen, the piracies of rivals, and the interruptions of war. When he died, bequeathing Greek literature as an inalienable possession to the world, he was a poor man. In order to promote Greek studies, Aldo founded an academy of Hellenists in 1500 under the title of the New Academy. Its rules were written in Greek. Its members were obliged to speak Greek. Their names were Hellenized, and their official titles were Greek. The biographies of all the famous men who were enrolled in this academy must be sought in the pages of Didot's *Alde Manuce*. It is enough here to mention that they included Erasmus and the English Linacre.

In 1499 Aldo married Maria, daughter of Andrea Torresano of Asola. Andrea had already bought the press established by Nicholas Jenson at Venice. Therefore Aldo's marriage combined two important publishing firms. Henceforth the names Aldus and Asolanus were associated on the title pages of the Aldine publications; and after Aldo's death in 1515, Andrea and his two sons carried on the business during the minority of Aldo's children. The device of the dolphin and the anchor, and the motto *festina lente*, which indicated quickness combined with firmness in the execution of a great scheme, were never wholly abandoned by the Aldines until the expiration of their firm in the third generation.

2. Paulus Manutius (1512–1574). By his marriage with Maria Torresano, Aldo had three sons, the youngest of whom, Paolo, was born in 1512. He had the misfortune to lose his father at the age of two. After this event his grandfather and two uncles, the three Asolani, carried on the Aldine press, while Paolo prosecuted his early studies at Venice. Excessive application hurt his health, which remained weak during the rest of his life. At the age of twenty-one he had acquired a solid reputation for scholarship and learning. In 1533 Paolo undertook the conduct of his father's business, which had latterly been much neglected by his uncles. In the interregnum between Aldo's death and Paolo's succession (1514–1533) the Asolani continued to issue books, the best of which were Latin classics. But, though their publications count a large number of first editions, and some are works of considerable magnitude, they were not brought out with the scholarly perfection at which Aldo aimed. The Asolani attempted to perform the whole duties of editing, and to reserve all its honours for themselves, dispensing with the service of competent collaborators. The result was that some of their editions, especially their Aeschylus of 1518, are singularly bad. Paolo determined to restore the glories of the house, and in 1540 he separated from his uncles. The field of Greek literature having been well-nigh exhausted, he devoted himself principally to the Latin classics. He was a passionate Ciceronian, and perhaps his chief contributions to scholarship are the corrected editions of Cicero's letters and orations, his own epistles in a Ciceronian style, and his Latin version of Demosthenes. Throughout his life he combined the occupations of a student and a printer, winning an even higher celebrity in the former field than his father had done. Four treatises from his pen on Roman antiquities deserve to be commemorated for their erudition no less than for the elegance of their Latinity. Several Italian cities contended for the possession of so rare a man; and he received tempting offers from the Spanish court. Yet his life was a long struggle with pecuniary difficulties. To prepare correct editions of the classics, and to print them in a splendid style, has always been a costly undertaking. And, though Paolo's publications were highly esteemed, their sale was slow. In 1556 he received for a time external support from the Venetian Academy, founded by Federigo Badoaro. But Badoaro failed disgracefully in 1559, and the academy was extinct in 1562. Meanwhile Paolo had established his brother, Antonio, a man of good parts but indifferent conduct, in a printing office and book shop at Bologna. Antonio died in 1559, having been a source of trouble and expense to Paolo during the last four years of his life. Other pecuniary embarrassments arose from a contract for supplying fish to Venice, into which Paolo had somewhat strangely entered with the government. In 1561 pope Pius IV. invited him to Rome, offering him a yearly stipend of 500 ducats, and undertaking to establish and maintain his press there. The profits on publications were to be divided between Paolo Manuzio and the Apostolic camera. Paolo accepted the invitation, and spent the larger portion of his life, under three papacies, with varying fortunes, in the city of Rome. Ill-health, the commercial interests he had left behind at Venice, and the coldness shown him by pope Pius V., induced him at various times and for several reasons to leave Rome. As was natural, his editions after his removal to Rome were mostly Latin works of theology and Biblical or patristic literature.

Paolo married Caterina Odoni in 1546. She brought him three sons and one daughter. His eldest son, the younger Aldus, succeeded him in the management of the Venetian printing house when his father settled at Rome in 1561. Paolo had never been a strong man, and his health was overtaxed with studies and commercial worries. Yet he lived into his sixty-second year, and died at Rome in 1574.

3. Aldus Manutius, Junior (1547–1597). The younger Aldo born in the year after his father Paolo's marriage, proved what is called an infant prodigy. When he was nine years old his name was placed upon the title page of the famous *Eleganze della lingua Toscana e Latina*. The *Eleganze* was probably a book made for his instruction and in his company by his father. In 1561, at the age of fourteen, he produced a work upon Latin spelling, called *Orthographiae ratio*. During a visit to his father at Rome in the next year he was able to improve this treatise by the study of inscriptions, and in 1575 he completed his labours in the same field by the publication of an *Epitome orthographiae*. Whether Aldo was the sole composer of the work on spelling, in its first edition, may be doubted; but he appropriated the subject and made it his own. Probably his greatest service to scholarship is this analysis of the principles of orthography in Latin.

Aldo remained at Venice, studying literature and superintending the Aldine press. In 1572 he married Francesca Lucrezia daughter of Bartolommeo Giunta, and great-grandchild of the first Giunta, who founded the famous printing house in Venice. This was an alliance which augured well of the Giunta for the future of the Aldines, especially as Aldo had recently found time to publish a new revised edition of Velleius Paterculus. Two years later the death of his father at Rome placed Aldo at the head of the firm. In concert with the Giunta, he now edited an extensive collection of Italian letters, and in 1576 he published his commentary upon the *Ars poetica* of Horace. About the same time, that is to say, about the year 1576, he was appointed professor of literature to the Cancelleria at Venice. The Aldine press continued through this period to issue books, but none of signal merit; and in 1585 Aldo determined to quit his native city for Bologna, where he occupied the chair of eloquence for a few months. In 1587 he left Bologna for Pisa, and there, in his quality of professor, he made the curious mistake of printing Alberti's comedy *Philodoxius* as a work of the classic Lepidus. Sixtus V. drew him in 1588 from Tuscany to Rome; and at Rome he hoped to make a permanent settlement as lecturer. But his public lessons were ill attended, and he soon fell back upon his old vocation of publisher under the patronage of a new pope, Clement VIII. In 1597 he died, leaving children, but none who cared or had capacity to carry on the Aldine press. Aldo himself, though a precocious student, a scholar of no mean ability, and a publisher of some distinction, was the least remarkable of the three men who gave books to the public under the old Aldine ensign. This does not of necessity mean that we should adopt Scaliger's critique of the younger Aldo without reservation. Scaliger called him "a poverty-stricken talent, slow in operation; his work is very commonplace; he aped his father." What is true in this remark lies partly in the fact that scholarship in Aldo's days had flown beyond the Alps, where a new growth of erudition, on a basis different from that of the Italian Renaissance, had begun.

See Renouard's *Annales de l'imprimerie des Aldes* (Paris, 1834); Didot's *Alde Manuce* (Paris, 1873); Omont's *Catalogue* of Aldine publications (Paris, 1892). (J. A. S.)

MANWARING, ROBERT, English 18th-century furniture designer and cabinet maker. The dates of his birth and death are unknown. He was a contemporary and imitator of Chippendale, and not the least considerable of his rivals. He prided himself upon work which he described as "genteel," and his speciality was chairs. He manifests the same surprising variations of quality that are noticed in the work of nearly all the English cabinet-makers of the second half of the 18th century, and while his best had an undeniable elegance his worst was exceedingly bad—squat, ill-proportioned and confused. Some of his chairbacks are so nearly identical with Chippendale's that it is difficult to suppose that the one did not copy from the other, and most of the designs of the greater man enjoyed priority of date. During a portion of his career Manwaring was a devotee of the Chinese taste; he likewise practised in the Gothic manner. He appears to have introduced the small bracket between the front rail of the seat and the top of the chair leg, or at all events to have made such constant use of it that it has come to be regarded as characteristic of his work. Manwaring described certain of his own work as "elegant and superb," and as possessing "grandeur and magnificence." He did not confine himself to furniture but produced many designs for rustic gates and railings, often very extravagant. One of his most absurd rural chairs has rock-work with a waterfall in the back.

Among Manwaring's writings were *The Cabinet and Chair Makers' Real Friend and Companion, or the Whole System of Chairmaking Made Plain and Easy* (1765); *The Carpenters' Compleat Guide to Gothic Railing* (1765); and *The Chair-makers' Guide* (1766).

MANYCH, a river and depression in S. Russia, stretching between the lower river Don and the Caspian Sea, through the Don Cossacks territory and between the government of Astrakhan on the N. and that of Stavropol on the S. During the greater part of the year it is either dry or occupied in part by a string of saline lakes (*limans* or *ilmens*); but in spring when the streams swell which empty into it, the water flows in two opposite directions from the highest point (near Shara-Khulusun). The western stream flows westwards, with an inclination northwards, until it reaches the Don, though when the latter river is running high, its water penetrates some 60 miles up the Manych. The eastern stream dies away in the sandy steppe about 25 miles from the Caspian, though it is said sometimes to reach the Kuma through the Huiduk, a tributary of the Kuma. Total length of the depression, 330 m. For its significance as a former (geologic) connexion between the Sea of Azov and the Caspian Sea, see CASPIAN SEA. By some authorities the Manych depression is taken as part of the boundary between Europe and Asia.

MANYEMA (*Una-Ma-Nyema*, eaters of flesh), a powerful and warlike Bantu-Negroid people in the south-east of the Congo basin. Physically they are of a light colour, with well formed noses and not over-full lips, the women being described as singularly pretty and graceful. Manyemaland was for the greater part of the 19th century an Eldorado of the Arab slave raiders.

MANZANARES, a town of Spain, in the province of Ciudad Real, on the river Azuer, a large sub-tributary of the Záncara, and on the railways from Madrid to Ciudad Real and Linares. Pop. (1900), 11,229. Manzanares is one of the chief towns of La Mancha, and thus in the centre of the district described by Cervantes in *Don Quixote*. Its citadel was founded as a Christian fortress after the defeat of the Moors at Las Navas de Tolosa (1212). Bull-fights were formerly held in the main *plaza*, where galleries to accommodate spectators were built between the buttresses of an ancient parish church. Manzanares has manufactures of soap, bricks and pottery, and an active trade in wheat, wine, spirits, aniseed and saffron.

MANZANILLO, a town and port on the Pacific coast of Mexico, in the state of Colima, 52 m. by rail W.S.W. of the city of that name. It is situated on a large harbour partly formed and sheltered by a long island extending southwards parallel with the coast. Southward also, and in the vicinity of the town, is the large stagnant, shallow lagoon of Cayutlán which renders the town unhealthy. Manzanillo is a commercial town of comparatively recent creation. Its new harbour works, the construction of which was begun in 1899, and its railway connexion with central Mexico, promise to make it one of the chief Pacific ports of the republic. These works include a breakwater 1300 ft. long, with a depth of 12 to 70 ft. and a maximum breadth of 320 ft. at the base and 25 ft. on top, and all the necessary berthing and mechanical facilities for the handling of cargoes. A narrow-gauge railway was built between Colima and Manzanillo toward the end of the nineteenth century, but the traffic was only sufficient for a tri-weekly service up to 1908, when the gauge was widened and the railway became part of the Mexican Central branch, completed in that year from Irapuato through Guadalajara to Colima. The exports include hides and skins, palm leaf hats, Indian corn, coffee, palm oil, fruit, lumber and minerals.

MANZANILLO, an important commercial city of Cuba, in Santiago province, on the gulf of Guacanabo, about 17 m. S. of the mouth of the Rio Cauto, on the shore of Manzanillo Bay. Pop. (1907), 15,819. It is shut off to the east and south by the Sierra Maestra. Besides the Cauto, the rivers Yara and Buey are near the city. Manzanillo is the only coast town of importance between Trinidad and Santiago. It exports large quantities of sugar, hides, tobacco, and bees-wax; also some cedar and mahogany. The history of the settlement begins in 1784, but the port was already important at that time for a trade in woods and fruits; French and English corsairs resorted thither for ship-building woods. The settlement was sacked by the French in 1792, and in the following year a fort was built for its protection. In 1833 it received an *ayuntamiento* (council) and in 1837, for its "loyalty" in not following the lead of Santiago in proclaiming the Spanish Constitution, received from the crown the title of *Fiel*. In 1827 the port was opened to commerce, national and foreign.

MANZOLLI, PIER ANGELO, Italian author, was born about the end of the fifteenth century at La Stellata, near Ferrara. He wrote a poem entitled *Zodiacus vitae*, published at Basel in 1543, and dedicated to Hercules II. of Ferrara. The poem is full of didactic writing on the subject of human happiness in connexion with scientific knowledge, and combines metaphysical speculation with satirical attacks on ecclesiastical hypocrisy, and especially on the Pope and on Luther. It was translated into several languages, but fell under the ban of the Inquisition on the ground of its rationalizing tendencies.

MANZONI, ALESSANDRO FRANCESCO TOMMASO ANTONIO (1785–1873), Italian poet and novelist, was born at Milan on the 7th of March 1785. Don Pietro, his father, then about fifty, represented an old family settled near Lecco, but originally feudal lords of Barzio, in the Valsassina, where the memory of their violence is still perpetuated in a local proverb, comparing it to that of the mountain torrent. The poet's maternal grandfather, Cesare Beccaria, was a well-known author, and his mother Giulia a woman of some literary ability. Manzoni's intellect was slow in maturing, and at the various colleges where his school days were passed he ranked among the dunces. At fifteen, however, he developed a passion for poetry, and wrote two sonnets of considerable merit. On the death of his father in 1805, he joined his mother at Auteuil, and spent two years there, mixing in the literary set of the so-called "idéologues," philosophers of the 18th century school, among whom he made many friends, notably Claude Fauriel. There too he imbibed the negative creed of Voltairianism, and only after his marriage, and under the influence of his wife, did he exchange it for that fervent Catholicism which coloured his later life. In 1806–1807, while at Auteuil, he first appeared before the public as a poet, with two pieces, one entitled *Urania*, in the classical style, of which he became later the most conspicuous adversary, the other an elegy in blank verse, on the death of Count Carlo Imbonati, from whom, through his mother, he inherited considerable property, including the villa of Brusuglio, thenceforward his principal residence.

Manzoni's marriage in 1808 to Henriette Blondel, daughter of a Genevese banker, proved a most happy one, and he led for many years a retired domestic life, divided between literature and the picturesque husbandry of Lombardy. His intellectual energy at this period was devoted to the composition of the *Inni sacri*, a series of sacred lyrics, and a treatise on Catholic morality, forming a task undertaken under religious guidance, in reparation for his early lapse from faith. In 1818 he had to sell his paternal inheritance, as his affairs had gone to ruin in the hands of a dishonest agent. His characteristic generosity was shown on this occasion in his dealings with his peasants, who were heavily indebted to him. He not only cancelled on the spot the record of all sums owing to him, but bade them keep for themselves the whole of the coming maize harvest.

In 1819 Manzoni published his first tragedy, *Il Conte di Carmagnola*, which, boldly violating all classical conventionalisms, excited a lively controversy. It was severely criticized in the *Quarterly Review*, in an article to which Goethe replied in its defence, "one genius," as Count de Gubernatis remarks, "having divined the other." The death of Napoleon in 1821 inspired Manzoni's powerful stanzas *Il Cinque maggio*, the most popular lyric in the Italian language. The political events of that year, and the imprisonment of many of his friends, weighed much on Manzoni's mind, and the historical studies in which he sought distraction during his subsequent retirement at Brusuglio suggested his great work. Round the episode of the *Innominato*, historically identified with Bernardino Visconti, the novel *I Promessi sposi* began to grow into shape, and was completed in September 1822. The work when published, after revision by friends in 1825–1827, at the rate of a volume a year, at once raised its author to the first rank of literary fame. In 1822, Manzoni published his second tragedy *Adelchi*, turning on the overthrow by Charlemagne of the Lombard domination in Italy, and containing many veiled allusions to the existing Austrian rule. With these works Manzoni's literary career was practically closed. But he laboriously revised *I Promessi sposi* in the Tuscan idiom, and in 1840 republished it in that form, with a sort of sequel, *La Storia della Colonna infame*, of very inferior interest. He also wrote a small treatise on the Italian language.

The end of the poet's long life was saddened by domestic sorrows. The loss of his wife in 1833 was followed by that of several of his children, and of his mother. In 1837 he married his second wife, Teresa Borri, widow of Count Stampa, whom he also survived, while of nine children born to him in his two marriages all but two preceded him to the grave. The death of his eldest son, Pier Luigi, on the 28th of April 1873, was the final blow which hastened his end; he fell ill immediately, and died of cerebral meningitis, on the 22nd of May. His country mourned him with almost royal pomp, and his remains, after lying in state for some days, were followed to the cemetery of Milan by a vast cortège, including the royal princes and all the great officers of state. But his noblest monument was Verdi's *Requiem*, specially written to honour his memory.

Biographical sketches of Manzoni have been published by Cesare Cantù (1885), Angelo de Gubernatis (1879), Arturo Graf (1898). Some of his letters have been published by Giovanni Sforza (1882).

MAORI (pronounced "Mowri"; a Polynesian word meaning "native," "indigenous"; the word occurs in distinction from *pakeha*, "stranger," in other parts of Polynesia in the forms *Maoi* and *Maoli*), the name of the race inhabiting New Zealand when first visited by Tasman in 1642.

That they were not indigenous, but had displaced an earlier Melanesian or Papuan race, the true aborigines, is certain. The Maoris are Polynesians, and, in common with the majority of their kinsfolk throughout the Pacific, they have traditions which point to Savaii, originally Savaiki, the largest island of the Samoan group, as their cradleland. They say they came to New Zealand from "Hawaiki," and they appear to distinguish between a large and small, or a nearer and farther, "Hawaiki." "The seed of our coming is from Hawaiki; the seed of our nourishing, the seed of mankind." Their great chief, Te Kupe, first landed, they say, on Aotearoa, as they called the north island, and, pleased with his discovery, returned to Hawaiki to tell his fellow-countrymen. Thereafter he returned with seven war canoes, each holding a hundred warriors, priests, stone idols and sacred weapons, as well as native plants and animals. Hawaiki, the name of Te Kupe's traditional home, is identical with several other Polynesian place-names, *e.g.* Hawaii, Apai in the Tonga Islands, Evava in the Marquesas, all of which are held to be derived from Savii or Savaiki. Dr Thomson, in his *Story of New Zealand*, quotes a Maori tradition, published by Sir George Grey, that certain islands, among which it names Rarotonga, Parima and Manono, are islands near Hawaiki. The Rarotongas call themselves Maori, and state that their ancestors came from Hawaiki, and Pirima and Manono are the native names of two islands in the Samoan group. The almost identical languages of the Rarotongas and the Maoris strengthen the theory that the two peoples are descended from Polynesians migrating, possibly at widely different dates, from Samoa. The distance from Rarotonga to New Zealand is about 2000 m., and, with the aid of the trade wind, large canoes could traverse the distance within a month. Moreover the fauna and flora of New Zealand in many ways resemble those of Samoa. Thus it would seem certain that the Maoris, starting from "further Hawaiki," or Samoa, first touched at Rarotonga, "nearer Hawaiki," whence, after forming a settlement, they journeyed on to New Zealand. Maori tradition is explicit as to the cause of the exodus from Samoa, gives the names of the canoes in which the journey was made and the time of year at which the coast of New Zealand was sighted. On the question of the date a comparison of genealogies of Maori chiefs shows that, up to the beginning of the 20th century, about eighteen generations or probably not much more than five centuries had passed since the first Maori arrivals. There is some evidence that the "tradition of the six canoes" does not represent the first contact of the Polynesian race with New Zealand. If earlier immigrants from Samoa or other eastern Pacific islands arrived they must have become absorbed into the native Papuan population—arguing from the absence of any distinct tradition earlier than that "of the six canoes." Some have sought to find in the Morioris of Chatham Island the remnants of this Papuan-Polynesian population, expelled by Te Kupe and his followers. The extraordinary ruined fortifications found, and the knowledge of the higher art of war displayed by the Maoris, suggest (what is no doubt the fact) that there was a hard fight for them when they first arrived, but the greatest resistance must have been from the purer Papuan inhabitants, and not from the half-castes who were probably easily overwhelmed. The shell heaps found on the coasts and elsewhere dispose of the theory that New Zealand was uninhabited or practically so six centuries back.

Any description of the Maoris, who in recent years have come more and more under the influence of white civilization, must necessarily refer rather to what they have been than what they are. Physically the Maoris are true Polynesians, tall, well-built, with straight or slightly curved noses, high foreheads and oval faces. Their colour is usually a darker brown than that of their kinsfolk of the eastern Pacific, but light-complexioned Maoris, almost European in features, are met with. Their hair is black and straight or wavy, scarcely ever curly. They have long been celebrated for their tattooing, the designs being most elaborate.

Among the most industrious of Polynesian races, they have always been famed for wood-carving; and in building, weaving and dyeing they had made great advances before the whites arrived. They are also good farmers and bold seamen. In the Maori wars they showed much strategic skill, and their knowledge of fortification was very remarkable. Politically the

Maoris have always been democratic. No approach to a monarchy ever existed. Each tribe under its chief was autonomous. Tribal lands were held in common and each man was entitled to a share in the products. They had slaves, but so few as not to alter the social conditions. Every Maori was a soldier, and war was the chief business and joy of his life. Tribal wars were incessant. The weapons were wooden spears, clubs and stone tomahawks. Cannibalism, which earned them in earlier years a terrible name, was generally restricted to the bloodthirsty banquets which always followed a victory. The Maoris ate their enemies' hearts to gain their courage, but to whatever degree animistic beliefs may have once contributed to their cannibalism, it is certain that long before Captain Cook's visit religious sanction for the custom had long given place to mere gluttonous enjoyment.

The Maoris had no regular marriage ceremony. Polygamy was universal, and even to-day they are not strictly monogamous. The power of the husband over the wife was absolute, but women took their meals with the men, were allowed a voice in the tribe's affairs, and sometimes accompanied the men into battle. Some tribes were endogamic, and there matriarchy was the rule, descent being traced through the female line. Ferocious as they were in war, the Maoris are generally hospitable and affectionate in their home-life, and a pleasant characteristic, noticed by Captain Cook, is their respect and care of the old. The Maoris buried their dead, the cemeteries being ornamented with carved posts. Their religion was a nature-worship intimately connected with the veneration of ancestors. There was a belief in the soul, which was supposed to dwell in the left eye. They had no doubt as to a future state, but no definite idea of a supreme being. They had no places of worship, nor, though they had sacred wooden figures, is there any reason to consider that they were idolaters in the strict sense of the word. The custom of taboo was very fully developed. Nowadays they are all nominally Christians. While they had no written language, a considerable oral literature of songs, legends and traditions existed. Their priesthood was a highly trained profession, and they had schools which taught a knowledge of the stars and constellations, for many of which they had names. All Maoris are natural orators and poets, and a chief was expected to add these accomplishments to his prowess as a warrior or his skill as a seaman. The Maoris of to-day are law-abiding, peaceable and indolent. They have been called the Britons of the south, and their courage in defending their country and their intelligence amply justify the compliment. By the New Zealanders they are cordially liked. At the census of 1906 they numbered 47,731, as against 45,470 in 1874; and there were 6516 half-castes. See also POLYNESIA and SAMOA.

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MAP (or MAPES), **WALTER** (d. *c.* 1208/9), medieval ecclesiastic, author and wit, to whose authority the main body of prose Arthurian literature has, at one time or another, been assigned, flourished in the latter part of the 12th and early years of the 13th centuries. Concerning the date of his birth and his parentage nothing definite is known, but as he ascribes his position at court to the merits of his parents they were probably people of some importance. He studied at Paris under Girard la Pucelle, who began to teach in or about 1160, but as he states in his book *De nugis curialium* that he was at the court of Henry II. before 1162, his residence at Paris must have been practically comprised in the decade 1150–1160.

Map's career was an active and varied one; he was clerk of the royal household and justice itinerant; in 1179 he was present at the Lateran council at Rome, on his way thither being entertained by the count of Champagne; at this time he apparently held a plurality of ecclesiastical benefices, being a prebend of St Paul's, canon and precentor of Lincoln and parson of Westbury, Gloucestershire. There seems to be no record of his ordination, but as he was a candidate for the see of Hereford in 1199 it is most probable that he was in priest's orders. The last reference to him, as living, is in 1208, when an order for payment to him is on record, but Giraldus Cambrensis, in the second edition of his *Hibernica*, redacted in 1210, utters a prayer for his soul, "cujus animae propitietur Deus," a proof that he was no longer alive.

The special interest of Map lies in the perplexing question of his relation to the Arthurian legend and literature. He is invariably cited as the author of the *Lancelot* proper (consisting of two parts), the *Queste* and the *Mort Artus*, all three of which are now generally found in one manuscript under the title of *Lancelot*. The *Mort Artus*, however, we know to be the prose working over of an earlier and independent poem. Sundry manuscripts of the yet more extensive compilation which begins with the *Grand Saint Graal* also refer to Map as having composed the cycle in conjunction with Robert de Borron, to whom, as a rule, the *Grand Saint Graal* and *Merlin* are exclusively assigned. The curious *Merlin* text, Bibl. Nat. 337 (fonds Français), refers throughout to Map as authority; and the enormous *Lancelot* codex, B. N. 112, a combination of the *Lancelot* and the *Tristan*, also couples his name with that of Robert de Borron. In fact it may safely be said that, with the exception of the prose *Tristan*, always attributed either to Luces de Gast, or Hélie de Borron, the authority of Map has been invoked for the entire vast mass of Arthurian prose romantic literature. Now it is practically impossible that one man, and that one an occupier of court and public offices, constantly employed in royal and public business, very frequently travelling abroad (*e.g.* we know he was at Limoges in 1173; at Rome in 1179; in Anjou in 1183; and at Angers in 1199), could have found the necessary leisure. On this point we have the testimony of his one undoubted work, *De nugis curialium*, which he tells us he composed "by snatches" during his residence at court. *De nugis* is a comparatively small book; if it were difficult to find leisure for that, much more would it have been difficult to find the time requisite for the composition of one only of the many long-winded romances which have been fathered on Map. Giraldus Cambrensis, with whom he was on most friendly terms, and who frequently refers to and quotes him, records a speech in which Map contrasted Giraldus' labours with his own, apparently to the disadvantage of the latter, "vos scripta dedistis, et nos verba"—a phrase which has been interpreted as meaning that Map himself had produced no literary work. But inasmuch as the *De nugis* is undoubtedly, and certain satirical poems directed against the loose life of the clergy of the day most probably, his work, the speech must not be taken too literally. It seems difficult also to believe that Map's name should be so constantly connected with our Arthurian tradition without any ground whatever; though it must be admitted that he himself never makes any such claim—the references in the romances are all couched in the third person, and bear no sign of being other than the record by the copyist of a traditional attribution.

A different and very interesting piece of evidence is afforded by the *Ipomedon* of Hue de Rotelande; in relating how his hero appeared at a tournament three days running, in three different suits of armour, red, black and white, the author remarks,

Sul ne sai pas de mentir l'art
Walter Map reset ben sa part.

This apparently indicated that Map, also, had made himself responsible for a similar story. Now this incident of the "Three Days' Tournament" is found alike in the prose *Lancelot* and in the German *Lanzelet*, this latter translated from a French poem which, in 1194, was in the possession of Hugo de Morville. The *Ipomedon* was written somewhere in the decade 1180–1190, and there is no evidence of the prose romance having then been in existence. We have no manuscript of any prose Arthurian romance earlier than the 13th century, to which period Gaston

Paris assigned them; they are certainly posterior to the verse romances. Chrétien de Troyes, in his *Cligès* (the date of which falls somewhere in the decade 1160–1170), knew and utilized the story of the "Three Days' Tournament," and moreover makes Lancelot take part in it. Map was, as we have seen, frequently in France; Chrétien had for patroness Marie, countess of Champagne, step-daughter to Henry II., Map's patron; Map's position was distinctly superior to that of Chrétien. Taking all the evidence into consideration it seems more probable that Map had, at a comparatively early date, before he became so important an official, composed a poem on the subject of Lancelot, which was the direct source of the German version, and which Chrétien also knew and followed.

The form in which certain of the references to him are couched favours the above view; the compiler of *Guiron le Cortois* says in his prologue that "*maistre Gautier Map qui fu clers au roi Henry—devisa cil l'estoire de monseigneur Lancelot du Lac, que d'autre chose ne parla il mie gramment en son livre*"; and in another place he refers to Map, "*qui fit lou propre livre de monsoingnour Lancelot dou Lac.*" Now only during the early part of his career could Map fairly be referred to as simple "*clers au roi Henry,*" and both extracts emphasize the fact that his work dealt, almost exclusively, with Lancelot. Neither of these passages would fit the prose romance, as we know it, but both might well suit the lost French source of the *Lanzelet*; where we are in a position to compare the German versions of French romances with their originals we find, as a rule, that the translators have followed their source faithfully.

One of the references to Map's works in the *Merlin* manuscript above referred to (B.N. 337) has an interesting touch not found elsewhere. After saying how Map translated the romance from the Latin at the bidding of King Henry, the usual statement, the scribe adds "*qui ricke loier l'en dona.*" It is of course possible that Map's rise at court may have been due to his having hit the literary taste of the monarch, who, we know, was interested in the Arthurian tradition, but it must be admitted that direct evidence on the subject is practically nil, and that in the present condition of our knowledge we can only advance possible hypotheses.

See art. "Map" in *Dict. Nat. Biog.* *De nugis curialium* and the *Latin Poems attributed to Map* have been edited for the Camden Society by T. Wright (1841). For discussion of his authorship of the *Lancelot* cf. *The Three Days' Tournament*, Grimm Library XV. See also under LANCELOT. The passages relating to Map cited above have been frequently quoted by scholars, *e.g.* Hucher, *Le Grand Saint Graal*; Paulin Paris, *Romans de la Table Ronde*; Alfred Nutt, *Studies in the Legend of the Holy Grail.* (J. L. W.)

MAP, a representation, on a plane and a reduced scale, of part or the whole of the earth's surface. If specially designed to meet the requirements of seamen it is called a chart, if on an exceptionally large scale a plan. The words map and chart are derived from *mappa* and *charta*, the former being the Latin for napkin or cloth, the latter for papyrus or parchment. Maps were thus named after the material upon which they were drawn or painted, and it should be noted that even at present maps intended for use in the open air, by cyclists, military men and others, are frequently printed on cloth. In Italian, Spanish and Portuguese the word *mappa* has retained its place, by the side of *carta*, for marine charts, but in other languages both kinds of maps[1] are generally known by a word derived from the Latin *charta*, as *carte* in French, *Karte* in German, *Kaart* in Dutch. A chart, in French, is called *carte hydrographique*, *marine* or *des côtes*; in Spanish or Portuguese *carta de marear*, in Italian *carta da navigare*, in German *Seekarte* (to distinguish it from *Landkarte*), in Dutch *Zeekaart* or *Paskaart*. A chart on Mercator's projection is called *Wassende graadkaart* in Dutch, *carte réduite* in French. Lastly, a collection of maps is called an atlas, after the figure of Atlas, the Titan, supporting the heavens, which ornamented the title of Lafreri's and Mercator's atlases in the 16th century.

Classification of Maps.—Maps differ greatly, not only as to the scale on which they are drawn, but also with respect to the fullness or the character of the information which they convey. Broadly speaking, they may be divided into two classes, of which the first includes topographical, chorographical and general maps, the second the great variety designed for special purposes.

Topographical maps and plans are drawn on a scale sufficiently large to enable the draughtsman to show most objects on a scale true to nature.[2] Its information should not only be accurate, but also conveyed intelligibly and with taste. Exaggeration, however, is not always to be avoided, for even on the British 1 in. ordnance map the roads appear as if they were 130 ft. in width.

Chorographical (Gr. χώρα, country or region) and general maps are either reduced from topographical maps or compiled from such miscellaneous sources as are available. In the former case the cartographer is merely called upon to reduce and generalize the information given by his originals, to make a judicious selection of place names, and to take care that the map is not overcrowded with names and details. Far more difficult is his task where no surveys are available, and the map has to be compiled from a variety of sources. These materials generally include reconnaissance survey of small districts, route surveys and astronomical observations supplied by travellers, and information obtained from native sources. The compiler, in combining these materials, is called upon to examine the various sources of information, and to form an estimate of their value, which he can only do if he have himself some knowledge of surveying and of the methods of determining positions by astronomical observation. A knowledge of the languages in which the accounts of travellers are written, and even of native languages, is almost indispensable. He ought not to be satisfied with compiling his map from existing maps, but should subject each explorer's account to an independent examination, when he will frequently find that either the explorer himself, or the draughtsman employed by him, has failed to introduce into his map the whole of the information available. Latitudes from the observations of travellers may generally be trusted, but longitudes should be accepted with caution; for so competent an observer as Captain Speke placed the capital of Uganda in longitude 32° 44′ E., when its true longitude as determined by more trustworthy observations is 32° 26′ E., an error of 18′. Again, on the map illustrating Livingstone's "Last Journals" the Luapula is shown as issuing from the Bangweulu in the north-west, when an examination of the account of the natives who carried the great explorer's remains to the coast would have shown that it leaves that lake on the south.

The second group includes all maps compiled for special purposes. Their variety is considerable, for they are designed to illustrate physical and political geography, travel and navigation, trade and commerce, and, in fact, every subject connected with geographical distribution and capable of being illustrated by means of a map. We thus have (1) physical maps in great variety, including geological, orographical and hydrographical maps, maps illustrative of the geographical distribution of meteorological phenomena, of plants and animals, such as are to be found in Berghaus's "Physical Atlas," of which an enlarged English edition is published by J. G. Bartholomew of Edinburgh; (2) political maps, showing political boundaries; (3) ethnological maps, illustrating the distribution of the varieties of man, the density of population, &c.; (4) travel maps, showing roads or railways and ocean-routes (as is done by Philips' "Marine Atlas"), or designed for the special use of cyclists or aviators; (5) statistical maps, illustrating commerce and industries; (6) historical maps; (7) maps specially designed for educational purposes.

Scale of Maps.—Formerly map makers contented themselves with placing upon their maps a linear scale of miles, deduced from the central meridian or the equator. They now add the proportion which these units of length have to nature, or state how many of these units are contained within some local measure of length. The former method, usually called the "natural scale," may be described as "international," for it is quite independent of local measures of length, and depends exclusively upon the size and figure of the earth. Thus a scale of 1:1,000,000 signifies that each unit of length on the map represents one million of such units in nature. The second method is still employed in many cases, and we find thus:—

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[1] The ancient Greeks called a map *Pinax*, The Romans *Tabula geographica*. *Mappa mundi* was the medieval Latin for a map of the world which the ancients called *Tabula totius orbis descriptionem continens*.

[2] Close, "The Ideal Topographical Map," *Geog. Journal*, vol. xxv. (1905).

1 in. = 1 statute mile (of 63,366 in.)	corresponds to	1 : 63,366
6 in. = 1 " " "	"	1 : 10,560
1 in. = 5 chains (of 858 in.) . .	"	1 : 4,890
1 in. = 1 nautical mile (of 73,037 in.) .	"	1 : 73,037
1 in. = 1 verst (of 42,000 in.) . .	"	1 : 42,000
2 Vienna in. = 1 Austrian mile (of 288,000 in.)	"	1 : 144,000
1 cm. = 500 metres (of 100 cm.) . .	"	1 : 50,000

In cases where the draughtsman has omitted to indicate the scale we can ascertain it by dividing the actual length of a meridian degree by the length of a degree measure upon the map. Thus a degree between 50° and 51° measures 111,226,000 mm.; on the map it is represented by 111 mm. Hence the scale is 1 : 1,000,000 approximately.

The linear scale of maps can obviously be used only in the case of maps covering a small area, for in the case of maps of greater extension measurements would be vitiated owing to the distortion or exaggeration inherent in all projections, not to mention the expansion or shrinking of the paper in the process of printing. As an extreme instance of the misleading character of the scale given on maps embracing a wide area we may refer to a map of a hemisphere. The scale of that map, as determined by the equator or centre meridian, we will suppose to be 1 : 125,000,000, while the encircling meridian indicates a scale of 1 : 80,000,000; and a "mean" scale, equal to the square root of the proportion which the area of the map bears to the actual area of a hemisphere, is 1 : 112,000,000. In adopting a scale for their maps, cartographers will do well to choose a multiple of 1000 if possible, for such a scale can claim to be international, while in planning an atlas they ought to avoid a needless multiplicity of scales.

Map Projections are dealt with separately below. It will suffice therefore to point out that the ordinary needs of the cartographer can be met by conical projections, and, in the case of maps covering a wide area, by Lambert's equal area projection. The indiscriminate use of Mercator's projection, for maps of the world, is to be deprecated owing to the inordinate exaggeration of areas in high latitudes. In the case of topographical maps sheets bounded by meridians and parallels are to be commended.

The meridian of Greenwich has been universally accepted as the initial meridian, but in the case of most topographical maps of foreign countries local meridians are still adhered to—the more important among which are:—

Paris (Obs. nationale) . .	2° 20′ 14″ E.	of Greenwich.
Pulkova (St Petersburg) .	30° 19′ 39″ E.	"
Stockholm	18° 3′ 30″ E.	"
Rome (Collegio Romano) .	12° 28′ 40″ E.	"
Brussels (Old town) . .	4° 22′ 11″ E.	"
Madrid	3° 41′ 16″ W.	"
Ferro (assumed) . . .	20° 0′ 0″ W.	of Paris.

The *outline* includes coast-line, rivers, roads, towns, and in fact all objects capable of being shown on a map, with the exception of the hills and of woods, swamps, deserts and the like, which the draughtsman generally describes as "ornament." Conventional signs and symbols are universally used in depicting these objects.

Delineation of the Ground.—The mole-hills and serrated ridges of medieval maps were still in almost general use at the close of the 18th century, and are occasionally met with at the present day, being cheaply produced, readily understood by the unlearned, and in reality preferable to the uncouth and misleading hatchings still to be seen on many maps. Far superior are those scenographic representations which enable a person consulting the map to identify prominent landmarks, such as the Pic du Midi, which rises like a pillar to the south of Pau, but is not readily discovered upon an ordinary map. This advantage is still fully recognized, for such views of distant hills are still commonly given on the margin of marine charts for the assistance of navigators; military surveyors are encouraged to introduce sketches of prominent landmarks upon their reconnaissance plans, and the general public is enabled to consult "Picturesque Relief Maps"—such as F. W. Delkeskamp's *Switzerland* (1830) or his *Panorama of the Rhine*. Delineations such as these do not, however, satisfy scientific requirements. All objects on a map are required to be shown as projected horizontally upon a plane. This principle must naturally be adhered to when delineating the features of the ground. This was recognized by J. Picard and other members of the Academy of Science whom Colbert, in 1668, directed to prepare a new map of France, for on David Vivier's map of the environs of Paris (1674, scale 1 : 86,400) very crude hachures bounding the rivers have been substituted for the scenographic hills of older maps. Little progress in the delineation of the ground, however, was made until towards the close of the 18th century, when horizontal contours and hachures regulated according to the angle of inclination of all slopes, were adopted. These contours intersect the ground at a given distance above or below the level of the sea, and thus bound a series of horizontal planes (see fig. 1). Contours of this kind were first utilized by M. S. Cruquius in his chart of the Merwede (1728); Philip Buache (1737) introduced such contours or isobaths (Gr. ἴσος, equal; βαθύς, deep) upon his chart of the Channel, and intended to introduce similar contours or isohypses (ὕψος, height) for a representation of the land. Dupain-Triel, acting upon a suggestion of his friend M. Ducarla, published his *La France considérée dans les différentes hauteurs de ses plaines* (1791), upon which equidistant contours at intervals of 16 toises found a place. The scientific value of these contoured maps is fully recognized. They not only indicate the height of the land, but also enable us to compute the declivity of the mountain slopes; and if minor features of ground lying between two contours—such as ravines, as also rocky precipices and glaciers—are indicated, as is done on the Siegfried atlas of Switzerland, they fully meet the requirements of the scientific man, the engineer and the mountain-climber. At the same time it cannot be denied that these maps, unless the contours are inserted at short intervals, lack graphic expression. Two methods are employed to attain this: the first distinguishes the strata or layers by colours; the second indicates the varying slopes by shades or hachures. The first of these methods yields a hypsographical, or—if the sea-bottom be included, in which case all contours are referred to a common datum line—a bathy hypsographical map. Carl Ritter, in 1806, employed graduated tints, increasing in lightness on proceeding from the lowlands to the highlands; while General F. von Hauslab, director of the Austrian Surveys, in 1842, advised that the darkest tints should be allotted to the highlands, so that they might not obscure details in the densely peopled plains. The desired effect may be produced by a graduation of the same colour, or by a polychromatic scale—such as white, pale red, pale brown, various shades of green, violet and purple, in ascending order. C. von Sonklar, in his map of the Hohe Tauern (1 : 144,000; 1864) coloured plains and valleys green; mountain slopes in five shades of brown; glaciers blue or white. E. G. Ravenstein's map of Ben Nevis (1887) first employed the colours of the spectrum, viz. green to brown, in ascending order for the land; blue, indigo and violet for the sea, increasing in intensity with the height or the depth. At first cartographers chose their colours rather arbitrarily. Thus Horsell, who was the first to introduce tints

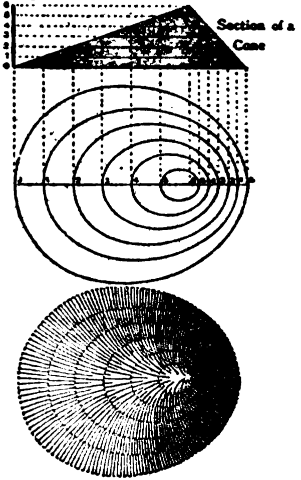

FIG. 1.

on his map of Sweden and Norway (1:600,000; 1835), coloured the lowlands up to 300 ft. in green, succeeded by red, yellow and white for the higher ground; while A. Papen, on his hypsographical map of Central Europe (1857) introduced a perplexing range of colours. At the present time compilers of strata maps generally limit themselves to two or three colours, in various shades, with green for the lowlands, brown for the hills and blue for the sea. On the international map of the world, planned by Professor A. Penck on a scale of 1 : 1,000,000, which has been undertaken by the leading governments of the world, the ground is shown by contours at intervals of 100 metres (to be increased to 200 and 500 metres in mountainous districts); the strata are in graded tints, viz. blue for the sea, green for lowlands up to 300 metres, yellow between 300 and 500 metres, brown up to 2000 metres, and reddish tints beyond that height.

The declivities of the ground are still indicated in most topographical maps by a system of strokes or hachures, first devised by L. Chr. Müller (*Plan und Kartenzeichnen*, 1788) and J. G. Lehmann, who directed a survey of Saxony, 1780–1806, and published his *Theorie der Bergzeichnung* in 1799. By this method the slopes are indicated by strokes or hachures crossing the contour lines at right angles, in the direction of flowing water, and varying in thickness according to the degree of declivity they represent (cf. for example, the map of SWITZERLAND in this work). The light is supposed to descend vertically upon the country represented, and in a true scale of shade the intensity increases with the inclination from 0° to 90°; but as such a scale does not sufficiently differentiate the lesser inclinations which are the most important, the author adopted a conventional scale, representing a slope of 45° or more, supposed to be inaccessible, as absolutely black, the level surfaces, which reflect all the light which falls upon them, as perfectly white, and the intervening slopes by a proportion between black and white, as in fig. 2. The main principles of this system have been maintained, but its details have been modified frequently to suit special cases. Thus the French survey commission of 1828 fixed the proportion of black to white at one and a half times the angle of slope; while in Austria, where steep mountains constitute an important feature, solid black has been reserved for a slope of 80°, the proportion of black to white varying from 80:0 (for 50°) to 8 : 72 (for 5°). On the map of Germany (1:100,000) a slope of 50° is shown in solid black while stippled hachures are used for gentle slopes up to 10°. Instead of shading lines following the greatest slopes, lines following the contours and varying in their thickness and in their intervals apart, according to the slope of the ground to be represented, may be employed This method affords a ready and expeditious means of sketching the ground, if the draughtsman limits himself to characteristically indicating its features by what have been called "form lines." This method can be recommended in the case of plotting the results of an explorer's route, or in the case of countries of which we have no regular survey (cf. the map of AFGHANISTAN in this work).

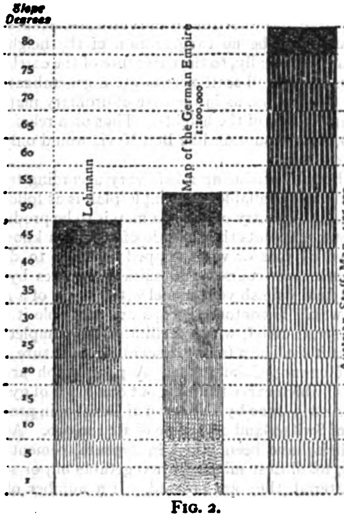

FIG. 2.

Instead of supposing the light to fall vertically upon the surface it is often supposed to fall obliquely, generally at an angle of 45° from the upper left-hand corner. It is claimed for this method that it affords a means of giving a graphic representation of Alpine districts where other methods of shading fail. The Dufour map of Switzerland (1:100,000) is one of the finest examples of this style of hill-shading. For use in the field, however, and for scientific work, a contoured map like Siegfried's atlas of Switzerland, or, in the case of hilly country, a map shaded on the assumption of a vertical light, will prove more useful than one of these, notwithstanding that truth to nature and artistic beauty are claimed on their behalf.

Instead of shading by lines, a like effect may be produced by mezzotint shading (cf. the map of ITALY, or other maps, in this work, on a similar method), and if this be combined with contour lines very satisfactory results can be achieved. If this tint be printed in grey or brown, isohypses, in black or red, show distinctly above it. The same combination is possible if hills engraved in the ordinary manner are printed in colours, as is done in an edition of the 1-inch ordnance map, with contours in red and hills hachured in brown.

Efforts have been made of late years to improve the available methods of representing ground, especially in Switzerland, but the so-called stereoscopic or relief maps produced by F. Becker, X. Imfeld, Kümmerly, F. Leuzinger and other able cartographers, however admirable as works of art, do not, from the point of utility, supersede the combination of horizontal contours with shaded slopes, such as have been long in use. There seems to be even less chance for the combination of coloured strata and hachures proposed by K. Peucker, whose theoretical disquisitions on aerial perspective are of interest, but have not hitherto led to satisfactory practical results.[1]

The above remarks apply more particularly to topographic maps. In the case of general maps on a smaller scale, the orographic features must be generalized by a skilful draughtsman and artist. One of the best modern examples of this kind is Vogel's map of Germany, on a scale of 1:500,000.

Selection of Names and Orthography.—The nomenclature or "lettering" of maps is a subject deserving special attention. Not only should the names be carefully selected with special reference to the objects which the map is intended to serve, and to prevent overcrowding by the introduction of names which can serve no useful object, but they should also be arranged in such a manner as to be read easily by a person consulting the map. It is an accepted rule now that the spelling of names in countries using the Roman alphabet should be retained, with such exceptions as have been familiarized by long usage. In such cases, however, the correct native form should be added within brackets, as Florence (Firenze), Leghorn (Livorno), Cologne (Cöln) and so on. At the same time these corrupted forms should be eliminated as far as possible. Names in languages not using the Roman alphabet, or having no written alphabet should be spelt phonetically, as pronounced on the spot. An elaborate universal alphabet, abounding in diacritical marks, has been devised for the purpose by Professor Lepsius, and various other systems have been adopted for Oriental languages, and by certain missionary societies, adapted to the languages in which they teach. The following simple rules, laid down by a Committee of the Royal Geographical Society, will be found sufficient as a rule; according to this system the vowels are to be sounded as in Italian, the consonants as in English, and no redundant letters are to be introduced. The diphthong *ai* is to be pronounced as in *aisle*; *au* as *ow* in *how*; *aw* as in *law*. *Ch* is always to be sounded as in *church*, *g* is always hard; *y* always represents a consonant; whilst *kh* and *gh* stand for gutturals. One accent only is to be used, the acute, to denote the syllable on which stress is laid. This system has in great measure been followed throughout the present work, but it is obvious that in numerous instances these rules must prove inadequate. The introduction of additional diacritical marks, such as ¯ and ˘, used to express quantity, and the diaeresis, as in *aï*, to express consecutive vowels, which are to be pronounced separately, may prove of service, as also such letters as *ä*, *ö* and *ü*, to be pronounced as in German, and in lieu of the French *ai*, *eu* or *u*.

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[1] K. Peucker, *Schattenplastik und Farbenplastik* (Vienna, 1898); *Geograph. Zeitschrift* (1902 and 1908).

The United States Geographic Board acts upon rules practically identical with those indicated, and compiles official lists of place-names, the use of which is binding upon government departments, but which it would hardly be wise to follow universally in the case of names of places outside America.

MEASUREMENT ON MAPS

Measurement of Distance.—The shortest distance between two places on the surface of a globe is represented by the arc of a great circle. If the two places are upon the same meridian or upon the equator the exact distance separating them is to be found by reference to a table giving the lengths of arcs of a meridian and of the equator. In all other cases recourse must be had to a map, a globe or mathematical formula. Measurements made on a topographical map yield the most satisfactory results. Even a general map may be trusted, as long as we keep within ten degrees of its centre. In the case of more considerable distances, however, a globe of suitable size should be consulted, or—and this seems preferable—they should be calculated by the rules of spherical trigonometry. The problem then resolves itself in the solution of a spherical triangle.

In the formulae which follow we suppose l and l' to represent the latitudes, a and b the co-latitudes ($90°-l$ or $90°-l'$), and t the difference in longitude between them or the meridian distance, whilst D is the distance required.

If both places have the same latitude we have to deal with an isosceles triangle, of which two sides and the included angle are given. This triangle, for the convenience of calculation, we divide into two right-angled triangles. Then we have $\sin \tfrac{1}{2}D = \sin a \sin \tfrac{1}{2}t$, and since $\sin a = \sin(90°-l) = \cos l$, it follows that

$$\sin \tfrac{1}{2}D = \cos l \sin \tfrac{1}{2}t.$$

If the latitudes differ, we have to solve an oblique-angled spherical triangle, of which two sides and the included angle are given. Thus,

$$\cos t = \frac{\cos D - \cos a \cos b}{\sin a \sin b}$$

$$\begin{aligned}\cos D &= \cos a \cos b + \sin a \sin b \cos t \\ &= \sin l \sin l' + \cos l \cos l' \cos t.\end{aligned}$$

In order to adapt this formula to logarithms, we introduce a subsidiary angle p, such that $\cot p = \cot l \cos t$; we then have

$$\cos D = \sin l \cos(l' - p) / \sin p.$$

In the above formulae our earth is assumed to be a sphere, but when calculating and reducing to the sea-level, a base-line, or the side of a primary triangulation, account must be taken of the spheroidal shape of the earth and of the elevation above the sea-level. The error due to the neglect of the former would at most amount to 1%, while a reduction to the mean level of the sea necessitates but a trifling reduction, amounting, in the case of a base-line 100,000 metres in length, measured on a plateau of 3700 metres (12,000 ft.) in height, to 57 metres only.

These orthodromic distances are of course shorter than those measured along a loxodromic line, which intersects all parallels at the same angle. Thus the distance between New York and Oporto, following the former (great circle sailing), amounts to 3000 m., while following the rhumb, as in Mercator sailing, it would amount to 3120 m.

These direct distances may of course differ widely with the distance which it is necessary to travel between two places along a road, down a winding river or a sinuous coast-line. Thus, the direct distance, as the crow flies, between Brig and the hospice of the Simplon amounts to 4·42 geogr. m. (slope nearly 9°), while the distance by road measures 13·85 geogr. m. (slope nearly 3°). Distances such as these can be measured only on a topographical map of a fairly large scale, for on general maps many of the details needed for that purpose can no longer be represented. Space runners for facilitating these measurements, variously known as chartometers, curvimeters, opisometers, &c., have been devised in great variety. Nearly all these instruments register the revolution of a small wheel of known circumference, which is run along the line to be measured.

The Measurement of Areas is easily effected if the map at our disposal is drawn on an equal area projection. In that case we need simply cover the map with a network of squares—the area of each of which has been determined with reference to the scale of the map—count the squares, and estimate the contents of those only partially enclosed within the boundary, and the result will give the area desired. Instead of drawing these squares upon the map itself, they may be engraved or etched upon glass, or drawn upon transparent celluloid or tracing-paper. Still more expeditious is the use of a planimeter, such as Captain Prytz's "Hatchet Planimeter," which yields fairly accurate results, or G. Coradi's "Polar Planimeter," one of the most trustworthy instruments of the kind.[1]

When dealing with maps not drawn on an equal area projection we substitute quadrilaterals bounded by meridians and parallels, the areas for which are given in the "Smithsonian Geographical Tables" (1894), in Professor H. Wagner's tables in the geographical *Jahrbuch*, or similar works.

It is obvious that the area of a group of mountains projected on a horizontal plane, such as is presented by a map, must differ widely from the area of the superficies or physical surface of those mountains exposed to the air. Thus, a slope of 45° having a surface of 100 sq. m. projected upon a horizontal plane only measures 59 sq. m., whilst 100 sq. m. of the snowclad Sentis in Appenzell are reduced to 10 sq. m. A hypsographical map affords the readiest solution of this question. Given the area A of the plane between the two horizontal contours, the height h of the upper above the lower contour, the length of the upper contour l, and the area of the face presented by the edge of the upper stratum $l.h = A_1$, the slope a is found to be $\tan a = hl / (A - A_1)$; hence its superficies, $A = A_1 \sec a$. The result is an approximation, for inequalities of the ground bounded by the two contours have not been considered.

The hypsographical map facilitates likewise the determination of the *mean height* of a country, and this height, combined with the area, the determination of volume, or cubic contents, is a simple matter.[2]

Relief Maps are intended to present a representation of the ground which shall be absolutely true to nature. The object, however, can be fully attained only if the scale of the map is sufficiently large, if the horizontal and vertical scales are identical, so that there shall be no exaggeration of the heights, and if regard is had, eventually, to the curvature of the earth's surface. Relief maps on a small scale necessitate a generalization of the features of the ground, as in the case of ordinary maps, as likewise an exaggeration of the heights. Thus on a relief on a scale of 1 : 1,000,000 a mountain like Ben Nevis would only rise to a height of 1·3 mm.

The methods of producing reliefs vary according to the scale and the materials available. A simple plan is as follows—draw an outline of the country of which a map is to be produced upon a board; mark all points the altitude of which is known or can be estimated by pins or wires clipped off so as to denote the heights; mark river-courses and suitable profiles by strips of vellum and finally finish your model with the aid of a good map, in clay or wax. If contoured maps are available it is easy to build up a strata-relief, which facilitates the completion of the relief so that it shall be a fair representation of nature, which the strata-relief cannot claim to be. A pantograph armed with cutting-files[3] which carve the relief out of a block of gypsum, was employed in 1893–1900 by C. Perron of Geneva, in producing his relief map of Switzerland on a scale of 1 : 100,000. After copies of such reliefs have been taken in gypsum, cement, statuary pasteboard, fossil dust mixed with vegetable oil, or some other suitable material, they are painted. If a number of copies is required it may be advisable to print a map of the country represented in colours, and either to emboss this map, backed with papier-mâché, or paste it upon a copy of the relief—a task of some difficulty. Relief maps are frequently objected to on account of their cost, bulk and weight, but their great use in teaching geography is undeniable.

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[1] Professor Henrici, *Report on Planimeters* (64th meeting of the British Association, Oxford, 1894); J. Tennant, "The Planimeter" (*Engineering*, xlv. 1903).

[2] H. Wagner's *Lehrbuch* (Hanover, 1908, pp. 241–252) refers to numerous authorities who deal fully with the whole question of measurement.

[3] Kienzl of Leoben in 1891 had invented a similar apparatus which he called a Relief Pantograph (*Zeitschrift*, Vienna Geog Soc. 1891).

Globes.[1]—It is impossible to represent on a plane the whole of the earth's surface, or even a large extent of it, without a considerable amount of distortion. On the other hand a map drawn on the surface of a sphere representing a terrestrial globe will prove true to nature, for it possesses, in combination, the qualities which the ingenuity of no mathematician has hitherto succeeded in imparting to a projection intended for a map of some extent, namely, equivalence of areas of distances and angles. Nevertheless, it should be observed that our globes take no account of the oblateness of our sphere; but as the difference in length between the circumference of the equator and the perimeter of a meridian ellipse only amounts to 0·16%, it could be shown only on a globe of unusual size.

The method of manufacturing a globe is much the same as it was at the beginning of the 16th century. A matrix of wood or iron is covered with successive layers of papers, pasted together so as to form pasteboard. The shell thus formed is then cut along the line of the intended equator into two hemispheres, they are then again glued together and made to revolve round an axis the ends of which passed through the poles and entered a metal meridian circle. The sphere is then coated with plaster or whiting, and when it has been smoothed on a lathe and dried, the lines representing meridians and parallels are drawn upon it. Finally the globe is covered with the paper gores upon which the map is drawn. The adaption of these gores to the curvature of the sphere calls for great care. Generally from 12 to 24 gores and two small segments for the polar regions printed on vellum paper are used for each globe. The method of preparing these gores was originally found empirically, but since the days of Albert Dürer it has also engaged the minds of many mathematicians, foremost among whom was Professor A. G. Kästner of Göttingen. One of the best instructions for the manufacture of globes we owe to Altmütter of Vienna.[2]

Larger globes are usually on a stand the top of which supports an artificial horizon. The globe itself rotates within a metallic meridian to which its axis is attached. Other accessories are an hour-circle, around the north pole, a compass placed beneath the globe, and a flexible quadrant used for finding the distances between places. These accessories are indispensable if it be proposed to solve the problems usually propounded in books on the "use of the globes," but can be dispensed with if the globe is to serve only as a map of the world. The size of a globe is usually given in terms of its diameter. To find its scale divide the mean diameter of the earth (1,273,500 m.) by the diameter of the globe; to find its circumference multiply the diameter by π (3·1416).

Map Printing.—Maps were first printed in the second half of the 15th century. Those in the *Rudimentum noviciorum* published at Lübeck in 1475 are from woodcuts, while the maps in the first two editions of Ptolemy published in Italy in 1472 are from copper plates. Wood engraving kept its ground for a considerable period, especially in Germany, but copper in the end supplanted it, and owing to the beauty and clearness of the maps produced by a combination of engraving and etching it still maintains its ground. The objection that a copper plate shows signs of wear after a thousand impressions have been taken has been removed, since duplicate plates are readily produced by electrotyping, while transfers of copper engravings, on stone, zinc or aluminium, make it possible to turn out large editions in a printing-machine, which thus supersedes the slow-working hand-press.[3] These impressions from transfers, however, are liable to be inferior to impressions taken from an original plate or an electrotype. The art of lithography greatly affected the production of maps. The work is either engraved upon the stone (which yields the most satisfactory result at half the cost of copper-engraving), or it is drawn upon the stone by pen, brush or chalk (after the stone has been "grained"), or it is transferred from a drawing upon transfer paper in lithographic ink. In chromolithography a stone is required for each colour. Owing to the great weight of stones, their cost and their liability of being fractured in the press, zinc plates, and more recently aluminium plates, have largely taken the place of stone. The processes of zincography and of algraphy (aluminium printing) are essentially the same as lithography. Zincographs are generally used for producing surface blocks or plates which may be printed in the same way as a wood-cut. Another process of producing such blocks is known as cerography (Gr. κηρός), wax. A copper plate having been coated with wax, outline and ornament are cut into the wax, the lettering is impressed with type, and the intaglio thus produced is electrotyped.[4] Movable types are utilized in several other ways in the production of maps. Thus the lettering of the map, having been set up in type, is inked in and transferred to a stone or a zinc-plate, or it is impressed upon transfer-paper and transferred to the stone. Photographic processes have been utilized not only in reducing maps to a smaller scale, but also for producing stones and plates from which they may be printed. The manuscript maps intended to be produced by photographic processes upon stone, zinc or aluminium, are drawn on a scale somewhat larger than the scale on which they are to be printed, thus eliminating all those imperfections which are inherent in a pen-drawing. The saving in time and cost by adopting this process is considerable, for a plan, the engraving of which takes two years, can now be produced in two days. Another process, photo- or heliogravure, for obtaining an engraved image on a copper plate, was for the first time employed on a large scale for producing a new topographical map of the Austrian Empire in 718 sheets, on a scale of 1 : 75,000, which was completed in seventeen years (1873–1890). The original drawings for this map had to be done with exceptional neatness, the draughtsman spending twelve months on that which he would have completed in four months had it been intended to engrave the map on copper; yet an average chart, measuring 530 by 630 mm., which would have taken two years and nine months for drawing and engraving, was completed in less than fifteen months—fifty days of which were spent in "retouching" the copper plate. It only cost £169 as compared with £360 had the old method been pursued.

For details of the various methods of reproduction see LITHOGRAPHY; PROCESS, &c.

HISTORY OF CARTOGRAPHY

A capacity to understand the nature of maps is possessed even by peoples whom we are in the habit of describing as "savages." Wandering tribes naturally enjoy a great advantage in this respect over sedentary ones. Our arctic voyagers—Sir E. W. Parry, Sir J. Ross, Sir F. L. MacClintock and others—have profited from rough maps drawn for them by Eskimos. Specimens of such maps are given in C. F. Hall's *Life with the Esquimaux* (London, 1864). Henry Youle Hind, in his work on the Labrador Peninsula (London, 1863) praises the map which the Montagnais and Nasquapee Indians drew upon bark. Similar essays at map-making are reported in connexion with Australians, Maoris and Polynesians. Tupaya, a Tahitian, who accompanied Captain Cook in the "Endeavour" to Europe, supplied his patron with maps; Raraka drew a map in chalk of the Paumotu archipelago on the deck of Captain Wilkes's vessel; the Marshall islanders, according to Captain Winkler (*Marine Rundschau*, Oct. 1893) possess maps upon which the bearings of the islands are indicated by small strokes. Far superior were the maps found among the semi-civilized Mexicans when the Spainiards first discovered and invaded their country. Among them were cadastral plans of villages, maps of the provinces of the empire of the Aztecs, of towns and of the coast. Montezuma presented Cortes with a map, painted on Nequen cloth, of the Gulf coast. Another map did the Conquistador good service on his campaign against Honduras (Lorenzana, *Historia de nueva España*, Mexico, 1770; W. H. Prescott, *History of the Conquest of Mexico*, New

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[1] M. Fiorini, *Erd- und Himmelsgloben, frei bearbeitet von S. Günther* (Leipzig, 1895).

[2] *Jahrb. des polytechn. Instituts in Wien*, vol. xv.

[3] Compare the maps of EUROPE, ASIA, &c., in this work.

[4] The great majority of the maps in this work are made by this process.

York, 1843). Peru, the empire of the Incas, had not only ordinary maps, but also maps in relief, for Pedro Sarmiento da Gamboa (*History of the Incas*, translated by A. R. Markham, 1907) tells us that the 9th Inca (who died in 1191) ordered such reliefs to be produced of certain localities in a district which he had recently conquered and intended to colonize. These were the first relief maps on record. It is possible that these primitive efforts of American Indians might have been further developed, but the Spanish conquest put a stop to all progress, and for a consecutive history of the map and map-making we must turn to the Old World, and trace this history from Egypt and Babylon, through Greece, to our own age.

The ancient Egyptians were famed as "geometers," and as early as the days of Rameses II. (Sesostris of the Greeks, 1333–1300 B.C.) there had been made a cadastral survey of the country showing the rows of pillars which separated the nomens as well as the boundaries of landed estates. It was upon a map based upon such a source that Eratosthenes (276–196 B.C.) measured the distance between Syene and Alexandria which he required for his determination of the length of a degree. Ptolemy, who had access to the treasures of the famous library of Alexandria was able, no doubt, to utilize these cadastral plans when compiling his *geography*. It should be noted that he places Syene only two degrees to the east of Alexandria instead of three degrees, the actual meridian distance between the two places; a difference which would result from an error of only 7° is the orientation of the map used by Ptolemy. Scarcely any specimens of ancient Egyptian cartography have survived. In the Turin Museum are preserved two papyri with rough drawings of gold mines established by Sesostris in the Nubian Desert.[1] These drawings have been commented upon by S. Birch, F. Chabas, R. J. Lauth and other Egyptologists, and have been referred to as the two most ancient maps in existence. They can, however, hardly be described as maps, while in age they are surpassed by several cartographical clay tablets discovered in Babylonia. On another papyrus in the same museum is depicted the victorious return of Seti I. (1366–1333) from Syria, showing the road from Pelusium to Heroopolis, the canal from the Nile with crocodiles, and a lake (mod. Lake Timsah) with fish in it. Apollonius of Rhodes who succeeded Eratosthenes as chief librarian at Alexandria (196 B.C.) reports in his *Argonautica* (iv. 279) that the inhabitants of Colchis whom, like Herodotus (ii., 104) he looks upon as the descendants of Egyptian colonists, preserved, as heirlooms, certain graven tablets (κύρβεις) on which land and sea, roads and towns were accurately indicated.[2] Eustathius (since 1160 archbishop of Thessalonica) in his commentary on Dionysius Periegetes, mentions route-maps which Sesostris caused to be prepared, while Strabo (i., 1. 5) dwells at length upon the wealth of geographical documents to be found in the library of Alexandria.

A cadastral survey for purposes of taxation was already at work in Babylonia in the age of Sargon of Akkad, 3800 B.C. In the British Museum may be seen a series of clay tablets, circular in shape and dating back to 2300 or 2100 B.C., which contain surveys of lands. One of these depicts in a rough way lower Babylonia encircled by a "salt water river," Oceanus.

Development of Map-making among the Greeks[3]—Ionian mercenaries and traders first arrived in Egypt, on the invitation of Psammetichus I. about the middle of the 7th century B.C. Among the visitors to Egypt, there were, no doubt, some who took an interest in the science of the Egyptians. One of the most distinguished among them was Thales of Miletus (640–543 B.C.), the founder of the Ionian school of philosophy, whose pupil, Anaximander (611–546 B.C.) is credited by Eratosthenes with having designed the first map of the world. Anaximander looked upon the earth as a section of a cylinder, of considerable thickness, suspended in the centre of the circular vault of the heavens, an idea perhaps borrowed from the Babylonians, for Job (xxvi. 7) already speaks of the earth as "hanging upon nothing." Like Homer he looked upon the habitable world (οἰκουμένη) as being circular in outline and bounded by a circumfluent river. The geographical knowledge of Anaximander was naturally more ample than that of Homer, for it extended from the Cassiterides or Tin Islands in the west to the Caspian in the east, which he conceived to open out into Oceanus. The Aegean Sea occupied the centre of the map, while the line where ocean and firmament seemed to meet represented an enlarged horizon.

Anaximenes, a pupil of Anaximander, was the first to reject the view that the earth was a circular plane, but held it to be an oblong rectangle, buoyed up in the midst of the heavens by the compressed air upon which it rested. Circular maps, however, remained in the popular favour long after their erroneousness had been recognized by the learned.

Even Hecataeus of Miletus (549–472 B.C.), the author of a *Periodos* or description of the earth, of whom Herodotus borrowed the terse saying that Egypt was the gift of the Nile, retained this circular shape and circumfluent ocean when producing his map of the world, although he had at his disposal the results of the voyage of Scylax of Caryanda from the Indus to the Red Sea, of Darius' campaign in Scythia (513), the information to be gathered among the merchants from all parts of the world who frequented an emporium like Miletus, and what he had learned in the course of his own extensive travels. Hecataeus was probably the author of the "bronze tablets upon which was engraved the whole circuit of the earth, the sea and rivers" (Herod. v. 49), which Aristagoras, the tyrant of Miletus, showed to Cleomenes, the king of Sparta, in 504, whose aid he sought in vain in a proposed revolt against Darius, which resulted disastrously in 494 in the destruction of Miletus. The map of the world brought upon the stage in Aristophanes' comedy of *The Clouds* (423 B.C.), whereon a disciple of the Sophists points out upon it the position of Athens and of other places known to the audience, was probably of the popular circular type, which Herodotus (iv. 36) not many years before had derided and which was discarded by Greek cartographers ever after. Thus Democritus of Abdera (b. *c.* 450, d. after 360), the great philosopher and founder, with Leucippus, of the atomic theory, was also the author of a map of the inhabited world which he supposed to be half as long again from west to east, as it was broad.

Dicaearcus of Messana in Sicily, a pupil of Aristotle (326–296 B.C.), is the author of a topographical account of Hellas, with maps, of which only fragments are preserved; he is credited with having estimated the size of the earth, and, as far as known he was the first to draw a parallel across a map.[4] This parallel, or dividing line, called *diaphragm* (partition) by a commentator, extended due east from the Pillars of Hercules, through the Mediterranean, and along the Taurus and Imaus (Himalaya) to the eastern ocean. It divided the inhabited world, as then known, into a northern and a southern half. In compiling his map he was able to avail himself of the information obtained by the *bematists* (surveyors who determined distances by pacing) who accompanied Alexander the Great on his campaigns; of the results of the voyage of Nearchus from the Indus to the Euphrates, and of the "Periplus" of Scylax of Caryanda, which described the coast from between India and the head of the Arabian Gulf. On the other hand he unwisely rejected the results of the observations for latitude made by Pytheas in 326 B.C. at his native town, Massilia, and during a subsequent voyage to northern Europe. In the end the map of Dicaearcus resembled that of Democritus.

Scientific geography profited largely from the labours of Eratosthenes of Cyrene, whom Ptolemy Euergetes appointed keeper of the famous library of Alexandria in 247 B.C., and died in that city in 195 B.C. He won fame as having been the first to determine the size of the earth by a scientific method. Having determined the difference of latitude between Alexandria and Syene which he erroneously believed to lie on the same meridian, and obtained the distance of those places from each other from the surveys made by Egyptian geometers, he concluded that a degree of the meridan measured 700 stadia.[1]

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[1] Lepsius, *Urkundenbuch*, Pl. XXII.

[2] These Colchians certainly were not Egyptians. The maps referred to may have been Assyrian.

[3] We are indebted to Strabo for nearly all we know about Greek cartographers anterior to Ptolemy, for none of their maps has been preserved.

[4] The gnomon was known to the Chinese in the 5th century B.C., and reached the Greeks (Anaximander) through Babylon. Pytheas, as far as known, was the first to utilize it for the determination of a latitude.

Eratosthenes is the author of a treatise which deals systematically with the geographical knowledge of his time, but of which only fragments have been preserved by Strabo and others. This treatise was intended to illustrate and explain his map of the world. In this task he was much helped by the materials collected in his library. Among the travellers of whose information he was thus able to avail himself were Pytheas of Massilia, Patroclus, who had visited the Caspian (285–282 B.C.), Megasthenes, who visited Palibothra on the Ganges, as ambassador of Seleucus Nicator (302–291 B.C.), Timosthenus of Rhodes, the commander of the fleet of Ptolemy Philadelphus (284–246 B.C.) who wrote a treatise "On harbours," and Philo, who visited Meroe on the upper Nile. His map formed a parallelogram measuring 75,800 stadia from Usisama (Ushant island) or Sacrum Promontorium in the west to the mouth of the Ganges and the land of the Coniaci (Comorin) in the east, and 46,000 stadia from Thule in the north to the supposed southern limit of Libya. Across it were drawn seven parallels, running through Meroe, Syene, Alexandria, Rhodes, Lysimachia on the Hellespont, the mouth of the Borysthenes and Thule, and these were crossed at right angles by seven meridians, drawn at irregular intervals, and passing through the Pillars of Hercules, Carthage, Alexandria, Thapsacus on the Euphrates, the Caspian gates, the mouth of the Indus and that of the Ganges. The position of all the places mentioned was supposed to have been determined by trustworthy authorities. The inhabited world thus delineated formed an island of irregular shape, surrounded on all sides by the ocean, the Erythrean Sea freely communicating with the western ocean. In his text Eratosthenes ignored the popular division of the world into Europe, Asia and Libya, and substituted for it a northern and southern division, divided by the parallel of Rhodes, each of which he subdivided into *sphragides* or *plinthia*—seals or plinths. The principles on which these divisions were made remain an enigma to the present day.

This map of Eratosthenes, notwithstanding its many errors, such as the assumed connexion of the Caspian with a northern ocean and the supposition that Carthage, Sicily and Rome lay on the same meridian, enjoyed a high reputation in his day. Even Strabo (*c.* 30 B.C.) adopted its main features, but while he improved the European frontier, he rejected the valuable information secured by Pytheas and retained the connexion between the Caspian and the outer ocean. In the extreme east his information extended no further than that of Eratosthenes, viz. to India and Taprobane (Ceylon) and the Sacae (Kirghiz).

Hipparchus, the famous astronomer, on the other hand, (*c.* 150 B.C.) proved a somewhat captious critic. He justly objected to the arbitrary network of the map of Eratosthenes. The parallels or *climata*[2] drawn through places, of which the longest day is of equal length and the decimation (distance) from the equator is the same, he maintained, ought to have been inserted at equal intervals, say of half an hour, and the meridians inserted on a like principle. In fact, he demanded that maps should be based upon a regular projection, several descriptions of which he had adopted for his star maps. He moreover accuses Eratosthenes, (whose determination of a degree he accepts without hesitation) with trusting too much to hypothesis in compiling his map instead of having recourse to latitudes and longitudes deduced by astronomical observations. Such observations, however, were but rarely available at the time. A few latitudes had indeed been observed, but although Hipparchus had shown how longitudes could be determined by the observation of eclipses, this method was in reality not available for want of trustworthy time-keepers. The determination of an ocean surrounding the inhabited earth he declared to be based on a mere hypothesis and that it would be equally allowable to describe the Erythraea as a sea surrounded by land. Hipparchus is not known to have compiled a map himself.

About the same time Crates of Mallus (d. 145 B.C.) embodied the views of the Stoic school of philosophy in a globe which has become typical as one of the insignia of royalty. On this globe an equatorial and a meridional ocean divide our earth into four quarters, each inhabited, thus anticipating the discovery of North and South America and Australia.[3]

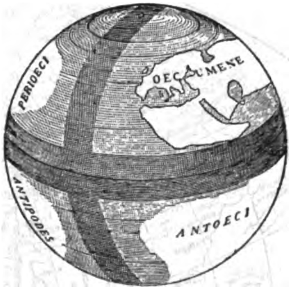

FIG. 2.—The Globe of Crates of Mallus.

The period between Eratosthenes and Marinus of Tyre was one of great political importance. Carthage had been destroyed (146 B.C.), Julius Caesar had carried on his campaign in Gaul (58–51 B.C.), Egypt had been occupied (30 B.C.), Britannia conquered (A.D. 41–79), and the Roman empire had attained its greatest extent and power under the emperor Trajan (A.D. 98–117). But although military operations added to our knowledge of the world, scientific cartography was utterly neglected.

Among Greek works written during this period there are several which either give us an idea of the maps available at that time, or furnish information of direct service to the compiler of a map. Among the latter a Periplus or coastal guide of the Erythrean Sea, which clearly reveals the peninsular shape of India (A.D. 90) and Arrian's *Periplus Ponti Euxeni* (A.D. 131) which Festus Avienus translated into Latin. Among travellers Eudoxus of Cyzicus occupies a foremost rank, since, between 115–87 B.C. he visited India and the east coast of Africa, which subsequently he attempted in vain to circumnavigate by following the route of Hanno, along the west coast. Among geographers should be mentioned Posidonius (13–551), the head of the Stoic school of Rhodes, who is stated to be responsible for having reduced the length of a degree to 500 stadia; Artemidorus of Ephesus, whose "Geographumena" (*c.* 100 B.C.) are based upon his own travels and a study of itineraries, and above all, Strabo, who has already been referred to. Among historians who looked upon geography as an important aid in their work are numbered Polybius (*c.* 210–120 B.C.), Diodorus Siculus (*c.* 30 B.C.) and Agathachidus of Cnidus (*c.* 120 B.C.) to whom we are indebted for a valuable account of the Erythrean Sea and the adjoining parts of Arabia and Ethiopia. The *Periegesis* of Dionysius of Alexandria is a popular description of the world in hexameters, of no particular scientific value (*c.* A.D. 130). He as well as Artemidorus and others accepted a circular or ellipsoidal shape of the world and a circumfluent ocean; Strabo alone adhered to the scientific theories of Eratosthenes.

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[1] If, with W. Dörpfeld, we assume an Attic stadium of 200 steps (500 ft.) to be equal to 164 metres, a degree of 700 stad. would be equal to 114,800 metres, its actual length according to modern measurement being 110,808 metres.

[2] *Climata* based on the length of the longest day were introduced by Hippocrates (*c.* 400 B.C.). *Zones* similar to those already drawn out for the celestial sphere were first introduced by the Pythagoreans. Parmenides of Elea (544–430 B.C.) distinguishes five of these zones, viz. a torrid zone, between the tropics of summer and winter, which was uninhabitable on account of heat; two frigid zones, uninhabitable on account of cold, and two intermediate temperate zones.

[3] Celestial globes were made much earlier than terrestrial ones. In the museum of Naples there is a celestial globe, 2 metres in diameter, supported upon the shoulders of an Atlas, which E. Heis, judging by the constellations engraved upon it (*Atlas coelestis novus*, Bonn, 1872) judges to date from the 4th century B.C. It may even be the work of Eudoxus (d. 386 B.C.) the famous astronomer. Aratus of Soli in Cilicia, in his poetical *Prognostics of Stars and the World*, refers to a globe in his possession. Archimedes, the famous mathematician, had a celestial globe of glass, in the centre of which was a small terrestrial globe. Hero of Alexandria (284–221 B.C.), the ingenious inventor of "Hero's Fountain," is believed to have possessed a similar apparatus. The celestial globe of Hipparchus still existed in the Alexandrian library in the time of Ptolemy, who himself refers to globes in his *Almagest*, as also in the *Geography*. Leontius, who wrote a book on the manufacture of globes (first published at Basel in 1539), is identified by Fiorini with a bishop of Neapolis (Cyprus) of the time of Constantine III. (642–668).

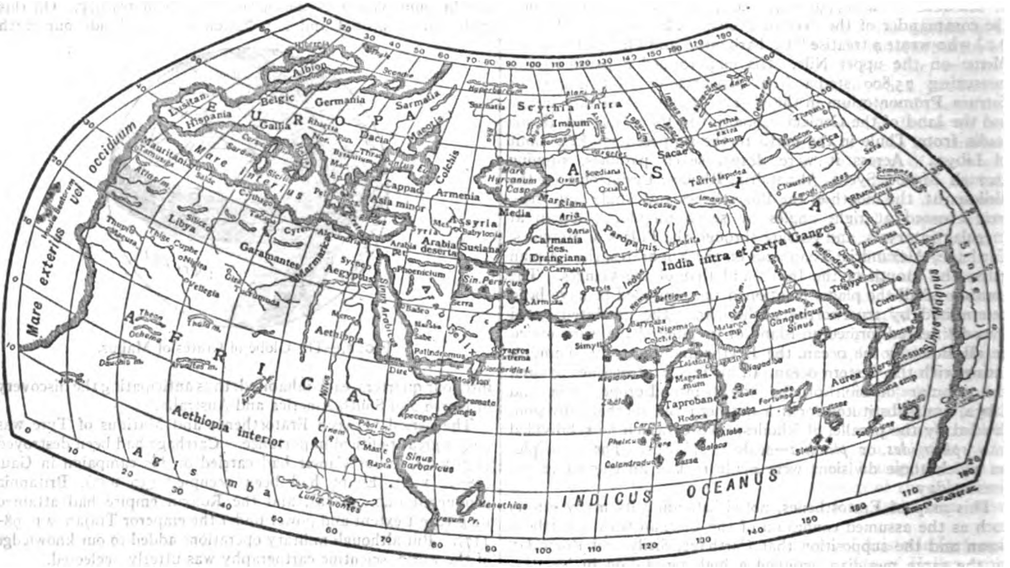

FIG. 3.—Ptolemy's Map.

The credit of having returned to the scientific principles innovated by Eratosthenes and Hipparchus is due to Marinus of Tyre (*c.* A.D. 120) which, though no longer occupying the pre-eminent position of former times, was yet an emporium of no inconsiderable importance, having extensive connexions by sea and land. The map of Marinus and the descriptive accounts which accompanied it have perished, but we learn sufficient concerning them from Ptolemy to be able to appreciate their merits and demerits. Marinus was the first who laid down the position of places on a projection according to their latitude and longitude, but the projection used by him was of the rudest. Parallels and meridians were represented by straight lines intersecting each other at right angles, the relative proportions between degrees of longitude and latitude being retained only along the parallel of Rhodes. The distortion of the countries represented would thus increase with the distance, north and south, from this central parallel. The number of places whose position had been determined by astronomical observation was as yet very small, and the map had thus to be compiled mainly from itineraries furnished by travellers or the dead reckoning of seamen. The errors due to an exaggeration of distances were still further increased on account of his assuming a degree to be equal to 500 stadia, as determined by Posidonius, instead of accepting the 700 stadia of Eratosthenes. He was thus led to assume that the distance from the first meridian drawn through the Fortunate islands to Sera (mod. Si-ngan-fu), the capital of China, was equal to 225°, which Ptolemy reduced to 177°, but which in reality only amount to 126°. A like overestimate of the distances covering the march of Julius Maternus to Agisymba, which Marinus places 24° south of the equator, a latitude which Ptolemy reduces to 18°, but which is probably no farther south than lat. 12° N. The map of Marinus was accompanied by a list of places arranged according to latitude and longitude. It must have been much in demand, for three editions of it were prepared. Masudi (10th century) saw a copy of it and declared it to be superior to Ptolemy's map.

Ptolemy (*q.v.*) was the author of a *Geography*[1] (*c.* A.D. 150) in eight books. "Geography," in the sense in which he uses the term, signifies the delineation of the known world, in the shape of a map, while chorography carries out the same objects in fuller detail, with regard to a particular country. In Book I. he deals with the principles of mathematical geography, map projections, and sources of information with special reference to his predecessor Marinus. Books II. to VII. form an index to the maps. They contain about 8000 names, with their

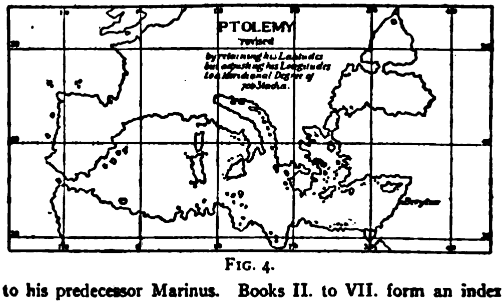
PTOLEMY
revised
by retaining his Latitudes
but adjusting his Longitudes
to a Meridional Degree of
700 Stadia.

FIG. 4.

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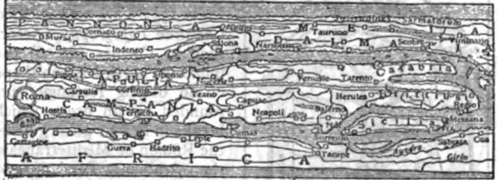
[1] The oldest MS. of Ptolemy's *Geography* is found in the Vatopedi monastery of Mt Athos. It dates from the 12th or 13th century and was published by Victor Langlois in 1867. For the latest edition we are indebted to the late Carl Müller (Paris, 1883–1906) to whom we are likewise indebted for an edition of the *Geographi graeci minores* (1855–1861).

latitudes and longitudes, and with their aid it is possible to reconstruct the maps. These maps existed, as a matter of course, before such an index could be compiled, but it is doubtful whether the maps in our available manuscript, which are attributed to Agathodaemon, are copies of Ptolemy's originals or have been compiled, after their loss, from this index. Book VIII. gives further details with reference to the principal towns of each map, as to geographical position, length of day, climata, &c.

Ptolemy's great merit consists in having accepted the views of Hipparchus with respect to a projection suited for a map of the world. Of the two projections proposed by him one is a modified conical projection with curved parallels and straight meridians; in the second projection (see fig. 3) both parallels and meridians are curved. The correct relations in the length of degrees of latitude and longitude are maintained in the first case along the latitude of Thule and the equator, in the second along the parallel of Agisymba, the equator and the parallels of Meroe, Syene and Thule. Following Hipparchus he divided the equator into 360° drawing his prime meridian through the Fortunate Islands (Canaries). The 26 special maps are drawn on a rectangular projection. As a map compiler Ptolemy does not take a high rank. In the main he copied Marinus whose work he revised and supplemented in some points, but he failed to realize the peninsular shape of India, erroneously exaggerated the size of Taprobane (Ceylon), and suggested that the Indian Ocean had no connexion with the western ocean, but formed Mare Clausum. Ptolemy knew but of a few latitudes which had been determined by actual observation, while of three longitudes resulting from simultaneous observation of eclipses he unfortunately accepted the least satisfactory, namely, that which placed Arbela 45° to the east of Carthage, while the actual meridian distance only amounts to 34°. An even graver source of error was Ptolemy's acceptance of a degree of 500 instead of 700 stadia. The extent to which the more correct proportion would have affected the delineation of the Mediterranean is illustrated by fig. 4. But in spite of his errors the scientific method pursued by Ptolemy was correct, and though he was neglected by the Romans and during the middle ages, once he had become known, in the 15th century, he became the teacher of the modern world.

Map-Making among the Romans.—We learn from Cicero, Vitruvius, Seneca, Suetonius, Pliny and others, that the Romans had both general and topographical maps. Thus, Varro (*De rustici*) mentions a map of Italy engraved on marble, in the temple of Tellus, Pliny, a map of the seat of war in Armenia, of the time of the emperor Nero, and the more famous map of the Roman Empire which was ordered to be prepared for Julius Caesar (44 B.C.), but only completed in the reign of Augustus, who placed a copy of it, engraved in marble, in the Porticus of his sister Octavia (7 B.C.). M. Vipsanius Agrippa, the son-in-law of Augustus (d. 12 B.C.), who superintended the completion of this famous map, also wrote a commentary illustrating it, quotations from which of Ammianus Marcellinus of Antioch (d. 330), Pliny and others, afford the only means of judging of its character. The map is supposed to be based upon actual surveys or rather reconnaissances, and if it be borne in mind that the Roman Empire at that time was traversed in all directions by roads furnished with mile-stones, that the Agrimensores employed upon such a duty were skilled surveyors, and that the official reports of the commanders of military expeditions and of provincial governors were available, this map, as well as the provincial maps upon which it was based, must have been a work of superior excellence, the loss of which is much to be regretted. A copy of it may possibly have been utilized by Marinus and Ptolemy in their compilations. The Romans have been reproached for having neglected the scientific methods of map-making advocated by Hipparchus. Their maps, however, seem to have met the practical requirements of political administration and of military undertakings.

Only two specimens of Roman cartography have come down to us, viz. parts of a plan of Rome, of the time of the emperor Septimius Severus (A.D. 193–211), now in the Museo Capitolino, and an *itinerarium scriptum*, or road map of the world, compressed within a strip 745 mm. in length and 34 mm. broad. Of its character the reduced copy of one of its 12 sections (fig. 5) conveys an idea. The map, apparently of the 3rd century, was copied by a monk at Colmar, in 1265, who fortunately contented himself with adding a few scriptural names, and having been acquired by the learned Conrad Peutinger of Augsburg it became known as *Tabula peutingeriana*. The original is now in the imperial library of Vienna.[1]



Emery Walker sc.

FIG. 5.—A Section of Peutinger's Tabula.

Map-Making in the Middle Ages.—In scientific matters the early middle ages were marked by stagnation and retrogression. The fathers of the church did not encourage scientific pursuits, which Lactantius (4th century) declared to be unprofitable. The doctrine of the sphericity of the earth was still held by the more learned, but the heads of the church held it to be unscriptural. Pope Zachary, when in 741 he condemned the views of Virgilius, the learned bishop of Salzburg, an Irishman who had been denounced as a heretic by St Boniface, declares it to be *perversa et iniqua doctrina*. Even after Gerbert of Aurillac, better known as Pope Sylvester II. (999–1063), Adam of Bremen (1075), Albertus Magnus (d. 1286), Roger Bacon (d. 1294), and indeed all men of leading had accepted as a fact and not a mere hypothesis the geocentric system of the universe and sphericity of the globe, the authors of maps of the world, nearly all of whom were monks, still locked in the main to the Holy Scriptures for guidance in outlining the inhabited world. We have to deal thus with three types of these early maps, viz. an oblong rectangular, a circular and an oval type, the latter being either a compromise between the two former, or an artistic development of the circular type. In every instance the inhabited world is surrounded by the ocean. The authors of rectangular maps look upon the Tabernacle as an image of the world at large, and believe that such expressions as the "four corners of the earth" (Isa. x. 12), could be reconciled only with a rectangular world. On the other hand there was the expression "circuit of the earth" (Isa. xl. 22), and the statement (Ezek. v. 5) that "God had set Jerusalem in the midst of the nations and countries." In

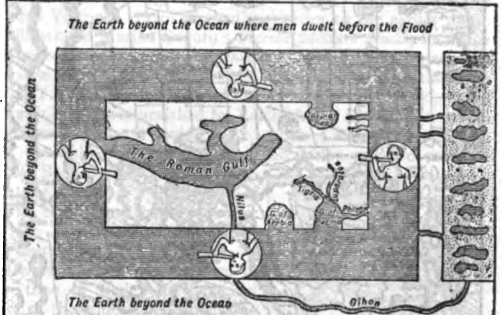

The Earth beyond the Ocean where men dwelt before the Flood
The Earth beyond the Ocean
Caspian Sea
The Roman Gulf
Nilus
Tigris
Euphrates
Phison
G. of Arabia
G. of Persia
The Earth beyond the Ocean
Gihon

FIG. 6.—The World according to Cosmas Indicopleustes (535).

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[1] Facsimiles of it have been published by Desjardins (1869–1871), by K. Miller (1886), who ascribes it to Castorius, A.D. 366, and by others.

nearly every case the East occupies the top of the map. Neither parallels nor meridians are indicated, nor is there a scale. Other features frequently met with are the Paradise in the Far East, miniatures of towns, plants, animals, human beings and monsters, and an indication of the twelve winds around the margin.

The oldest rectangular map of the world is contained in a most valuable work written by Cosmas, an Alexandrian monk, surnamed Indicopleustes, after returning from a voyage to India (535 A.D.), and entitled *Christian Topography*. According to Cosmas (fig. 6) the inhabited earth has the shape of an oblong rectangle surrounded by an ocean which breaks in in four great gulfs—the Roman or Mediterranean, the Arabian, Persian and Caspian Sea. Beyond this ocean lies another world, which was occupied by man before the Deluge, and within which Cosmas placed the Terrestrial Paradise. Above this rise the walls of the heavens like unto the tent of the Tabernacle. Far more simple is a small map of the world of the 8th century found in a codex in the library of Albi, an archiepiscopal seat in the department of Tarn. Its scanty nomenclature is almost wholly derived from the "Historiae adversum paganos" of Paulus Orosius (418). Far greater interest attaches to the so-called Anglo-Saxon Map of the World in the British Museum (Cotton MSS.), where it is bound up in a codex which also contains a copy of the *Periegesis* of Priscianus. Map and Periegesis are copies by the same hand, but no other connexion exists between them. More than half the nomenclature of the map is derived from Orosius, an annotated Anglo-Saxon version of which had been produced by King Alfred (871–901). The Anglo-Saxons of the time were of course well acquainted with Island (first thus named in 870) Slesvic and Norweci (Norway), and there is no need to have recourse to Adam of Bremen (1076) to account for their presence upon this map. The broad features of the map were derived no doubt from an older document which may likewise have served as the basis for the map of the world engraved on silver for Charlemagne, and was also consulted by the compilers of the Hereford and Ebstorf maps (see fig. 11).

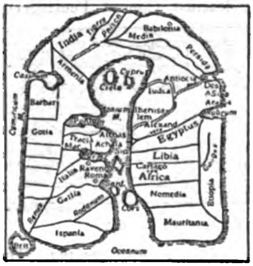

FIG. 7.—Map of Albi (8th century).

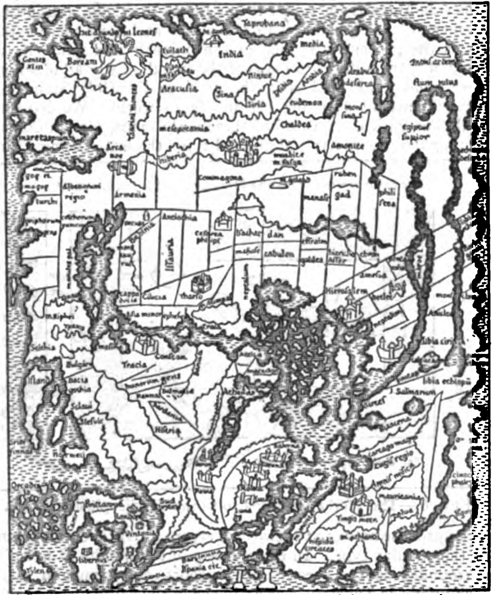

FIG. 8.—Anglo-Saxon Map of the World (9th century).

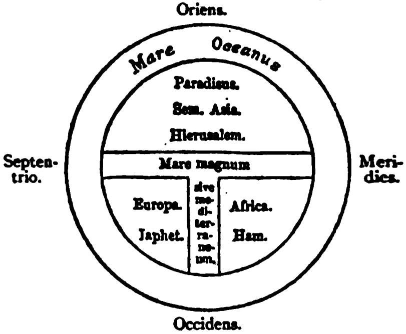

FIG. 9.—T map from Isidor of Seville's *Origines*.

The map or diagram of which Leonardo Dati in his poem on the Sphere (Della Spera) wrote in 1422 " un T dentre a uno O mostra il disegno " (a T within an O shows the design) is one of the most persistent types among the circular or wheel maps of the world. It perpetuates the tripartite division of the world by the ancient Greeks and survives in the Royal Orb. A diagram of this description will be found in Isidor of Seville's *Origines* (630), see fig. 9.

T maps of more elaborate design illustrate the MS. copies of Sallust's *Bellum jugurthinum*; one of these taken from a codex of the 11th century in the Leipzig town library is shown in fig. 10.

The outlines of several medieval maps resemble each other to such an extent that there can be no doubt that they are derived from the same original source. This source by some authors is assumed to have been the official map of the Roman Empire, but if we compare the crude outline given to the Mediterranean with the more correct delineation of Ptolemy, who was certainly in a position to avail himself of these official sources, such an assumption is untenable. The earliest delineation of the description has already been referred to as the Anglo-Saxon map of the world. Next in the order of age, follows the oval map which Henry, canon of Mayence Cathedral, dedicated to Mathilda, consort of the emperor Henry V. (1110). Of far greater importance is the map seen in Hereford Cathedral. It is the work of Richard of Haldingham, and has a diameter of 134 cm. (53 ins.). The " survey " ordered by Julius Caesar is referred to in the legend, evidently derived from the Cosmography of

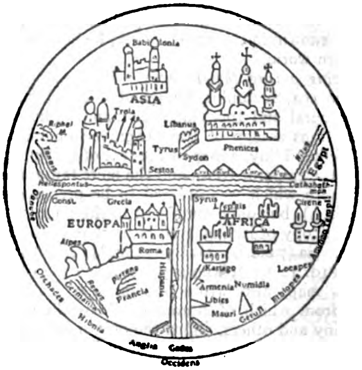

FIG. 10.—Map illustrating Sallust's *Bellum jugurthinum* (11th century, Leipzig).

Aethicus a work widely read at the time, but this does not prove that the author was able to avail himself of a map based upon that survey. A map essentially identical with that of Hereford, but larger—its diameter is 156 cm. (6 in.), and consequently fuller of information—was discovered in 1830 in the old monastery of Ebstorf in Hanover. Its date is 1484. Both maps abound in miniature pictures of towns, animals, fabulous beings and other subjects. The Hereford map is surmounted by a picture of the Day of Judgment. Similar in design, though much smaller of scale and oval in form, are the maps which illustrate the popular *Polychronicon* of Ranulf Higden, a monk of St Werburgh's Abbey of Chester (d. 1363).

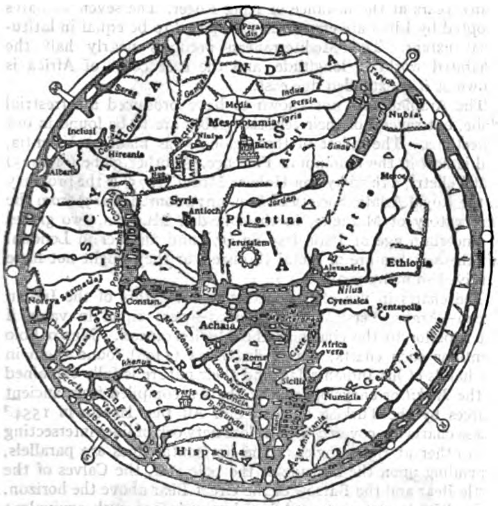

FIG. 11.—The Hereford Map (*c.* 1280).

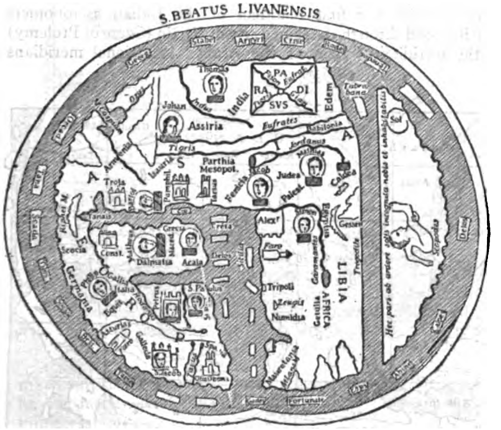

FIG. 12.—The Map of Beatus (776).

Pomponius Mela tells us that beyond the Ethiopian Ocean which sweeps round Africa in the south and the uninhabitable torrid zone, there lies an *alter orbis*, or fourth part of the world inhabited by *Antichthones*. On a diagram illustrating the *origines* of Isidore of Seville (d. 636) this country is shown, but is described as a *terra inhabitabilis*. It is shown likewise upon a number of maps which illustrate the *Commentaries on the Apocalypse*, by Beatus, a Benedictine monk of the abbey of Valcavado at the foot of the hills of Liebana in Asturia (776).

Our little map (fig. 12) is taken from a copy of Beatus' work made in 1203, and preserved at Burgo de Osma in Castille. Similar maps illustrating the *Commentaries* exist at St Sever (1050), Paris (1203), and Tunis; others are rectangular, the oldest being in Lord Ashburnham's library (970). Beatus, too, describes the southern land as *inhabitabilis*. The habitable world is divided among the twelve apostles, whose portraits are given. On the maps illustrating the encyclopaedic *Liber floridus* by Lambert, a canon of St Omer (1120), this south land "unknown to the sons of Adam," is stated to be inhabited "according to the philosophers" by Antipodes. Lambert, indeed, seems to have believed in the sphericity of the earth. Fig. 13 shows his map of the world reduced from a MS. at Wolfenbüttel, to which is added a diagram of the zones from a MS. at Ghent, which illustrates Macrobius' commentary on Cicero's *Somnium Scipionis*. Diagrams illustrating the division of the world into climata, are to be found in the *opus majus* of Roger Bacon (d. 1294) and in Cardinal Pierre d'Ailly's *De imagine Mundi* (1410).

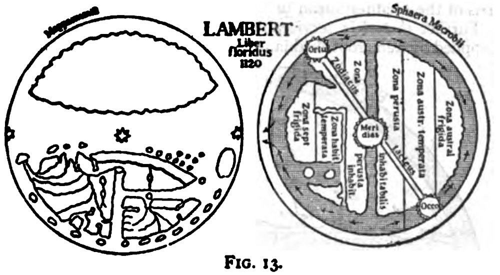

FIG. 13.

Among countries represented on a larger scale on maps, Palestine not unnaturally occupies a prominent place in this age of pilgrimages and crusades (1095–1291). The maps which accompany St Jerome's translation of the *Onomasticon* of St Eusebius (388). The same subject is illustrated by a picture-map in mosaic, portions of which were discovered in 1896 on the floor of the church of Madaba to the east of the Dead Sea. This is the oldest original of a map in existence, for it dates back to the 6th century. Among more recent maps of Palestine, that by Petrus Vesconte (1320) is greatly superior to the earlier maps. It illustrates Marino Sanuto's *Secreta fidelium crucis*, in which its author vainly appeals to Christendom to undertake another crusade. One of the earliest plans of Jerusalem is contained in *Gesta Francorum*, a history of the Crusades up to 1106, based upon information furnished by Fulcherius of Chartres (*c.* 1109).

There existed, no doubt, special maps of European countries, but the only documents of that description are two maps of Great Britain, the one of the 12th century, the other by Matthew of Paris, the famous historiographer of the monastery of St Albans (1236–1259).[1]

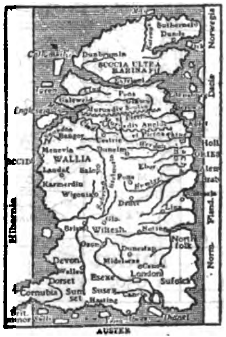

FIG. 14.—Matthew of Paris (1236–1259).

Celestial globes were known in the time of Bede; they formed part of the educational apparatus of the monastic schools. Gerbert of Aurillac is known to have made such globes (929). Their manufacture is described by Alphonso the Wise (1252), as also in *De sphaera solida* of G. Campanus of Novara (1303). Terrestrial globes, however, are not referred to.

Map-making among the Arabians and other Nations of the East.—Bagdad early became a famous seat of learning. Indian astronomers found apt pupils there among the Arabs; the works of

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[1] R. Gough, *British Topography* (London 1768). His "Histories" are published in *Rerum brit. scriptores* XL. and LVII. 1866–1869.

Ptolemy were translated into Arabic, and in 827, in the reign of the caliph Abdullah al Mamun, an arc of the meridian was measured in the plain of Mesopotamia. Most famous among these Arabian astronomers were Al Batani (d. 998), Ibn Yunis of Cairo (d. 1008), Zarkala (Azarchel), who determined the meridian distance between his observatory in Toledo and Bagdad to amount to 51° 30′, an error of 3° only, as compared with Ptolemy's error of 18°, and Abul Hassan (1230) who reduced the great axis of the Mediterranean to 44°.

Further materials serviceable to the compilers of maps were supplied by numerous Arabian travellers and geographers, among whom Masudi (915–940), Istakhri (950), Ibn Haukal (942–970), Al Biruni (d. 1038), Ibn Batuta (1325–1356) and Abul Feda (1331–1370), occupy a foremost place, yet the few maps which have reached us are crude in the extreme. Masudi, who saw the maps in the Horismos or Rasm el Ard, a description of the world by Abu Jafar Mahommed ben Musa of Khiva, the librarian of the caliph el Mamun (833), declares them to be superior to the maps of Ptolemy or Marinus, but maps of a later date by Istakhri (950) or Ibn al Wardi (1349) are certainly of a most rudimentary type. Nor can Idrisi's map of the world, which was engraved for King Roger of Sicily upon a silver plate, or the rectangular map in 70 sheets which accompanies his geography (Nushat-ul Mushtat) take rank with Ptolemy's work. These maps are based upon information collected during many years at the instance of King Roger. The seven climates adopted by Idrisi are erroneously supposed to be equal in latitudinal extent. The Mediterranean occupies nearly half the inhabited world in longitude, and the east coast of Africa is shown as if it extended due east.

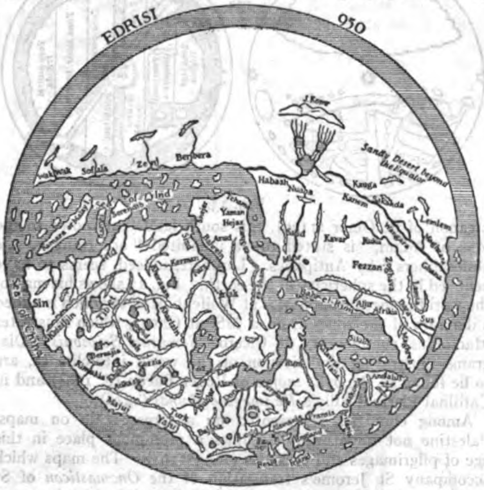

FIG. 15.—Idrisi (1154).

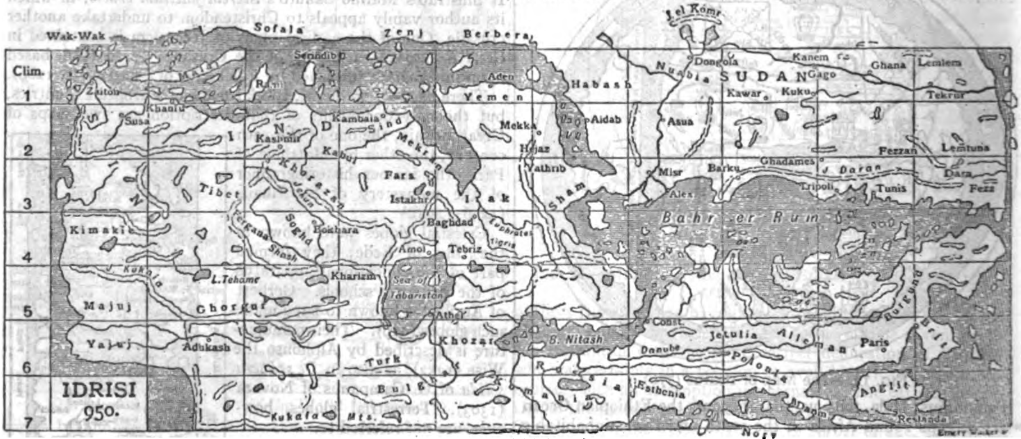

FIG. 16.—Idrisi (1154).

The Arabians are not known to have produced a terrestrial globe, but several of their celestial globes are to be found in our collections. The oldest of these globes was made at Valentia, and is now in the museum of Florence. Another globe (of 1225) is at Velletri; a third by Ibn Hula of Mosul (1275) is the property of the Royal Asiatic Society of London; a fourth (1289) from the observatory of Maragha, in the Dresden Museum, two globes of uncertain age at Paris (see fig. 17) and another in London. All these globes are of metal (bronze), or they might not have survived so many years.

The charts in use of the medieval navigators of the Indian Ocean—Arabs, Persians or Dravidas—were equal in value if not superior to the charts of the Mediterranean. Marco Polo mentions such charts; Vasco da Gama (1498) found them in the hands of his Indian pilot, and their nature is fully explained in the *Mohit* or encyclopaedia of the sea compiled from ancient sources by the Turkish admiral Sidi Ali Ben Hosein in 1554.[1] These charts are covered with a close network of lines intersecting each other at right angles. The horizontal lines are parallels, depending upon the altitude of the pole star, the Calves of the Little Bear and the Barrow of the Great Bear above the horizon. This altitude was expressed in *isbas* or inches each equivalent to 1° 42′ 50″. Each *isba* was divided into *zams* or eights. The interval between two parallels thus only amounted to 12′ 51″. These intervals were mistaken by the Portuguese occasionally for degrees, which account for Malacca, which is in lat. 2′ 13″ N., being placed on Cantino's Chart (1502) in lat. 14′ S. It may have been a map of this kind which accounts for Ptolemy's moderate exaggerations of the size of Taprobana (Ceylon). A first meridian, separating a leeward from a windward region, passed through Ras Kumhari (Comorin) and was thus nearly identical with the first meridian of the Indian astronomers which passed through the sacred city of Ujjain (Ozere of Ptolemy) or the meridian of Azin of the Arabs. Additional meridians were drawn at intervals of *zams*, supposed to be equal to three hours' sail.

In China, maps in the olden time were engraved on bronze or stone, but after the 10th century they were printed from wood-blocks. Among the more important productions of more recent times, may be mentioned a map of the empire, said to be based upon actual surveys by Yhang (721), who also manufactured a celestial globe (an older globe by Ho-shing-tien, 4 metres in circumference was produced in 450), and an atlas of the empire on a large scale by Thu-sie-pun (1311–1312) of which new enlarged editions with many maps were published in the 16th century and in 1799. None of these maps was graduated, which is all the more surprising as the Chinese astronomers are credited with having made use of the gnomon as early as 1000 B.C. for determining latitudes.

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[1] M. Bittner, *Die topogr. Capital des ind. Seespiegels* (Vienna, 1897).

Fig. 17.—Globe in Bibliothèque Nationale, Paris

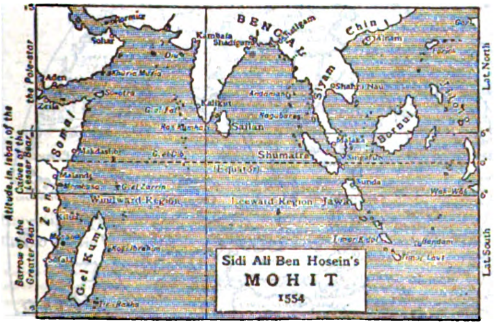

Fig. 18.—The Indian Ocean according to Mohit, as interpreted by Dr Tomaschek.

In the case of Japan, the earliest reference to a map is of 646, in which year the emperor ordered surveys of certain provinces to be made.

Portolano Maps.—During the long period of stagnation in cartography, which we have already dealt with, there survived among the seamen of the Mediterranean charts of remarkable accuracy, illustrating the *Portolani* or sailing directories in use among them. Charts of this description are first mentioned in connexion with the Crusade of Louis XI. in 1270, but they originated long before that time, and in the eastern part of the Mediterranean they embody materials available even in the days before Ptolemy, while the correct delineation of the west seems to be of a later date, and may have been due to Catalan seamen. These charts are based upon estimated bearings and distances between the principal ports or capes, the intervening coast-line being filled in from more detailed surveys. The bearings were dependent upon the seaman's observation of the heavens, for these charts were in use long before the compass had been introduced on board ship (as early as 1205, according to Guiot de Provins) although it became fully serviceable only after the needle had been attached to the compass card, an improvement probably introduced by Flavio Gioja of Amalfi in the beginning of the 14th century. The compass may of course have been used for improving these charts, but they originated without its aid, and it is therefore misleading to describe them as *Compass or Loxodromic* charts, and they are now known as *Portolano* charts.

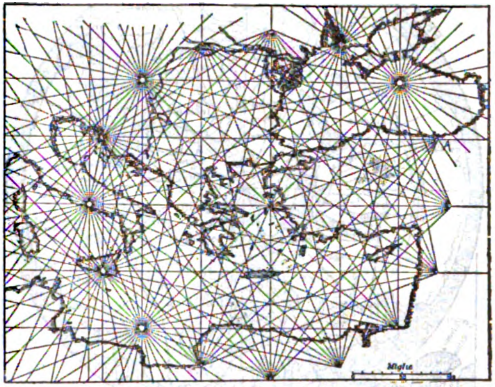

Fig. 19.—The Eastern Mediterranean, by Petrus Vesconte (1311).

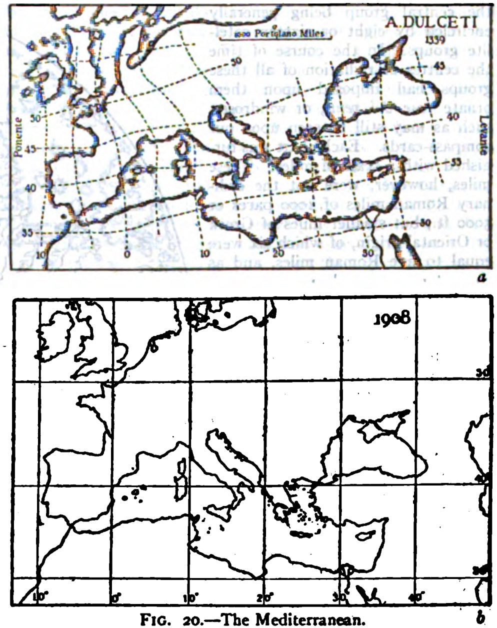

Fig. 20.—The Mediterranean.
a, According to A. Dulceti, 1339, and
b, On Mercator's projection, according to modern maps.

None of these charts is graduated, and the horizontal and vertical lines which cross many of them represent neither parallels nor meridians. Their most characteristic feature, and one by which they can most readily be recognized, is presented by groups or systems of rhumb-lines, each group of these lines radiating from a common centre, the central group being generally encircled by eight or sixteen satellite groups. In the course of time the centres of radiation of all these groups had imposed upon them ornate *rose dei venti*, or windroses, such as may still be seen upon our compass-cards. Each chart was furnished with a scale of miles. These miles, however, were not the ordinary Roman miles of 1000 paces or 5000 ft., but smaller miles of Greek or Oriental origin, of which six were equal to five Roman miles, and as the latter were equal to 1480 metres, the Portolano miles had a length of only 1233 metres, and 75·2 of the former, and 90·3 of the latter were equal to a degree. The difference between these miles was known, however, only to the more learned among the map-makers, and when the charts were extended to the Atlantic seaboard the two were assumed to be identical.

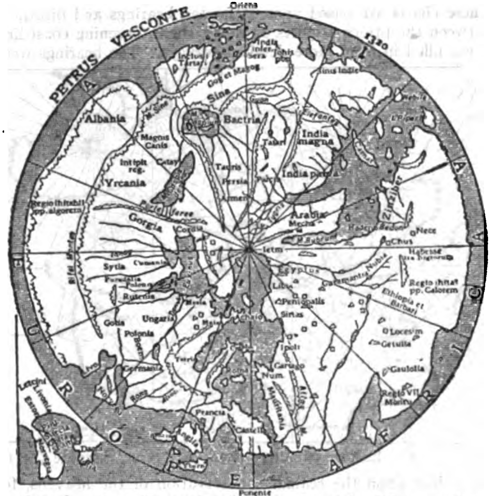

FIG. 21.—Map illustrating Marino Sanuto's *Liber secretorum fidelium crucis*.

On these old charts the Mediterranean is delineated with surprising fidelity. The meridian distance between the Straits of Gibraltar and Beirut in Syria amounts upon them to about 3000 Portolano miles, equal in lat. 36° N. to 40·9°, as compared with an actual difference of 41·2°, and a difference of 61° assumed by Ptolemy. There exists, however, a serious error of orientation, due, according to Professor H. Wagner, to the inexperience of the cartographers who first combined the charts of the separate basins of the Mediterranean so as to produce a chart of the whole. This accounts for Gibraltar and Alexandria being shown as lying due east and west of each other, although there is a difference of 5° of latitude between them, a fact known long before Ptolemy.

The production of these charts employed numerous licensed draughtsmen in the principal seaports of Italy and Catalonia, and among seamen these MS. charts remained popular long after the productions of the printing-press had become available. The oldest of these maps which have been preserved, the so-called "Pisan chart," which belongs probably to the middle of the 13th century, and a set of eight charts, known by the name of its former owner, the Cavaliere Tamar Luxoro, of somewhat later date, are both the work of Genoese artists. Among more eminent Genoese cartographers are Joannes da Carignano (d. 1344), Petrus Vesconte, who worked in 1311 and 1327, and is the draughtsman of the maps illustrating Marino Sanuto's *Liber secretorum fidelium crucis*, which was to have roused Christendom to engage in another crusade (figs. 19 and 21) Battista Beccario (1426, 1435) and Bartolomeo Pareto (1455). Venice ranks next to Genoa as a centre of cartographic activity. Associated with it are Francesco Pizigano (1367–1373), Francesco de Cesanis (1421), Giacomo Giroldi (1422–1446), Andrea Bianco (1436–1448) Giovanni Leardo (1442–1452), Alvise Cadamosto, who was associated with the Portuguese explorers on the west coast of Africa (1454–1456) and whose *Portolano* was printed at Venice in 1490, and Fra Mauro (1457).

Associated with Ancona are Grazioso Benincasa and his son Andreas, whose numerous charts were produced between 1461 and 1508, and Count Ortomano Freducci (1497–1538).

The earliest among Majorcan and Catalonian cartographers is Angelino Dulcert (1325–1339) whom A. Managhi claims as a Genoese, whose true name according to him was Angelino Dalorto.

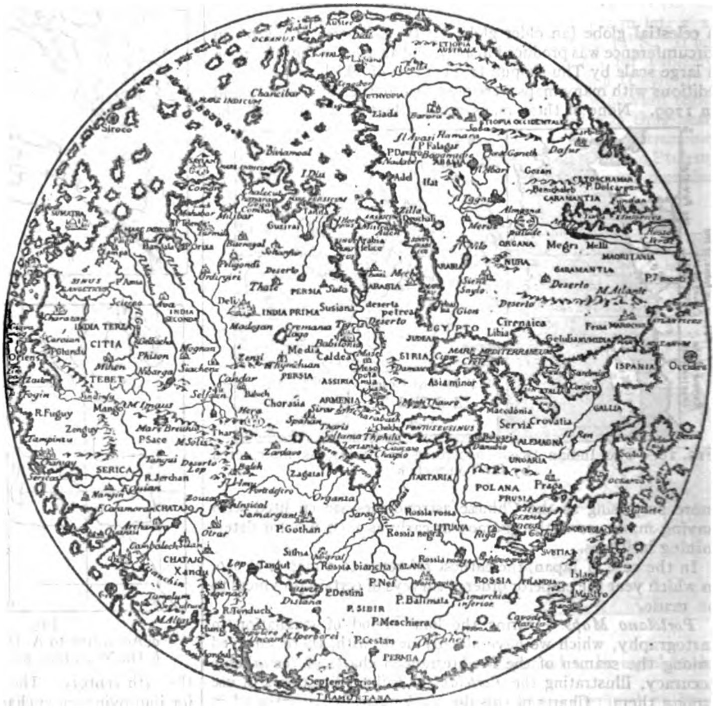

FIG. 22.—Fra Mauro (1457).

Other Catalans are Jahuda Cresques, a Jew of Barcelona, the supposed author of the famous Catalan map of the world (1375), Guglielmo Solerio (1384), Mecia de Viladestes (1413–1433) Gabriel de Valleseche (1439–1447) and Pietro Roselli, a pupil of Beccario of Genoa (1462).

These maps were originally intended for the use of seamen navigating the Mediterranean and the coasts of the Atlantic, but in the course of time they were extended to the mainland and ultimately developed into maps of the whole world as then known. Thus Pizigano's map of 1367 extends as far east as the Gulf of Persia, whilst the Medicean map of 1356 (at Florence) is remarkable on account of a fairly correct delineation of the Caspian, the Shari river in Africa, and the correct direction given to the west coast of India, which had already been pointed out in a letter of the friar Giovanni da Montecorvino of 1252. Most of the expansions of Portolano maps into maps of the world are circular in shape, and resemble the wheel maps of an earlier period. This is the character of the map of Petrus Vesconte of 1320 (fig. 21), of Giovanni Leardo (1448) and of a Catalan map of 1450. Jerusalem occupies the centre of these maps, Arab sources of information are largely drawn upon, while Ptolemy is neglected and contemporary travellers are ignored. Far superior to these maps is Fra Mauro's map (1457), for the author has availed himself not only of the information collected by Marco Polo and earlier travellers, but was able, by personal intercourse, to gather additional information from Nicolo de' Conti, who had returned from the east in 1440, and more especially from Abyssinians who lived in Italy at that time. His delineation of Abyssinia, though unduly spread over a wide area, is indeed wonderfully correct.

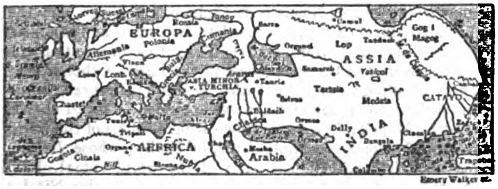

FIG. 23.—Catalan Map of the World (1375).

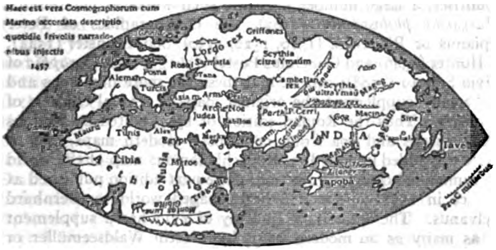
Haec est vera Cosmographorum cum Marino accordata descriptio quotidie frivolis narracionibus infecta
1457
Scythia
INDIA
Libia
Japoba

FIG. 24.—Genoese Map (1457).

Very different in character is the Catalan map of 1375, for its author, discarding Ptolemy, shows India as a peninsula. On the other hand, an anonymous Genoese would-be reformer of maps (1457; fig. 24), still adheres to the erroneous Ptolemaic delineation of southern Asia, and the same error is perpetuated by Henricus Marvellus Germanus on a rough map showing the Portuguese discoveries up to 1489. None of these maps is graduated, but if we give the Mediterranean a length of 3000 Portolano miles, equivalent in 36° N. to 41°, then the longitudinal extent of the old world as measured on the Genoese map of 1457 would be 136° instead of 177° or more as given by Ptolemy.

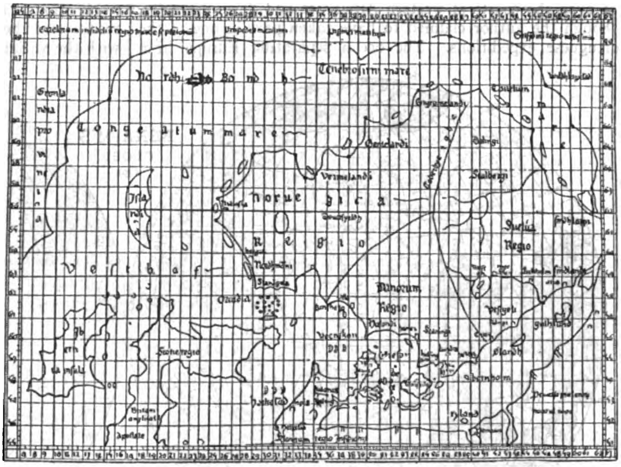

FIG. 25.—*Claudius Clavus Swartha* (1427).

The Revival of Ptolemy.—Ptolemy's great work became known in western Europe after Jacobus Angelus de Scarparia had translated it into Latin in 1410. This version was first printed in 1475 at Vicenza, but its contents had become known through MS. copies before this, and their study influenced the construction of maps in two respects. They led firstly to the addition of degree lines to maps, and secondly to the compilation of new maps of those countries which had been inadequately represented by Ptolemy. Thus Claudius Clavus Swartha (Niger), who was at Rome in 1424, compiled a map of the world, extending westward as far as Greenland. The learned Cardinal Nicolaus Krebs, of Cusa (Cues) on the Moselle, who died 1464, drew a map of Germany which was first published in 1491; D. Nicolaus Germanus, a monk of Reichenbach, in 1466 prepared a set of Ptolemy's maps on a new projection with converging meridians; and Paolo del Pozzo Toscanelli in 1474 compiled a new chart on a rectangular projection, which was to guide the explorer across the western ocean to Cathay and India.

Of the seven editions of Ptolemy which were published up to the close of the 15th century, all except that of Vicenza (1475) contained Ptolemy's 27 maps, while Francesco Berlinghieri's version (Florence 1478), and two editions published at Ulm (1482 and 1486), contained four or five modern maps in addition, those of Ulm being by Nicolaus Germanus.

The geographical ideas which prevailed at the time Columbus started in search of Cathay may be most readily gathered from two contemporary globes, the one known as the Laon globe because it was picked up in 1860 at a curiosity shop in that town, the other produced at Nuremberg in 1492 by Martin Behaim.[1] The Laon globe is of copper gilt, and has a diameter of 170 mm. The information which it furnishes, in spite of a legend intended to lead us to believe that it presents us with the results of Portuguese explorations up to the year 1493, is of more ancient date. The Nuremberg globe is a work of a more ambitious order. It was undertaken at the suggestion of George Holzschuher, a travelled member of the town council. The work was entrusted to Martin Behaim, who had resided for six years in Portugal and the Azores, and was believed to be a thoroughly qualified cosmographer.

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[1] E. G. Ravenstein, *Martin Behaim, his Life and his Globe* (London, 1908). On the original only equator, ecliptics, tropics, polar circles and one meridian 80° to the west of Lisbon are laid down.

The globe is of pasteboard covered with whiting and parchment, and has a diameter of 507 mm. The author followed Ptolemy not only in Asia, but also in the Mediterranean. He did not avail himself of the materials available in his day. Not even the coasts of western Africa are laid down correctly, although the author claimed to have taken part in one of the Portuguese expeditions. The ocean separating Europe from Asia is assumed as being only 126° wide, in accordance with Toscanelli's ideas of 1474. Very inadequate use has been made of the travels of Marco Polo, Nicolo de' Conti, and of others in the east.[1] On the other hand, the globe is made gay with flags and other decorations, the work of George Glockendon, a well-known illuminator of the time.

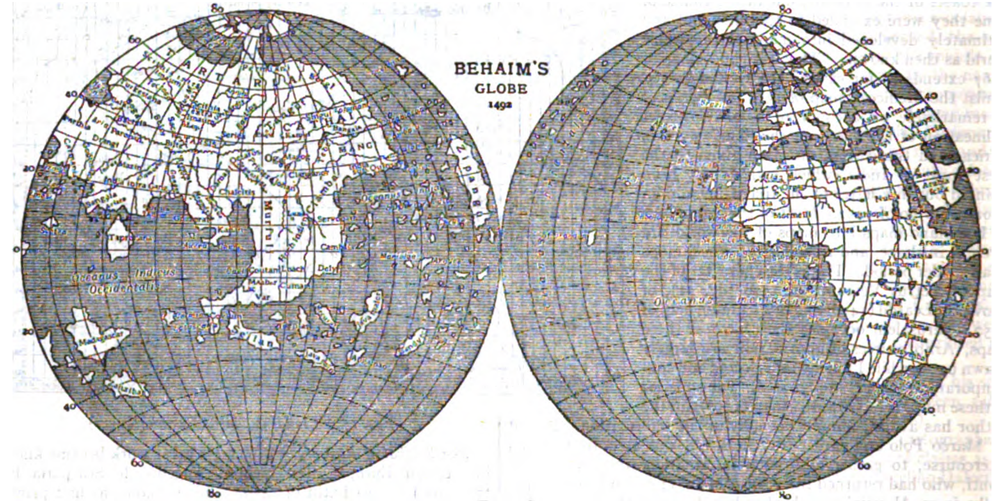

FIG. 26.

The maritime discoveries and surveys of that age of great discoveries were laid down upon so-called "plane-charts," that is, charts having merely equidistant parallels indicated upon them, together with the equator, the tropics and polar circles, or, in a more advanced stage, meridians also. The astrolabe quadrant or cross-staff enabled the mariner to determine his latitude with a certain amount of accuracy, but for his longitude he was dependent upon dead reckoning, for although various methods for determining a longitude were known, the available astronomical ephemerides were not trustworthy, and errors of 30° in longitude were by no means rare. It was only after the publication of Kepler's *Rudolphine Table* (1626) that more exact results could be obtained. A further difficulty arose in connexion with the variation of the compass, which induced Pedro Reinel to introduce two scales of latitude on his map of the northern Atlantic (1504; fig. 27).

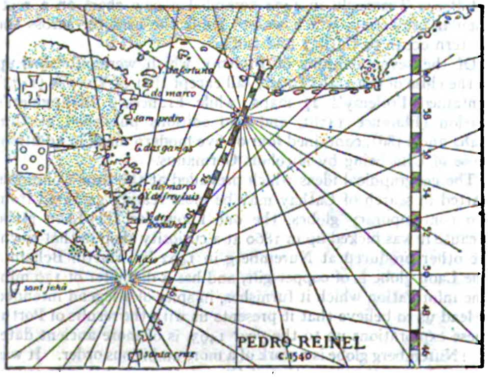

FIG. 27.

The chart of the world by Juan de la Cosa, the companion of Columbus, is the earliest extant which depicts the discoveries in the new world (1500), Nicolaus de Canerio, a Genoese, and the map which Alberto Cantino caused to be drawn at Lisbon for Hercules d'Este of Ferrara (1502), illustrating in addition the recent discoveries of the Portuguese in the East. Other cosmographers of distinction were Pedro Reinel (1504–1542), Nuno Garcia de Toreno (1520), to whom we are indebted for 21 charts, illustrating Magellan's voyage, Diogo Ribero (maps of the world 1527, 1529),[2] Alonzo de Santa Cruz, of Seville, whose *Isolario general* includes charts of all parts of the world (1541), John Rotz or Rut (1542), Sebastian Cabot (1544), as also Nicolas Desliens, Pierre Desceliers, G. Breton and V. Vallard, all of Arques, near Dieppe, whose charts were compiled between 1541 and 1554.

Of the many general maps of the world or of particular countries, a large number illustrate such works as G. Reisch's *Margarita philosophica* (1163), the cosmographies of Peter Apianus or Bienewitz (1520, 1522, 1530), Seb. Münster (1544), J. Honter (1546) and Gulielmus Postel (1561) or the *Geographia* of Livio Sanuto (1588); others, and these the more numerous and important, supplement the original maps of several editions of Ptolemy. Thus the Roman edition of 1507, edited by Marcus Benaventura and Joa Cota, contains 6 modern maps, and to these was added in 1508 Joh. Ruysch's famous map of the world on a modified conical projection. The next edition published at Venice in 1511 contained a heart-shaped world by Bernhard Sylvanus. The Strassburg Ptolemy of 1513 has a supplement of as many as 20 modern maps by Martin Waldseemüller or Ilacomilus, several among which are copied from Portuguese originals. Waldseemüller was one of the most distinguished cartographers of his day. He was born at Radolfzell in Baden in 1470, was associated with Ringmann at the gymnasium of

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[1] See fig. 23, Catalan Map of the World (1375).

[2] J. G. Kohl published facsimiles of the American section of the maps (Weimar, 1860).

St Dié, and died in 1521. He published in 1507 a huge map of the world, in 12 sheets, together with a small globe of a diameter of 110 mm., the segments for which were printed from wood-blocks. On these documents the new world is called America, after Amerigo Vespucci, its supposed discoverer. In 1511 Waldseemüller published a large map of Europe, in 1513 he prepared his maps for the Strassburg edition of Ptolemy, and in 1516 he engraved a copy of Canerio's map of the world. The Strassburg Ptolemy of 1522 contains Waldseemüller's maps,[1] edited on a reduced scale by Laurentius Frisius, together with three additional ones. The same set of maps is reprinted in the Strassburg edition of 1524, newly translated by W. Pirckheimer with notes by Joh. Müller Regiomontanus, and in the Lyon edition of 1535, edited by Michael Servetus. The new maps of the Basel edition of 1540, twenty-one in number, are by Sebastian Münster; Jacob Gastaldo supplied the Venice edition of 1548 with 34 modern maps, and these with a few additions are repeated in Girolamo Ruscelli's Italian translation of Ptolemy published at Venice in 1561.

Equally interesting with these Ptolemaic supplements are collections like that of Anton Lafreri, which contains reprints of 142 maps of all parts of the world originally published between 1556 and 1572 (*Geografica tavole moderne*, Rome, n.d.), or that of J. F. Camocio, published at Venice in 1576, which contains 88 reprints.

The number of cartographers throughout Europe was considerable, and we confine ourselves to mentioning a few leading men. Among them Germany is then represented by G. Glockedon, the author of an interesting road-map of central Europe (1501), Sebastian Münster (1489–1552), Elias Camerarius, whose map of the mark of Brandenburg won the praise of Mercator; Wolfgang Latz von Lazius, to whom we are indebted for maps of Austria and Hungary (1561), and Philip Apianus, who made a survey of Bavaria (1553–1563), which was published 1568 on the reduced scale of 1:144,000, and is fairly described as the topographical masterpiece of the 16th century. For maps of Switzerland we are indebted to Konrad Türst (1495–1497), Johann Stumpf (1548) and Aegidius Tschudi (1538). A map of the Netherlands from actual survey was produced by Jacob of Deventer (1536–1539). Leonardo da Vinci, the famous artist, while in the service of Cesare Borgia as military engineer, made surveys of several districts in central Italy. Other Italian cartographers of merit were Giovanni Battiste Agnese of Venice, whose atlases (1517–1564) enjoyed a wide popularity; Benedetto Bordone (1528); Giacomo Gastaldo, cosmographer of the Venetian Republic (1534–1568), and his successor, Paolo Forlani. New maps of Spain and Portugal appeared in 1560, the former being due to Pedro de Medina, the latter to Fernando Alvarez Secco and Hernando Alvaro. Among the French map-makers of this period may be mentioned Oronce Finée (Finaeus), who in 1525 published a map of France, and Jean Jolivet (*c.* 1560). Gregorio Lilly (1546) and Humphrey Lhuyd of Denbigh (d. 1510) furnished maps of the British Isles, Olaus Magnus (1539) of Scandinavia, Anton Wied (1542), Sigismund von Herberstein (1549) and Anthony Jenkinson (1562) of Muscovy.

The cylindrical and modified conical projections of Marinus and Ptolemy were still widely used, the stereographical projection of Hipparchus, was for the first time employed for terrestrial maps in the 16th century, but new projections were introduced in addition to these. The earliest of these, a trapeziform projection with equidistant parallels, by D. Nicolaus Germanus (1466), naturally led to what is generally known as Flamsteed's projection. Joh. Stabius (1502) and his pupil J. Werner (1514) devised three heart-shaped projections, one of which was equivalent. Petrus Apianus (1524) gave his map an elliptical shape. H. Glareanus (1510) was the first to employ an equidistant zenithal polar projection.

No reasonable fault can be found with the marine surveyors of this period, but the scientific cartographers allowed themselves too frequently to be influenced by Ptolemaic traditions. Thus Gastaldo (1548) presents us with a map of Italy, which, except as to nomenclature, differs but little from that of Ptolemy, although on the Portolano charts the peninsula had long since assumed its correct shape. Many of the local maps, too, were excellent specimens of cartography, but when we follow any cartographer of the period into regions the successful delineation of which depended upon an intelligent interpretation of itineraries, and of information collected by recent travellers, they are generally found to fail utterly. This is illustrated by the four sketch maps shown in fig. 28.

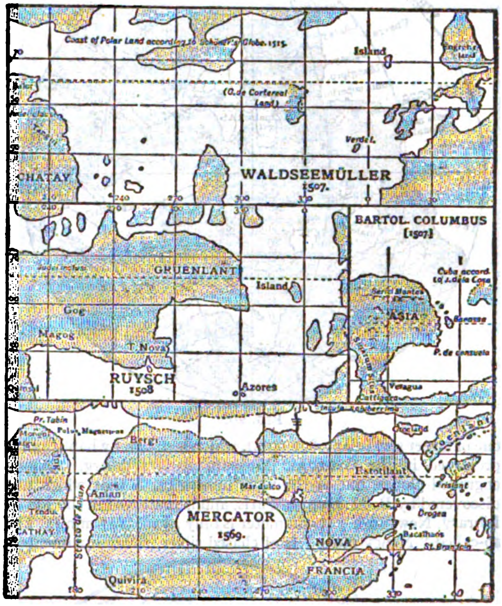

FIG. 28.

Columbus, trusting to Toscanelli's misleading chart, looked upon the countries discovered by him as belonging to eastern Asia, a view still shared about 1507 by his brother Bartolomeo. Waldseemüller (1507) was the first to separate America and Asia by an ocean of considerable width, but J. Ruysch (1508) returns to the old idea, and even joins Greenland (Gruenlant) to eastern Asia. Bologninus Zalterius on a map of 1566, and Mercator on his famous chart of 1569, separates the two continents by a narrow strait which they call Streto de Anian, thus anticipating the discovery of Bering Strait by more than a hundred and fifty years. Anian, however, which they place upon the American coast, is no other than Marco Polo's Anica or Anin, our modern Annam. Such an error could never have arisen had the old compilers of maps taken the trouble to plan Marco Polo's routes.

Globes, both celestial and terrestrial, became popular after the discovery of America. They were included among the scientific apparatus of ships and of educational establishments. Columbus and Magellan had such globes, those of the latter produced by P. Reinel (1519), and Conrad Celtes tells us that he illustrated his lectures at the university of Vienna with the help of globes (1501). Globes were still engraved on copper, or painted by hand, but since 1507, in which year Waldseemüller published a small globe of a diameter of 110 mm., covered with printed segments or gores, this cheap and expeditious method has come into general use. Waldseemüller constructed his gores graphically, A. Dürer (1525) and Hen. Loriti Glareanus (1527) were the first who dealt scientifically with the principles underlying their construction. Globes

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[1] Facsimiles of the maps of 1507 and 1517 were published by J. Fischer and F. M. von Wieser (Innsbruck, 1903).

covered with printed gores were produced by L. Boulenger (1514), Joh. Schöner (1515), P. Apianus, Gemma Frisius (1530) and G. Mercator (1541). Leonardo da Vinci's rough map of the world in 8 segments (*c.* 1513) seems likewise to have been intended for a globe. Of J. Schöner we know that he produced four globes, three printed from segments (1515, 1523, 1533), and one of larger size (diam. 822 mm.), which is drawn by hand, and is preserved in the Germanic Museum at Nuremberg. Among engraved globes, one of the most interesting is that which was discovered by R. M. Hunt in Paris, and is preserved in the Lenox Library, New York. Its diameter is only 4⅗ in. (127 mm.). The so-called "Nancy globe" is of chased silver, richly ornamented, and formerly served the purpose of a pyx. Its diameter is 160 mm., its date about 1530. About the same date is assigned to a globe by Robert de Bailly, engraved on copper and gilt (diam. 440 mm.). Celestial globes were manufactured by Regiomontanus (d. 1476) at Nuremberg, by Joh. Stöffler (1499), and by G. Hartmann (1535).

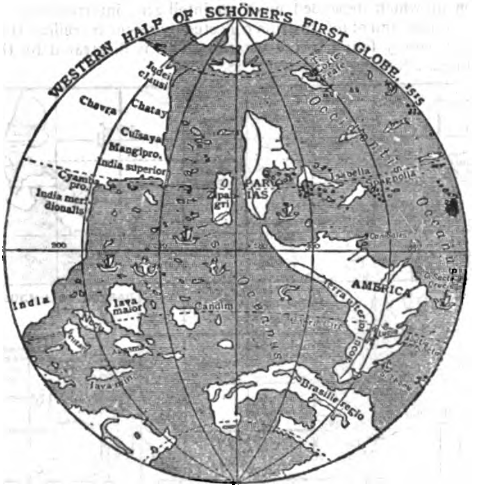

FIG. 29.

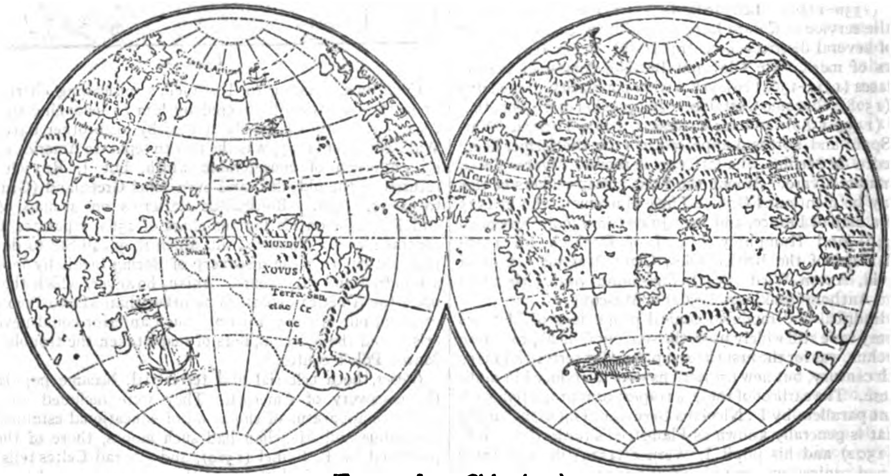

FIG. 30.—Lenox Globes (1510).

Mercator and his Successors.—Of Gerhard Kremer (1512–1594) the earliest works are a map of Palestine (1537), a map of the world on a double heart-shaped projection (1525), and a topographical map of Flanders based upon his own surveys (1540), a pair of globes (1541, diam. 120 mm.), and a large map of Europe which has been praised deservedly for its accuracy (1554). He is best known by his marine chart (1569) and his atlas. The projection of the former may have been suggested by a note by W. Pirkheimer in his edition of Ptolemy (1525). Mercator constructed it graphically, the mathematical principles underlying it being first explained by E. Wright (1594). The "Atlas" was only published after Mercator's death, in 1595. It only contained nine maps, but after the plates had been sold to Jodocus (Jesse) Hondius the number of maps was rapidly increased, although Mercator's name was retained. Mercator's maps are carefully engraved on copper. Latin letters are used throughout; the miniatures of older maps are superseded by symbols, and in the better-known countries the maps are fairly correct, but they fail lamentably when we follow their author into regions—the successful delineation of which depends upon a critical combination of imperfect information.

Even before Mercator's death, Antwerp and Amsterdam had become great centres of cartographic activity, and they maintained their pre-eminence until the beginning of the 18th century. Abraham Ortelius (1527–1592), of Antwerp, a man of culture and enterprise, but not a scientific cartographer, published the first edition of his *Theatrum orbis terrarum* in 1570. It then contained 53 maps, by various authors. By 1595 the number of maps had increased to 119, including a *Parergon* or supplement of 12 maps illustrating ancient history. In 1578 was published the *Speculum orbis terrarum* of Gerard de Jude or de Judaeis. Lucas Janszon Waghenaer (Aurigarius) of Enkhuizen published the first edition of his *Spiegel der Zeevaart* (Mariners' Mirror) at Leiden in 1585. It was the first collection of marine maps, lived through many editions, was issued in several languages and became known as *Charettier* and *Waggoner*. In the same year Adrian Gerritsz published a valuable *Paskaarte* of the European Sea. Ten years afterwards, in 1595, W. Barentszoon published a marine atlas of the Mediterranean, the major axis of which he reduced to 42 degrees. Jodocus Hondius has already been referred to as the purchaser of Mercator's plates. The business founded by him about 1602 was continued by his sons and his son-in-law, Jan Janszon (Jansonius) and others. By 1653 this firm had already produced atlases including 451 charts. Willem Janszon, the father of Hondius's partner, published a collection of charts (1608), to which he gave the title of *Het Licht der Zeevaart* (the seaman's light).

Another cartographic publishing firm was established at Amsterdam in 1612 by Willem Janszon Blaeu (1571–1638), a friend of Tycho Brahe, from 1633 "mapmaker" of the states-general, and a man of scientific culture. He was succeeded by his son Jan (d. 1673) and grandson Cornelius, and before the end of the century turned out a *Zee-Spiegel* of 108 charts (1623), an *Atlas novus* (*Nieuwe Atlas*), 1642, enlarged in the course of time until it consisted of 12 folio volumes containing hundreds of maps. J. A. Colom in 1633 published a collection of maps under the quaint title of *Vurig Colom der Zeevaert* (Fiery Column of Navigation). Among more recent Dutch map publishers are Nicolaus Vischer (Piscator), R. Goos, H. Doncker, F. de Wit, and J. and G. van Keulen, whose atlases were published between 1681 and 1722. These Dutch maps and charts are generally accompanied by descriptive notes or sailing directions printed on the back of them. A similar work is the *Arcano del mare* of Sir Robert Dudley, duke of Northumberland, the numerous sheets of which are on Mercator's projection (1631).

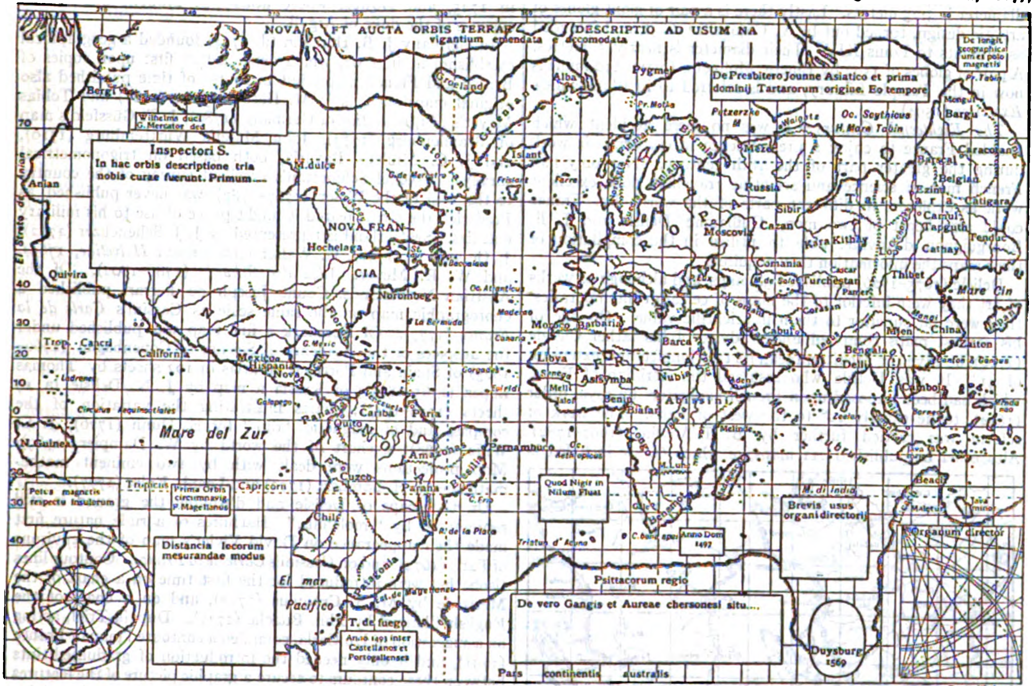
NOVA ET AUCTA ORBIS TERRAE DESCRIPTIO AD USUM NAvigantium emendata accomodata
Inspectori S.
In hac orbis descriptione tria nobis curae fuerunt. Primum....
De Presbitero Joanne Asiatico et prima dominii Tartarorum origine. Eo tempore
Wilhelmo duci G. Mercator ded
De longit. geographica
Groenland
Islant
NOVA FRAN
Hochelaga
Norombega
Quivira
California
Mexico
Hispania Nova
Mare del Zur
N. Guinea
Peru
Brasilia
Cuzco
Chile
Patagonia
T. de fuego
El mar Pacifico
Tropicus Capricorni
Trop. Cancri
Circulus Aequinoctialis
Polus magnetis respectu insularum
Prima Orbis circumnavig. P. Magellanus
Distancia locorum mesurandae modus
Anno 1493 inter Castellanos et Portogallenses
EUROPA
Russia
Moscovia
AFRICA
Barbaria
Libya
Nubia
Abissini
Congo
Mare rubrum
Quod Nigir in Nilum Fluat
Anno Dom 1497
Psittacorum regio
De vero Gangis et Aureae chersonesi situ....
Pars continentis australis
Brevis usus organi directorii
Organum directorium
Duysburg 1569
Tartaria
Cathay
China
Zaiton
Bengala
Java
M. di India
Arabia
Persia
Pygmei

FIG. 31.—Mercator's Chart of the World (1569).

In France, in the meantime, an arc of the meridian had been measured (1669–1670) by Jean Picard, numerous longitudes had been observed between 1672 and 1680 by the same, and by Phil. de Lahire (d. 1719), and these were utilized in a *Carte de France* "as corrected from the observations of the members of the Academy of Sciences" (1666–1699), in a map of the world (1694) by D. Cassini, as also in *Le Neptune François* (1693) with contributions by Pene, D. Cassini and others. These corrected longitudes were not yet available for the maps produced by Nicolas Sanson of Abbeville, since 1627. The cartographical establishment founded by him in that year was carried on after his death in 1667 by his sons, his son-in-law, P. Duval (d. 1683) and his grandson Robert du Vaugondy (d. 1766). Among the cartographers whom he employed were M. Tavernier and Mariette, and in many instances he mentioned the authors whose maps he copied. By 1710 the maps published by the firm numbered 466. Nicolas de Fer, the great rival of Sanson, and his heirs, are stated to have published as many as 600 maps after 1700.

In no other country of Europe was there at the close of the 16th century a geographical establishment capable of competing with the Dutch towns or with Sanson, but the number of those who produced maps, in many instances based upon original surveys, was large. Germany is thus represented, among others, by C. Henneberger (map of Prussia, 1576), by M. Oeder, (survey of Saxony, 1586–1607), A. Rauh (fine hill features on a map of the environs of Wangen and Lindau, 1617), W. Schickhardt (survey of Württemberg, 1624–1635), and G. M. Vischer (map of Austria and Styrai, 1669–1786); Switzerland by H. C. Gyger (Canton of Zürich, a masterpiece, 1667); Italy by G. A. Magini (1558–1610), and V. Coronelli, appointed cosmographer of the Venetian Republic, 1685, and founder of the Ac. Cosmogr. dei Argonauti, the earliest geographical society, and Diogo Homem, a Portuguese settled at Venice (1558–1574); Denmark by J. Mejer of Husum (1650); Sweden by A. Buraeus, the "father of Swedish cartographers" (1650–1660); the British Islands by Ch. Saxton (County Atlas of England and Wales 1575), J. Speed (*Theatrum* of Great Britain, 1610), Timothy Pont and Robert Gordon of Strathloch (map of Scotland, 1608), and A. Moll. A *Novus atlas sinensis*, based upon Chinese surveys, was published in 1655 by Martin Martini, S.J., a missionary recently returned from China. Isaac Voss, in his work *De Nili* (1659), published a map of central Africa, in which he anticipated D'Anville by rejecting all the fanciful details which found a place upon Filippo Pigafetta's map of that continent.

The first maps illustrating the variation of the compass were published by Chris. Burrus (d. 1632) and Athanasius Kircher (*Magnes*, Rome, 1643), and maps of the ocean and tidal currents by the latter in his *Mundus subterraneus* (1665). Edmund Halley, the astronomer, compiled the first variation chart of scientific value (1683), as also a chart of the winds (1686).

Globes manufactured for commercial purposes by Blaeu and others have already been mentioned, but several large globes, for show rather than for use, were produced in addition to these. Thus A. Busch, of Limburg (1656–1664), manufactured a globe for Duke Frederick of Holstein, formerly at Gottorp, but since 1713 at Tsarskoye Zelo. It has a diameter of 11 ft. (3·57 metres) and is hollow, the inner surface of the shell being covered with a star map, and the outer surface with a map of the world. Professor Erh. Weigel (1696) produced a hollow celestial globe in copper, having a small terrestrial globe in its centre. Its diameter is 3·25 metres. Lastly there is a pair of giant globes of artistic design, turned out by V. Coronelli (1623), and intended as presents to Louis XIV. Their diameter is nearly 5 metres. A pair of globes of 1592 by Emeric Molineux (diam. 610 mm.) is now in the Temple Library, and is referred to in Blundeville's *Exercises* (1594).

The Eighteenth Century.—It was no mere accident which enabled France to enjoy a pre-eminence in cartographic work during the greater part of the 18th century. Not only had French men of science and scientific travellers done excellent work as explorers in different parts of the world, but France could also boast of two men, Guillaume Delisle and J. B. Bourguignon d'Anville, able to utilize in the compilation of their maps the information they acquired.

Delisle (1675–1726) published 98 maps, and although as works of art they were inferior to the maps of certain contemporaries, they were far superior to them in scientific value. On one of his earliest maps compiled under advice of his father Claude (1700), he gave the Mediterranean its true longitudinal extension of 41°. It was Delisle who assumed the meridian of Ferro, which had been imposed upon French navigators by royal order (1634), to lie exactly 20° to the west of Paris. The work of reform was carried further by B. D'Anville (1697–1782). Altogether he published 211 maps, of which 66 are included in his *Atlas général* (1737–1780); he swept away the fanciful lakes from off the face of Africa, thus forcibly bringing home to us the poverty of our knowledge (fig. 32), delineated the Chinese Empire in accordance with the map based on the surveys conducted during the reign of the emperor Kanghi, with the aid of Jesuit missionaries, and published in 1718; boldly refused to believe in the existence of an Antarctic continent covering half the southern hemisphere, and always brought a sound judgment to bear upon the materials which the ever-increasing number of travellers placed at his disposal. Among other French works of importance deserving notice are *Le Neptune oriental* of Mannevillette (1745) and more especially the *Carte géometrique de la France*, which is based upon surveys carried on (1744–1783) by César François Cassini de Thury and his son Dominique de Cassini. It is on a transversal cylindrical (rectangular) projection devised by Jacques Cassini (d. 1746). The hills are shown in rough hachures.

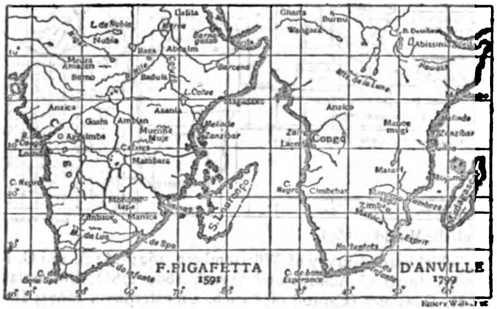

Fig. 32.

England, which had entered upon a career of naval conquest and scientific exploration, had reason to be proud of J. F. W. Desbarres, *Atlantic Neptune* (1774), a North-American Pilot (1779), which first made known the naval surveys of J. Cook and of others; and Tho. Jefferys's *West Indian* and *American Atlases* (1775, 1778). James Rennell (1742–1830), who was surveyor-general of India, published the *Bengal Atlas* (1781), and sagaciously arranged the vast mass of information collected by British travellers and others in India and Africa, but it is chiefly with the name of Aaron Arrowsmith, who came to London in 1778, and his successors, with which the glory of the older school of cartographers is most intimately connected. His nephew John died in 1873. Among local cartographers may be mentioned H. Moll (d. 1732), J. Senex, whose atlas was published in 1725, and Dowet, whose atlas was brought out at the expense of the duke of Argyll.

In Germany J. B. Homann (d. 1724) founded a geographical establishment in 1702, which depended at first upon copies of British and French maps, but in course of time published also original maps such as J. M. Hase's *Africa* (1727) and Tobias Meyer's *Mappa critica* of Germany (1780), J. T. Güssfeld's map of Brandenburg (1773), John Majer's Württemburg (1710), and J. C. Müller's Bavaria, both based on trigonometrical surveys. Colonel Schmettau's excellent survey of the country to the west of the Weser (1767–1787) was never published, as Frederick the Great feared it might prove of use to his military enemies. Switzerland is represented by J. J. Scheuchzer (1712), J. Gessner (d. 1790), G. Walser (*Atlas novus Helvetiae*, 1769), and W. R. Meyer, *Atlas der Schweiz* (1786–1802). Of the Austrian Netherlands, Count Joseph de Ferrari published a chorographic map on the same scale as Cassini's *Carte de la France* (1777). Of Denmark a fine map was published under the auspices of the Academy of Science of Copenhagen (1766–1825) of Spain and Portugal an atlas in 102 sheets by Thomas Lopez (1765–1802); of Russia a map by J. N. Delisle in 19 sheets (1739–1745); charts illustrating the variation of the compass and of magnetic "dip" by E. Dunn (1776), J. C. Wiffe (1768); a chart of the world by W. Dampier (1789). Map projections were dealt with by two eminent mathematicians, J. H. Lambert (1772) and Leonh. Euler (1777).

On the maps of Delisle and d'Anville the ground is still represented by "molehills." Hachures of a rude nature first made their appearance on David Vivier's map of the environs of Paris (1674), and on Cassini's *Carte de la France*. Contour lines (isobaths) were introduced for the first time on a chart of the Merwede by M. S. Cruquius (1728), and on a chart of the English Channel by Phil. Busche (1737). Dupain-Triel, acting on a suggestion of Du Carla, compiled a contoured map of France (1791), and it only needed the introduction of graduated tints between these contours to secure a graphic picture of the features of the ground. It was J. G. Lehmann (1783) who based his method of hill-shading or hachuring upon these horizontal contours. More than 80 methods of showing the hills have found advocates since that time, but all methods must be based upon contours to be scientifically satisfactory.

Two relief maps of Central Switzerland deserve to be mentioned, the one by R. L. Pfyffer in wax, now in Lucerne, the other by J. R. Meyer of Aarau and Müller of Engelberg in papier mâché, now in Zurich. Globes of the usual commercial type were manufactured in France by Delisle (1700), Forbin (1710–1731), R. and J. de Vaugondy (1752), Lalande (1771); in England by E. and G. Adams (1710–1766); Germany by Homann and Seutter (1750). A hollow celestial globe 18 ft. in diameter was set up by Dr Roger Long at Cambridge; the terrestrial globe which Count Ch. Gravie of Vergennes presented to Louis XVI. in 1787 had a diameter of 26 metres, or 85 ft.

Modern Cartography.—The compiler of maps of the present day enjoys many advantages not enjoyed by men similarly occupied a hundred years ago. Topographical surveys are gradually extending, and explorers of recent years are better trained for their work than they were a generation ago, whilst technical processes of recent invention—such as lithography, photography and heliogravure—facilitate or expedite the completion of his task. This task, however, has grown more difficult and exacting. Mere outline maps, such as formerly satisfied the public, suffice no longer. He is called upon more especially to give a satisfactory delineation of the ground, he must meet the requirements of various classes of the public, and be prepared to record cartographically all the facts of physical or political geography which are capable of being recorded on his maps. The ingenuity of the compiler is frequently taxed when called upon to illustrate graphically the results of statistical information of every description.

Germany since the middle of the 19th century has become the headquarters of scientific cartography. This is due as much to the inspiriting teachings of Ritter and Humboldt as to the general culture and scientific training combined with technical skill commanded by the men who more especially devote themselves to this branch of geography, which elsewhere is too frequently allowed to fall into the hands of mere mechanics. Men like H. Berghaus (1797–1884), H. Kiepert (1818–1899), and A. Petermann (1822–1878) must always occupy a foremost place in the history of cartography. Among the geographical establishments of Germany, that founded by Justus Perthes (1785), at Gotha, occupies the highest rank. Among its publications are A. Stieler's *Hand-Atlas* (1817–1832), K. von Spruner's *Historical Atlas* (1438–1488), H. Berghaus' *Physical Atlas* (1838–1842), E. von Sydow's *Wall Maps for Schools* (1838–1840) and *School Atlas* (1847). The titles of these atlases survive, though the authors of the original editions are long dead, and the maps have been repeatedly superseded by others bringing the information up to the date of publication. To the same firm we are indebted for Petermann's *Mitteilungen*, started in 1855 by A. Petermann, after whose death in 1902 they were successively edited by E. Behm, A. Supan and P. Langhans, as also the *Geographisches Jahrbuch* (since 1866), at first edited by E. Behm, afterwards by Professor H. Wagner. Among other geographical institutes in Germany which deserve mention are the Weimar Institut, founded in 1791 by F. J. Bertuch, and directed in 1845–1852 by H. Kiepert; Paul Fleming at Glogau (K. Sohr's Handatlas, 1845), A. Ravenstein at Frankfort, D. Reimer at Berlin (H. Kiepert, *Handatlas*, 1860); R. Andree (*Hand-Atlas*, 1880), and E. Debes (*Hand-Atlas*, 1894) in Leipzig, and E. Hölzer in Vienna (Vincenz von Haardt's maps). France is represented by the publishing firms of Ch. Delagrave (Levaseur's maps), Hachette (Vivien de St Martin's *Atlas universel*, in progress since 1875, F. Schrader's *Atlas de géographie moderne*, 1880), and Armand Colin (Vidal de la Blache's *Atlas général*, 1894). In Great Britain A. Arrowsmith established himself in London in 1770 (*General Atlas*, 1817), but the cartographical business ceased on the death of John Arrowsmith in 1873. John Walker, to whose initiative the charts published by the admiralty are indebted for the perspicuous, firm and yet artistic execution, which facilitate their use by the mariner, was also the author of the maps published by the Society for the Diffusion of Useful Knowledge (1829–1840). Among more recent firms are W. and A. K. Johnston (founded 1825; *Royal Atlas*, 1855); J. Bartholomew & Co., now carried on by J. G. Bartholomew (Reduced Survey maps, *Atlas of the World's Commerce*, 1906); Philip & Sons (*Imperial Atlas*, 1890; *Systematic Atlas* by E. G. Ravenstein, 1894; *Mercantile Marine Atlas*, 1904, globes), and E. Stanford (*London Atlas*).

In 1890 Professor A. Penck proposed to prepare a map of the world, including the oceans, on a scale of 1 : 1,000,000, and his scheme was promised the support of a committee which met in London in 1909, and upon which were represented the leading powers of the world. Maps on that scale of a great part of Africa, Asia and America have been published by British, French, German and United States authorities. A bathymetrical chart of the oceans, by Professor J. Thoulet was published in 1904 at the expense of Prince Albert of Monaco.

Reliefs from printed maps were first produced by Bauerkeller of Darmstadt and Dondorf at Frankfort, from originals furnished by A. Ravenstein (1838–1844). The exaggeration in altitude, on these maps and on those of a later date and on a larger scale, was very considerable. No such exaggeration exists in the case of reliefs of parts of the Alps, on a large scale, by P. Keil and Pelikan (1890), X. Imfeld (1891), P. Oberlerchner (1891–1895), C. Perron (1893–1900), F. Becker (1900), A. Heim (1904) and others. A relief globe was first suggested in a letter of M. Maestlin to J. Kepler (1596). The first globe of this description for the use of the blind, was made by A. Zeune in 1810. H. Erben is the author of a rough relief on a convex surface (1842), but the finest example of this description is a relief of Italy, by César Pomba and H. Fritsche, on a scale of 1 : 1,000,000 and without exaggeration of heights (1880–1884). A map of Italy in the baptistery of St Peter at Rome has occasionally been described as a relief, though it is merely a rude outline map of Italy, by Carlo Fontana (1698), carved into a convex surface.

Several globes of unusual dimensions were produced in the course of last century. That which Colonel Langlois erected in the Champs Elysées (1824) had a diameter of 39 metres. James Wyld's hollow globe, or "Georama," diam. 18 metres, occupied Leicester Square until swept away as a nuisance. The giant globe proposed by Elisée Reclus in 1895 has never been erected; he has, however, produced maps on a concave surface, as suggested by J. D. Hauber in 1742.

AUTHORITIES.—The history of maps is dealt with ably in Vivien de Saint Martin's *Histoire de la géographie* (Paris, 1875), and in Peschel's *Geschichte der Erdkunde* (2nd ed. by Sophus Ruge, Berlin, 1877), as also by W. Wollkenhauer (*Leitfaden zur Geschichte der Kartographie*, Breslau, 1895), and H. Zondervan (*Allgemeine Kartenkunde*, Leipzig, 1901). J. Lelewel's *Geographie du moyen âge*, with an atlas (Brussels, 1850–1857), has in part been superseded by more recent researches. There are, however, a number of works, beautifully illustrated, which deal fully with particular periods of the subject. Among these may be mentioned Konrad Miller's *Die ältesten Weltkarten* (Stuttgart, 1895–1897), which only deals with maps not influenced by the ideas of Ptolemy. The contents of the following collections are more varied in their nature, viz. E. F. Jomard's *Monuments de la géographie* (Paris, 1862), Santarem's *Atlas composé de mappemondes et de portulans*, &c. (Paris, 1842–1853, 78 plates). A. E. Nordenskiöld's *Facsimile Atlas* (Stockholm, 1889), Gabriel Marcell, *Choix de cartes et de mappemondes XIV*^{e} *et XV*^{e} *siècles* (Paris, 1896) C. H. Coote's *Remarkable Maps of the XVth, XVIth and XVIIth Centuries reproduced in their Original Size* (Amsterdam, 1894–1897), and *Bibliotheca lindesiana* (London, 1898) with facsimiles of the Harleian and other Dieppese maps of the 16th century. Nautical charts are dealt with in A. E. Nordenskiöld's *Periplus* (Stockholm, 1869), and Th. Fischer's *Sammlung mittelälterlicher Welt- und Seekarten* (Vienna, 1886). The discovery and mapping of America are illustrated by F. Kunstmann's *Entdeckung Amerikas* (Munich, 1859), K. Kretschmer's *Atlas zur Entdeckung Amerikas* (Berlin, 1892), G. Marcel's *Reproductions de cartes et de globes relatives à la découverte de l'Amerique du XVI*^{e} *au XVIII*^{e} *siècle* (Paris, 1893) and E. L. Stevenson's *Maps Illustrating the early Discovery and Exploration of America, 1502–1530* (New Brunswick, N.J., 1906). In addition to these collections, numerous single maps have been published in geographical periodicals or separately. See also V. Hantzsch and L. Schmidt, *Kartog. Denkmäler zur Entdeckungsgeschichte von Amerika, Asien, Australien und Afrika aus der k. Bibliothek zu Dresden* (Leipzig, 1903), and the Crown Collection of photographs of American maps (1600–1800), selected and edited by A. B. Hulbert (Cleveland, 1904–1909).

For reports on the progress of cartography, see *Geographisches Jahrbuch* (Gotha, since 1866); for announcements of new publications, *Bibliotheca geographica*, published annually by the Berlin Geographical Society, and to the *geographical Journal* (London).

Topographical Surveys.

United Kingdom.

The year 1784 marks the beginning of the ordnance survey, for in that year Major-General Roy measured a base line of 27,404 ft. on Hounslow Heath. Six additional base lines were measured up to 1849, including the Lough Foyle, in 1827–1828, and that on Salisbury Plain, in 1849. The primary triangulation was only completed in 1858, but in the meantime, in 1791, the detail survey had begun. At first it was merely intended to produce a map sufficiently accurate on a scale of 1 in. to a mile (1 : 63,360). Ireland having been surveyed (1824–1842) on a scale of 6 in. to a mile (1 : 10,560), it was determined in 1840, after the whole of England and Wales, with the exception of Lancashire and Yorkshire, had been completed on one-inch scales, to adopt that scale for the whole of the United Kingdom. Finally, in 1854, a cadastral survey of the whole of the United Kingdom, only excepting uncultivated districts, was resolved upon, on a scale of 1 : 2500, still larger scales (1 : 500 or 1 : 1000) being adopted for town plans. Parish boundaries are laid down with the help of local meresmen appointed by justices at quarter sessions. The horizontal contours are based upon instrumental measurement, and as a whole these ordnance maps were undoubtedly superior in accuracy, with rare exceptions, to similar maps published by foreign governments. Even though the hill hachures on the older one-inch maps are not quite satisfactory, this deficiency is in a large measure compensated for by the presence of absolutely trustworthy contours. Originally the maps were engraved on copper, and the progress of publication was slow; but since the introduction of modern processes, such as electrotyping (in 1840), photography (in 1855) and zincography (in 1859), it has been rapid. A plan, the engraving of which formerly took two years, can now be produced in two days.

The one-inch map for the whole of the United Kingdom was completed in 1890. It covers 697 sheets (or 488 of a "new series" in large sheets), and is published in three editions, viz. (*a*) in outline, with contours in black, (*b*) with hills hachured in brown or black, and (*c*) printed in five colours. Carefully revised editions of these and of the other maps are brought out at intervals of 15 years at most. Since 1898 the department has also published maps on a smaller scale, viz. a map of England and Wales, on a scale of 2 m. to 1 in., in two editions, both printed in colour, the one with hills stippled in brown, the other coloured on the "layer system" as a strata-relief map; a map of the United Kingdom on a scale of 4 m. to 1 in., also in two editions, the one in outline, showing five classes of roads and parish boundaries, the other in colours, with stippled hills; a map on a scale of 10 m. to 1 in., also in two editions, and finally a map of the United Kingdom on a scale of 1 : 1,000,000.

The geological surveys of Great Britain and Ireland were connected from 1832 to 1853 with the ordnance survey, but are now carried on independently. The ordnance survey, too, no longer depends on the war office but upon the board of agriculture and fisheries. A *Bathymetrical Survey of the Freshwater Lochs of Scotland*, under the direction of Sir John Murray and L. Pullar, was completed in 1908, and the results published by the Royal Geographical Society.

France. Proposals for a new map of France, to replace the famous Cassini map of 1744–1793 were made in 1802 and again by R. Bonne in 1808, but owing to the wars then devastating Europe no steps were taken until 1817, and the *Carte de France de l'état major* on a scale of 1 : 80,000 was only completed in 1880. It is engraved on copper. The hachured hills are based upon contours, and are of admirable commensurability. It has served as a basis for a *Carte de la France*, published by the Service Vicinal on a scale of 1 : 100,000, in 596 sheets, and of a general map prepared by the ministère des travaux publics on a scale of 1 : 200,000 in 80 sheets. On both these maps the hills are printed in grey chalk. A third topographical map of France is being published in accordance with the recommendation of a committee presided over by General de la Noix in 1897. The surveys for this map were begun in 1905. The maps are based upon the cadastral plans (1 : 1000), thoroughly revised and connected with the triangulation of France and furnished with contours at intervals of 5 m. by precise measurement. These *minutes* are published on a scale of 1 : 10,000 or 1 : 20,000 for mountain districts, while the scale of the general map is 1 : 50,000. Each sheet is bounded by parallels and meridians. The hills are shown in brown contours at intervals of 10 m. and grey shading in chalk (Berthaut, *La Carte de France, 1750–1898*; Paris, 1899). A geological map of France on a scale of 1: 80,000 is nearly completed, there are also a map (1: 500,000) by Carez and Vasseur, and an official *Carte géologique* (1: 1,000,000; 1906).

Germany. By the middle of the 19th century topographical maps of the various German states had been completed, and in several instances surveys of a more exact nature had been completed or begun, when in 1878 the governments of Prussia, Saxony, Bavaria and Württemberg agreed to supersede local maps by publishing a map of the empire (*Reichskarte*) in 674 sheets on a scale of 1:100,000. The earlier sheets of this excellent map were lithographed, but these are gradually being superseded by maps engraved on copper. Colour-printing is employed since 1901. The hills are hachured and in some instances contours at intervals of 50 metres are introduced. The map was completed in 1909, but is continually undergoing renewal. The *Messtischblätter*, called *Positionsblätter* in Bavaria, are on a scale of 1:25,000. The older among them leave much to be desired, but those of a later date are satisfactory. This applies more especially to the maps of Saxony (since 1879) and Württemberg (since 1893). The features of the ground on most of these maps are shown by contours at intervals of 10 metres. The map produced on this large scale numbers over 5000 sheets, and is used as a basis for the geological surveys carried on in several of the states of Germany. A general map of the German Empire (*Uebersichtskarte*) on a scale of 1 : 200,000, in 196 sheets, is in progress since 1893. It is printed in three colours, and gives contours at intervals of 10 metres. In addition to these maps there are D. G. Reymann's well-known *Specialkarte von Mittel Europa* (1 : 200,000), acquired by the Prussian government in 1874 (it will ultimately consist of 796 sheets), a government and Liebenow's map of central Europe (1:300,000) and C. Vogel's beautiful map of Germany (1 : 500,000).

Austria-Hungary. The *Specialkarte* of Austria-Hungary on a scale of 1:75,000 (765 sheets), based upon a triangulation and cadastral surveys (1816–1867), was completed in 1889, and published in heliogravure. This map was repeatedly revised, but as it no longer met modern requirements as to accuracy the director of the military geographical establishment at Vienna, Field Marshal Chr. von Steeb, in 1896, organized what practically amounts to a re-survey of the entire monarchy, to be completed in 75 years. At the same time the cadastral plans, reduced to a scale of 1:25,000, are being published in photo-lithography. A general map of central Europe in 283 sheets published by the Austrian government (1: 200,000) includes nearly the whole of the Balkan Peninsula.

Switzerland. The famous map of Switzerland, with which is associated the name of General H. Dufour (d. 1875), is based upon a triangulation (1809–1833) and surveys on a scale of 1:25,000 for the lowlands, 1:50,000 for the alpine districts, and was published (1842–1865) on a scale of 1:100,000. The hills are hachured, the light, in the case of the loftier regions, being supposed to fall obliquely. The original surveys, carefully revised, have been published since 1870 as a *Topographical Atlas of Switzerland*—the so-called *Siegfried Atlas*, in 552 sheets. They are printed in three colours, contours at intervals of 10 and 20 metres being in brown, incidental features (ravines, cliffs, glaciers) in black or blue. To mountain-climbers these contour maps are invaluable, but for ordinary purposes "strata maps," such as J. M. Ziegler's hypsometric maps (1856) or so-called "relief maps," which attempt to delineate the ground so as to give the impression of a relief, are generally preferred.

Belgium. The new survey of Belgium was completed in 1872 and there have been published 527 plane-table sections or *planchettes* on a scale of 1:20,000 (1866–1880), a "Carte topographique de la Belgique," in 72 sheets, on a scale of 1:40,000 (1861–1883), and a more recent map in 26 sheets on a scale of 1:100,000 (1903–1912). The last is printed in five colours, the ground is shown in contours of 10 metres interval and grey stippling.

Holland. The new survey of the Netherlands, based upon General Krayenhoff's primary triangulation (1802–1811) was completed in 1855. The results have been published on a scale of 1:25,000 (776 sheets, since 1866), 1:50,000 (Topographic and Military Map, 62 sheets, 1850–1864, and a Waterstaatskaart, 1864–1892), and 1:200,000 (Topographical Atlas, 21 sheets, 1868–1871).

Denmark. In Denmark, on the proposal of the Academy of Science, a survey was carried out in 1766–1825, but the maps issued by the Danish general staff depend upon more recent surveys. These include plane-table sections (*Maalebordsblade*), 1209 sheets on a scale of 1:20,000, with contours at intervals of 5 to 10 ft., published since 1830; *Atlasblade* of Jutland and of *De Danske Öer*, on a scale of 1:40,000, the former in 131 sheets, since 1870, the latter, on the same scale, in 94 sheets, since 1890, and still in progress, and a general staff map on a scale of 1:100,000, in 68 sheets, since 1890. Maps of the Faroer and of Iceland have likewise been issued.

Scandinavia.

Modern surveys in Sweden date from the organization of a corps of "Landemätare," known since 1874 as a topographical department of the general staff. The maps issued by this authority include one of southern Sweden, 1:100,000, another of northern Sweden, 1:200,000, and a general map on a scale of 1:1,000,000. In Norway a geographical survey (*Opmaaling*) has been in progress since 1783, but the topographical map of the kingdom on a scale of 1:100,000 in 340 sheets, has not yet been completed.

Russia.

Of Russia in Europe only the more densely peopled governments have been surveyed, since 1816, in the manner of other European countries, while for most regions there are only so-called "military surveys." The most readily available map of the whole country is the 10-verst map (1:420,000), known as General J. A. Strelbitzki's, and published 1865–1880. A topographic map (1:126,000) embracing the whole of western Russia, with Poland and the country of the Don Cossacks, is designed to be extended over the whole empire. Certain governments—Moscow, Kief, Volhynia, Bessarabia, the Crimea, &c.—have been published on a scale of 1:24,000, while Finland, as far as 61° N., was re-surveyed in 1870–1895, and a map on a scale of 1:42,000 is approaching completion.

Surveys in Asiatic Russia are conducted by the topographical departments organized at Orenburg, Tashkent, Omsk, Irkutsk and Tiflis. To the latter we are indebted for a valuable map of Caucasia, 1:210,000, which since the first publication (1863–1885) has undergone careful revision. The Siberian departments have published a number of maps on a scale of 1:420,000. In addition to these the survey for the Trans-Siberian railway has been published on a scale of 1:630,000, as also maps of the Russo-Chinese frontier districts, 1:210,000 and 1:1,168,000. A map of Asiatic Russia, 1:420,000, by Bolshef, in 192 sheets, is in course of publication.

Portugal and Spain.

Passing to southern Europe we find that Portugal has completed a *Charta chorographica* (1:100,000) since 1856. In Spain a plane-table survey on a scale of 1:20,000 has been in progress since 1870, but of the map of Spain in 1078 sheets on a scale of 1:50,000 only 150 had been issued by the depósito de la guerra up to 1910. Meanwhile reference may be made to B. F. Coello's *Atlas de la España* (1848–1890), the maps of which are on a scale of 1:200,000.

Italy.

In Italy *Tavolette rilevata* on a scale of 1:25,000 or 1:50,000, with contours, based on surveys made 1862–1890, are being published, and a *Carta del regno d'Italia*, 1:100,000, is practically complete. There are a *Carta idrologica* and a *Carta geologica* on the same scale, and a *Carta orografica* on a scale of 1:500,000.

Greece.

Greece is still dependent upon foreigners for its maps, among which the *Carte de Grèce* (1:200,000) from rapid surveys made by General Palet in 1828, was published in a new edition in 1880. A similar map, mainly based upon surveys made by Austrian officers and revised by H. Kiepert (1:300,000), was published by the Military Geographical Institute of Vienna in 1885. Far superior to these maps is the *Karte von Attika* (1:100,000 and 1:25,000) based upon careful surveys made by Prussian officers and published by E. Curtius and J. H. Kaupert on behalf of the German Archaeological Institute in Athens (1878), or A. Philippson's map of the Peloponnese (1:300,000; 1901).

Balkan States.

For maps of the Balkan Peninsula we are still largely indebted to the rapid surveys carried on by Austrian and Russian officers. The Austrian map of central Europe embraces the whole of the Balkan Peninsula on a scale of 1:200,000; the Russian surveys (1877–1879) are embodied in a map of the eastern part of the Balkan on a scale 1:126,000, and a map of Bulgaria and southern Rumelia, on a scale 1:200,000, both published in 1883. A map of Turkey in Europe, scale 1:210,000, was published by the Turkish general staff (1899), and another map, scale 1:250,000, by the intelligence division of the British war office is in progress since 1906. Bosnia and Herzegovina are now included with the surveys of the Austrian Empire, the kingdom of Servia has been surveyed (1880–1891) and the results published on a scale of 1:75,000; in eastern Rumania surveys have been in progress since 1874 and the results have been published on a scale of 1:50,000; a general map of the entire kingdom, scale 1:200,000, was published in 1906–1907; a map of Montenegro (1:75,000), based on surveys by Austrian and Russian officers, was published at Vienna in 1894.

Asia.

In Asiatic Turkey several districts of historical interest have been surveyed, and surveys have likewise been made in the interest of railways, or by boundary commissions, but there is no such thing as a general survey carried on under the direction of government. We are thus, to a large extent, still dependent upon compilations, such as R. Kiepert's *Asia Minor* (1:400,000; 1904–1908), a map of eastern Turkey in Asia, Syria and western Persia (1:2,000,000; 1910), published by the Royal Geographical Society, or a Russian general map (1:630,000, published 1880–1885). Among maps based upon actual surveys those of Palestine, by Lieutenant G. R. Conder and H. H. (afterwards Lord) Kitchener (1:63,360, 1880), of the Sinai Peninsula by Sir C. W. Wilson and H. S. Palmer (1:126,730, 1870), of Arabia Petraea by Dr A. Musil (1:300,000, 1907) or of the Aden territory (1905) are among the more interesting. Of Cyprus an excellent map from surveys by Major (Lord) H. H. Kitchener was published in 1884 (1:63,360).

In the case of Persia and Afghanistan we are still dependent upon compilations such as a Russian staff map (1:840,000, published in 1886), Colonel Sir T. H. Holdich's map of Persia (1:1,014,000, Simla, 1897–1899), or a smaller map (1:2,028,000 and 1:4,056,000), published by the geographical division of the general staff. The settlement of boundaries in northern Afghanistan (1883) and in Seistan (1870) has necessitated surveys of some interest.

A trigonometrical survey of British India was begun in 1800 and the country can now boast of a survey which in most respects is equal to those of most European states. The surveys are made on scales varying according to the necessities of the case or the nature of the country, and they have been extended since 1862 beyond the boundaries of India proper. Revenue surveys for land settlement are published on a scale of 1:4000, but the usual scale for topographical maps is 1:63,360. An *Indian Atlas*, on a scale of 1:255,660, includes also Ceylon and the Malay Peninsula, but although begun so long ago as 1827 many of its sheets are unpublished. There are in addition an official map of India (1:1,000,000), the first edition of which was published in 1903, as also maps of the great provinces of India, including Burma, all on a scale of 1:2,827,520, and a variety of physical and statistical maps. Ceylon and the Straits Settlements, with the Federal Malay States, have their own surveyors-general. The British North Borneo Company published a *Map of British North Borneo*, on a scale of 1:633,600 (1905).

In Siam a regular survey was organized by Mr J. McCarthy (1881–1883), a former official of the Indian survey, which did good work in connexion with the determination of the Franco-Siamese frontier (1906). The surveys are made on the scales of 1:4000, 1:31,680 and 1:63,360.

In French Indo-China surveys have been in progress since 1881. The Bureau of the Indo-Chinese general staff, has published a map of Indo-China, including Cambodia, in 45 sheets (1:200,000, 1895), while to the service géographique de l'Indo-Chine, organized in 1899, we owe a *Carte de l'Indo-Chine* (1:500,000).

For China we are still largely dependent upon careful compilations like Baron F. von Richthofen's *Atlas von China* (1:750,000, Berlin, 1885–1890) or Bretschneider's *Map of China* (1:4,600,000) a new edition of which appeared at St Petersburg in 1900. There are good survey maps of the British colony of Hong-Kong, of Wei-hai-Wei and of the country around Kiao-chou, and the establishment of topographical offices at Peking and Ngan-king holds out some promise of native surveys. In the meantime large scale maps prepared by European authorities are to be welcomed, such as maps of Chih-li and Shan-tung (1:200,000), from surveys by Prussian officers, 1901–1905, maps on East China (1:1,000,000) and of Yun-nan by British, German and Indian officers, of the Indo-Chinese frontier (1:200,000, Paris 1908), and of the upper Yangtsze-kiang by S. Chevalier (Shanghai, 1900).

Japan has a regular survey department originated by Europeans and successfully carried on by natives. The primary triangulation was completed in 1880, a topographical map coloured geologically (1:200,000) was published 1889–1897, and in addition to this there are being published an agronomical map on a scale of 1:100,000 (since 1887) and others. The Japanese government has likewise published a map of Korea (1:1,000,000; 1898).

The Philippine Islands are represented in a carefully compiled map by C. W. Hodgson (1:1,115,000, New York, 1908). Of Java we possess an excellent topographical map based upon surveys made 1850–1887 (1:100,000). A similar map has been in progress for Sumatra since 1883, while the maps for the remaining Dutch Indies are still based, almost exclusively, upon flying surveys. For general purposes the *Atlas der Nederlandsche Bezittingen in Oost-Indie* by J. N. Stemfoort and J. J. Ten Siethoff, of which a new edition has been published since 1900, may be consulted with confidence.

Africa.

In Africa nearly all the international boundaries have been carefully surveyed and marked on the ground, since 1880, and yield a good basis as a guide for the map compiler. A general map of Africa, by Colonel Lannoy de Bissy, on a scale of 1 : 2,000,000 was first published in 1882–1888, but is carefully revised from time to time. The geographical section of the British general staff is publishing maps of all Africa on scales of 1 : 250,000 and 1 : 1,000,000. In Egypt excellent work has been done by a survey department organized and directed by Captain H. G. Lyons up to 1909. It has published a topographical map of the Nile valley (1:50,000), an irrigation map (1:100,000), a general map (1:250,000), numerous cadastral plans, &c. Work on similar lines is carried on in the Anglo-Egyptian Sudan. Algeria has been in course of survey since 1868, Tunis since 1878, and the results have been published on scales of 1:50,000 and 1:250,000. Of Morocco there are many maps, among which several compiled by the French service géographique de l'armée, including a *Carte du Maroc* (1:200,000), in progress since 1909. In the British colonies of tropical and of South Africa[1] surveys for the most part are carried on actively. Of the Gambia Colony there is a map by Major E. L. Cowie (1:250,000, 1904–1905); the survey of the Gold Coast Colony is being published by Major F. G. Guggisberg since 1907 (1:125,000 and 1:200,000); southern and northern Nigeria are adequately represented on the maps of the general staff (1:250,000). The states of British South Africa have each their surveyor-general, and a reconnaissance survey has been in progress since 1903. It is based upon a careful triangulation, superintended by Sir D. Gill, and carried in 1907 within 70 m. of Lake Tanganyika. This survey is rapidly superseding other maps, such as the surveyor-general's map of Cape Colony (1:127,000); A. Duncan's map of the Orange River State (1:148,705; 1902–1904) and Jeppe's map of the Transvaal (1:476,000; 1899). The results of a survey of southern Rhodesia are given on the map of the British general staff (1:500,000; 1909), while of north-eastern Rhodesia we have an excellent map compiled by C. L. Beringer in 1907 (1:1,000,000). Surveys in British Central Africa were taken up in 1894; a survey of Lake Nyasa, by Lieut. E. L. Rhoades and W. B. Phillips, was published in 1902. As regards British East Africa and Uganda, the surveys in the latter (on scales of 1:10,000 and 1:125,000) have made considerable progress. The Victoria Nyanza was surveyed by Captain B. Whitehouse (1898–1900), and the results have been published on a scale of 1:292,000. These British possessions, together with the whole of Somaliland and southern Abyssinia, are satisfactorily represented on the maps of the British general staff.

Maps of the French Africa Colonies have been published by the service géographique de l'Afrique occidental and the service géographique des colonies. A map of Senegal (1:100,000) is in progress since 1905. The official maps of the other colonies have been compiled by A. Meunier between 1902 and 1909. They include French West Africa, (1:2,000,000; 2nd ed., 1908), French Guinea (1:500,000; 1902) and the Ivory Coast and Dahomey (1:1,500,000; 1907–1908). A map of the French Congo by J. Hansen (1:1,500,000), was published in 1907. In Madagascar a topographical bureau was established by General J. S. Gallieni in 1896, and the surveys are being published since 1900 on a scale of 1:100,000.

As regards the German colonies we are dependent upon compilations by R. Kiepert, P. Sprigade and M. Moisel. Good maps of the Portuguese colonies are to be found in an *Atlas colonial Portugues*, a second edition of which was published by the Commissão de Cartographia in 1909. Of the Congo State we have an official map on a scale of 1:1,000,000, published in 1907. Of Italian Eritrea we have excellent maps on various scales of 1:100,000, 1:200,000 and 1:500,000, based upon surveys made between 1888 and 1900.

Australia.

In the states of Australia cadastral surveys conducted by surveyors-general have been in progress for many years, as also trigonometrical surveys (Western Australia excepted), and the publication of parish and township or county maps keeps pace with the settlement of the country; but with the exception of Victoria none of these states is in possession of a topographical map equal in accuracy to similar maps published in Europe. In Victoria the so-called geodetic survey was begun in 1858; the maps are published on a scale of 1:126,730. There exists also a general map, on a scale of 1:506,930. Maps on the same scale are available of New South Wales, South Australia and Tasmania, on a scale of 1:560,000 for Western Australia, on a scale of 1:253,460 for Queensland. There are likewise maps on smaller scales, which undergo frequent revision. The map of British New Guinea is on a scale of 1:330,200 (1898). New Zealand has a good general map on a scale of 1:633,700. A trigonometrical survey was given up and only details of immediate practical use are required. The "Lands Department" of the Fiji Islands has published a map on a scale of 1:380,000 (1908).

North America.

The cadastral surveys in Canada are carried on by a commission of Crown-lands in the old provinces and by a Dominion land office, which lays out townships as in the United States, but with greater accuracy. A surveyor-general is attached to the department of the interior, at Ottawa. He publishes the topographical maps (1:63,366) since 1906. They are based upon theodolite traverses 15 m. apart, and connected with the United States lake and coast surveys, the details being filled in by plane-table surveys on a scale of 1:31,680. The contours, 25 ft. apart, depend upon spirit-levelling. In the Rocky Mountains surveys photographic apparatus is successfully employed. The surveyor-general issues also "sectional maps" (1:190,000 and 1:40,000) and so-called "Standard" topographical maps for the thinly peopled west, on scales of 1:250,000 and 1:500,000. He is responsible likewise for maps of Yukon and of Labrador, supplied by the geological survey, the former on a scale of 1:380,200, the latter of 1:1,584,000. The intelligence branch of the Canadian department of military defence is publishing since 1904 topographical maps on scales of 1:63,366 and 1:126,730, with contours. A geodetic survey department, under Dr. W. F. King, chief astronomer of the Dominion, was established in 1909.

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[1] See "The Survey in British Africa": the *Annual Report* of the Colonial Survey Commission.

Maps of Newfoundland, orographical as well as geological, scale 1: 1,584,200, have been published.

In the United States a "geological survey" was organized in 1879, under Clarence King as director, whose successor, Major J. W. Powell, rightly conceived that it was necessary to produce good topographical maps before a geological survey could be pursued with advantage. It is under his wise guidance that the survey has attained its present efficiency. It is based upon a triangulation by the U.S. Coast and Geodetic Survey. The maps of the more densely peopled parts of the Union are published on a scale of 1 : 62,500, and those of the remainder of the country on half or a quarter of that scale. The hills are shown by contours at intervals of 10 or 100 ft. The details given are considered sufficient to admit of the selection of general routes for railways or other public works. The survey progresses at the rate of about 40,000 sq. m. annually, and in course of time it will supersede the map of the separate states, based on older surveys. A "reconnaissance" map of Alaska (on a scale of 1 : 250,000) was published in 1908.

Central America.

In Mexico the surveys are in charge of a comision geografica-exploradora attached to the secretaria de Fomento, but only about 140 sheets of a *Carta general* on a scale of 1 : 100,000 have been published. There are also a map of the state of S. Luis Potosi (1 : 250,000), of the environs of Puebla (1 : 50,000) and a *Carta general de la republica mexicana* (1 : 250,000).

A useful map of Central America has been published by the topographical section of the British general staff on a scale of 1 : 170,300. Of great value for cartographical work is a careful survey, carried out by American engineers (1897–1898), for a continental railway running along the west coast from Mexico to Chile. In South America, in proportion to the area of the country, only few surveys of a thoroughly scientific nature have been made, and it is therefore satisfactory that the service géographique of the French army should be publishing, since 1900, a map of the entire continent on a scale of 1 : 1,000,000.

Colombia is but inadequately represented by rough maps. For Colombia we have F. L. Vergara y Velasco's *Atlas de geografia colombiana* (1906–1908); Ecuador is fairly well represented by Th. Wolf (1892) and Hans Meier (1907); in the case of Peru we still largely depend upon Paz Soldan's *Atlas geografica* (1865–1867) and A. Raimondi's *Mapa del Peru* (1 : 500,000) based upon surveys made before 1869. Sir Martin Conway's "Map of the Andes of La Paz" (1 : 600,000; 1900) as well as Major P. H. Fawcett's survey of the Brazilian boundary (1906–1907) are welcome additions to our knowledge of Bolivia. In Chile a comision topografico was appointed as long ago as 1848, but the map produced under its auspices by Professor F. Pissis (1 : 250,000, 1870–1877), leaves much to be desired. Since that time, however, valuable maps have been published by an *Oficina de mensura de tierras*, by a *seccion de geografia y minas* connected with the department of public works, by the *Oficina hidrografica*, and more especially in connexion with surveys necessitated by the boundary disputes with Argentina, which were settled by arbitration in 1899 and 1902. The surveys which led to the latter were conducted by Sir Thomas Holdich.

In Venezuela a commission for producing a *plano militar* or military map of the country was appointed by General Castro in 1904, but little progress seems to have been made, and meantime we are dependent upon a revised edition of A. Codazzi's map of 1840 which was published in 1884. In Brazil little or nothing is done by the central government, but the progressive states of São Paulo and Mines Geraes have commissãos geographicos e geologicos engaged in the production of topographical maps. Valuable materials have likewise been acquired by several river surveys including those of the Amazonas by Azevedo and Pinto (1862–1864) and W. Chandless (1862–1869) and of the Rio Madeira by Colonel G. Earl Church and Keller-Leuzinger (1869–1875). The proposal of a committee presided over by the Marshal H. de Beaurepaire-Rohan (1876) to prepare a map of Brazil on a scale of 1 : 200,000 has never been acted upon, and in the meantime we are dependent upon works like the *Atlas do imperio do Brazil* by Mendes de Almeida (1868) or the maps in our general atlases.

In Argentina an official geographical institute was established in 1879, but neither A. Seelstrang's *Atlas* (1886–1892) nor H. Hoskold's *Mapa topografica* (1 : 2,000,000; London, 1895), which were published by it, nor any of the numerous provincial maps are based upon scientific surveys.

It need hardly be said that hydrographic surveys have been of great service to compilers of maps. There are few coast-lines, frequented by shipping, which have not yet been surveyed in a definite manner. In this work the British hydrographic office may justly claim the credit of having contributed the chief share. Great Britain has likewise taken the lead in those deep-sea explorations which reveal to us the configuration of the sea-bottom, and enable us to construct charts of the ocean bed corresponding to the contoured maps of dry land yielded by topographical surveys.

(E. G. R.)

MAP PROJECTIONS

In the construction of maps, one has to consider how a portion of spherical surface, or a configuration traced on a sphere, can be represented on a plane. If the area to be represented bear a very small ratio to the whole surface of the sphere, the matter is easy: thus, for instance, there is no difficulty in making a map of a parish, for in such cases the curvature of the surface does not make itself evident. If the district is larger and reaches the size of a county, as Yorkshire for instance, then the curvature begins to be sensible, and one requires to consider how it is to be dealt with. The sphere cannot be opened out into a plane like the cone or cylinder; consequently in a plane representation of configurations on a sphere it is impossible to retain the desired proportions of lines or areas or equality of angles. But though one cannot fulfil all the requirements of the case, we may fulfil some by sacrificing others; we may, for instance, have in the representation exact similarity to all very small portions of the original, but at the expense of the areas, which will be quite misrepresented. Or we may retain equality of areas if we give up the idea of similarity. It is therefore usual, excepting in special cases, to steer a middle course, and, by making compromises, endeavour to obtain a representation which shall not involve large errors of scale.

A globe gives a perfect representation of the surface of the earth; but, practically, the necessary limits to its size make it impossible to represent in this manner the details of countries. A globe of the ordinary dimensions serves scarcely any other purpose than to convey a clear conception of the earth's surface as a whole, exhibiting the figure, extent, position and general features of the continents and islands, with the intervening oceans and seas; and for this purpose it is indeed absolutely essential and cannot be replaced by any kind of map.

The construction of a map virtually resolves itself into the drawing of two sets of lines, one set to represent meridians, the other to represent parallels. These being drawn, the filling in of the outlines of countries presents no difficulty. The first and most natural idea that occurs to one as to the manner of drawing the circles of latitude and longitude is to draw them according to the laws of perspective. Perhaps the next idea which would occur would be to derive the meridians and parallels in some other simple geometrical way.

Cylindrical Equal Area Projection.—Let us suppose a model of the earth to be enveloped by a cylinder in such a way that the cylinder touches the equator, and let the plane of each parallel such as PR be prolonged to intersect the cylinder in the circle *pr*. Now unroll the cylinder and the projection will appear as in fig. 2. The whole world is now represented as a rectangle, each parallel is a straight line, and its total length is the same as that of the equator, the distance of each parallel from the equator is sin *l* (where *l* is the latitude and the radius of the model earth is taken as unity). The meridians are parallel straight lines spaced at equal distances.

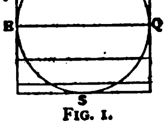

FIG. 1.

This projection possesses an important property. From the elementary geometry of sphere and cylinder it is clear that each strip of the projection is *equal in area* to the zone on the model which it represents, and that each portion of a strip is equal in area to the corresponding portion of a zone. Thus, each small four-sided figure (on the model) bounded by meridians and parallels is represented on the projection by a rectangle which is of exactly the same area, and this applies to any such figure however small. It therefore follows that any figure, of any shape on the model, is correctly represented as regards area by its corresponding figure on the projection. Projections having this property are said to be *equal-area projections* or *equivalent projections*; the name of the projection just described is "the cylindrical equal-area projection." This projection will serve to exemplify the remark made in the first paragraph that it is possible to select certain qualities of the model which shall be represented truthfully, but only at the expense of other qualities. For instance, it is clear that in this case all meridian lengths are too small and all lengths along the parallels, except the equator, are too large. Thus although the areas are preserved the shapes are, especially away from the equator, much distorted.

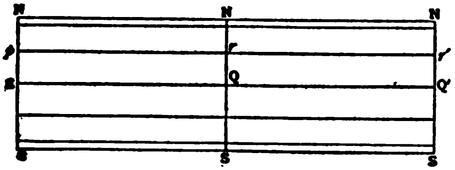

FIG. 2.

The property of preserving areas is, however, a valuable one when the purpose of the map is to exhibit areas. If, for example, it is desired to give an idea of the area and distribution of the various states comprising the British Empire, this is a fairly good projection. Mercator's, which is commonly used in atlases, preserves local shape at the expense of area, and is valueless for the purpose of showing areas.

Many other projections can be and have been devised, which depend for their construction on a purely geometrical relationship between the imaginary model and the plane. Thus projections may be drawn which are derived from cones which touch or cut the sphere, the parallels being formed by the intersection with the cones of planes parallel to the equator, or by lines drawn radially from the centre. It is convenient to describe all projections which are derived from the model by a simple and direct geometrical construction as "geometrical projections." All other projections may be known as "non-geometrical projections." Geometrical projections, which include perspective projections, are generally speaking of small practical value. They have loomed much more largely on the map-maker's horizon than their importance warrants. It is not going too far to say that the expression "map projection" conveys to most well-informed persons the notion of a geometrical projection; and yet by far the greater number of useful projections are non-geometrical. The notion referred to is no doubt due to the very term "projection," which unfortunately appears to indicate an arrangement of the terrestrial parallels and meridians which can be arrived at by direct geometrical construction. Especially has harm been caused by this idea when dealing with the group of conical projections. The most useful conical projections have nothing to do with the secant cones, but are simply projections in which the meridians are straight lines which converge to a point which is the centre of the circular parallels. The number of really useful geometrical projections may be said to be four: the *equal-area cylindrical* just described, and the following perspective projections—the *central*, the *stereographic* and *Clarke's external*.

Perspective Projections.

In perspective drawings of the sphere, the plane on which the representation is actually made may generally be any plane perpendicular to the line joining the centre of the sphere and the point of vision. If V be the point of vision, P any point on the spherical surface, then p, the point in which the straight line VP intersects the plane of the representation, is the projection of P.

Orthographic Projection.—In this projection the point of vision is at an infinite distance and the rays consequently parallel; in this case the plane of the drawing may be supposed to pass through the centre of the sphere. Let the circle (fig. 3) represent the plane of the equator on which we propose to make an orthographic representation of meridians and parallels. The centre of this circle is clearly the projection of the pole, and the parallels are projected into circles having the pole for a common centre. The diameters aa', bb' being at right angles, let the semicircle bab' be divided into the required number of equal parts; the diameters drawn through these points are the projections of meridians. The distances of c, of d and of e from the diameter aa' are the radii of the successive circles representing the parallels. It is clear that, when the points of division are very close, the parallels will be very much crowded towards the outside of the map; so much so, that this projection is not much used.

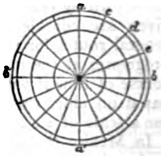

FIG. 3.

For an orthographic projection of the globe on a meridian plane let $qnrs$ (fig. 4) be the meridian, ns the axis of rotation, then qr is the projection of the equator. The parallels will be represented by straight lines passing through the points of equal division; these lines are, like the equator, perpendicular to ns. The meridians will in this case be ellipses described on ns as a common major axis, the distances of c, of d and of e from ns being the minor semiaxes.

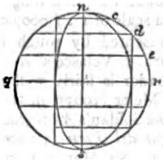

FIG. 4.

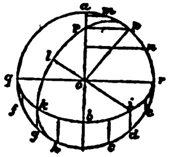

FIG. 5.

Let us next construct an orthographic projection of the sphere on the horizon of any place.

Set off the angle aop (fig. 5) from the radius oa, equal to the latitude. Drop the perpendicular pP on oa, then P is the projection of the pole. On ao produced take $ob = p$P, then ob is the minor semiaxis of the ellipse representing the equator, its major axis being qr at right angles to ao. The points in which the meridians meet this elliptic equator are determined by lines drawn parallel to aob through the points of equal subdivision $cdefgh$. Take two points, as d and g, which are 90° apart, and let ik be their projections on the equator; then i is the pole of the meridian which passes through k. This meridian is of course an ellipse, and is described with reference to i exactly as the equator was described with reference to P. Produce io to l, and make lo equal to half the shortest chord that can be drawn through i; then lo is the semi-axis of the elliptic meridian, and the major axis is the diameter perpendicular to iol.

For the parallels: let it be required to describe the parallel whose co-latitude is u; take $pm = pn = u$, and let $m'n'$ be the projections of m and n on oPa; then $m'n'$ is the minor axis of the ellipse representing the parallel. Its centre is of course midway between m' and n', and the greater axis is equal to mn. Thus the construction is obvious. When pm is less than pa the whole of

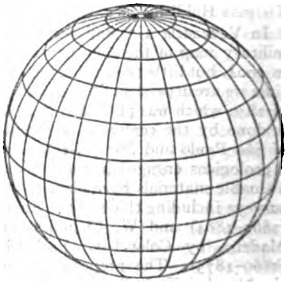
FIG. 6.—Orthographic Projection.

the ellipse is to be drawn. When pm is greater than pa the ellipse touches the circle in two points; these points divide the ellipse into two parts, one of which, being on the other side of the meridian plane aqr, is invisible. Fig. 6 shows the complete orthographic projection.

Stereographic Projection.—In this case the point of vision is on the surface, and the projection is made on the plane of the great circle whose pole is V. Let kplV (fig. 7) be a great circle through the point of vision, and ors the trace of the plane of projection. Let c be the centre of a small circle whose radius is $cp = cl$; the straight line pl represents this small circle in orthographic projection.

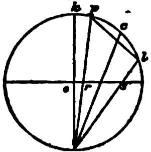

FIG. 7.

We have first to show that the stereographic projection of the small circle pl is itself a circle; that is to say, a straight line through V, moving along the circumference of pl, traces a circle on the plane of projection ors. This line generates an oblique cone standing on a circular base, its axis being cV (since the angle pVc = angle cVl); this cone is divided symmetrically by the plane of the great circle kpl, and also by the plane which passes through the axis Vc, perpendicular to the plane kpl. Now Vr·Vp, being = Vo sec kVp·Vk cos kVp = Vo·Vk, is equal to Vs·Vl; therefore the triangles Vrs, Vlp are similar, and it follows that the section of the cone by the plane rs is similar to the section by the plane pl. But the latter is a circle, hence also the projection is a circle; and since the representation of every infinitely small circle on the surface is itself a circle, it follows that in this projection the representation of small parts is strictly similar. Another inference is that the angle in which two lines on the sphere intersect is represented by the same angle in the projection. This may otherwise be proved by means of fig. 8, where Vok is the diameter of the sphere passing through the point of vision, fgh the plane of projection, kt a great circle, passing of course through V, and ouv the line of intersection of these two planes. A tangent plane to the surface at t cuts the plane of projection in the line rvs perpendicular to ov; tv is a tangent to the circle kt at t, tr and ts are any two tangents to the surface at t. Now the angle vtu (u being the projection of t) is $90° - ot\text{V} = 90° - o\text{V}t = ou\text{V} = tuv$, therefore tv is equal to uv; and since tvs and uvs are right angles, it follows that the angles vts and vus are equal. Hence the angle rts also is equal to its projection rus; that is, any angle formed by two intersecting lines on the surface is truly represented in the stereographic projection.

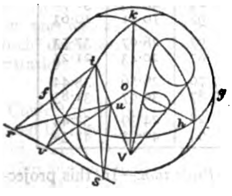

FIG. 8.

In this projection, therefore, angles are correctly represented and every small triangle is represented by a similar triangle. Projections having this property of similar representation of small parts are called *orthomorphic*, *conform* or *conformable*. The word orthomorphic, which was introduced by Germain[1] and adopted by Craig,[2] is perhaps the best to use.

Since in orthomorphic projections very small figures are correctly represented, it follows that the scale is the same in all directions round a point in its immediate neighbourhood, and orthomorphic projections may be defined as possessing this property. There are many other orthomorphic projections, of which the best known is Mercator's. These are described below.

We have seen that the stereographic projection of any circle of the sphere is itself a circle. But in the case in which the circle to be projected passes through V, the projection becomes, for a great circle, a line through the centre of the sphere; otherwise, a line anywhere. It follows that meridians and parallels are represented in a projection on the horizon of any place by two systems of orthogonally cutting circles, one system passing through two fixed points, namely, the poles; and the projected meridians as they pass through the poles show the proper differences of longitude.

To construct a stereographic projection of the sphere on the horizon of a given place. Draw the circle $vlkr$ (fig. 9) with the diameters kv, lr at right angles; the latter is to represent the central meridian. Take koP equal to the co-latitude of the given place, say u; draw the diameter PoP′, and vP, vP′ cutting lr in pp': these are the projections of the poles, through which all the circles representing meridians have to pass. All their centres then will be in a line smn which crosses pp' at right angles through its middle point m. Now to describe the meridian whose west longitude is ω, draw pn making the angle $opn = 90° - \omega$, then n is the centre of the required circle, whose direction as it passes through p will make an angle $opg = \omega$ with pp'. The lengths of the several lines are

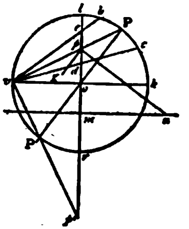

FIG. 9.

$$op = \tan\tfrac{1}{2}u;\ op' = \cot\tfrac{1}{2}u;\ om = \cot u;\ mn = \operatorname{cosec} u \cot \omega.$$

Again, for the parallels, take Pb = Pc equal to the co-latitude, say c, of the parallel to be projected; join vb, vc cutting lr in e, d. Then ed is the diameter of the circle which is the required projection; its centre is of course the middle point of ed, and the lengths of the lines are

$$od = \tan\tfrac{1}{2}(u - c);\quad oe = \tan\tfrac{1}{2}(u + c).$$

The line sn itself is the projection of a parallel, namely, that of which the co-latitude $c = 180° - u$, a parallel which passes through the point of vision.

Notwithstanding the facility of construction, the stereographic projection is not much used in map-making. It is sometimes used for maps of the hemispheres in atlases, and for star charts.

External Perspective Projection.—We now come to the general case in which the point of vision has any position outside the sphere. Let $abcd$ (fig. 10) be the great circle section of the sphere by a plane passing through c, the central point of the portion of surface to be represented, and V the point of vision. Let pj perpendicular to Vc be the plane of representation, join mV cutting pj in f, then f is the projection of any point m in the circle abc, and ef is the representation of cm.

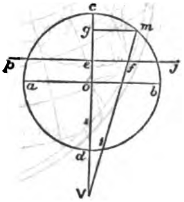

FIG. 10.

Let the angle $com = u$, V$e = k$, V$o = h$, $ef = \rho$; then, since $ef : e\text{V} = mg : g\text{V}$, we have $\rho = k \sin u/(h + \cos u)$, which gives the law connecting a spherical distance u with its rectilinear representation ρ. The relative scale at any point in this system of projection is given by

$$\sigma = d\rho/du,\ \sigma' = \rho/\sin u,$$
$$\sigma = k(1 + h\cos u)/(h + \cos u)^2;\ \sigma' = k/(h + \cos u),$$

the former applying to measurements made in a direction which passes through the centre of the map, the latter to the transverse direction. The product $\sigma\sigma'$ gives the exaggeration of areas. With respect to the alteration of angles we have $\Sigma = (h + \cos u)/(1 + h\cos u)$, and the greatest alteration of angle is

$$= \sin^{-1}\left(\frac{h-1}{h+1}\tan^2\frac{u}{2}\right).$$

This vanishes when $h = 1$, that is if the projection be stereographic; or for $u = 0$, that is at the centre of the map. At a distance of 90° from the centre, the greatest alteration is $90° - 2\cot^{-1}\sqrt{h}$. (See *Phil. Mag.* 1862.)

Clarke's Projection.—The constants h and k can be determined, so that the total misrepresentation, viz.:

$$\text{M} = \int_0^\beta \{(\sigma - 1)^2 + (\sigma' - 1)^2\} \sin u\,du,$$

shall be a minimum, β being the greatest value of u, or the spherical radius of the map. On substituting the expressions for σ and σ' the integration is effected without difficulty. Put

$$\lambda = (1 - \cos\beta)/(h + \cos\beta);\quad \nu = (h - 1)\lambda,$$
$$\text{H} = \nu - (h+1)\log_e(\lambda + 1),\ \text{H}' = \lambda(2 - \nu + \tfrac{1}{3}\nu^2)/(h+1).$$

Then the value of M is

$$\text{M} = 4\sin^2\tfrac{1}{2}\beta + 2k\text{H} + k^2\text{H}'.$$

When this is a minimum,

$$d\text{M}/dh = 0;\quad d\text{M}/dk = 0$$
$$\therefore k\text{H}' + \text{H} = 0;\quad 2d\text{H}/dh + kd h\text{H}'/dh = 0.$$

Therefore $\text{M} = 4\sin^2\tfrac{1}{2}\beta - \text{H}^2/\text{H}'$, and h must be determined so as to make $\text{H}^2 : \text{H}'$ a maximum In any particular case this maximum can only be ascertained by trial, that is to say, $\log \text{H}^2 - \log \text{H}'$ must be calculated for certain equidistant values of h, and then the particular value of k which corresponds to the required maximum can be obtained by interpolation. Thus we find that if it be required to make the best possible perspective representation of a hemisphere, the values of h and k are $h=1·47$ and $k=2·034$; so that in this case

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[1] A. Germain, *Traité des Projections* (Paris, 1865).

[2] T. Craig, *A Treatise on Projections* (U.S. Coast and Geodetic Survey, Washington, 1882).

$$\rho=\frac{2·034 \sin u}{1·47+\cos u}.$$

For a map of Africa or South America, the limiting radius β we may take as 40°; then in this case

$$\rho=\frac{2·543 \sin u}{1·625+\cos u}.$$

For Asia, $\beta=54$, and the distance h of the point of sight in this case is 1·61. Fig. 11 is a map of Asia having the meridians and parallels laid down on this system.

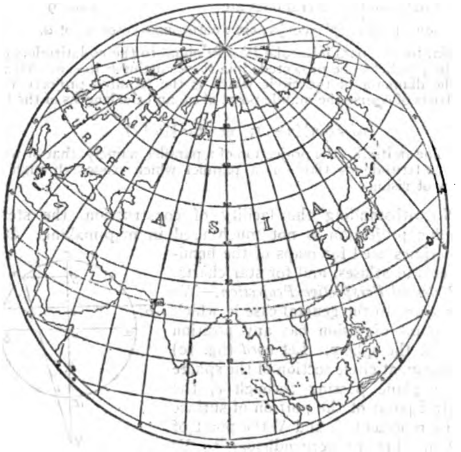

FIG. 11.

Fig. 12 is a perspective representation of more than a hemisphere, the radius β being 108°, and the distance h of the point of vision, 1·40.

The co-ordinates xy of any point in this perspective may be expressed in terms of latitude and longitude of the corresponding point on the sphere in the following manner. The co-ordinates originating at the centre take the central meridian for the axis of y and a line perpendicular to it for the axis of x. Let the latitude of the point G, which is to occupy the centre of the map, be γ; if ϕ, ω be the latitude and longitude of any point P (the longitude being reckoned from the meridian of G), u the distance PG, and μ the azimuth of P at G, then the spherical triangle whose sides are $90°-\gamma$, $90°-\phi$, and u gives these relations—

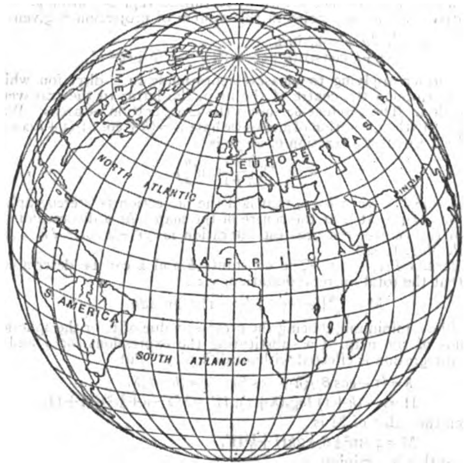

FIG. 12.—Twilight Projection. Clarke's Perspective Projection for a Spherical Radius of 108°.

$$\begin{aligned}\sin u \sin \mu &= \cos \phi \sin \omega,\\ \sin u \cos \mu &= \cos \gamma \sin \phi - \sin \gamma \cos \phi \cos \omega,\\ \cos u &= \sin \gamma \sin \phi + \cos \gamma \cos \phi \cos \omega.\end{aligned}$$

Now $x=\rho \sin \mu$, $y=\rho \cos \mu$, that is,

$$\frac{x}{k}=\frac{\cos \phi \sin \omega}{h+\sin \gamma \sin \phi+\cos \gamma \cos \phi \cos \omega},$$

$$\frac{y}{k}=\frac{\cos \gamma \sin \phi-\sin \gamma \cos \phi \cos \omega}{h+\sin \gamma \sin \phi+\cos \gamma \cos \phi \cos \omega},$$

by which x and y can be computed for any point of the sphere. If from these equations we eliminate ω, we get the equation to the parallel whose latitude is ϕ; it is an ellipse whose centre is in the central meridian, and its greater axis perpendicular to the same. The radius of curvature of this ellipse at its intersection with the centre meridian is $k \cos \phi/(h \sin \gamma+\sin \phi)$.

The elimination of ϕ between x and y gives the equation of the meridian whose longitude is ω, which also is an ellipse whose centre and axes may be determined.

The following table contains the computed co-ordinates for a map of Africa, which is included between latitudes 40° north and 40° south and 40° of longitude east and west of a central meridian.

ϕ	Values of x and y.				
	$\omega=0°$	$\omega=10°$	$\omega=20°$	$\omega=30°$	$\omega=40°$
0°	$x=$ 0·00 $y=$ 0·00	9·69 0·00	19·43 0·00	29·25 0·00	39·17 0·00
10°	$x=$ 0·00 $y=$ 9·69	9·60 9·75	19·24 9·92	28·95 10·21	38·76 10·63
20°	$x=$ 0·00 $y=$19·43	9·32 19·54	18·67 19·87	28·07 20·43	37·53 21·25
30°	$x=$ 0·00 $y=$29·25	8·84 29·40	17·70 29·87	26·56 30·67	35·44 31·83
40°	$x=$ 0·00 $y=$39·17	8·15 39·36	16·28 39·94	24·39 40·93	32·44 42·34

Central or Gnomonic (Perspective) Projection.—In this projection the eye is imagined to be at the centre of the sphere. It is evident that, since the planes of all great circles of the sphere pass through the centre, the representations of all great circles on this projection will be straight lines, and this is the special property of the *central projection*, that any great circle (*i.e.* shortest line on the spherical surface) is represented by a straight line. The plane of projection may be either parallel to the plane of the equator, in which case the parallels are represented by concentric circles and the meridians by straight lines radiating from the common centre; or the plane of projection may be parallel to the plane of some meridian, in which case the meridians are parallel straight lines and the parallels are hyperbolas; or the plane of projection may be inclined to the axis of the sphere at any angle λ.

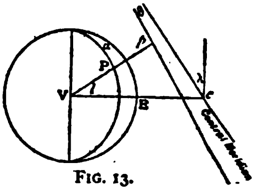

FIG. 13.

In the latter case, which is the most general, if θ is the angle any meridian makes (on paper) with the central meridian, a the longitude of any point P with reference to the central meridian, l the latitude of P, then it is clear that the central meridian is a straight line at right angles to the equator, which is also a straight line, also $\tan \theta=\sin \lambda \tan a$, and the distance of p, the projection of P, from the equator along its meridian is (on paper) $m \sec a \sin l / \sin (l+x)$, where $\tan x=\cot \lambda \cos a$, and m is a constant which defines the scale.

The three varieties of the central projection are, as is the case with other perspective projections, known as polar, meridian or horizontal, according to the inclination of the plane of projection.

Fig. 14 is an example of a *meridian central projection* of part of the Atlantic Ocean. The term "gnomonic" was applied to this projection because the projection of the meridians is a similar problem to that of the graduation of a sun-dial. It is, however, better to use the term "central," which explains itself. The central projection is useful for the study of direct routes by sea and land. The United States Hydrographic Department has published some charts on this projection. False notions of the direction of shortest lines, which are engendered by a study of maps on Mercator's projection, may be corrected by an inspection of maps drawn on the central projection.

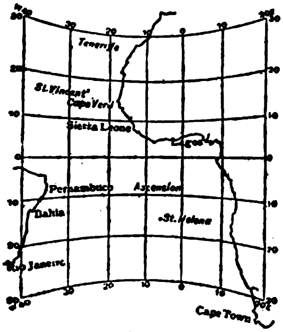

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FIG. 14.—Part of the Atlantic Ocean on a Meridian Central Projection. The shortest path between any two points is shown on this projection by a straight line.

There is no projection which accurately possesses the property of showing shortest paths by straight lines when applied to the spheroid; one which very nearly does so is that which results from the intersection of terrestrial normals with a plane.

We have briefly reviewed the most important projections which are derived from the sphere by direct geometrical construction, and we pass to that more important branch of the subject which deals with projections which are not subject to this limitation.

Conical Projections.

Conical projections are those in which the parallels are represented by concentric circles and the meridians by equally spaced radii. There is no necessary connexion between a conical projection and any touching or secant cone. Projections for instance which are derived by geometrical construction from secant cones are very poor projections, exhibiting large errors, and they will not be discussed. The name conical is given to the group embraced by the above definition, because, as is obvious, a projection so drawn can be bent round to form a cone. The simplest and, at the same time, one of the most useful forms of conical projection is the following:

Conical Projection with Rectified Meridians and Two Standard Parallels.—In some books this has been, most unfortunately, termed the "secant conical," on account of the fact that there are two parallels of the correct length. The use of this term in the past has caused much confusion. Two selected parallels are represented by concentric circular arcs of their true lengths; the meridians are their radii. The degrees along the meridians are represented by their true lengths; and the other parallels are circular arcs through points so determined and are concentric with the chosen parallels.

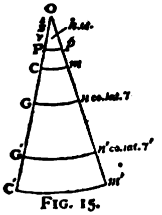

FIG. 15.

Thus in fig 15 two parallels Gn and G$'n'$ are represented by their true lengths on the sphere; all the distances along the meridian PGG$'$, pnn' are the true spherical lengths rectified.

Let γ be the co-latitude of Gn; γ' that of Gn'; ω be the true difference of longitude of PGG$'$ and pnn'; $h\omega$ be the angle at O; and OP $=z$, where Pp is the representation of the pole. Then the true length of parallel Gn on the sphere is $\omega \sin \gamma$, and this is equal to the length on the projection, *i.e.* $\omega \sin \gamma = h\omega(z+\gamma)$; similarly $\omega \sin \gamma' = h\omega(s+\gamma')$.

The radius of the sphere is assumed to be unity, and z and γ are expressed in circular measure. Hence $h = \sin \gamma/(s+\gamma) = \sin \gamma'(s+\gamma')$; from this h and s are easily found.

In the above description it has been assumed that the two errorless parallels have been *selected*. But it is usually desirable to impose some condition which itself will fix the errorless parallels. There are many conditions, any one of which may be imposed. In fig. 15 let Cm and C$'m'$ represent the extreme parallels of the map, and let the co-latitudes of these parallels be c and c', then any one of the following conditions may be fulfilled:—

(*a*) The errors of scale of the extreme parallels may be made equal and may be equated to the error of scale of the parallel of maximum error (which is near the mean parallel).

(*b*) Or the errors of scale of the extreme parallels may be equated to that of the mean parallel. This is not so good a projection as (*a*).

(*c*) Or the absolute errors of the extreme and mean parallels may be equated.

(*d*) Or in the last the parallel of maximum error may be considered instead of the mean parallel.

(*e*) Or the mean length of all the parallels may be made correct. This is equivalent to making the total area between the extreme parallels correct, and must be combined with another condition, for example, that the errors of scale on the extreme parallels shall be equal.

We will now discuss (*a*) above, viz. a conical projection with rectified meridians and two standard parallels, the scale errors of the extreme parallels and parallel of maximum error being equated.

Since the scale errors of the extreme parallels are to be equal,

$$\frac{h(z+c)}{\sin c} - 1 = \frac{h(z+c')}{\sin c'} - 1, \text{ whence } z = \frac{c' \sin c - c \sin c'}{\sin c' - \sin c} \qquad \text{(i.)}$$

The error of scale along any parallel (near the centre), of which the co-latitude is b is

$$1 - \{h(s+b)/\sin b\}. \qquad \text{(ii.)}$$

This is a maximum when

$$\tan b - b = s, \text{ whence } b \text{ is found.}$$

$$\text{Also} \qquad 1 - \frac{h(s+b)}{\sin b} = \frac{h(s+c)}{\sin c} - 1, \text{ whence } h \text{ is found.} \qquad \text{(iii.)}$$

For the errorless parallels of co-latitudes γ and γ' we have

$$h = (s+\gamma)/\sin \gamma = (s+\gamma')/\sin \gamma'.$$

If this is applied to the case of a map of South Africa between the limits 15° S. and 35° S. (see fig. 16) it will be found that the parallel of maximum error is 25° 20′; the errorless parallels, to the nearest degree, are those of 18° and 32°. The greatest scale error in this case is about 0·7 %.

In the above account the earth has been treated as a sphere. Of course its real shape is approximately a spheroid of revolution, and the values of the axes most commonly employed are those of Clarke or of Bessel. For the spheroid, formulae arrived at by the same principles but more cumbrous in shape must be used. But it will usually be sufficient for the selection of the errorless parallels to use the simple spherical formulae given above; then, having made the selection of these parallels, the true spheroidal lengths along the meridians between them can be taken out of the ordinary tables (such as those published by the Ordnance Survey or by the U.S. Coast and Geodetic Survey). Thus, if a_1, a_2, are the lengths of 1° of the errorless parallels (taken from the tables), d the true rectified length of the meridian arc between them (taken from the tables),

$$h = \{(a_2 - a_1)/d\}180/\pi,$$

and the radius on paper of parallel, a_1 is $a_1d/(a_2 - a_1)$, and the radius of any other parallel = radius of $a_1 \pm$ the true meridian distance between the parallels.

This class of projection was used for the 1/1,000,000 Ordnance map of the British Isles. The three maximum scale errors in this case work out to 0·23 %, the range of the projection being from 50° N. to 61° N., and the errorless parallels are 59° 31′ and 51° 44′.

Where no great refinement is required it will be sufficient to take the errorless parallels as those distant from the extreme parallels about one-sixth of the total range in latitude. Thus suppose it is required to plot a projection for India between latitudes 8° and 40° N. By this rough rule the errorless parallels should be distant from the extreme parallels about 32°/6, *i.e.* 5° 20′; they should therefore, to the nearest degree, be 13° and 35° N. The maximum scale errors will be about 2 %.

The scale errors vary approximately as the square of the range of latitude; a rough rule is, largest scale error = $L^2/50{,}000$, where L is the range in the latitude in degrees. Thus a country with a range of 7° in latitude (nearly 500 m.) can be plotted on this projection with a maximum linear scale error (along a parallel) of about 0·1 %;[1] there is no error along any meridian. It is immaterial with this projection (or with any conical projection) what the extent in longitude is. It is clear that this class of projection is accurate, simple and useful.

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[1] This error is much less than that which may be expected from contraction and expansion of the paper upon which the projection is drawn or printed.

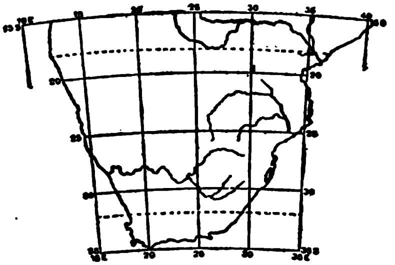

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FIG. 16.—South Africa on a conical projection with rectified meridians and two standard parallels. Scale 800 m. to 1 in.

In the projections designated by (*c*) and (*d*) above, absolute errors of length are considered in the place of errors of scale, *i.e.* between any two meridians (*c*) the absolute errors of length of the extreme parallels are equated to the absolute error of length of the middle parallel. Using the same notation

$$h\,(z+c)-\sin c=h\,(z+c')-\sin c'=-h\,(z+\tfrac{1}{2}c+\tfrac{1}{2}c')-\sin\tfrac{1}{2}\,(c+c').$$

L. Euler, in the *Acta Acad. Imp. Petrop.* (1778), first discussed this projection.

If a map of Asia between parallels 10° N. and 70° N. is constructed on this system, we have $c=20°$, $c'=80°$, whence from the above equations $z=66{\cdot}7°$ and $h=6138$. The absolute errors of length along parallels 10°, 40° and 70° between any two meridians are equal but the scale errors are respectively 5, 6·7, and 15%.

The modification (*d*) of this projection was selected for the 1:1,000,000 map of *India and Adjacent Countries* under publication by the Survey of India. An account of this is given in a pamphlet produced by that department in 1903. The limiting parallels are 8° and 40° N., and the parallel of greatest error is 23° 40′ 51″. The errors of scale are 1·8, 2·3, and 1·9%.

It is not as a rule desirable to select this form of the projection. If the surface of the map is everywhere equally valuable it is clear that an arrangement by which errors of scale are larger towards the pole than towards the equator is unsound, and it is to be noted that in the case quoted the great bulk of the land is in the north of the map. Projection (*a*) would for the same region have three equal maximum scale errors of 2%. It may be admitted that the practical difference between the two forms is in this case insignificant, but linear scale errors should be reduced as much as possible in maps intended for general use.

f. In the fifth form of the projection, the total area of the projection between the extreme parallels and any two meridians is equated to the area of the portion of the sphere which it represents, and the errors of scale of the extreme parallels are equated. Then it is easy to show that

$$z=(c'\sin c-c\sin c')/(\sin c'-\sin c);$$
$$h=(\cos c-\cos c')/(c'-c)\{z+\tfrac{1}{2}\,(c+c')\}.$$

It can also be shown that any other zone of the same range in latitude will have the same scale errors along its limiting parallels. For instance, a series of projections may be constructed for zones, each having a range of 10° of latitude, from the equator to the pole. Treating the earth as a sphere and using the above formulae, the series will possess the following properties: the meridians will all be true to scale, the area of each zone will be correct, the scale errors of the limiting parallels will all be the same, so that the length of the upper parallel of any zone will be equal to that of the lower parallel of the zone above it. But the curvatures of these parallels will be different, and two adjacent zones will not fit but will be capable of exact rolling contact. Thus a very instructive flat model of the globe may be constructed which will show by suitably arranging the points of contact of the zones the paths of great circles on the sphere. The flat model was devised by Professor J. D. Everett, F.R.S., who also pointed out that the projection had the property of the equality of scale errors of the limiting parallels for zones of the same width. The projection may be termed *Everett's Projection*.

Simple Conical Projection.—If in the last group of projections the two selected parallels which are to be errorless approach each other indefinitely closely, we get a projection in which all the meridians are, as before, of the true rectified lengths, in which one parallel is errorless, the curvature of that parallel being clearly that which would result from the unrolling of a cone touching the sphere along the parallel represented. And it was in fact originally by a consideration of the tangent cone that the whole group of conical projections came into being. The quasi-geometrical way of regarding conical projections is legitimate in this instance.

The simple conical projection is therefore arrived at in this way: imagine a cone to touch the sphere along any selected parallel, the radius of this parallel on paper (P*p*, fig. 17) will be $r\cot\phi$, where r is the radius of the sphere and ϕ is the latitude; or if the spheroidal shape is taken into account, the radius of the parallel on paper will be $\nu\cot\phi$ where ν is the normal terminated by the minor axis (the value ν can be found from ordinary geodetic tables). The meridians are generators of the cone and every parallel such as HH′ is a circle, concentric with the selected parallel P*p* and distant from it the true rectified length of the meridian arc between them.

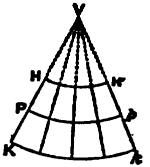


FIG. 17

This projection has no merits as compared with the group just described. The errors of scale along the parallels increase rapidly as the selected parallel is departed from, the parallels on paper being always too large. As an example we may take the case of a map of South Africa of the same range as that of the example given in (*a*) above, viz. from 15° S. to 35° S. Let the selected parallel be 25° S.; the radius of this parallel on paper (taking the radius of the sphere as unity) is cot 25°; the radius of parallel 35° S. = radius of 25° − meridian distance between 25° and 35° = $\cot 25°-10\pi/180=1{\cdot}970$. Also $h=\sin$ of selected latitude $=\sin 25°$, and length on paper along parallel 35° of $\omega°=\omega h\times 1{\cdot}970=\omega\times 1{\cdot}970\times\sin 25°$,

but length on sphere of $\omega=\omega\cos 35°$,

$$\text{hence scale error}=\frac{1{\cdot}970\sin 25°}{\cos 35°}-1=1{\cdot}6\%,$$

an error which is more than twice as great as that obtained by method (*a*).

Bonne's Projection.—This projection, which is also called the "modified conical projection," is derived from the simple conical, just described, in the following way: a central meridian is chosen and drawn as a straight line; degrees of latitude spaced at the true rectified distances are marked along this line; the parallels are concentric circular arcs drawn through the proper points on the central meridian, the centre of the arcs being fixed by describing one chosen parallel with a radius of $\nu\cot\phi$ as before; the meridians on each side of the central meridian are drawn as follows: along *each* parallel distances are marked equal to the true lengths along the parallels on sphere or spheroid, and the curve through corresponding points so fixed are the meridians (fig. 18).

This system is that which was adopted in 1803 by the "Dépôt de la Guerre" for the map of France, and is there known by the title of *Projection de Bonne*. It is that on which the ordnance survey map of Scotland on the scale of 1 in. to a mile is constructed, and it is frequently met with in ordinary atlases. It is ill-adapted for countries having great extent in longitude, as the intersections of the meridians and parallels become very oblique—as will be seen on examining the map of Asia in most atlases.

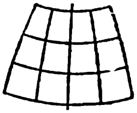


FIG. 18.

If ϕ_0 be taken as the latitude of the centre parallel, and co-ordinates be measured from the intersection of this parallel with the central meridian, then, if ρ be the radius of the parallel of latitude ϕ, we have $\rho=\cot\phi_0+\phi_0-\phi$. Also, if S be a point on this parallel whose co-ordinates are x, y, so that $\mathrm{VS}=\rho$, and θ be the angle VS makes with the central meridian, then $\rho\theta=\omega\cos\phi$; and $x=\rho\sin\theta$, $y=\cot\phi_0-\rho\cos\theta$.

The projection has the property of equal areas, since each small element bounded by two infinitely close parallels is equal in length and width to the corresponding element on the sphere or spheroid. Also all the meridians cross the chosen parallel (but no other) at right angles, since in the immediate neighbourhood of that parallel the projection is identical with the simple conical projection. Where an equal-area projection is required for a country having no great extent in longitude, such as France, Scotland or Madagascar, this projection is a good one to select.

Sinusoidal Equal-area Projection.— This projection, which is sometimes known as Sanson's, and is also sometimes incorrectly called Flamsteed's, is a particular case of Bonne's in which the selected parallel is the equator. The equator is a straight line at right angles to the central meridian which is also a straight line. Along the central meridian the latitudes are marked off at the true rectified distances, and from points so found the parallels are drawn as straight lines parallel to the equator, and therefore at right angles to the central meridian. True rectified lengths are marked along the parallels and through corresponding points the meridians are drawn. If the earth is treated as a sphere the meridians are clearly sine curves, and for this reason d'Avezac has given the projection the name sinusoidal. But it is equally easy to plot the spheroidal lengths. It is a very suitable projection for an equal-area map of Africa.

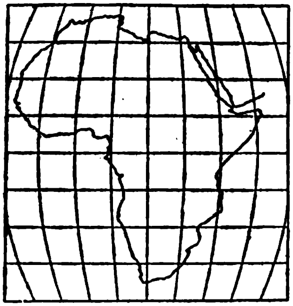


FIG. 19.—Sinusoidal Equal-area Projection.

Werner's Projection.—This is another limiting case of Bonne's equal-area projection in which the selected parallel is the pole. The parallels on paper then become incomplete circular arcs of which the pole is the centre. The central meridian is still a straight line which is cut by the parallels at true distances. The projection (after Johann Werner, 1468–1528), though interesting, is practically useless.

Polyconic Projections.

These pseudo-conical projections are valuable not so much for their intrinsic merits as for the fact that they lend themselves to tabulation. There are two forms, the *simple* or *equidistant polyconic*, and the *rectangular polyconic*.

The Simple Polyconic.—If a cone touches the sphere or spheroid along a parallel of latitude ϕ and is then unrolled, the parallel will on paper have a radius of $\nu \cot \phi$, where ν is the normal terminated by the minor axis. If we imagine a series of cones, each of which touches one of a selected series of parallels, the apex of each cone will lie on the prolonged axis of the spheroid; the generators of each cone lie in meridian planes, and if each cone is unrolled and the generators in any one plane are superposed to form a straight central meridian, we obtain a projection in which the central meridian is a straight line and the parallels are circular arcs each of which has a different centre which lies on the prolongation of the central meridian, the radius of any parallel being $\nu \cot \phi$.

So far the construction is the same for both forms of polyconic. In the *simple polyconic* the meridians are obtained by measuring outwards from the central meridian along each parallel the true lengths of the degrees of longitude. Through corresponding points so found the meridian curves are drawn. The resulting projection is accurate near the central meridian, but as this is departed from the parallels increasingly separate from each other, and the parallels and meridians (except along the equator) intersect at angles which increasingly differ from a right angle. The real merit of the projection is that each particular parallel has for every map the same absolute radius, and it is thus easy to construct tables which shall be of universal use. This is especially valuable for the projection of single sheets on comparatively large scales. A sheet of a degree square on a scale of 1:250,000 projected in this manner differs inappreciably from the same sheet projected on a better system, *e.g.* an orthomorphic conical projection or the conical with rectified meridians and two standard parallels; there is thus the advantage that the simple polyconic when used for single sheets and large scales is a sufficiently close approximation to the better forms of conical projection. The simple polyconic is used by the topographical section of the general staff, by the United States coast and geodetic survey and by the topographical division of the U.S. geological survey. Useful tables, based on Clarke's spheroid of 1866, have been published by the war office and by the U.S. coast and geodetic survey.

Rectangular Polyconic.—In this the central meridian and the parallels are drawn as in the simple polyconic, but the meridians are curves which cut the parallels at right angles.

In this case, let P (fig. 20) be the north pole, CPU the central meridian, U, U′ points in that meridian whose co-latitudes are z and $z+dz$, so that UU′$=dz$. Make PU$=z$, UC$=\tan z$, U′C′$=\tan(z+dz)$; and with CC′ as centres describe the arcs UQ, U′Q′, which represent the parallels of co-latitude z and $z+dz$. Let PQQ′ be part of a meridian curve cutting the parallels at right angles. Join CQ, C′Q′; these being perpendicular to the circles will be tangents to the curve. Let UCQ$=2\alpha$, UC′Q′$=2(\alpha+d\alpha)$, then the small angle CQC′, or the angle between the tangents at QQ′, will$=2d\alpha$. Now

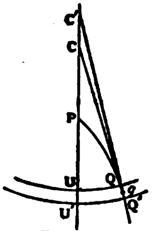


FIG. 20.

$$CC' = C'U' - CU - UU' = \tan(z+dz) - \tan z - dz = \tan^2 z\, dz.$$

The tangents CQ, C′Q′ will intersect at q, and in the triangle CC′q the perpendicular from C on C′q is (omitting small quantities of the second order) equal to either side of the equation

$$\tan^2 z\, dz \sin 2\alpha = -2 \tan z\, d\alpha.$$
$$-\tan z\, dz = 2d\alpha/\sin 2\alpha,$$

which is the differential equation of the meridian: the integral is $\tan \alpha = \omega \cos z$, where ω, a constant, determines a particular meridian curve. The distance of Q from the central meridian, $\tan z \sin 2\alpha$, is equal to

$$\frac{2 \tan z \tan \alpha}{1+\tan^2\alpha} = \frac{2\omega \sin z}{1+\omega^2 \cos^2\alpha}$$

At the equator this becomes simply 2ω. Let any equatorial point whose actual longitude is 2ω be represented by a point on the developed equator at the distance 2ω from the central meridian, then we have the following very simple construction (due to O'Farrell of the ordnance survey). Let P (fig. 21) be the pole, U any point in the central meridian, QUQ′ the represented parallel whose radius CU$=\tan z$. Draw SUS′ perpendicular to the meridian through U; then to determine the point Q, whose longitude is, say, 3°, lay off US equal to half the true length of the arc of parallel on the sphere, *i.e.* 1° 30′ to radius $\sin z$, and with the centre S and radius SU describe a circular arc, which will intersect the parallel in the required point Q. For if we suppose 2ω to be the longitude of the required point Q, US is by construction$=\omega \sin z$, and the angle subtended by SU at C is

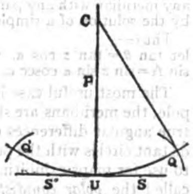


FIG. 21.

$$\tan^{-1}\left(\frac{\omega \sin z}{\tan z}\right) = \tan^{-1}(\omega \cos z) = \alpha,$$

and therefore UCQ$=2\alpha$ as it should be. The advantages of this method are that with a remarkably simple and convenient mode of construction we have a map in which the parallels and meridians intersect at right angles.

Fig. 22 is a representation of this system of the continents of Europe and Africa, for which it is well suited. For Asia this system would not do, as in the northern latitudes, say along the parallel of 70°, the representation is much cramped.

With regard to the distortion in the map of Africa as thus constructed, consider a small square in latitude 40° and in 40° longitude east or west of the central meridian, the square being so placed as to be transformed into a rectangle. The sides, originally unity, became 0·95 and 1·13, and the area 1·08, the diagonals intersecting at 90°±9° 56′. In Clarke's perspective projection a

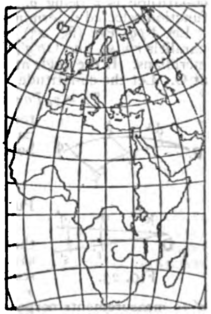


FIG. 22.

square of unit side occupying the same position, when transformed to a rectangle, has its sides 1·02 and 1·15, its area 1·17, and its diagonals intersect at 90° ± 7° 6′. The latter projection is therefore the best in point of "similarity," but the former represents areas best. This applies, however, only to a particular part of the map; along the equator towards 30° or 40° longitude, the polyconic is certainly inferior, while along the meridian it is better than the perspective—except, of course, near the centre. Upon the whole the more even distribution of distortion gives the advantage to the perspective system. For single sheets on large scales there is nothing to choose between this projection and the simple polyconic. Both are sensibly perfect representations. The rectangular polyconic is occasionally used by the topographical section of the general staff.

Zenithal Projections.

Some point on the earth is selected as the central point of the map; great circles radiating from this point are represented by straight lines which are inclined at their true angles at the point of intersection. Distances along the radiating lines vary according to any law outwards from the centre. It follows (on the spherical assumption), that circles of which the selected point is the centre are also circles on the projection. It is obvious that all perspective projections are zenithal.

Equidistant Zenithal Projection.—In this projection, which is commonly called the "equidistant projection," any point on the sphere being taken as the centre of the map, great circles through this point are represented by straight lines of the true rectified lengths, and intersect each other at the true angles.

In the general case—
if z_1 is the co-latitude of the centre of the map, z the co-latitude of any other point, a the difference of longitude of the two points, A the azimuth of the line joining them, and c the spherical length of the line joining them, then the position of the intersection of any meridian with any parallel is given (on the spherical assumption) by the solution of a simple spherical triangle.

Thus—
let $\tan\theta = \tan z \cos a$, then $\cos c = \cos z \sec\theta \cos(z-\theta)$, and $\sin A = \sin z \sin a \operatorname{cosec} c$.

The most useful case is that in which the central point is the pole; the meridians are straight lines inclined to each other at the true angular differences of longitude, and the parallels are equidistant circles with the pole as centre. This is the best projection to use for maps exhibiting the progress of polar discovery, and is called the *polar equidistant projection*. The errors are smaller than might be supposed. There are no scale errors along the meridians, and along the parallels the scale error is $(z/\sin x)-1$, where z is the co-latitude of the parallel. On a parallel 10° distant from the pole the error of scale is only 0·5%.

General Theory of Zenithal Projections.—For the sake of simplicity it will be at first assumed that the pole is the centre of the map, and that the earth is a sphere. According to what has been said above, the meridians are now straight lines diverging from the pole, dividing the 360° into equal angles; and the parallels are represented by circles having the pole as centre, the radius of the parallel whose co-latitude is z being ρ, a certain function of z. The particular function selected determines the nature of the projection.

Let Ppq, Prs (fig. 23) be two contiguous meridians crossed by parallels rp, sq, and $Op'q'$, $Or's'$ the straight lines representing these meridians. If the angle at P is $d\mu$, this also is the value of the angle at O. Let the co-latitude

$$Pp = z,\ Pq = z + dz;\ Op' = \rho,\ Oq' = \rho + d\rho,$$

the circular arcs $p'r'$, $q's'$ representing the parallels pr, qs. If the radius of the sphere be unity,

$$p'q' = d\rho;\ p'r' = \rho d\mu,$$
$$pq = dz;\ pr = \sin z d\mu.$$

Put

$$\sigma = d\rho/dz;\ \sigma' = \rho/\sin z,$$

then $p'q' = \sigma pq$ and $p'r' = \sigma' pr$. That is to say, σ, σ' may be regarded as the relative scales, at co-latitude z, of the representation, σ applying to meridional measurements, σ' to measurements perpendicular to the meridian. A small square situated in co-latitude z, having one side in the direction of the meridian—the length of its side being i—is represented by a rectangle whose sides are $i\sigma$ and $i\sigma'$; its area consequently is $i^2\sigma\sigma'$.

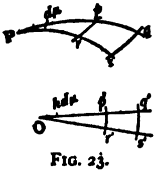


FIG. 23.

If it were possible to make a perfect representation, then we should have $\sigma = 1$, $\sigma' = 1$ throughout. This, however, is impossible. We may make $\sigma = 1$ throughout by taking $\rho = z$. This is the *Equidistant Projection* just described, a very simple and effective method of representation.

Or we may make $\sigma' = 1$ throughout. This gives $\rho = \sin z$, a perspective projection, namely, the *Orthographic*.

Or we may require that areas be strictly represented in the development. This will be effected by making $\sigma\sigma' = 1$, or $\rho d\rho = \sin z dz$, the integral of which is $\rho = 2\sin\frac{1}{2}z$, which is the *Zenithal Equal-area Projection* of Lambert, sometimes, though wrongly referred to as *Lorgna's Projection* after Antonio Lorgna (b. 1736). In this system there is misrepresentation of form, but no misrepresentation of areas.

Or we may require a projection in which all small parts are to be represented in their true forms *i.e.* an orthomorphic projection. For instance, a small square on the spherical surface is to be represented as a small square in the development. This condition will be attained by making $\sigma = \sigma'$, or $d\rho/\rho = dz/\sin z$, the integral of which is, c being an arbitrary constant, $\rho = c \tan\frac{1}{2}z$. This, again, is a perspective projection, namely, the *Stereographic*. In this, though all small parts of the surface are represented in their correct shapes, yet, the scale varying from one part of the map to another, the *whole* is not a similar representation of the original. The scale, $\sigma = \frac{1}{2}c\sec^2\frac{1}{2}z$, at any point, applies to all directions round that point.

These two last projections are, as it were, at the extremes of the scale; each, perfect in its own way, is in other respects objectionable. We may avoid both extremes by the following considerations. Although we cannot make $\sigma = 1$ and $\sigma' = 1$, so as to have a perfect picture of the spherical surface, yet considering $\sigma - 1$ and $\sigma' - 1$ as the local errors of the representation, we may make $(\sigma-1)^2 + (\sigma'-1)^2$ a minimum over the whole surface to be represented. To effect this we must multiply this expression by the element of surface to which it applies, viz. $\sin z dz d\mu$, and then integrate from the centre to the (circular) limits of the map. Let β be the spherical radius of the segment to be represented, then the total misrepresentation is to be taken as

$$\int_0^\beta \left\{ \left(\frac{d\rho}{dz}-1\right)^2 + \left(\frac{\rho}{\sin z}-1\right)^2 \right\} \sin z dz,$$

which is to be made a minimum. Putting $\rho = z + y$, and giving to y only a variation subject to the condition $\delta y = 0$ when $z = 0$, the equations of solution—using the ordinary notation of the calculus of variations—are

$$N - \frac{d(P)}{dz} = 0;\ P\beta = 0,$$

$P\beta$ being the value of $2p \sin z$ when $z = \beta$. This gives

$$\sin^2 z \frac{d^2y}{dz^2} + \sin z \cos z \frac{dy}{dz} - y = z - \sin z \left(\frac{dy}{dz}\right)_\beta = 0.$$

This method of development is due to Sir George Airy, whose original paper—the investigation is different in form from the above, which is due to Colonel Clarke—will be found in the *Philosophical Magazine* for 1861. The solution of the differential equation leads to this result—

$$\rho = 2\cot\tfrac{1}{2}z \log_e \sec\tfrac{1}{2}z + C\tan\tfrac{1}{2}z,$$
$$C = 2\cot^2\tfrac{1}{2}\beta \log_e \sec\tfrac{1}{2}\beta.$$

The limiting radius of the map is $R = 2C\tan\frac{1}{2}\beta$. In this system, called by Sir George Airy *Projection by balance of errors*, the total misrepresentation is an absolute minimum. For short it may be called *Airy's Projection*.

Returning to the general case where ρ is any function of z, let us consider the local misrepresentation of direction. Take any indefinitely small line, length $= i$, making an angle a with the meridian in co-latitude z. Its projections on a meridian and parallel are $i\cos a$, $i\sin a$, which in the map are represented by $i\sigma\cos a$, $i\sigma'\sin a$. If then a' be the angle in the map corresponding to a

$$\tan a' = (\sigma'/\sigma)\tan a.$$

Put

$$\sigma'/\sigma = \rho dz/\sin z d\rho = \Sigma,$$

and the error $a' - a$ of representation $= \epsilon$, then

$$\tan\epsilon = \frac{(\Sigma-1)\tan a}{1+\Sigma\tan^2 a}$$

Put $\Sigma = \cot^2\zeta$, then ϵ is a maximum when $a = \zeta$, and the corresponding value of ϵ is

$$\epsilon = \tfrac{1}{2}\pi - 2\zeta.$$

For simplicity of explanation we have supposed this method of development so applied as to have the pole in the centre. There is, however, no necessity for this, and any point on the surface of the sphere may be taken as the centre. All that is necessary is to calculate by spherical trigonometry the azimuth and distance, with reference to the assumed centre, of all the points of intersection of meridians and parallels within the space which is to be represented in a plane. Then the azimuth is represented unaltered, and any spherical distance z is represented by ρ. Thus we get all the points of intersection transferred to the representation, and it remains merely to draw continuous lines through these points, which lines will be the meridians and parallels in the representation.

Thus treating the earth as a sphere and applying the *Zenithal Equal-area Projection* to the case of Africa, the central point selected being on the equator, we have, if θ be the spherical distance of any point from the centre, ϕ, α the latitude and longitude (with reference to the centre), of this point, $\cos\theta = \cos\phi\cos\alpha$. If A is the azimuth of this point at the centre, $\tan A = \sin\alpha\cot\phi$. On paper a line from the centre is drawn at an azimuth A, and the distance θ is represented by $2\sin\frac{1}{2}\theta$. This makes a very good projection for a single-sheet equal-area map of Africa. The exaggeration in such systems, it is important to remember, whether of linear scale, area, or angle, is the same for a given distance from the centre, whatever be the azimuth; that is, the exaggeration is a function of the distance from the centre only.

General Theory of Conical Projections.

Meridians are represented by straight lines drawn through a point, and a difference of longitude ω is represented by an angle $h\omega$. The parallels of latitude are circular arcs, all having as centre the point of divergence of the meridian lines. It is clear that perspective and zenithal projections are particular groups of conical projections.

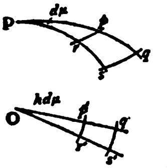


FIG. 24.

Let z be the co-latitude of a parallel, and ρ, a function of z, the radius of the circle representing this parallel. Consider the infinitely small space on the sphere contained by two consecutive meridians, the difference of whose longitude is $d\mu$, and two consecutive parallels whose co-latitudes are z and $z+dz$. The sides of this rectangle are $pq=dz$, $pr=\sin z\,d\mu$; in the projection $p'q'r's'$ these become $p'q'=d\rho$, and $p'r'=\rho h\,d\mu$.

The scales of the projection as compared with the sphere are $p'q'/pq=d\rho/dz=$ the scale of meridian measurements $=\sigma$, say, and $p'r'/pr=\rho h\,d\mu/\sin z\,d\mu=\rho h/\sin z=$ scale of measurements perpendicular to the meridian $=\sigma'$, say.

Now we may make $\sigma=1$ throughout, then $\rho=z+\text{const}$. This gives either the group of *conical projections with rectified meridians*, or as a particular case the *equidistant zenithal*.

We may make $\sigma=\sigma'$ throughout, which is the same as requiring that at any point the scale shall be the same in all directions. This gives a group of *orthomorphic projections*.

In this case $d\rho/dz=\rho h/\sin z$, or $d\rho/\rho=h\,dz/\sin z$.

Integrating,

$$\rho=k(\tan\tfrac{1}{2}z)^h, \tag{i.}$$

where k is a constant.

Now h is at our disposal and we may give it such a value that two selected parallels are of the correct lengths. Let z_1, z_2 be the co-latitudes of these parallels, then it is easy to show that

$$h=\frac{\log\sin z_1-\log\sin z_2}{\log\tan\frac{1}{2}z_1-\log\tan\frac{1}{2}z_2} \tag{ii.}$$

This projection, given by equations (i.) and (ii.), is Lambert's orthomorphic projection—commonly called Gauss's projection; its descriptive name is the *orthomorphic conical projection with two standard parallels*.

The constant k in (i.) defines the scale and may be used to render the scale errors along the selected parallels not nil but the *same*; and some other parallel, *e.g.* the central parallel may then be made errorless.

The value $h=\frac{1}{2}$, as suggested by Sir John Herschel, is admirably suited for a map of the world. The representation is fan-shaped, with remarkably little distortion (fig. 24).

If any parallel of co-latitude z is true to scale $hk(\tan\frac{1}{2}z_1)^h=\sin z$, if this parallel is the equator, so that $z_1=90°$, $kh=1$, then equation (i.) becomes $\rho=(\tan\frac{1}{2}z)^h/h$, and the radius of the equator $=1/h$. The distance r of any parallel from the equator is $1/h-(\tan\frac{1}{2}z)^h/h=(1/h)\{1-(\tan\frac{1}{2}z)^h\}$.

If, instead of taking the radius of the earth as unity we call it a, $r=(a/h)\{1-(\tan\frac{1}{2}z)^h\}$. When h is very small, the angles between the meridian lines in the representation are very small; and proceeding to the limit, when h is zero the meridians are parallel—that is, the vertex of the cone has removed to infinity. And at the limit when h is zero we have $r=a\log_e\cot\frac{1}{2}z$, which is the characteristic equation of Mercator's projection.

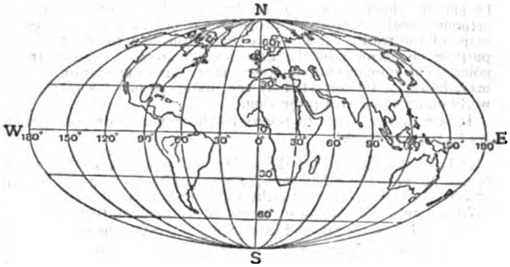


FIG. 25.—Elliptical equal-area Projection, showing the whole surface of the globe.

Mercator's Projection.—From the manner in which we have arrived at this projection it is clear that it retains the characteristic property of orthomorphic projections—namely, similarity of representation of small parts of the surface. In Mercator's chart the equator is represented by a straight line, which is crossed at right angles by a system of parallel and equidistant straight lines representing the meridians. The parallels are straight lines parallel to the equator, and the distance of the parallel of latitude ϕ from the equator is, as we have seen above, $r=a\log_e\tan(45°+\frac{1}{2}\phi)$. In the vicinity of the equator, or indeed within 30° of latitude of the equator, the representation is very accurate, but as we proceed northwards or southwards the exaggeration of area becomes larger, and eventually excessive—the poles being at infinity. This distance of the parallels may be expressed in the form $r=a(\sin\phi+\frac{1}{3}\sin^3\phi+\frac{1}{5}\sin^5\phi+\ldots)$, showing that near the equator r is nearly proportional to the latitude. As a consequence of the similar representation of small parts, a curve drawn on the sphere cutting all meridians at the same angle—the loxodromic curve—is projected into a straight line, and it is this property which renders Mercator's chart so valuable to seamen. For instance: join by a straight line on the chart Land's End and Bermuda, and measure the angle of intersection of this line with the meridian. We get thus the bearing which a ship has to retain during its course between these ports. This is not great-circle sailing, and the ship so navigated does not take the shortest path. The projection of a great circle (being neither a meridian nor the equator) is a curve which cannot be represented by a simple algebraic equation.

If the true spheroidal shape of the earth is considered, the semi-axes being a and b, putting $e=\sqrt{(a^2-b^2)}/a$, and using common logarithms, the distance of any parallel from the equator can be shown to be

$$(a/M)\{\log\tan(45°+\tfrac{1}{2}\phi)-e^2\sin\phi-\tfrac{1}{3}e^4\sin^3\phi\ldots\}$$

where M, the modulus of common logarithms, $=0\cdot434294$. Of course Mercator's projection was not originally arrived at in the manner above described; the description has been given to show that Mercator's projection is a particular case of the conical orthomorphic group. The introduction of the projection is due to the fact that for navigation it is very desirable to possess charts which shall give correct local outlines (*i.e.* in modern phraseology shall be orthomorphic) and shall at the same time show as a straight line any line which cuts the meridians at a constant angle. The latter condition clearly necessitates parallel meridians, and the former a continuous increase of scale as the equator is departed from, *i.e.* the scale at any point must be equal to the scale at the equator × sec. latitude. In early days the calculations were made by assuming that for a small increase of latitude, say 1′, the scale was constant, then summing up the small lengths so obtained. Nowadays (for simplicity the earth will be taken as a sphere) we should say that a small length of meridian $a\,d\phi$ is represented in this projection by $a\sec\phi\,d\phi$, and the length of the meridian in the projection between the equator and latitude ϕ,

$$\int_0^\phi a\sec\phi\,d\phi=a\log_e\tan(45°+\tfrac{1}{2}\phi),$$

which is the direct way of arriving at the law of the construction of this very important projection.

Mercator's projection, although indispensable at sea, is of little value for land maps. For topographical sheets it is obviously unsuitable; and in cases in which it is required to show large areas on small scales on an orthomorphic projection, that form should be chosen which gives two standard parallels (Lambert's conical orthomorphic). Mercator's projection is often used in atlases for maps of the world. It is not a good projection to select for this purpose on account of the great exaggeration of scale near the poles. The misconceptions arising from this exaggeration of scale may, however, be corrected by the juxtaposition of a map of the world on an equal-area projection.

It is now necessary to revert to the general consideration of conical projections.

It has been shown that the scales of the projection (fig. 23) as compared with the sphere are $p'q'/pq = d\rho/ds = \sigma$ along a meridian, and $p'r'/pr' = \rho k/\sin s = \sigma'$ at right angles to a meridian.

Now if $\sigma\sigma' = 1$ the areas are correctly represented, then

$$k\rho d\rho = \sin s ds, \text{ and integrating } \tfrac{1}{2}k\rho^2 = C - \cos s; \qquad \text{(i.)}$$

this gives the whole group of *equal-area conical projections*.

As a special case let the pole be the centre of the projected parallels, then when

$$s = 0, \rho = 0, \text{ and const} = 1, \text{ we have } \rho = 2 \sin \tfrac{1}{2}s/\sqrt{k} \qquad \text{(ii.)}$$

Let s_1 be the co-latitude of some parallel which is to be correctly represented, then $2k \sin \tfrac{1}{2}s_1/\sqrt{k} = \sin s_1$, and $k = \cos^2 \tfrac{1}{2}s_1$; putting this value of k in equation (ii.) the radius of any parallel

$$= \rho = 2 \sin \tfrac{1}{2}s \sec \tfrac{1}{2}s_1 \qquad \text{(iii.)}$$

This is Lambert's *conical equal-area projection with one standard parallel*, the pole being the centre of the parallels.

If we put $s_1 = \theta$, then $k = 1$, and the meridians are inclined at their true angles, also the scale at the pole becomes correct, and equation (iii.) becomes

$$\rho = 2 \sin \tfrac{1}{2}s; \qquad \text{(iv.)}$$

this is the *zenithal equal-area projection*.

Reverting to the general expression for *equal-area conical projections*

$$\rho = \sqrt{\{2(C - \cos s)/k\}} \qquad \text{(i.)}$$

we can dispose of C and k so that any two selected parallels shall be their true lengths; let their co-latitudes be s_1 and s_2, then

$$2k(C - \cos s_1) = \sin^2 s_1 \qquad \text{(v.)}$$
$$2k(C - \cos s_2) = \sin^2 s_2 \qquad \text{(vi.)}$$

from which C and k are easily found, and the radii are obtained from (i.) above. This is H. C. Albers' *conical equal-area projection with two standard parallels*. The pole is not the centre of the parallels.

Projection by Rectangular Spheroidal Co-ordinates.

If in the simple conical projection the selected parallel is the equator, this and the other parallels become parallel straight lines and the meridians are straight lines spaced at equatorial distances, cutting the parallels at right angles; the parallels are their true distances apart. This projection is the *simple cylindrical*. If now we imagine the touching cylinder turned through a right-angle in such a way as to touch the sphere along any meridian, a projection is obtained exactly similar to the last, except that in this case we represent, not parallels and meridians, but small circles parallel to the given meridian and great circles at right angles to it. It is clear that the projection is a special case of conical projection. The position of any point on the earth's surface is thus referred, on this projection, to a selected meridian as one axis, and any great circle at right angles to it as the other. Or, in other words, any point is fixed by the length of the perpendicular from it on to the fixed meridian and the distance of the foot of the perpendicular from some fixed point on the meridian, these spherical or spheroidal co-ordinates being plotted as plane rectangular co-ordinates.

The perpendicular is really a plane section of the surface through the given point at right angles to the chosen meridian, and may be briefly called a great circle. Such a great circle clearly diverges from the parallel; the exact difference in latitude and longitude between the point and the foot of the perpendicular can be at once obtained by ordinary geodetic formulae, putting the azimuth = 90°. Approximately the difference of latitude in seconds is $x^2 \tan \phi \operatorname{cosec} 1''/2\rho\nu$ where x is the length of the perpendicular, ρ that of the radius of curvature to the meridian, ν that of the normal terminated by the minor axis, ϕ the latitude of the foot of the perpendicular. The difference of longitude in seconds is approximately $x \sec \rho \operatorname{cosec} 1''/\nu$. The resulting error consists principally of an exaggeration of scale north and south and is approximately equal to $\sec x$ (expressing x in arc); it is practically independent of the extent in latitude.

It is on this projection that the 1/2,500 Ordnance maps and the 6-in. Ordnance maps of the United Kingdom are plotted, a meridian being chosen for a group of counties. It is also used for the 1-in., ½ in. and ¼ in. Ordnance maps of England, the central meridian chosen being that which passes through a point in Delamere Forest in Cheshire. This projection should not as a rule be used for topographical maps, but is suitable for cadastral plans on account of the convenience of plotting the rectangular co-ordinates of the very numerous trigonometrical or traverse points required in the construction of such plans. As regards the errors involved, a range of about 150 miles each side of the central meridian will give a maximum error in scale in a north and south direction of about 0·1 %.

Elliptical Equal-area Projection.

In this projection, which is also called Mollweide's projection the parallels are parallel straight lines and the meridians are ellipses, the central meridian being a straight line at right angles to the equator, which is equally divided. If the whole world is represented on the spherical assumption, the equator is twice the length of the central meridian. Each elliptical meridian has for one axis the central meridian, and for the other the intercepted portion of the equally divided equator. It follows that the meridians 90° east and west of the central meridian form a circle. It is easy to show that to preserve the property of equal areas the distance of any parallel from the equator must be $\sqrt{2} \sin \delta$ where $\pi \sin \phi = 2\delta + \sin 2\delta$, ϕ being the latitude of the parallel. The length of the central meridian from pole to pole $= 2\sqrt{2}$, where the radius of the sphere is unity. The length of the equator $= 4\sqrt{2}$.

The following equal-area projections may be used to exhibit the entire surface of the globe: Cylindrical equal area, Sinusoidal equal area and Elliptical equal area.

Conventional or Arbitrary Projections.

These projections are devised for simplicity of drawing and not for any special properties. The most useful projection of this class is the *globular projection*. This is a conventional representation of a hemisphere in which the equator and central meridian are two equal straight lines at right angles, their intersection being the centre of the circular boundary. The meridians divide the equator into equal parts and are arcs of circles passing through points so determined and the poles. The parallels are arcs of circles which divide the central and extreme meridians into equal parts. Thus in fig. 26 NS = EW and each is divided into equal parts (in this case each division is 10°); the circumference NESW is also divided into 10° spaces and circular arcs are drawn through the corresponding points. This is a simple and effective projection and one well suited for conveying ideas of the

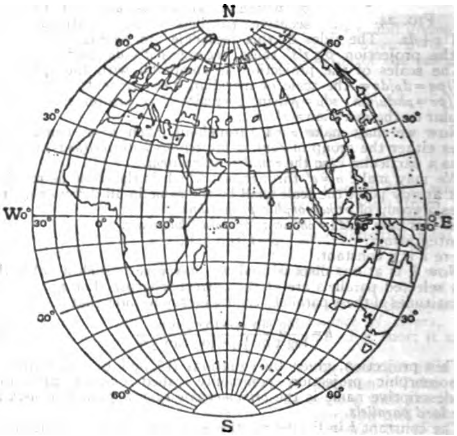
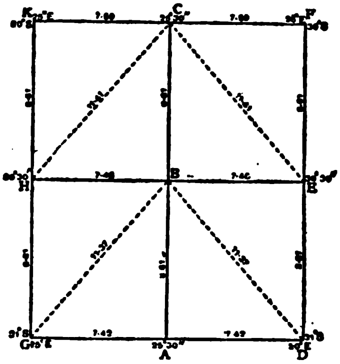


FIG. 26.—Globular Projection.

general shape and position of the chief land masses; it is better for this purpose than the stereographic, which is commonly employed in atlases.



(From *Text Book of Topographical Surveying*, by permission of the Controller of H.M. Stationery Office.)

FIG. 27.—Plane Table Graticule, dimensions in inches, for a scale of 4 in. to 1 m.

Projections for Field Sheets.

Field sheets for topographical surveys should be on conical projections with rectified meridians; these projections for small areas and ordinary topographical scales—not less than 1/500,000—are sensibly errorless. But to save labour it is customary to employ for this purpose either form of polyconic projection, in which the errors for such scales are also negligible. In some surveys, to avoid the difficulty of plotting the flat arcs required for the parallels, the arcs are replaced by polygons, each side being the length of the portion of the arc it replaces. This method is especially suitable for scales of 1:125,000 and larger, but it is also sometimes used for smaller scales.

Fig. 27 shows the method of plotting the projection for a field sheet. Such a projection is usually called a graticule. In this case ABC is the central meridian; the true meridian lengths of 30′ spaces are marked on this meridian, and to each of these, such as AB, the figure (in this case representing a square half degree), such as ABED, is applied. Thus the point D is the intersection of a circle of radius AD with a circle of radius BD, these lengths being taken from geodetic tables. The method has no merit except that of convenience.

Summary.

The following projections have been briefly described:—

Perspective
1. Cylindrical equal-area.
2. Orthographic.
3. Stereographic (which is orthomorphic).
4. General external perspective.
5. Minimum error „ (Clarke's).
6. Central.

Conical
7. Conical, with rectified meridians and two standard parallels (5 forms).
8. Simple conical.
9. Simple cylindrical (a special case of 8).
10. Modified conical equal-area (Bonne's).
11. Sinusoidal „ „ (Sanson's).
12. Werner's conical „ „
13. Simple polyconic.
14. Rectangular polyconic.
15. Conical orthomorphic with 2 standard parallels (Lambert's, commonly called Gauss's).
16. Cylindrical orthomorphic (Mercator's).
17. Conical equal-area with one standard parallel.
18. „ „ „ two „ parallels.
19. Projection by rectangular spheroidal co-ordinates.

Zenithal
20. Equidistant zenithal.
21. Zenithal equal-area.
22. Zenithal projection by balance of errors (Airy's).
23. Elliptical equal-area (Mollweide's).
24. Globular (conventional).
25. Field sheet graticule.

Of the above 25 projections, 23 are conical or quasi-conical, if zenithal and perspective projections be included. The projections may, if it is preferred, be grouped according to their properties. Thus in the above list 8 are equal-area, 3 are orthomorphic, 1 balances errors, 1 represents all great circles by straight lines, and in 5 one system of great circles is represented correctly.

Among projections which have not been described may be mentioned the circular orthomorphic (Lagrange's) and the rectilinear equal-area (Collignon's) and a considerable number of conventional projections, which latter are for the most part of little value.

The choice of a projection depends on the function which the map is intended to fulfil. If the map is intended for statistical purposes to show areas, density of population, incidence of rainfall, of disease, distribution of wealth, &c., an *equal-area* projection should be chosen. In such a case an area scale should be given. At sea, *Mercator's* is practically the only projection used except when it is desired to determine graphically great circle courses in great oceans, when the *central* projection must be employed. For conveying good general ideas of the shape and distribution of the surface features of continents or of a hemisphere *Clarke's perspective* projection is the best. For exhibiting the progress of polar exploration the *polar equidistant* projection should be selected. For special maps for general use on scales of 1/1,000,000 and smaller, and for a series of which the sheets are to fit together, the *conical, with rectified meridians and two standard parallels*, is a good projection. For topographical maps, in which each sheet is plotted independently and the scale is not smaller than 1/500,000, either form of *polyconic* is very convenient.

The following are the projections adopted for some of the principal official maps of the British Empire:—

Conical, with Rectified Meridians and Two Standard Parallels.—The 1 : 1,000,000 Ordnance map of the United Kingdom, special maps of the topographical section, General Staff, *e.g.* the 64-mile map of Afghanistan and Persia. The 1 : 1,000,000 Survey of India series of India and adjacent countries.

Modified Conical, Equal-area (Bonne's).—The 1 in., ½ in., ¼ in. and $\frac{1}{10}$ in. Ordnance maps of Scotland and Ireland. The 1 : 800,000 map of the Cape Colony, published by the Surveyor-General.

Simple Polyconic and Rectangular Polyconic maps on scales of 1 : 1,000,000, 1 : 500,000, 1 : 250,000 and 1 : 125,000 of the topographical section of the General Staff, including all maps on these scales of British Africa. A rectilinear approximation to the simple polyconic is also used for the topographical sheets of the Survey of India. The simple polyconic is used for the 1 in. maps of the Militia Department of Canada.

Zenithal Projection by Balance of Errors (Airy's).—The 10-mile to 1 in. Ordnance map of England.

Projection by Rectangular Spheroidal Co-ordinates.—The 1 : 2500 and the 6 in. Ordnance sheets of the United Kingdom, and the 1 in., ½ in. and ¼ in. Ordnance maps of England. The cadastral plans of the Survey of India, and cadastral plans throughout the empire.

AUTHORITIES.—See *Traité des projections des cartes géographiques*, by A. Germain (Paris, 1865) and *A Treatise on Projections*, by T. Craig, United States Coast and Geodetic Survey (Washington, 1882). Both Germain and Craig (following Germain) make use of the term *projections by development*, a term which is apt to convey the impression that the spherical surface is developable. As this is not the case, and since such projections are conical, it is best to avoid the use of the term. For the history of the subject see d'Avezac, "Coup d'œil historique sur la projection des cartes géographiques," *Société de géographie de Paris* (1863).

J. H. Lambert (*Beiträge zum Gebrauch der Mathematik, u.s.w.* Berlin, 1772) devised the following projections of the above list: 1, 15, 17, and 21; his transverse cylindrical orthomorphic and the transverse cylindrical equal-area have not been described, as they are seldom used. Among other contributors we mention Mercator, Euler, Gauss, C. B. Mollweide (1774–1825), Lagrange, Cassini, R. Bonne (1727–1795), Airy and Colonel A. R. Clarke. (C. F. CL.; A. R. C.)

MAPLE, SIR JOHN BLUNDELL, BART. (1845–1903), English business magnate, was born on the 1st of March 1845. His father, John Maple (d. 1900), had a small furniture shop in Tottenham Court Road, London, and his business began to develop about the time that his son entered it. The practical management soon devolved on the younger Maple, under whom it attained colossal dimensions. The firm became a limited liability company, with a capital of two millions, in 1890, with Mr Maple as chairman. He entered parliament as Conservative member for Dulwich in 1887, was knighted in 1892, and was made a baronet in 1897. He was the owner of a large stud of race-horses, and from 1885 onwards won many important races, appearing at first under the name of "Mr Childwick." His public benefactions included a hospital and a recreation ground to the city of St Albans, near which his residence, Childwickbury, was situated, and the rebuilding, at a cost of more than £150,000, of University College Hospital, London. He died on the 24th of November 1903. His only surviving daughter married in 1896 Baron von Eckhardstein, of the German Embassy.

MAPLE, in botany. The maple (O. E. *mapel-trēow*, *mapulder*) and sycamore trees are species of *Acer*, of the order *Acerineae*. The genus includes about sixty species, natives of Europe, North America and Asia, especially the Himalayas, China and Japan. Maples are for the most part trees with opposite, long-stalked, palmately lobed leaves. The flowers are in fascicles, appearing before the leaves as in the Norway maple, or in racemes or panicles appearing with, or later than, the leaves as in sycamore. Some of the flowers are often imperfect, the stamens or pistil being more or less aborted. The fruit is a two-winged "samara." The genus was represented in the Tertiary flora of Europe, when it extended into the polar regions; nineteen species have been recorded from the Miocene strata of Oeningen in Switzerland. The common maple, *A. campestre*, is the only species indigenous to Great Britain. This and the sycamore were described by Gerard in 1597 (*Herball*, p. 1299), the latter being "a stranger to England." Many species have been introduced, especially from Japan, for ornamental purposes. The following are more especially worthy of notice.

Acer campestre, the common maple, is common in hedgerows, but less often seen as a tree, when it is seldom more than 20 ft. high, though in sheltered situations 30 ft. or more is attained. The leaves are generally less than 2 in. across, and the five main lobes are blunter than in the sycamore. The clusters of green flowers terminate the young shoots and are erect; the two wings of the fruit spread almost horizontally, and are smaller than in the sycamore. It occurs in northern Europe, the Caucasus, and northern Asia. The wood is excellent fuel, and makes the best charcoal. It is compact, of a fine grain, sometimes beautifully veined, and takes a high polish. Hence it has been celebrated from antiquity for tables, &c. The wood of the roots is frequently knotted, and valuable for small objects of cabinet work. The young shoots, being flexible and tough, are employed in France as whips.

A. pseudo-platanus, the sycamore or great maple, is a handsome tree of quick growth, with a smooth bark. The leaves are large, with finely acute and serrated lobes, affording abundant shade. The flowers are borne in long pendulous racemes, and the two wings of the fruit are ascending. It lives from 140 to 200 years. It is found wild chiefly in wooded mountainous situations in central Europe. The wood when young is white, but old heartwood is yellow or brownish. Like the common maple it is hard and takes a high polish. It is much prized by wheelwrights, cabinet-makers, sculptors, &c., on the Continent; while knotted roots are used for inlaying. Sugar has been obtained from the sap of this as from other species, the most being one ounce from a quart of sap. The latter has also been made into wine in the Highlands of Scotland. It withstands the sea and mountain breezes better than most other timber trees, and is often planted near farm-houses and cottages in exposed localities for the sake of its dense foliage. Its wood is valued in turnery for cups, bowls and pattern blocks. It produces abundance of seeds, and is easily raised, but it requires good and tolerably dry soil; it will not thrive on stiff clays nor on dry sands or chalks. There are many varieties, the variegated and cut-leaved being the most noticeable. The lobed shape of its leaf and its dense foliage caused it to be confused with the true sycamore —*Ficus sycamorus*—of scripture.

A. platanoides, the Norway maple, is met with from Norway to Italy, Greece, and central and south Russia. It was introduced into Britain in 1683. It is a lofty tree (from 40 to 70 ft.), resembling the sycamore, but with yellow flowers, appearing before the leaves, and more spreading wings to the fruit. There are several varieties. The wood is used for the same purposes as that of the sycamore. Sugar has been made from the sap in Norway and Sweden.

Many varieties of *A. palmatum*, generally known as *polymorphum*, with variously laciniated and more or less coloured foliage, have been introduced from Japan as ornamental shrubs. The branches and corolla are purple, the fruit woolly. The foliage of the typical form is bright green with very pointed lobes. It occurs in the central mountains of Nippon and near Nagasaki. Beautiful varieties have been introduced under the varietal names, *ampelopsifolium*, *atropurpureum*, *dissectum*, &c. They are remarkable for the coppery purple tint that pervades the leaves and young growths of some of the varieties. Other Japanese species are *A. japonicum*, the varieties of which are among the most handsome of small deciduous shrubs; *A. rufinerve*, with the habit of the sycamore; *A. distylum*, bearing leaves without lobes; *A. diabolicum*, with large plane-like leaves; and *A. carpinifolium*, with foliage resembling that of the hornbeam.

A. saccharinum, a North American species, the sugar, rock, or bird's-eye maple, was introduced in 1735. It sometimes attains to 70 or even over 100 ft., more commonly 50 to 60 ft. It is remarkable for the whiteness of the bark. The wood is white, but acquires a rosy tinge after exposure to light. The grain is fine and close, and when polished has a silky lustre. The timber is used instead of oak where the latter is scarce, and is employed for axle-trees and spokes, as well as for Windsor chairs, &c. It exhibits two accidental forms in the arrangement of the fibres, an undulated one like those of the curled maple (*A. rubrum*), and one of spots, which gives the name bird's-eye to the wood of this species. Like the curled maple, it is used for inlaying mahogany. It is much prized for bedsteads, writing-desks, shoe-lasts, &c. The wood forms excellent fuel and charcoal, while the ashes are rich in alkaline principles, furnishing a large proportion of the potash exported from Boston and New York. Sugar is principally extracted from this species, the sap being boiled and the syrup when reduced to a proper consistence runs into moulds to form cakes. Trees growing in low and moist situations afford the most sap but least sugar. A cold north-west wind, with frosty nights and sunny days in alternation, tends to incite the flow, which is more abundant during the day than the night. A thawing night is said to promote the flow, and it ceases during a south-west wind and at the approach of a storm; and so sensitive are the trees to aspect and climatic variations that the flow of sap on the south and east side has been noticed to be earlier than on the north and west side of the same tree. The average quantity of sap per tree is from 12 to 24 gallons in a season.

A. rubrum, the red-flowering or scarlet maple, is a middle-sized tree, and was introduced in 1656. The bright scarlet or dull red flowers appear before the leaves in March and April. The wood, like that of other species, is applicable to many purposes—as for the seats of Windsor chairs, turnery, &c. The grain in very old trees is sometimes undulated, which suggested the name of curled maple, and gives beautiful effects of light and shade on polished surfaces. The most constant use of curled maple is for the stocks of fowling-pieces and rifles, as it affords toughness and strength combined with lightness and elegance. The inner bark is dusky red. On boiling, it yields a purple colour which with sulphate of iron affords a black dye. The wood is inferior to that of the preceding species in strength and as fuel. Sugar was made from the sap by the French Canadians, but the production is only half as great as that from the sugar maple. In Britain it is cultivated as an ornamental tree, as being conspicuous for its flowers in spring, and for its red fruit and foliage in autumn.

A. macrophyllum, a north-western American species, is a valuable timber tree.

For a good account of the North American species see C. S. Sargent's *Silva of North America*, vol. ii. See also under SUGAR.

MAPU, ABRAHAM (1808–1867), Hebrew novelist. His works are chiefly historical romances in Hebrew. His most famous books were *The Love of Zion* and the *Transgression of Samaria*. Besides their intrinsic merits, these novels stand high among the works which produced the romantic movement in modern Hebrew literature. Mapu's plots were somewhat sensational, incident being more prominent than characterization. But underlying all was a criticism of contemporary life. His novels made a deep impression and became instantly popular. Mapu's Hebrew style is simple and classical. An English translation of the *Love of Zion* bears the title *Amnon, Prince and Peasant*, by F. Jaffe (1887). Mapu's stories have been often translated into other languages.

See N. Slouschz, *The Renascence of Hebrew Literature* (1909), ch. v. (I. A.)

MAQQARĪ, or MAḲḲARĪ [Abū-l-'Abbās Aḥmad ibn Mahommed ul-Maqqarī] (*c.* 1591–1632), Arabian historian, was born at Tlemcen in Algeria and studied at Fez and Marrakesh, where he remained engaged in literary work until he made the pilgrimage to Mecca in 1618. In the following year he settled in Cairo. In 1620 he visited Jerusalem and Damascus, and during the next six years made the pilgrimage five times. In 1628 he was again in Damascus, where he gave a course of lectures on Bukhārī's collection of *Traditions*, spoke much of the glories of Moslem Spain, and received the impulse to write his work on this subject later. In the same year he returned to Cairo, where he spent a year in writing his history. He was just making preparations to settle definitely in Damascus when he died in 1632.

His great work, *The Breath of Perfume from the Branch of Green Andalusia and Memorials of its Vizier Lisān ud-Dīn ibn ul-Khaṭīb*, consists of two parts. The first is a compilation from many authors on the description and history of Moslem Spain; it was published by Wright, Krehl, Dozy and Dugat as *Analectes sur l'histoire et la littérature des Arabes d'Espagne* (Leiden, 1855–1861), and in an abridged English translation by P. de Gayangos (London, 1840–1843). The whole work has been published at Būlāq (1863) and Cairo (1885).

For other works of Maqqarī see C. Brockelmann's *Gesch. der arabischen Litteratur* (Berlin, 1902), ii. 297. (G. W. T.)

MAQRĪZĪ, or Makrizi [Taqī ud-Dīn Aḥmad ibn 'Alī] (1364–1442), Arabian historian, known as al-Maqrīzī because of his ancestral connexion with Maqrīz, a suburb of Baalbek, was born at Cairo and spent most of his life in Egypt, where he was trained in the Hanifite school of law, though later he became a Shāfi'ite with an inclination to Zāhirite views. In 1385 he made the pilgrimage. For some time he was secretary in a government office, and in 1399 became inspector of markets for Cairo and northern Egypt. This post he soon gave up to become preacher at the mosque of 'Amr, president of the mosque ul-Hākim, and a lecturer on tradition. In 1408 he went to Damascus to become inspector of the Qalānisīyya and lecturer. Later he retired into private life at Cairo. In 1430 he made the pilgrimage with his family and travelled for some five years. His learning was great, his observation accurate and his judgment good, but his books are largely compilations, and he does not always acknowledge the sources to which he is indebted Most of his works are concerned with Egypt. The most important is the *Mawā'iz wal-I'tibār fī dhikr ul-Ḥiṭaṭ wal-Āthār* (2 vols., Bulāq, 1854), translated into French by U. Bouriant as *Description topographique et historique de l'Égypte* (Paris, 1895-1900; cf. A. R. Guest, "A List of Writers, Books and other Authorities mentioned by El Maqrīzī in his *Khiṭaṭ*," in *Journal of the Royal Asiatic Society*, 1902, pp. 103–125). Of his *History of the Fatimites* an extract was published by J G. L. Kosegarten in his *Chrestomathia* (Leipzig, 1828), pp. 115–123, the *History of the Ayyūbit and Mameluke Rulers* has been translated into French by E. Quatremère (2 vols., Paris, 1837–1845). Maqrīzī began a large work called the *Muqaffā*, a cyclopaedia of Egyptian biography in alphabetic order. It was intended to be in 80 volumes, but only 16 were written. Three autograph volumes exist in MS. in Leiden, and one in Paris.

Among smaller works published are the *Mahommedan Coinage* (ed. O. G. Tychsen, Rostock, 1797; French translation by S. de Sacy, Paris, 1797); *Arab Weights and Measures* (ed. Tychsen, Rostock, 1800); the *Arabian Tribes that migrated to Egypt* (ed. F Wüstenfeld, Göttingen, 1847); the *Account of Hadhramaut* (ed. P. B. Noskowyj, Bonn, 1866); the *Strife between the Banī Umayya and the Banī Hāshim* (ed G. Vos, Leiden, 1888), and the *Moslems in Abyssinia* (ed. F. T. Rink, Leiden, 1790). For Maqrīzī's life see the quotations from contemporary biographies in S. de Sacy's *Chrestomathie arabe* (2nd ed., Paris, 1826), ii. 112 seq., and for other works still in MS. C. Brockelmann, *Gesch. der arabischen Litteratur* (Berlin, 1902), ii. 38–41. (G. W. T.)

MAR, EARLDOM OF. Mar, one of the ancient divisions or provinces of Scotland, comprised the larger portion of Aberdeenshire, extending from north of the Don southward to the Mounth. Like other such districts, it was in Celtic times under the rule of a *mormaer*. In the 12th century his place was taken by an earl, but no definite succession of earls appears till the 13th century, nor is any connexion established between them and the *mormaers*. From the middle of the 13th century the earls were recognized as among "the seven earls of Scotland" and held a great position. Earl Gratney (*fl. c.* 1300) married a sister of (King) Robert Bruce, who brought him the lordship of Garioch and castle of Kildrummy, which she held against the earl of Athole, an ally of the English (1335). Their son Donald was made regent in July 1332, but was disastrously defeated and slain at Dupplin next month. His daughter and eventual heir, Margaret, brought the earldom to her husband, William, earl of Douglas, and on the accession of her daughter Isabel a troublous time followed.

While she was living as a widow at her castle of Kildrummy, it was stormed by Alexander Stewart, a bastard, who forced her to execute a charter (August 12, 1404) settling the reversion to the earldom on himself and his heirs. This act she revoked by a charter of the 19th of September 1404, which cannot now be found; but on marrying him, on the 9th of December 1404, she granted him the earldom for life, the king confirming this on the 21st of June 1405. After her death in 1408 the earl played a great part, commanding the royal forces at the battle of Harlaw, when the Lord of the Isles was defeated in 1411, and afterwards acting as warden of the Marches. In 1426 he resigned the earldom to the Crown, the king granting it by a fresh creation to him and certain heirs, with reversion to the Crown. On the earl's death in 1435 the earldom was claimed by Robert, Lord Erskine, as heir of Gratney, earl of Mar, through a daughter; but the Crown claimed as reversionary under the creation of 1426. A long struggle followed, till in 1457 James II. obtained from a justiciary court at Aberdeen a recognition of the Crown's right to the earldom and its lands, and shortly after bestowed them on his son John as earl of Mar and Garioch. He died unmarried in 1479, and in 1483 his elder brother Alexander duke of Albany received the earldom, but was soon forfeited. James III. created his son John earl of Mar and Garioch in 1486, and after his death unmarried in 1503, James IV. alienated to Lord Elphinstone (1507–1510) many of the Mar lands, including Kildrummy. The title was not revived till 1562, when James Stewart, earl of Murray, held it for a few months.

In 1565 John, Lord Erskine, succeeded in getting returned heir to the earldom, and shortly after (June 23, 1565) Queen Margaret restored the charter to him and his heirs "all and hail the said earldom of Mar." As earl he took part against the queen in 1567, and in 1571 was made regent of Scotland, which post he retained till his death (1572). His son, earl John (*c.* 1558–1634), played a great part in the history of the family. His great achievement was the recovery of the Mar estates, alienated by the Crown during the long period that his family had been out of possession, including Kildrummy, the "head" of the earldom. It was in his time that the precedence of the earldom (see below) was settled. John, the next earl (*c.* 1585–1654) was a Royalist, as was his son John (d. 1668), much to the injury of the family fortune, which was further impaired by the attachment of the family, after the Revolution, to the Stuarts. His son Charles (1650–1689) was arrested by the government just before his death (1689), and the next earl, John (1675–1732), a prominent Jacobite (see below), was attainted, the earldom remaining under forfeiture for 108 years; by the Old Pretender he was created duke of Mar.

Alloa and other Erskine estates of the attainted earl were repurchased for the family, and descended to John Francis Erskine (1741–1825), his heir-male, who was also his heir of line through his daughter. To him, in his eighty-third year, as grandson and lineal representative of the attainted earl, the earldom was restored by act of parliament in 1824. His grandson, who succeeded him in 1828, inherited the earldom of Kellie (1619) and other Erskine dignities by decision of 1835. At his death in 1866, his earldom of Mar was the subject of rival claims, and the right to the succession was not determined till 1875. His estates passed to his cousin and heir-male, who succeeded to his earldom of Kellie and claimed "the honour and dignity of earl of Mar." But the latter was also claimed by a Mr Goodeve, whose father had married the late earl's eldest sister, and who assumed the title. It was not suggested that the late earl had more than one earldom of Mar, but Lord Kellie claimed it as descendible to heirs-male under a creation by Queen Mary, and Mr Goodeve as descendible to heirs of line under an earlier creation. The House of Lords decided (Feb. 25, 1875) that Lord Kellie was entitled to the earldom as having been created by Queen Mary in 1565, with a limitation which must be presumed to be to heirs-male of the body. This decision gave great dissatisfaction, but was described as "final, right or wrong, and not to be questioned" by Lord Selborne and the lord chancellor in 1877, and Lord Kellie was thenceforth recognized as holding the earldom on the Union Roll, the only one known, though Mr Goodeve continued to assume the title. The Lords' decision could not be reversed, but in 1885, after much agitation, a means was found of evading it in practice by the "Earldom of Mar Restitution Act." By "an equivocation on the facts of the case," it was recited that "doubts may exist whether the said ancient honour, dignity, and title of peerage of earl of Mar . . was or was not . . . by any lawful means surrendered or merged in the Crown" before 1565, and that the House of Lords had decided that Queen Mary's known charter of 1565 applied only to lands and "did not operate or extend to restore" the peerage dignity, and enacted that "John Francis Erskine Goodeve Erskine" (which last name the claimant had added) should be "restored to" the ancient earldom. His previous assumption of the title was thus rejected as invalid, but from the passing of the act two earldoms of Mar were in existence, that of Lord Kellie being confirmed and allowed the precedence of 1565, while the restored earldom was allowed that of the dignity on the Union Roll, the only one known till then. This precedence had been assigned to it by the Decreet of Ranking (1606), and assigns to it an origin in 1404 (or, as some say, 1395). It is frequently, but absurdly, stated to have been "created before 1014," and wrongly spoken of as the Premier Scottish Earldom (see EARL). A barony of Garioch is also wrongly said to be annexed to it, but the title is used by the earl's eldest son in default of any other.

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MAR, JOHN ERSKINE, 1ST OR 6TH EARL OF (d. 1572), regent of Scotland, was a son of John, 5th Lord Erskine (d. 1552), who was guardian of King James V., and afterwards of Mary Queen of Scots. The younger John, who succeeded his father as 6th Lord Erskine in 1552, joined the religious reformers, but he was never very ardent in the cause, although he subscribed the letter asking Knox to return to Scotland in 1557. The custody of Edinburgh Castle was in his hands, and during the struggle between the regent, Mary of Lorraine, and the lords of the Congregation he appears to have acted consistently in the interests of peace. When Mary Stuart returned to Scotland in 1561 Lord Erskine was a member of her council, he favoured her marriage with Lord Darnley, and his wife, Annabella Murray, called by Knox a "verray Jesabell," was a frequent companion of the queen. In 1565 Erskine was granted the earldom of Mar (see above). As guardian of James, afterwards King James VI., he prevented the young prince from falling into the hands of Bothwell, and when the Scottish nobles rose against Mary and Bothwell, Mar was one of their leaders; he took part in the government of Scotland during Mary's imprisonment at Lochleven, and also after her subsequent abdication. In September 1571 he was chosen regent of Scotland, but he was overshadowed and perhaps slighted by the earl of Morton, and he died at Stirling on the 29th of October 1572.

MAR, JOHN ERSKINE, 2ND OR 7TH EARL OF (*c.* 1558–1634), Scottish politician, was the only son of the preceding. Together with King James VI. he was educated by George Buchanan. After attaining his majority he was nominally the guardian of the young king, who was about seven years his junior, and who lived with him at Stirling; but he was in reality a puppet in the hands of the regent, the earl of Morton; and he lost power and position when Morton was imprisoned. He was concerned in the seizure of James VI. in 1582 (a plot known as the raid of Ruthven); but when James escaped from his new custodians the earl fled into the west of Scotland. Then leaving his hiding-place Mar seized Stirling Castle, whereupon James marched against him, and he took refuge in England. Queen Elizabeth interceded for him, but in vain, and after some futile communications between the governments of England and Scotland Mar and his friends gathered an army, entered the presence of the king at Stirling, and were soon in supreme authority (1585). Mar was restored to his lands and titles. Henceforward he stood high in the royal favour; he became governor of Edinburgh Castle and was made tutor to James's son, Prince Henry, and for his second wife he married Mary, daughter of Esmé Stewart, duke of Lennox. In 1601 the earl was sent as envoy to London; here Elizabeth assured him that James should be her successor, and his mission was conducted with tact and prudence. Having joined the English privy council Mar was created Lord Cardross in 1610; he was a member of the Court of High Commission and was lord high treasurer of Scotland from 1615 to 1630. He died at Stirling on the 14th of December 1634. John (*c.* 1585–1654), his only son by his first wife, succeeded to his earldom; by his second wife he had five sons, among them being James (d. 1640), earl of Buchan; Henry (d. 1628), whose son David (d. 1671) succeeded to the barony of Cardross, and Charles, the ancestor of the earls of Rosslyn.

MAR, JOHN ERSKINE, 6TH OR 11TH EARL OF (1675–1732), Scottish Jacobite, was the eldest son of Charles, the 5th earl (1650–1689), from whom he inherited estates which were heavily loaded with debt. He was associated with the party favourable to the English government; he was one of the commissioners for the Union, and was made a Scottish secretary of state, becoming after the Union of 1707 a representative peer for Scotland, keeper of the signet and a privy councillor. In 1713 Mar was made an English secretary of state by the Tories, but he seems to have been equally ready to side with the Whigs, and in 1714 he assured the new king, George I., of his loyalty. However, like the other Tories, he was deprived of his office, and in August 1715 he went in disguise to Scotland and placed himself at the head of the adherents of James Edward, the Old Pretender. Meeting many Highland chieftains at Aboyne he avowed an earnest desire for the independence of Scotland, and at Braemar on the 6th of September 1715 he proclaimed James VIII. king of Scotland, England, France and Ireland. Gradually the forces under his command were augmented, but as a general he was a complete failure. Precious time was wasted at Perth, a feigned attack on Stirling was resultless, and he could give little assistance to the English Jacobites. At Sheriffmuir, where a battle was fought in November 1715, Mar's forces largely outnumbered those of his opponent, Archibald Campbell, afterwards 3rd duke of Argyll; but no bravery could atone for the signal incompetence displayed by the earl, and the fight was virtually a decisive defeat for the Jacobites. Mar then met James Edward at Fetteresso; the cause however was lost, and the prince and the earl fled to France. Mar sought to interest foreign powers in the cause of the Stuarts; but in the course of time he became thoroughly distrusted by the Jacobites. In 1721 he accepted a pension of £3500 a year from George I., and in the following year his name was freely mentioned in connexion with the trial of Bishop Atterbury, whom it was asserted that Mar had betrayed. This charge may perhaps be summarized as not proven. At the best his conduct was highly imprudent, and in 1724 he left the Pretender's service. His later years were spent in Paris and at Aix-la-Chapelle, where he died in May 1732.

Mar, who was known as "bobbing John," married for his second wife, Frances (d. 1761), daughter of the 1st duke of Kingston, and was thus a brother-in-law of Lady Mary Wortley Montagu. He had been attainted in 1716, and his only son, Thomas, Lord Erskine, died childless in March 1766.

Mar's brother, JAMES ERSKINE (1679–1754), was educated as a lawyer and became lord justice clerk of the Court of Session and Lord Grange in 1710. He took no part in the rising of 1715, although there is little doubt that at times he was in communication with the Jacobites; but was rather known for his piety and for his sympathy with the Presbyterians. He is more famous, however, owing to the story of his wife's disappearance. This lady, Rachel Chicely, was a woman of disordered intellect; probably with reason she suspected her husband of infidelity, and after some years of unhappiness Grange arranged a plan for her seizure. In January 1732 she was conveyed with great secrecy from Edinburgh to the island of Hesker, thence to St Kilda, where she remained for about ten years, thence she was taken to Assynt in Sutherland, and finally to Skye. To complete the idea that she was dead her funeral was publicly celebrated, but she survived until May 1745. Meanwhile in 1734 Grange had resigned his judgeship and had become an English member of parliament; here he was a bitter opponent of Sir Robert Walpole. He died in London on the 20th of January 1754.

See the *Journal of the Earl of Mar* (1716); R. Patten, *History of the late Rebellion* (1717); and A. Lang, *History of Scotland*, vol. iv. (1907).

MARA, GERTRUD ELISABETH (1749–1833), German singer, was born at Cassel, the daughter of a poor musician named Schmeling. From him she learnt the violin, and while still a child her playing at the fair at Frankfort was so remarkable that money was collected to provide for her. She was helped by influential friends, and studied under Hillel at Leipzig for five years, proving to be endowed with a wonderful soprano voice. She began to sing in public in 1771, and was soon recognized as the greatest singer that Germany had produced. She was permanently engaged for the Prussian Court, but her marriage to a debauched violinist named Mara created difficulties, and in 1780 she was released. After singing at Vienna, Munich and elsewhere, she appeared in Paris in 1782, where her rivalry with the singer Todi developed into a regular faction. In 1784 she went to London, and continued to appear there with great success, with visits at intervals to Italy and to Paris till 1802, when for some years she retired to Russia. She visited England again in 1819, but then abandoned the stage. She went to Livonia, and died on the 20th of January 1833 at Revel.

MARABOUT (the French form of the Arab. *murābiṭ*, "one who pickets his horse on a hostile frontier"; cf. Portug. *marabuto*; Span. *morabito*), in Mahommedan religion a hermit or devotee. The word is derived from *ribāṭ*, a fortified frontier station. To such stations pious men betook them to win religious merit in war against the infidel, their leisure was spent in devotion, and the habits of the convent superseded those of the camp (see M'G. De Slane in *Jour As.*, 1842, i. 168; Dozy, *Suppl.* i. 502). Thus *ribāṭ* came to mean a religious house or hospice (*zāwiya*). The great sphere of the marabouts is North Africa. There it was that the community formed by Yahya b. Ibrāhīm and the doctor Abdullah developed into the conquering empire of the Murābiṭs, or, as Christian writers call them, the ALMORAVIDES (*q.v.*), and there still, among the Berbers, the marabouts enjoy extraordinary influence, being esteemed as living saints and mediators. They are liberally supported by alms, direct all popular assemblies, and have a decisive voice in intertribal quarrels and all matters of consequence. On their death their sanctity is transferred to their tombs (also called marabouts), where chapels are erected and gifts and prayers offered. The marabouts took a prominent part in the resistance offered to the French by the Algerian Moslems, and they have been similarly active in politico-religious movements in Tunisia and Tripoli.

See L. Rinn, *Marabouts et Khouan* (Algiers, 1884); and the article DERVISH.

MARACAIBO, a large lake of western Venezuela, extending southward from the Gulf of Venezuela, into which it opens through a long neck, or strait, obstructed at its mouth by islands and bars, and having a large drainage basin bounded on the W. by the Eastern Cordillera, on the S.E. by the Cordillera de Merida, and on the E. by a low range of mountains extending N. by W. from Trujillo to the coast. The lake is roughly quadrangular in shape, and extends from the 9th to the 11th parallel of S. lat. and from the 71st to the 72nd meridian. It opens into the Gulf through 13 channels, the depth on the bar in the main channel ranging from 7 ft. at low water to 12 ft. at high water. Inside the bar the depth is about 30 ft., and the lake is navigable for vessels of large size. It receives the waters of many rivers, principally on its west and south sides, the largest of which are the Catatumbo and Zulia, Escalante, Chanudo, Ceniza, Sant'Ana, Negro, Apan and Palmar. The first three have navigable channels for river steamers. There are a number of small lakes near Lake Maracaibo's southern and western margins, the largest of which is the Laguna de Zulia. The heavy rainfall on the eastern slopes of the Eastern Cordillera, which is said to exceed 86 in. per annum, is responsible for the great volume of water discharged into the lake. The average annual precipitation over the whole basin is said to be 70 in. In the upper half of the lake the water is sweet, but below that, where the tidal influence is stronger, it becomes brackish. The only port of consequence on the lake is Maracaibo, but there are small ports at its upper end which are in direct communication with the inland cities of Trujillo, Merida and San Cristobal. The Catatumbo River, which enters from the west near the north end of the lake, and its principal tributary, the Zulia, are navigable as far as Villamizar, in Colombia, and afford an excellent transportation route for the coffee and other products of Santander.

MARACAIBO (sometimes MARACAYBO), a city and seaport of Venezuela and capital of the state of Zulia (formerly Maracaibo), on the west shore of the broad channel or neck which connects Lake Maracaibo with the Gulf of Venezuela, or Maracaibo, about 25 m. from the mouth of the channel opening into the latter. Pop. (1889), 34,284; (1905), 49,817; there is a considerable German element in the vicinity. The best residential suburb, Haticos, extends along the lake shore toward the south. The city is provided with tramways, telephone service and electric lighting, but the water supply and drainage are inferior. The most important buildings are the executive's residence. the legislative chambers, the municipal hall, the Baralt theatre, the prison, the market, a hospital and six churches. The city also has a school of arts, a public library, and a public garden. In colonial times Maracaibo had a famous Jesuits' college (now gone) and was one of the educational centres of Spanish America; the city now has a national college and a nautical school. The industries include shipbuilding, and the manufacture of saddlery and other leather products, bricks and tile, rum, beer, chocolate and coco-nut oil. Maracaibo is chiefly known, however, as one of the principal commercial centres and shipping ports on the northern coast of South America. The bar at the entrance to Maracaibo channel does not admit vessels drawing more than 12 ft., but there is a depth of 30 ft. inside and near the city. Steam communication is maintained on the Catatumbo and Zulia rivers to Villamizar, and on the Escalante to Santa Cruz. The principal exports from Maracaibo are coffee, hides and skins, cabinet and dye-woods, cocoa, and mangrove bark, to which may be added dividivi, sugar, copaiba, gamela and hemp straw for paper-making, and fruits. In 1906, 26% of the coffee exports was of Colombian origin.

Maracaibo was founded in 1571 by Alonso Pacheco, who gave it the name Nueva Zamora. Up to 1668 the entrepôt for the inland settlements was a station named Gibraltar at the head of the lake, but the destruction of that station by pirates in that year transferred this valuable trade to Maracaibo. The city did not figure actively in the War of Independence until 1821 (Jan. 28), when the province declared its independence and sought an alliance with Colombia. This brought to an end the armistice between Bolívar and Morillo, and thenceforward the city experienced all the changing fortunes of war until its final capture by the revolutionists in 1823.

MARĀGHA, a town of Persia in the province of Azerbaijan, on the Safi River, in 37° 23′ N., 46° 16′ E., 80 m. from Tabriz. Pop. about 16,000. It is pleasantly situated in a narrow valley running nearly north and south at the eastern extremity of a well-cultivated plain opening towards Lake Urmia, which lies 18 m. to the west. The town is encompassed by a high wall ruined in many places, and has four gates. Two stone bridges in good condition, said to have been constructed during the reign of Hulaku Khan (1256–1265), and since then several times repaired, lead over the Safi River on the western side of the town. The place is surrounded by extensive vineyards and orchards, all well watered by canals led from the river, and producing great quantities of fruit for exportation to Russia. On a hill west of the town are the remains of a famous observatory (*rasad*) constructed under the direction of the great astronomer Nasr-ud-din of Tus. The hills west of the town consist of horizontal strata of sandstone covered with irregular pieces of basalt and the top of the hill on which the observatory stood was made level by taking away the basalt. The building, which no doubt served as a citadel as well, enclosed a space of 380 yds. by 150, and the foundations of the walls were 4½ to 5 ft. in thickness. The marble, which is known throughout Persia as Marāgha marble, is a travertine obtained at the village of Dashkesen (Turkish for "stone-breakers" (about 30 m. north-west from Maragha. It is deposited from water, which bubbles up from a number of springs in the form of horizontal layers, which at first are thin crusts and can easily be broken, but gradually solidify and harden into blocks with a thickness of 7 to 8 in. It is a singularly beautiful substance, being of pink, greenish, or milk-white colour, streaked with reddish, copper-coloured veins. An analysis of the marble gave the following result: calcium carbonate, 90·93; magnesium, ·75; iron, 1·37; manganese, 4·34; calcium sulphate, 2·30; calcium phosphate, ·24 (R. T. Günther, *Geog. Journ.* xiv. 517).

MARANHÃO, or MARANHAM (Span. *Marañon*, the name given to the upper Amazon), a northern state of Brazil, bounded N. by the Atlantic, E. and S.E. by Piauhy, S.W. and W. by Goyaz and Pará. Area, 177,569 sq. m.; pop. (1890), 430,854; (1900), 499,308. The coastal zone and the north-west corner of the state belong to the Amazon valley region, being a heavily forested plain traversed by numerous rivers. The eastern and southern parts, however, belong to the lower terraces of the great Brazilian plateau, broken by eroded river-courses between which are high open plains. There are no true mountain ranges in Maranhão, those indicated on the maps being only plateau escarpments marking either its northern margin or the outlines of river valleys. The climate is hot, and the year is divided into a wet and dry season, extreme humidity being characteristic of the former. The heat, however, is greatly modified on the coast by the south-east trade winds, and the climate is generally considered healthy, though beri-beri and eruptive diseases are common on the coast. The coast itself is broken and dangerous, there being many small indentations, which are usually masked by islands or shoals. The largest of these are the Bay of Tury-assú, facing which is the island of São João, and several others of small size, and the contiguous bays of São Marcos and São José, between which is the large island of Maranhão. The rivers of the state all flow northward to the Atlantic and a majority of them have navigable channels. The Parnahyba forms the eastern boundary of Maranhão, but it has one large tributary, the Balsas, entirely within the state. A part of the western boundary is formed by the Tocantins, and another part by the Gurupy, which separates the state from Pará. The principal rivers of the state are the Maracassumé and Tury-assú, the Mearim and its larger tributaries (the Pindaré, Grajahú, Flôres and Corda) which discharge into the Bay of São Marcos, and the Itapicurú and Monim which discharge into the Bay of São José. Like the Amazon, the Mearim has a *pororoca* or bore in its lower channel, which greatly interferes with navigation. There are a number of small lakes in the state, some of which are, apparently, merely reservoirs for the annual floods of the rainy season.

The principal industries of Maranhão are agricultural, the river valleys and coastal zone being highly fertile and being devoted to the cultivation of sugar-cane, cotton, rice, coffee, tobacco, mandioca and a great variety of fruits. The southern highlands, however, are devoted to stock-raising, which was once an important industry. Troublesome insects, vampire bats, and the failure to introduce new blood into the degenerated herds, are responsible for its decline. Agriculture has also greatly declined, the state producing for export only a comparatively small quantity of cotton, rice, sugar and *aguardiente*. Besides São Luiz, the capital of the state, the principal towns, with the population of their municipal districts in 1890, are: Caxias (19,443), Alcantara (4730), Carolina (7266), Grajahú (11,704), Tury-assú (8983) and Viana (9965).

The coast of Maranhão was first discovered by Pinzon in 1500, but it was included in the Portuguese grant of captaincies in 1534. The first European settlement, however, was made by a French trading expedition under Jacques Riffault, of Dieppe, in 1594, who lost two of his three vessels in the vicinity of the island of Maranhão, and left a part of his men on that island when he returned home. Subsequently Daniel de la Rivardière was sent to report on the place, and was then commissioned by the French crown to found a colony on the island; this was done in 1612. The French were expelled by the Portuguese in 1615, and the Dutch held the island from 1641 to 1644. In 1621 Ceará, Maranhão and Pará were united and called the "Estado do Maranhão," which was made independent of the southern captaincies. Ceará was subsequently detached, but the "state" of Maranhão remained independent until 1774, when it again became subject to the colonial administration of Brazil. Maranhão did not join in the declaration of independence of 1822, but in the following year the Portuguese were driven out by Admiral Lord Cochrane and the province became a part of the new empire of Brazil.

MARANO (accursed or banned), a term applied to Jewish Christians in Spain. Converted to Roman Catholicism under compulsion, these "New Christians" often continued to observe Jewish rites in their homes, as the Inquisition records attest. It was in fact largely due to the Maranos that the Spanish Inquisition was founded. The Maranos made rapid strides in prosperity, and "accumulated honours, wealth and popular hatred" (Lea, *History of the Spanish Inquisition*, i. 125). This was one of the causes that led to the expulsion of the Jews from Spain in 1492. Maranos emigrated to various countries, but many remained in the Peninsula. Subsequently distinguished individuals left home for more tolerant lands. The Jewish community in London was refounded by Maranos in the first half of the 17th century. Hamburg commerce, too, owed much to the enterprise of Portuguese Maranos. In Amsterdam many Maranos found asylum; Spinoza was descended from such a family. There are still remnants of Marano families in Portugal.

See Lea, *loc. cit.* and elsewhere; see index *s.v.* "New Christian"; Graetz, *History of the Jews*, Eng. trans, see index *s.v.* "Marranos"; M. Kayserling, in *Jewish Encyclopedia*, viii. 318 seq.; and for the present day *Jewish Quarterly Review*, xv. 251 seq. (I. A.)

MARASH (anc. *Germanicia-Marasion*), the chief town of a sanjak of the same name in the Aleppo vilayet, altitude 2600 ft. situated E. of the Jihan river, at the foot of Mt Taurus. The sanjak lies almost wholly in Mt Taurus, and includes the Armenian town of Zeitun. Marash is prosperous, and has a large trade in Kurd carpets and embroideries. The climate is good, except in summer. Of the population (50,000) about half are Turkish-speaking Armenians. There are a college, church and schools belonging to the American mission, a native Protestant church and a Jesuit establishment. The site, which lies near the mouths of the three main passes over the eastern Taurus—viz. those descending from Geuksun (Cocysus), Albistan-Yarpuz (Arabissus), and Malatia (Melitene)—is shown to have had early importance, not only by the occurrence of *Marasi* in Assyrian inscriptions, but by the discovery of several "Hittite" monuments on the spot. These, said to have been unearthed, for the most part, near the Kirk Geuz spring above the modern town, are now in Constantinople and America, and include an inscribed lion, once built into the wall of the citadel known in the middle ages as al-Marwani, and several *stelae*. No more is known of the place until it appears as Germanicia-Caesarea, striking imperial coins with the head of L. Verus (middle of 2nd cent. A.D.). The identification of Marash with Germanicia has been disputed, but successfully defended by Sir W. M. Ramsay; and it is borne out by the Armenian name *Kermanig*, which has been given to the place since at least the 12th century. Before the Roman period Marash doubtless shared the fortunes of the Seleucid kingdom of Commagene. *Germanicia-Marasion* played a great part in Byzantine border warfare: Heraclius was there in A.D 640; but before 700 it had passed into Saracen hands and been rebuilt by the caliph Moawiya. During the 8th and 9th centuries, when the direct pass from Cocysus came into military use, Marasion (the older name had returned into general use) was often the Byzantine objective and was more than once retaken; but after 770, when Mansur incorporated it in "Palestine" it remained definitely in Moslem power and was refortified by Harun-al-Rashid. It was seized by the crusaders after their march across Mt Taurus, A.D. 1097, became an important town of Lesser Armenia and was taken by the Seljuks in 1147. In the 16th century it was added to the Osmanli Empire by Selim I. Marash passed with the rest of Syria into Egyptian hands in 1832, and in 1839 received fugitives from the defeat of Nizib, among whom was Moltke. Ibrahim Pasha was encamped near it when directed by his father, at the bidding of the powers, to stay his further advance. Since its reversion to Ottoman power (1840) the history of Marash has been varied only by Armenian troubles, largely connected with the fortunes of Zeitun, for the reduction of which place it has more than once been used as a base. There was less disturbance there in 1895–1896 than in other north Syrian towns. (D. G. H.)

MARAT, JEAN PAUL (1743–1793), French revolutionary leader, eldest child of Jean Paul Marat, a native of Cagliari in Sardinia, and Louise Cabrol of Geneva, was born at Boudry, in the principality of Neuchâtel, on the 24th of May 1743. His father was a designer, who had abandoned his country and his religion, and married a Swiss Protestant. On his mother's death in 1759 Marat set out on his travels, and spent two years at Bordeaux in the study of medicine, whence he moved to Paris, where he made use of his knowledge of his two favourite sciences, optics and electricity, to subdue an obstinate disease of the eyes. After some years in Paris he went to Holland, and then on to London, where he practised his profession. In 1773 he made his first appearance as an author with a *Philosophical Essay on Man*. The book shows a wonderful knowledge of English, French, German, Italian and Spanish philosophers, and directly attacks Helvetius, who had in his *De l'esprit* declared a knowledge of science unnecessary for a philosopher. Marat declares that physiology alone can solve the problems of the connexion between soul and body, and proposes the existence of a nervous fluid as the true solution. In 1774 he published *The Chains of Slavery*, which was intended to influence constituencies to return popular members, and reject the king's friends. Its author declared later that it procured him an honorary membership of the patriotic societies of Carlisle, Berwick and Newcastle. He remained devoted to his profession, and in 1775 published in London a little *Essay on Gleets*, and in Amsterdam a French translation of the first two volumes of his *Essay on Man*. In this year he visited Edinburgh, and on the recommendation of certain Edinburgh physicians was made an M.D. of St Andrews. On his return to London he published an *Enquiry into the Nature, Cause, and Cure of a Singular Disease of the Eyes*, with a dedication to the Royal Society. In the same year there appeared the third volume of the French edition of the *Essay on Man*, which reached Ferney, and exasperated Voltaire, by its onslaught on Helvetius, into a sharp attack which only made the young author more conspicuous. His fame as a clever doctor was now great, and on the 24th of June 1777, the comte d'Artois, afterwards Charles X. of France, made him by brevet physician to his guards with 2000 livres a year and allowances.

Marat was soon in great request as a court doctor among the aristocracy; and even Brissot, in his *Mémoires*, admits his influence in the scientific world of Paris. The next years were much occupied with scientific work, especially the study of heat, light and electricity, on which he presented memoirs to the Académie des Sciences, but the academicians were horrified at his temerity in differing from Newton, and, though acknowledging his industry, would not receive him among them. His experiments greatly interested Benjamin Franklin, who used to visit him and Goethe always regarded his rejection by the academy as a glaring instance of scientific despotism. In 1780 he had published at Neuchâtel a *Plan de législation criminelle*, founded on the principles of Beccaria. In April 1786 he resigned his court appointment. The results of his leisure were in 1787 a new translation of Newton's *Optics*, and in 1788 his *Mémoires académiques, ou nouvelles découvertes sur la lumière*.

His scientific life was now over, his political life was to begin; in the notoriety of that political life his great scientific and philosophical knowledge was to be forgotten, the high position he had given up denied, and he himself scoffed at as an ignorant charlatan, who had sold quack medicines about the streets of Paris, and been glad to earn a few sous in the stables of the comte d'Artois. In 1788 the notables had met, and advised the assembling of the states-general. The elections were the cause of a flood of pamphlets, of which one, *Offrande à la patrie*, was by Marat, and, though now forgotten, dwelt on much the same points as the famous brochure of the Abbé Siéyès: *Qu'est-ce que le tiers état?* When the states-general met, Marat's interest was as great as ever, and in June 1789 he published a supplement to his *Offrande*, followed in July by *La constitution*, in which he embodies his idea of a constitution for France, and in September by his *Tableau des vices de la constitution d'Angleterre*, which he presented to the Assembly. The latter alone deserves remark. The Assembly was at this time full of anglomaniacs, who desired to establish in France a constitution similar to that of England. Marat had seen that England was at this time being ruled by an oligarchy using the forms of liberty, which, while pretending to represent the country, was really being gradually mastered by the royal power. His heart was now all in politics; and he decided to start a paper. At first appeared a single number of the *Moniteur patriote*, followed on the 12th of September by the first number of the *Publiciste parisien*, which on the 16th of September took the title of *L'Ami du peuple* and which he edited, with some interruptions, until the 21st of September 1792.

The life of Marat now becomes part of the history of the French Revolution. From the beginning to the end he stood alone. He was never attached to any party; the tone of his mind was to suspect whoever was in power. About his paper, the incarnation of himself, the first thing to be said is that the man always meant what he said; no poverty, no misery or persecution, could keep him quiet; he was perpetually crying, "Nous sommes trahis." Whoever suspected any one had only to denounce him to the *Ami du peuple*, and the denounced was never let alone till he was proved innocent or guilty. Marat began by attacking the most powerful bodies in Paris—the Constituent Assembly, the ministers, the corps municipal, and the court of the Châtelet. Denounced and arrested, he was imprisoned from the 8th of October to the 5th of November 1789. A second time, owing to his violent campaign against Lafayette, he narrowly escaped arrest and had to flee to London (Jan. 1790). There he wrote his *Dénonciation contre Necker*, and in May dared to return to Paris and continue the *Ami du peuple*. He was embittered by persecution, and continued his vehement attacks against all in power, and at last, after the day of the Champs du Mars (July 17, 1790), against the king himself. All this time he was in hiding in cellars and sewers, where he was attacked by a horrible skin disease, tended only by the woman Simonne Evrard, who remained true to him. The end of the Constituent Assembly he heard of with joy and with bright hopes for the future, soon dashed by the behaviour of the Legislative Assembly. When almost despairing, in December 1791, he fled once more to London, where he wrote his *Ecole du citoyen*. In April 1792, summoned again by the Cordeliers' Club, he returned to Paris, and published No. 627 of the *Ami*. The war was now the question, and Marat saw clearly that it was to serve the purposes of the Royalists and the Girondins, who thought of themselves alone. Again denounced, Marat had to remain in hiding until the 10th of August. The early days of the war being unsuccessful, the proclamation of the duke of Brunswick excited all hearts; who could go to save France on the frontiers and leave Paris in the hands of his enemies? Marat, like Danton, foresaw the massacres of September. After the events of the 10th of August he took his seat at the commune, and demanded a tribunal to try the Royalists in prison. No tribunal was formed, and the massacres in the prisons were the inevitable result. In the elections to the Convention, Marat was elected seventh out of the twenty-four deputies for Paris, and for the first time took his seat in an assembly of the nation. At the declaration of the republic, he closed his *Ami du peuple*, and commenced, on the 25th, a new paper, the *Journal de la république française*, which was to contain his sentiments as its predecessor had done, and to be always on the watch. In the Assembly Marat had no party; he would always suspect and oppose the powerful, refuse power for himself. After the battle of Valmy, Dumouriez was the greatest man in France; he could almost have restored the monarchy; yet Marat did not fear to denounce him in placards as a traitor.

His unpopularity in the Assembly was extreme, yet he insisted on speaking on the question of the king's trial, declared it unfair to accuse Louis for anything anterior to his acceptance of the constitution, and though implacable towards the king, as *the* one man who must die for the people's good, he would not allow Malesherbes, the king's counsel, to be attacked in his paper, and speaks of him as a "sage et respectable vieillard." The king dead, the months from January to May 1793 were spent in an unrelenting struggle between Marat and the Girondins. Marat despised the ruling party because they had suffered nothing for the republic, because they talked too much of their feelings and their antique virtue, because they had for their own virtues plunged the country into war; while the Girondins hated Marat as representative of that rough red republicanism which would not yield itself to a Roman republic, with themselves for tribunes, orators and generals. The Girondins conquered at first in the Convention, and ordered that Marat should be tried before the Revolutionary Tribunal. But their victory ruined them, for on the 24th of April Marat was acquitted, and returned to the Convention with the people at his back. The fall of the Girondins on the 31st of May was a triumph for Marat. But it was his last. The skin disease he had contracted in the subterranean haunts was rapidly closing his life; he could only ease his pain by sitting in a warm bath, where he wrote his journal, and accused the Girondins, who were trying to raise France against Paris. Sitting thus on the 13th of July he heard in the evening a young woman begging to be admitted to see him, saying that she brought news from Caen, where the escaped Girondins were trying to rouse Normandy. He ordered her to be admitted, asked her the names of the deputies then at Caen, and, after writing their names, said, "They shall be soon guillotined," when the young girl, whose name was Charlotte Corday (*q.v.*), stabbed him to the heart.

His death caused a great commotion at Paris. The Convention attended his funeral, and placed his bust in the hall where it held its sessions. Louis David painted "Marat Assassinated," and a veritable cult was rendered to the Friend of the People, whose ashes were transferred to the Panthéon with great pomp on the 21st of September 1794—to be cast out again in virtue of the decree of the 8th of February 1795.

Marat's name was long an object of execration on account of his insistence on the death penalty. He stands in history as a bloodthirsty monster, yet in judging him one must remember the persecutions he endured and the terrible disease from which he suffered.

Besides the works mentioned above, Marat wrote: *Recherches physiques sur l'électricité, &c.* (1782); *Recherches sur l'électricité médicale* (1783); *Notions élémentaires d'optique* (1764); *Lettres de l'observateur Bon Sens à M. de M. . . . sur la fatale catastrophe des infortunés Pilatre de Rozier et Romain, les aéronautes et l'aérostation* (1785); *Observations de M. l'amateur Avec à M. l'abbé Sans . . . &c.,* (1785); *Éloge de Montesquieu* (1785), published 1883 by M. de Bresetz; *Les Charlatans modernes, ou lettres sur le charlatanisme académique* (1791); *Les Aventures du comte Potowski* (published in 1847 by Paul Lacroix, the "bibliophile Jacob"); *Lettres polonaises* (unpublished). Marat's works were published by A. Vermorel, *Œuvres de J. P. Marat, l'ami du peuple, recueillies et annotées* (1869). Two of his tracts, (1) *On Gleets*, (2) *A Disease of the Eyes*, were reprinted, ed. J. B. Bailey, in 1891.

See A. Vermorel, *Jean Paul Marat* (1880); François Chévremont, *Marat: esprit politique, accomp. de sa vie* (2 vols., 1880); Auguste Cabanès, *Marat inconnu* (1891); A. Bougeart, *Marat, l'ami du peuple* (2 vols., 1865); M. Tourneux, *Bibliographie de l'histoire de Paris pendant la révolution française* (vol. ii., 1894; vol. iv., 1906), and E. B. Bax, *J. P. Marat* (1900). The *Correspondance de Marat* has been edited with notes by C. Villay (1908). (R. A.*)

MARATHI (properly *Marāṭhī*),[1] the name of an important Indo-Aryan language spoken in western and central India. In 1901 the number of speakers was 18,237,899, or about the same as the population of Spain. Marathi occupies an irregular triangular area of approximately 100,000 sq.m., having its apex about the district of Balaghat in the Central Provinces, and for its base the western coast of the peninsula from Daman on the Gulf of Cambay in the north to Karwar on the open Arabian Sea in the south. It covers parts of two provinces of British India—Bombay and the Central Provinces (including Berar)—with numerous settlers in Central India and Madras, and is also the principal language of Portuguese India and of the north-western portion of His Highness the Nizam's dominions. The standard form of speech is that of Poona in Bombay, and, in its various dialects it covers the larger part of that province, in which it is the vernacular of more than eight and a half millions of people.

As explained in the article Indo-Aryan Languages, there were in ancient times two main groups of these forms of speech—one, the language of the Midland, spoken in the country near the Gangetic Doab, and the other, the languages of the so-called "Outer Band," containing the Midland on three sides, west, east and south. The country to the south of the Midland, in which members of this Outer group of languages were formerly spoken, included the modern Rajputana and Gujarat, and extended to the basin of the river Nerbudda, being bounded on the south by the Vindhya hills. In the course of time the population of the Midland expanded, and gradually occupied this tract, reaching the sea in Gujarat. The language of the Outer Band was thus forced farther afield. Its speakers crossed the Vindhyas and settled in the central plateau of the Deccan and on the Konkan coast. Here they came into contact with speakers of the Dravidian languages of southern India. As happened elsewhere in India, they retained their own Aryan tongue, and gradually through the influence of their superior civilization imposed it upon the aborigines, so that all the inhabitants of this tract became the ancestors of the speakers of modern Marathi.

In Rajputana and Gujarat the language (see Gujarat) is to a certain extent mixed. Near the original Midland there are few traces of the Outer language, but as we go farther and farther away from that centre we find, as might be expected, the influence of the Midland language becoming weaker and weaker, and traces of the Outer language becoming more and more evident, until in Gujarati we recognize several important survivals of the old language once spoken by the earlier Aryan inhabitants.

Dialects.—Besides the standard form of speech, there is only one real dialect of Marathi, viz. Konkani (Kōnkaṇī), spoken in the country near Goa. There are also several local varieties, and we may conveniently distinguish between the Marathi of the Deccan, that of the Central Provinces (including Berar), and that of the northern and central Konkan. In the southern part of the district of Ratnagiri this latter Konkani variety of Marathi gradually merges into the true Konkani dialect through a number of intermediate forms of speech. There are also several broken jargones, based upon Marathi, employed by aboriginal tribes surviving in the hill country.

Relations with other Indo-Aryan Languages.—Marathi has to its north, in order from west to east, Gujarati, Rajasthani, Western Hindi and Eastern Hindi. To its east and south it has the Dravidian languages, Gondi, Telugu and Kanarese. Elsewhere in India Aryan languages gradually fade away into each other, so that it is impossible to fix any definite boundary line between them. But this is not the case with Marathi. It does not merge into any of the cognate neighbouring forms of speech, but possesses a distinct linguistic frontier. A native writer[2] says: "The Gujarati language agrees very closely with the languages of the countries lying to the north of it, because the Gujarati people came from the north. If a native of Delhi, Ajmere, Marwar, Mewar, Jaipur, &c., comes into Gujarat, the Gujarati people find no difficulty in understanding his language. But it is very wonderful that when people from countries bordering Gujarat on the south, as the Konkan, Maharashtra, &c.

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[1] The name is sometimes spelt *Mahrāṭhī*, with an *h* before the *r*, but, according to a phonetic law of the Aryan languages of western India, this is incorrect. The original *h* in "Māhārāṣṭrī," from which the word is derived, is liable to elision on coming between two vowels.

[2] Shastri Vrajlal Kalidas, quoted by Beames in *Comparative Grammar*, i. 102.

(*i.e.* people speaking Marathī) come to Gujarat, the Gujarati people do not in the least comprehend what they say." This isolated character of Marathi is partly due to the barrier of the Vindhya range which lies to its north, and partly to the fact that none of the northern languages belongs now to the Outer Band, but are in more or less close relationship to the language of the Midland. There was no common ground either physical or linguistic, upon which the colliding forms of speech could meet on equal terms. Eastern Hindi is more closely related to Marathi than the others, and in its case, in its bordering dialects, we do find a few traces of the influence of Marathi—traces which are part of the essence of the language, and not mere borrowed waifs floating on the top of a sea of alien speech and not absorbed by it.

Written Character.—Marathi books are generally printed in the well-known Nagari character (see SANSKRIT), and this is also used to a great extent in private transactions and correspondence. In the Maratha country it is known as the *Bālbōdh* ("teachable to children," *i.e.* "easy") character. A cursive form of Nagari called *Mōḍī*, or "twisted," is also employed as a handwriting. It is said to have been invented in the 17th century by Balaji Avaji, the secretary of the celebrated Sivaji. Its chief merit is that each word can be written as a whole without lifting the pen from the paper, a feat which is impossible in the case of Nagari.[1]

Origin of the Language.—The word "Marāṭhī" signifies (the language) of the Maratha country. It is the modern form of the Sanskrit *Māhārāṣṭrī*, just as "Marāṭhā" represents the old *Māhā-rāṣṭra*, or Great Kingdom. *Māhārāṣṭrī* was the name given by Sanskrit writers to the particular form of Prakrit spoken in Mahārāṣṭra, the great Aryan kingdom extending southwards from the Vindhya range to the Kistna, broadly corresponding to the southern part of the Bombay Presidency and to the state of Hyderabad. As pointed out in the article PRAKRIT this Māhārāṣṭrī early obtained literary pre-eminence in India, and became the form of Prakrit employed as the language not only of lyric poetry but also of the formal epic (*kāvya*). Dramatic works were composed in it, and it was the vehicle of the non-canonical scriptures of the Jaina religion. The oldest work in the language of which we have any knowledge is the *Sattasaī*, or Seven Centuries of verses, compiled at Pratisthāna, on the Gōdāvarī, the capital of King Hāla, at some time between the 3rd and 7th centuries A.D. Pratiṣṭhāna is the modern Paithan in the Aurangabad district of Hyderabad, and that city was for long famous as a centre of literary composition. In later times the political centre of gravity was changed to Poona, the language of which district is now accepted as the standard of the best Marathi.

General Character of the Language.—In the following account of the main features of Marathi, the reader is presumed to be familiar with the leading facts stated in the articles INDO-ARYAN LANGUAGES and PRAKRIT. In the Prakrit stage of the Indo-Aryan languages we can divide the Prakrits into two well-defined groups, an Inner, Śaurasēnī and its connected dialects on the one hand, and an Outer, Māhārāṣṭrī, Ardhamāgadhī, and Māgadhī with their connected dialects on the other. These two groups differed in their phonetic laws, in their systems of declension and conjugation, in vocabulary, and in general character.[2] In regard to the last point reference may be made to the frequent use of meaningless suffixes, such as *-alla*, *-illa*, *-ulla*, &c., which can be added, almost *ad libitum* to any noun, adjective or particle in Māhārāstrī and Ardhamāgadhī, but which are hardly ever met in Śaurasēnī. These give rise to numerous secondary forms of words, used, it might be said, in a spirit of playfulness, which give a distinct flavour to the whole language. Similarly the late Mr Beames (*Comparative Grammar*, i. 103) well describes Marathi as possessing "a very decided individuality, a type quite its own, arising from its comparative isolation for so many centuries." Elsewhere (p. 38) he uses language which would easily well apply to Māhārāṣṭrī Prakrit when he says, "Marathi is one of those languages which we may call playful—it delights in all sorts of jingling formations, and has struck out a larger quantity of secondary and tertiary words, diminutives, and the like, than any of the cognate tongues," and again (p. 52):—

> "In Marathi we see the results of the Pandit's file applied to a form of speech originally possessed of much natural wildness and licence. The hedgerows have been pruned and the wild briars and roses trained into order. It is a copious and beautiful language, second only to Hindi. It has three genders, and the same elaborate preparation of the base as Sindhi, and, owing to the great corruption which has taken place in its terminations, the difficulty of determining the gender of nouns is as great in Marathi as in German. In fact, if we were to institute a parallel in this respect, we might appropriately describe Hindi as the English, Marathi as the German of the Indian group—Hindi having cast aside whatever could possibly be dispensed with, Marathi having retained whatever has been spared by the action of time. To an Englishman Hindi commends itself by its absence of form, and the positional structure of its sentences resulting therefrom; to our High-German cousins the Marathi, with its fuller array of genders, terminations, and inflexions, would probably seem the completer and finer language."

In the article PRAKRIT it is explained that the literary Prakrits were not the direct parents of the modern Indo-Aryan vernaculars. Each Prakrit had first to pass through an intermediate stage—that of the Apabhramśa—before it took the form current at the present day. While we know a good deal about Māhārāṣṭrī and very little about Śaurasēnī Prakrit, the case is reversed in regard to their respective Apabhramśas. The Śaurasēnā Apabhramśa is the only one concerning which we have definite information. Although it would be quite possible to reason from analogy, and thus to obtain what would be the corresponding forms of Māhārāstra Apabhramśa, we should often be travelling upon insecure ground, and it is therefore advisable to compare Marathi, not with the Apabhramśa from which it is immediately derived, but with its grandmother, Māhārāṣṭrī Prakrit. We shall adopt this course, so far as possible, in the following pages.

Vocabulary.—In the article INDO-ARYAN LANGUAGES it is explained that, allowing for phonetic development, the vocabulary of Śaurasēnī Prakrit was the same as that of Sanskrit, but that the farther we go from the Midland, the more examples we meet of a new class of words, the so-called *dēśyas*, descendants of the old Primary Prakrits spoken outside the Midland, and strange to Sanskrit. Māhārāṣṭri Prakrit, the most independent of the Outer languages, was distinguished by the large proportion of these *dēśyas* found in its vocabulary, and the same is consequently the case in Marathi. The Brahmins of the Maratha country have always had a great reputation for learning, and their efforts to create a literary language out of their vernacular took, as in other parts of India, the direction of borrowing *tatsamas* from Sanskrit, to lend what they considered to be dignity to their sentences. But the richness of the language in *dēśya* words has often rendered such borrowing unnecessary, and has saved Marathi, although the proportion of *tatsamas* to *tadbhavas*[3] in the language is more than sufficiently high, from the fate of the Pandit-ridden literary Bengali, in which 80 to 90 % of the vocabulary is pure Sanskrit. There is indeed a tradition of stylistic chastity in the Maratha country from the earliest times, and even Sanskrit writers contrasted the simple elegance of the Deccan (or *Vaidarbhī*) style with the flowery complexity of eastern India.

The proportion of Persian and, through Persian, of Arabic words in the Marathi vocabulary is comparatively low, when compared with, say, Hindostani. The reason is, firstly, the predominance in the literary world of these learned Brahmins, and, secondly, the fact that the Maratha country was not conquered by the Mussulmans till a fairly late period, nor was it so thoroughly occupied by them as were Sind, the Punjab, and the Gangetic valley.

Phonetics.[4]—In the standard dialect the vowels are the same as in Sanskrit, but ṛ and ḷ only appear in words borrowed directly from that language (*tatsamas*). Final short vowels (*a*, *i* and *u*) have all disappeared in prose pronunciation, except in a few local dialects, and final *i* and *u* are not even written. On the other hand, in the Nagari character, the non-pronunciation of a final *a* is not indicated. After an accented syllable a medial *a* is pronounced very lightly, even when the accent is not the main accent of the word. Thus, if we indicate the main accent by ′, and subsidiary accents (equivalent to the Hebrew *methegh*) by , then the word *kárawat*, a saw, is pronounced *kárᵃwat*; and *kàḷakáḷaṇē̃*, to be agitated, is pronounced *kàḷᵃkáḷᵃṇē̃*. In Konkani the vowel *a* assumes the sound of *o* in "hot," a sound which is also heard in the language of Bengal. In dialectic speech *ē̃* is often interchangeable with short or long *a*, so that the standard *sā̃ngitᵃlē̃*, it was said, may appear as *sā̃ngitᵃlā* or *sā̃ngitᵃlā̃*. The vowels *ē* and *ō* are apparently always long in the standard dialect, thus following Sanskrit; but in Konkani there is a short and a long form of each vowel. Very probably, although the distinction is not observed in writing, and has not been noticed by native scholars, these vowels are also pronounced short in the standard dialect under the circumstances to be now described. When a long *ā*, *ī* or *ū* precedes an accented syllable it is usually shortened. In the case of *ā* the shortening is not indicated by the spelling, but the written long *ā* is pronounced short like the *ă* in the Italian *ballo*. Thus, the dative of *pīk*, a ripe crop, is *pikā́s*, and that of *hāt*, a hand, is *hātā́s*, pronounced *hătā́s*. Almost the only compound consonants which survived in the Prakrit stage were double letters, and in M. these are usually simplified, the preceding vowel being lengthened in compensation. Thus, the Prakrit *kannō* becomes *kān*, an ear; Pr. *bhikkhā* becomes *bhīk*, alms; and Pr. *puttō* becomes *pūt*, a son. In the Piśāca (see INDO-ARYAN LANGUAGES) and other languages of north-western India it is not usual to lengthen the vowel in compensation, and the same tendency is observable in Konkani, which, it may be remarked, appears to contain many relics of the old Prakrit (Saurāṣṭrī) spoken in the Gujarat country before the invasion from the Midland. Thus, in Konkani, we have *put* as well as *pūt*, while the word corresponding to the Pr. *ekkō*, one, is *ek* as well as the standard *ēk*.

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[1] See B. A. Gupte in *Indian Antiquary* (1905), xxxiv. 27.

[2] For details see Dr Sten Konow's article on Māhārāstrī and Marāthī in *Indian Antiquary* (1903), xxxii. 180 seq.

[3] For the explanation of these terms see INDO-ARYAN LANGUAGES.

[4] Abbreviations: Skr. = Sanskrit. Pr. = Māhārāṣṭrī Prakrit. M. = Marathi.

On the whole, the consonantal system is much the same as in other Indian languages. Nasalization of long vowels is very common, especially in Konkani. In this article it is indicated by the sign ˜ placed over the affected vowel. The palatals are pronounced as in Skr. in words borrowed from that language or from Hindostani, and also in Marathi *tadbhavas* before *i*, *ī*, *ē* or *y*. Thus, *caṇḍ* (*tatsama*), fierce; *jamā* (Hindostani), collected; *cikhal* (M. *tadbhava*), mud. In other cases they are pronounced *ts*, *tsh*, *dz*, *dzh* respectively. Thus *tsākar* (for *cākar*), a servant; *dzāṇē̃* (for *jāṇē̃*), to go. There are two *s*-sounds in the standard dialect which are very similarly distinguished. *Ś*, pronounced like an English *sh*, is used before *i*, *ī*, *ē* or *y*; and *s*, as in English "sin," elsewhere. Thus, *śimphī*, a caste-name; *śīl*, a stone; *śēt*, a field; *śyām*, dark blue; but *sāp*, a snake; *sumār* (Persian *shumār*), an estimate; *strī*, a woman. In the dialects *s* is practically the only sibilant used, and that is changed by the vulgar speakers of Konkani to *h* (again as in north-western India). Aspirated letters show a tendency to lose their aspiration, especially in Konkani. Thus, *bhīk* (for *bhīkh*), alms, quoted above; *hāt* (Pr. *hatthō*), a hand. In Konkani we have words such as *boiṇ*, a sister, against standard *bhain*; *gēr*, standard *gharī*, in a house; *āmī*, standard *āmhī*, we. Here again we have agreement with north-western India. Generally speaking Marathi closely follows Māhārāṣṭrī when that differs from the Prakrits of other parts of India. Thus we have Skr. *vrajati*, Māhārāṣṭrī *vaccai* (instead of *vajjai*), he goes; Konkani *votsū̃*, to go; Saurasēnī *genhiduim*, Māhārāṣṭrī *ghettuṁ*, to take; Marathi *ghētᵃlē̃*, taken. There is similarly both in Marathi and Māhārāṣṭrī a laxness in distinguishing between cerebral and dental letters (which again reminds us of north-western India). Thus, Skr. *daśati*, Māhārāṣṭrī *ḍasai*, he bites; M. *dasᵃṇē̃* to bite; Skr. *dahati*, Māhārāṣṭrī *ḍahai*, he burns; M. *ḍādzᵃṇē̃*, to be hot; Skr. *gardabhas*; Saurasēnī *gaddahō*; Hindostani *gadhā*; but Māhārāṣṭrī *gaḍḍahō*; M. *gāḍhav*, an ass; and so many others. In Māhārāṣṭrī every *n* becomes *ṇ*, but in Jaina MSS. when the *n* was initial or doubled it remained unchanged. A similar rule is followed regarding *l* and the cerebral *ḷ* common in Vedic Sanskrit, in MSS. coming from southern India, and, according to the grammarians, also in the Piśāca dialects of the north-west. In M. a Pr. double *nn* or *ll* is simplified, according to the usual rule, to *n* or *l* respectively, with lengthening of the preceding vowel in compensation. Both *ṇ* and *ḷ* are of frequent occurrence in M., but only as medial letters, and then only when they represent *ṇ* or *ḷ* in the Pr. stage. When the letter is initial or represents a double *nn* or *ll* of Pr. it is always *n* or *l* respectively, thus offering a striking testimony to the accuracy of the Jaina and southern MSS. Thus, ordinary Māhārāṣṭrī *ṇa*; but Jaina Māhārāṣṭrī *na*, M. *na*, not; Māhārāṣṭrī (both kinds) *ghaṇō*, M. *ghaṇ*, dense; Māhārāṣṭrī *soṇṇaaṁ*, Jaina *sonnaaṁ*, M. *sōnē̃*, gold; Māhārāṣṭrī *kālō*, time, southern MSS. of the same *kāḷō*, M. *kāḷ*, time; Māhārāṣṭrī *callai*, M. *tsālē*, he goes or used to go. In some of the local dialects, following the Vedic practice, we find *ḷ* where *ḍ* is employed elsewhere, as in (Berar) *ghōḷā* for *ghōḍā*, a horse; and there are instances of this change occurring even in Māhārāṣṭrī; *e.g.* Skr. *taḍagaṁ*, Māhārāṣṭrī *taḷāaṁ*, M. *taḷē̃*, a pond.

The Skr. compound consonant *jñ* is pronounced *dny* in the standard dialect, but *gy* in the Konkan. Thus, Skr. *jñānaṁ* becomes *dnyān* or *gyān* according to locality.

Declension.—Marathi and Gujarati are the only Indo-Aryan languages which have retained the three genders, masculine, feminine and neuter, of Sanskrit and Prakrit. In rural dialects of Western Hindi and of Rajasthani sporadic instances of the neuter gender have survived, but elsewhere the only example occurs in the interrogative pronoun. In Marathi the neuter denotes not only inanimate things but also animate beings when both sexes are included, or when the sex is left undecided. Thus, *ghōḍē̃*, neut., a horse, without regard to sex. In the Konkan the neuter gender is further employed to denote females below the age of puberty, as in *cē̃ḍū̃*, a girl. Numerous masculine and feminine words, however, denote inanimate objects. The rules for distinguishing the gender of such nouns are as complicated as in German, and must be learned from the grammars. For the most part, but not always, words follow the genders of their Skr. originals; and the abrasion of terminations in the modern language renders it impossible to lay down any complete set of rules on the subject. We may, however, say that strong bases (see below) in *ā*—and these do not include *tatsamas*—are masculine, and that the corresponding feminine and neuter words end in *ī* and *ē̃* respectively. Thus, *mulᵃgā*, a son; *mulᵃgī*, a daughter; *mulᵃgē̃*, a child of so and so. As a further guide we may say that sex is usually distinguished by the use of the masculine and feminine genders, and that large and powerful inanimate objects are generally masculine, while small, delicate things are generally feminine. In the case of some animals (as in our "horse" and "mare") sex is distinguished by the use of different words; *e.g.* *bŏkaḍ*, he-goat, and *śē̃ḷī*, a nanny-goat.

The nominative form of a *tadbhava* word is derived from the nominative form in Sanskrit and Prakrit, but *tatsama* words are generally borrowed in the form of the Sanskrit crude base. Thus, Skr. crude base *mālin*, nom. sing. *mālī*; Pr. nom. *māliō* (*māḷiō*); M. *māḷī* (*tadbhava*), a gardener; Skr. base *mati-*; nom. *matis*; M. *mati* (*tatsama*). Some *tatsamas* are, however, borrowed in the nominative form, as in Skr. *dhanin*, nom. *dhanī*; M. *dhanī*, a rich man. In Prakrit the nominative singular of many masculine *tatsamas* ended in *ō*. In the Apabhraṁśa stage this *ō* was weakened to *u*, and in modern Marathi, under the general rule, this final short *u* was dropped, the noun thus reverting as stated above to the form of the Sanskrit crude base. But in old Marathi, the short *u* was still retained. Thus, the Sanskrit *īśvaras*, lord, became, as a Prakrit *tatsama*, *īśvarō*, which in Apabhraṁśa took the form *īśvaru*. The old Marathi form was also *īśvaru*, but in modern Marathi we have *īśvar*. *Tadbhavas* derived from Sanskrit bases in *a* are treated very similarly, the termination being dropped in the modern language. Thus, Skr. nom. masc. *karṇas*, Pr. *kannō*, M. *kān*; Skr. nom. sing. fem. *khaṭvā*, Pr. *khaṭṭā*, M. *khāṭ*, a bed; Skr. nom. sing. neut. *gṛhaṁ*, Pr. *gharaṁ*, M. *ghar*, a house. Sometimes the Skr. nom. sing. fem. of these nouns ends in *ī*, but this makes no difference, as in Skr. and Pr. *cullī*, M. *cūl*, a fireplace. There is one important set of exceptions to this rule. In the article PRAKRIT attention is drawn to the frequent use of pleonastic suffixes, especially of *-(a)ka-* (masc. and neut.), *-(i)kā* (fem.). This could in Sanskrit be added to any noun, whatever the termination of the base might be. In Prakrit the *k* of this suffix, being medial, was elided, so that we get forms like Skr. nom. sing. masc. *ghōṭa-kas*, Pr. *ghōḍa-ō*, M. *ghōḍā*, a horse; Skr. nom. sing. fem. *ghōṭi-kā*, Pr. *ghōḍi-ā*, M. *ghōḍī*, a mare; Skr. *ghōṭa-kaṁ*, Pr. *ghōḍa-(y)aṃ*, M. *ghōḍē*, a horse (without distinction of sex). Such modern forms made with this pleonastic suffix, and ending in *ā*, *ī* or *ē̃* are called "strong forms," while all those made without it are called "weak forms." As a rule the fact that a noun is in a weak or a strong form does not affect its meaning, but sometimes the use of a masculine strong form indicates clumsiness or hugeness. Thus *bhākar* (weak form) means "bread," while *bhākᵃrā* (strong form) means "a huge loaf of bread." The other pleonastic suffixes mentioned under PRAKRIT are also employed in Marathi, but usually with specific senses. Thus the suffix *-illa-* generally forms adjectives, while *-ḍa-ka-* (in M. *-ḍā*, fem. *-ḍī*, neut. *-ḍē̃*) implies contempt.

The synthetic declension of Sanskrit and Prakrit has been preserved in Marathi more completely than in any other Indo-Aryan language. While Māhārāṣṭrī Prakrit, like all others, passed through the Apabhraṁśa stage in the course of its development, the conservative character of the language retained even in that stage some of the old pure Māhārāṣṭrī forms. In the article PRAKRIT we have seen how there gradually arose a laxity in distinguishing the cases. In Māhārāṣṭrī the Sanskrit dative fell into almost entire disuse, the genitive being used in its place, while in Apabhraṁśa the case terminations become worn down to *-hu*, *-ho*, *-hi*, *-hī* and *-hā̃*, of which *-hi* and *-hī* were employed for several cases, both singular and plural. There was also a marked tendency for these terminations to become confused, so that in the earliest stages of most of the modern Indo-Aryan vernaculars we find *-hi* freely employed for any oblique case of the singular, and *-hī* for any oblique case of the plural. Another feature of Prakrit was the simplification of the complicated declensional system of Sanskrit by assimilating it in all cases to the declension of *a*-bases, corresponding to the first and second declensions in Latin.

In the formation of the plural the Prakrit declensions are very closely followed by Marathi. We shall confine our remarks to *a*-bases, which may be either weak or strong forms, and of which the feminine ends sometimes in *ā*, and sometimes in *ī*. In Prakrit the nom. plur. of these nouns ends masc. *ā*, fem. *āō*, *īō*, neut. *āiṁ*. We thus get the following:—

	Masculine.		Feminine.				Neuter.	
	Nom. Sing.	Nom. Plur.	Nom. Sing.	Nom. Plur.	Nom. Sing.	Nom. Plur.	Nom. Sing.	Nom. Plur.
Weak form.								
Prakrit . . .	*kannō*, an ear.	*kannā*	*khaṭṭā*, a bed.	*khaṭṭāō*	*cullī*, a fireplace.	*cullīō*	*gharaṁ*, a house.	*gharāiṁ*
Marathi . .	*kān*	*kān*	*khāṭ*	*khāṭā*	*cūl*	*cūlī*	*ghar*	*gharẽ*
Strong form.								
Prakrit	*ghōḍaō*, a horse.	*ghōḍayā*	*ghōḍiā*, a mare.	*ghōḍiāō*	—	—	**ghōḍayaṁ*, a horse.	**ghōḍayāiṁ*
Marathi	*ghōḍā*	*ghōḍẽ*	*ghōḍī*	*ghōḍyā*	—	—	*ghōḍẽ*	*ghōḍī*

Several of the old synthetic cases have survived in Marathi, especially in the antique form of the language preserved in poetry. Most of them have fallen into disuse in the modern prose language. We may note the following, some of which have preserved the Māhārāṣṭrī forms, while others are directly derived from the Apabhraṁśa stage of the language. We content ourselves with giving some of the synthetic cases of one noun, a weak neuter *a*-base, *ghar*, a house.

	Māhārāṣṭrī Prakrit.	Apabhraṁśa.	Marathi.
Sing.			
Nominative .	*gharaṁ*	*gharu*	*ghar*
Dative . .	*gharassa* (genitive)	*gharaho* (genitive)	*gharās* (dative)
Locative . .	*gharē*	*gharahi* (-*hĩ*)	*gharĩ*, *gharā*
General oblique	*gharassa* (genitive)	*gharaho* (genitive)	*gharās*, *gharā*
Plur.			
Nominative .	*gharāiṁ*	*gharaĩ*	*gharẽ*
Locative .	*gharēsu*	*gharahi* (-*hĩ*)	*gharĩ*
General oblique	*gharāṇa* (genitive)	*gharahā̃* (genitive)	*gharā̃*

As already stated, in Prakrit the genitive is employed instead of the dative, and thus forms the basis of the Marathi dative singular. The genitive plural is not used as a dative plural in Marathi, but it is the basis of the plural general oblique case. The Marathi singular general oblique case is really the same as the Marathi dative singular, but in the standard form of speech when so used the final *s* is dropped, *gharās*, as a general oblique case, being only found in dialects. This general oblique case is the result of the confusion of the various oblique cases originally distinguished in Sanskrit and in literary Prakrit. In Apabhraṁśa the genitive began to usurp the function of all the other cases. It is obvious that if it were regularly employed in so indeterminate a sense, it would give rise to great confusion. Hence when it was intended to show clearly what particular case was meant, it became usual to add, to this indeterminate genitive, defining particles corresponding to the English "of," "to," "from," "by," &c., which, as in all Indo-Aryan languages they follow the main word, are called "postpositions." Before dealing with these, it will be convenient to give the modern Marathi synthetic declension of the commoner forms of nouns. The only synthetic case which is now employed in prose is the dative, and this can always be formed from the general oblique case by adding an *s* to the end of the word. It is therefore not given in the following table.

	Masculine.			Feminine.			Neuter.		
Meaning.	Ear.	Horse.	Gardener.	Bed.	Fireplace.	Mare.	House.	Horse.	Pearl.
Sing.									
Nom.	*kān*	*ghōḍā*	*māḷī*	*khāṭ*	*cūl*	*ghōḍī*	*ghar*	*ghōḍẽ*	*mōtī*
Gen. obl. . .	*kānā*	*ghōḍyā*	*māḷyā*	*khāṭē*	*cūlī*	*ghōḍī*	*gharā*	*ghōḍyā*	*mōtyā*
Plur.									
Nom.	*kān*	*ghōḍẽ*	*māḷī*	*khāṭā*	*cūlī*	*ghōḍyā*	*gharẽ*	*ghōḍĩ*	*mōtyẽ*
Gen. obl. . .	*kānā̃*	*ghōḍyā̃*	*māḷyā̃*	*khāṭā̃*	*cūlī*	*ghōḍyā̃*	*gharā̃*	*ghōḍyā̃*	*mōtyā̃*

The usual postpositions are:—

Instrumental: *nẽ*, plural *nĩ*, by. Dative: *lā*, plural also *nā*, to or for. Ablative: *hūn*, *ūn*, from. Genitive: *tsā*, of. Locative: ˜*t*, in. We thus get the following complete modern declension of *ghar*, a house (neut.):—

	Sing.	Plur.
Nom.	*ghar*	*gharẽ*
Acc.	*ghar*	*gharẽ*
Instr.	*gharānẽ*	*gharā̃nĩ*
Dat.	*gharās*, *gharālā*	*gharā̃s*, *gharā̃lā*, *gharā̃nā*
Abl.	*gharāhūn*, *gharūn*	*gharā̃hūn*
Gen.	*gharātsā*	*gharā̃tsa*
Loc.	*gharā̃t*	*gharā̃t*

The accusative is usually the same as the nominative, but when definiteness is required the dative is employed instead. The termination *ṇẽ*, with its plural *nĩ*, is, as explained in the article GUJARATI, really the oblique form, by origin a locative, of the *nā* or *nō*, employed in Gujarati to form the genitive. The suffix *nā* of the dative plural is derived from the same word. Here it is probably a corruption of the Apabhraṁśa *nāu* or *naho*. The postposition *lā* is probably a corruption of the Sanskrit *lābhē*, Apabhraṁśa *lahi*, for the benefit (of). As regards the ablative, we have in old Marathi poetry a form corresponding to *gharāhu-niyā̃*, which explains the derivation. *Gharāhu* is a by-form of the Prakrit synthetic ablative *gharāu*, to which *niyā*, another oblique form of *nā*, is added to define the meaning. The locative termination ˜*t* is a contraction of the Pr. *antō*, Skr. *antar*, within.

The genitive *gharātsā* is really an adjective meaning "belonging to the house," and agrees in gender, number and case with the noun which is possessed. Thus:

māḷyātsā ghōḍā, the gardener's horse. *māḷyācē ghōḍē*, the gardener's horses.
māḷyācī ghōḍī, the gardener's mare. *māḷyācyā ghōḍyā*, the gardener's mares.
māḷyācẽ ghōḍẽ, the gardener's horse (neut.). *māḷyācĩ ghōḍĩ*, the gardener's horses (neut.).

The suffix *tsā*, *cī*, *cẽ*, is derived from the Sanskrit suffix *tyakas*, Pr. *caō*, which is used in much the same sense. In Sanskrit it may be added either to the locative or to the unmodified base of the word to which it is attached, thus, *ghōṭakē-tyakas* or *ghōṭaka-tyakas*. Similarly in Marathi, while it is usually added to the general oblique base, it may also be added to the unmodified noun, in which case it has a more distinctly adjectival force. The use of *tsā* has been influenced by the fact that the Sanskrit word *kṛtyas*, Pr. *kiccaō*, also takes the same form in Marathi. As explained in the article HINDOSTANI, synonyms of this word are used in other Indo-Aryan languages to form suffixes of the genitive.[1]

Strong adjectives, including genitives, can be declined like substantives, and agree with the qualified noun in gender, number and case. When the substantive is in an oblique case, the adjective is put into the general oblique form without any defining postposition, which is added to the substantive alone. Weak adjectives are not inflected in modern prose, but are inflected in poetry. As in other Indo-Aryan languages, comparison is effected by putting the noun with which comparison is made in the ablative case.

The pronouns closely follow the Prakrit originals. The origin of all these is discussed in the article HINDOSTANI, and the account need not be repeated here. As usual in these languages, there is no pronoun of the third person, its place being supplied by the demonstratives. The following are the principal pronominal forms:—

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[1] Fuller information regarding all the above postpositions will be found in G. A. Grierson's article "On Certain Suffixes in the Modern Indo-Aryan Vernaculars," on pp. 473 seq. of the *Zeitschrift für vergleichende Sprachforschung* for 1903.

mī, I, instr. *mī*, *myā*, dat. *malā*, obl. *mads*; *āmhī*, we, instr. *āmhī*, obl. *āmhā*; *mādshā*, my, of me; *āmtsā*, our, of us.

tū, thou, instr. *tū*, *twā*, dat. *tulā*, obl. *tuds*; *tumhī*, you, instr. *tumhī*, obl. *tumhā*; *tudshā*, thy, of thee; *tumtsā*, your, of you.

āpaṇ, self, obl. *āpᵃṇa*, gen. *āpᵃlā*. This is also employed as an honorific pronoun of the second person, and, in addition, to mean "we including you."

hā, this, fem. *hī*, neut. *hẽ*; *tō*, he, that, fem. *tī*, neut. *tẽ*; *dzō*, who, fem. *jī*, neut. *jẽ*.

kōṇ, who? *kāy*, what? obl. *kāśa*; *kōṇī*, any one; *kāhī*, anything.

In all these the plural is employed honorifically instead of the singular.

Conjugation.—In Prakrit (*q.v.*) the complicated system of Sanskrit conjugation had already disappeared, and all verbs fell into two classes, the first, or *a*-, conjugation, and the second, or *ē*-, conjugation, in which the *ē* represents the *aya* of the Sanskrit tenth conjugation and of causal and denominative verbs. Marathi follows Prakrit in this respect and has two conjugations. The first, corresponding to the Prakrit *a*-class, as a rule consists of intransitive verbs, and the second, corresponding to the *e*- or causal class, of transitive verbs, but there are numerous exceptions. Verbs whose roots end in vowels or in *h* belong partly to one and partly to the other conjugation. These conjugations differ only in the present and past participles and in the tenses formed from them. Here, in the first conjugation an *a*, and in the second conjugation an *i*, is inserted between the base and the termination.

The only original Prakrit tenses which have survived in Marathi are the present and the imperative. The present has lost its original meaning and is now a habitual past. It is also the base of the Marathi future. These three tenses, the habitual past, the imperative and the future, are conjugated as follows. They should be compared with the corresponding forms in the article PRAKRIT. The verb selected is the root *uṭh*, rise, of the first conjugation.

Person.	Habitual past (old present), I used to rise.		Imperative. Let me rise.		Future. I shall rise.	
	Sing.	Plural.	Sing.	Plural.	Sing.	Plural.
1	*uṭhẽ*	*uṭhũ*	*uṭhũ*	*uṭhũ*	*uṭhēn*	*uṭhū*
2	*uṭhẽs*	*uṭhā*	*uṭh*	*uṭhā*	*uṭhᵃśīl*	*uṭhāl*
3	*uṭhẽ*	*uṭhat*	*uṭhō*	*uṭhōt*	*uṭhēl*	*uṭhᵃtīl*

As in Rajasthani, Bihari and the Indo-Aryan language of Nepal (see PAHARI), the future is formed by adding *l*, or in the first person singular *n*, to the old present. In the second person singular the *l* has been added to a form derived from the Pr. *uṭṭhasi*, which is also the origin of the old present *uṭhẽs*. Some scholars, however, see in *uṭhaśī* a derivation of the Prakrit future *uṭṭhihisi*, thou shalt arise, and a confusion of the Prakrit present and future is quite possible.

The remaining tenses are modern forms derived from the participles. The verbal nouns, participles and infinitives are as follows:—

	Prakrit (First Conjugation).	Marathi First Conjugation.	Marathi Second Conjugation.
Verbal Noun	*uṭṭhaṇīaṁ*	*uṭhᵃṇẽ*, the act of rising.	*mārᵃṇẽ*, the act of killing.
Infinitive	*uṭṭhiuṁ*	*uṭhũ*, to rise.	*mārũ*, to kill.
Present Participle	*uṭṭhantō*, *uṭṭhantaō*	*uṭhat*, *uṭhᵃtā*, rising.	*mārīt*, *māritā*, killing.
Past Participle	*uṭṭhiallaō*	*uṭhᵃlā*, risen.	*mārilā*, killed.
Future Participle Active	*uṭṭhaṇaaḍō*	*uṭhᵃṇār*, about to rise.	*mārᵃṇār*, about to kill.
Future Participle Passive	*uṭṭhiavvaō*	*uṭhāwā*, about to be risen.	*mārāwā*, about to be killed
Conjunctive Participle	*uṭṭhiu*	*uṭhūn*, having risen.	*mārūn*, having killed.

The only form that requires notice is that of the conjunctive participle. It is derived from the Apabhraṁśa form *uṭṭhiu*, to which the dative suffix *n* (old Marathi *ni*, *niyā*) has been added.

Various tenses are formed by adding personal suffixes to the present, past or future passive participle. When the subject of the verb is in the nominative the tense so formed agrees with it in gender, number and person. We may note four such tenses: a present, *uṭhᵃtō*, I rise; a past, *uṭhᵃlō*, I rose; past conditional, *uṭhᵃtō*, had I risen; and a subjunctive, *uṭhāwā*, I should rise. In the present, the terminations are relics of the verb substantive, and in the other tenses of the personal pronouns. In these latter, as there is no pronoun of the third person, the third persons have no termination, but are simply the unmodified participle. We thus get the present and the past conjugated as follows, with a masculine subject:—

	Present, I rise.		Past, I rose.	
	Singular.	Plural.	Singular.	Plural.
1	*uṭhᵃtō*	*uṭhᵃtō*	*uṭhᵃlō*	*uṭhᵃlō*
2	*uṭhᵃtōs*	*uṭhᵃtā*	*uṭhᵃlās*	*uṭhᵃlā*
3	*uṭhᵃtō*	*uṭhᵃtāt*	*uṭhᵃlā*	*uṭhᵃlē*

The feminine and neuter forms differ from the above: thus, *uṭhᵃtēs*, thou (fem.) risest; *uṭhᵃlīs*, thou (fem.) didst rise; and so on for the other persons and for the neuter.

It will be observed that, in the case of transitive verbs, while the present participle is active, the past and future passive participles are passive in meaning. The same is the case with the future passive participle of the intransitive verb. In tenses, therefore, formed from these participles the sentence must be construed passively. The subject must be put into the instrumental case, and the participle inflected to agree with the object. If the object is not expressed, or, as is sometimes the case, is expressed in the guise of a kind of ethic dative, the participle is construed impersonally, and is employed in the neuter form. Thus (present tense) *mulᵃgā* (nom. masc.) *pōthī vācitō*, the boy reads a book, but (past tense) *mulᵃgyānẽ* (instrumental *pōthī* (nom. fem.) *vācilī* (fem.) the boy read a book, literally, by-the-boy a-book was-read; or *mulᵃgyānẽ pōthīlā* (dative) *vācilẽ* (neuter), the boy read the book, literally, by-the-boy, with-reference-to-the-book, it-(impersonal)-was-read. Similarly in the subjunctive formed from the future passive participle, *mulᵃgyānẽ pōthī vācāwī*, the boy should read a book (by-the-boy a-book is-to-be-read) or *mulᵃgyānẽ pōthīlā vācāwẽ*, the boy should read the book [by-the-boy with-reference-to-the-book, it (impersonal)-is-to-be-read]. As an example of the subjunctive of an intransitive verb, we have *twā uṭhāwẽ*, by-thee it-is-to-be-risen, thou shouldst rise. As in intransitive verbs the passive sense is not so strong, in their case the tense may also be used actively, as in *tū uṭhāwās*, thou shouldst rise, *lit.*, thou (art) to-be-risen. It will be noted that when a participle is used passively it takes no personal suffix.

We have seen that the present tense is formed by compounding the present participle with the verb substantive. Further tenses are similarly made by suffixing, without compounding, various tenses of the verb substantive to the various participles. Thus *mī uṭhat āhẽ*, I am rising; *mī uṭhat hōtō*, I was rising; *myā uṭhāvẽ hōtẽ* (impersonal construction), I should have risen. In the case of tenses formed from the past participle, the auxiliary is appended, not to the participle, but to the past tense, as in *mī uṭhᵃlō āhẽ*, I have risen; *myā mārilā āhẽ* (personal passive construction) or *myā mārilẽ āhẽ* (impersonal passive construction), I have killed. Similarly *mī uṭhᵃlō hōtō* (active construction), I had risen. The usual forms of the present and past of the verb substantive are:—

	Present, I am.		Past, I was (masc).	
	Singular	Plural.	Singular.	Plural.
1	*āhẽ*	*āhẽ*	*hōtō*	*hōtō*
2	*āhẽs*	*āhā*	*hōtās*	*hōtā*
3	*āhẽ*	*āhēt*	*hōtā*	*hōtē*

The past changes for gender, but the present is immutable in this respect. *Āhẽ* is usually considered to be a descendant of the Sanskrit *asmi*, I am,[1] while *hōtō* is derived from the Pr *hontaō*, the present participle of what corresponds to the Skr. root *bhū*, become.

A potential passive and a causal are formed by adding *av* to the root of a simple verb. The former follows the first, or intransitive, and the latter the second or transitive conjugation. The potential passive of a neuter verb is necessarily construed impersonally. The causal verb denotes indirect agency; thus, *karᵃṇẽ*, to do, *karavᵃṇẽ*, to cause a person to do; *tyācyā-kaḍūn myā tẽ karavilẽ*, I caused him to do that, literally, by-means-of-him by-me that was-caused-to-be-done. The potential, being passive, has the subject in the dative (cf. Latin *mihi est ludendum*) or in the instrumental of the genitive, as in *malā* (dative), or *mājhyānẽ* (instr. of *mādshā*, of me), *uṭhᵃvatẽ*, I can rise, literally, for-me, or by-my-(action), rising-can-be-done. So, *Rāmālā*, or *Rāmācyānẽ*, *pōthī vācᵃvalī*, Rām could read a book (by R. a book could be read).

Several verbs are irregular. These must be learnt from the grammars. Here we may mention *hōṇẽ*, to become, past participle *dzhālā*; *yēṇẽ*, to come, past participle *ālā*; and *dsāṇẽ*, to go, past participle *gēlā*. There are also numerous compound verbs. One of these, making a passive, is formed by conjugating the verb *dsāṇẽ*, to go, with the past participle of the principal verb. Thus, *mārilā dsātō*, he is being killed, literally, he goes killed.

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[1] See, however, Hoernle, *Comparative Grammar*, p. 364.

Literature.—As elsewhere in India, the modern vernacular literature of the Maratha country arose under the influence of the religious reformation inaugurated by Rāmānuja early in the 12th century. He and his followers taught devotion to a personal deity instead of the pantheism hitherto prevalent. The earliest writer of whom we have any record is Nāmdēv (13th century), whose hymns in honour of Vithoba, a personal form of Vishnu, have travelled far beyond the home of their writer, and are even found in the Sikh *Ādi Granth*. Dnyānōbā, a younger contemporary, wrote a paraphrase of the Sanskrit *Bhagavad Gītā*, which is still much admired. Passing over several intermediate writers we come to the period of the warrior Sivaji, the opponent of Aurangzeb. He was a disciple of Rāmdās (1608–1681), who exercised great influence over him, and whose *Dāsbōdh*, a work on religious duty, is a classic. Contemporary with Rāmdās and Sivaji was Tukārām (1608–1649), a Śūdra by caste, and yet the greatest writer in the language. He began life as a petty shopkeeper, and being unsuccessful both in his business and in his family relations, he abandoned the world and became a wandering ascetic. His *Abhangs* or "unbroken" hymns, probably so called from their indefinite length and loose, flowing metre, are famous in the country of his birth. They are fervent, but though abounding in excellent morality, do not rise to any great height as poetry. Other Marathi poets who may be mentioned are Śrīdhar (1678–1728), the most copious of all, who translated the *Bhāgavata Purāṇa*, and the learned Mayūra or Mōrōpant (1729–1794), whose works smell too much of the lamp to satisfy European standards of criticism. Mahīpati (1715–1790) was an imitator of Tukārām, but his chief importance rests on the fact that he collected the popular traditions about national saints, and was thus the author of the *Acta sanctorum* of the Marathas. *Lāvaṇīs*, or erotic lyrics, by various writers, are popular, but are often more passionate than decent. Another branch of Marathi literature is composed of *Pāwāḍās* or war-ballads, mostly by nameless poets, which are sung everywhere throughout the country. There is a small prose literature, consisting of narratives of historical events (the so-called *Bakhars*), moral maxims and popular tales.

In the 19th century the facilities of the printing press are responsible for a great mass of published matter. Most of the best works have been written in English by learned natives, upon whom the methods of European scholarship have exercised more influence than elsewhere in India, and have given rise to a happy combination of western science with Oriental lore. No vernacular authors of outstanding merit have appeared during the last century.

Konkani once had a literature of its own, which is said to have been destroyed by the Inquisition at Goa. Temples and manuscripts were burnt wholesale. Under Roman Catholic auspices a new literature arose, the earliest writer being an Englishman, Thomas Stephens (Thomaz Estevão), who came to Goa in 1579, wrote the first Konkani grammar, and died there in 1619. Amongst other works, he was the author of a Konkani paraphrase of the New Testament in metrical form, which has been several times reprinted and is still a favourite work with the native Christians. Since his time there has grown up a considerable body of Christian literature from the pens of Portuguese missionaries and native converts.

AUTHORITIES.—Marathi is fortunate in possessing the best dictionary of any modern Indian language, J. T. Molesworth's (2nd ed., Bombay, 1857). Navalkar's (3rd ed., Bombay, 1894) is the best grammar. The earliest students of Marathi were the Portuguese, who were familiar only with the language as spoken on the coast, *i.e.* with the standard dialect of the northern Konkan and with Konkani. They have since devoted themselves to these two forms of speech. For the former, reference may be made to the *Grammatica da lingua Concani no dialecto do norte*, by J. F. da Cunha Rivara (Goa, 1858). For Konkani proper, see A. F. X. Maffei's *Grammar* (Mangalore, 1882) and *Dictionaries* (ibid., 1883). These are in English. Monsenhor S. R. Dalgado is the author of a *Konkan-Portuguese Dictionary* (Bombay, 1893).

For further information regarding Marathi in general, see the list of authorities under INDO-ARYAN LANGUAGES. For accounts of Marathi literature, see the preface to Molesworth's *Dictionary*; also J. Murray Mitchell's "The Chief Marathi Poets" in *Transactions of the Congress of Orientalists, London, 1892*, i. 282 sqq., and ch. viii. of M. G. Ranade's *Rise of the Maratha Power* (Bombay, 1900). For Konkani literature, see J. Gerson da Cunha's "Materials for the History of Oriental Studies among the Portuguese," in the *Proceedings of the Fourth International Congress of Orientalists*, ii. 179 sqq. (Florence, 1881). A full account of Marathi, given in great detail, will be found in vol. vii. of the *Linguistic Survey of India* (Calcutta, 1905). (G. A. GR.)

MARATHON, a plain on the N.E. coast of Attica, divided from the plain of Athens by the range of Pentelicus; it contained four villages—Marathon, Probalinthos, Tricorythos and Oenoe—which originally formed an independent *tetrapolis* and in historical times still upheld peculiar rites and legendary associations, chiefly connected with Heracles and Theseus. In the 6th century B.C. it served as a base for Peisistratus (*q.v.*), who owned much property in that district, for securing the rest of Attica. The plain derives its fame mainly from the battle in which the Athenians and Plataeans defeated the Persians (490 B.C.). The Persian force had been sent by King Darius to punish the Athenians for previous interferences in Asia and to restore their tyrant Hippias. It was probably by advice of the latter that the generals Datis and Artaphernes landed their troops, numbering perhaps 50,000, at Marathon. The Athenians, on the recommendation of their strategus Miltiades, resolved to meet this force in the open field, and sent out their full levy of 9000 heavy infantry under the polemarch Callimachus. They were joined on the way by 1000 Plataeans, but were disappointed of the assistance which they expected from Sparta. From their station at the head of the Vrana valley, which slopes down to Marathon plain, the Athenians for some days observed the Persian army, which gave no sign of proceeding to attack. After some waiting, Miltiades, who seems throughout to have played a more prominent part than his superior Callimachus, drew up the Athenian army for battle and charged down upon the enemy, whose line was formed on the level about a mile distant. The Athenian wings, whose formation had been made specially deep, broke the opposing divisions by their impact; the centre was at first overborne by the superior weight of the native Persians, but ultimately was relieved by the victorious wings, which closed in upon the Persian centre. The Persians were thereupon driven back into the sea all along the line, and, although the majority regained their ships, no less than 6400 were left dead, as against 192 Athenians. The Persian fleet, of which perhaps a detachment had been sent on before the battle, now sailed round Cape Sunium in order to effect a landing at Phalerum, close by Athens, and with the help of traitors within the walls to take the city by surprise. But Miltiades, who had suspected some plot all along, and had lately been warned by a signal on Mt Pentelicus which he interpreted as a message to the Persians, marched back the victorious army in time to defend Athens. The enemy, upon noticing his presence, did not venture a second disembarcation and retired straightway out of Greek waters. The details of the battle, and the Persian plan of campaign, are not made clear by our ancient sources, but reconstructions have been attempted by numerous modern authorities. (M. O. B. C.)

The tumulus or "Soros" was excavated by M. Stais in 1891 and 1892. A slight previous excavation had brought to light some prehistoric implements, and it was supposed that the mound had no connexion with the battle; but it has now been discovered that the presence of those prehistoric objects was accidental. Underlying the mound was found a stratum about 85 ft. long by 20 broad, consisting of a layer of sand, above which lay the ashes and bones of many corpses; together with these were the remains of many lecythi and other vases, some of them contemporary with the Persian wars, some of them of much earlier style, and probably taken in the emergency from neighbouring cemeteries. It is conjectured with some probability that a large vase containing ashes may have been used as the burial urn of one of the Athenian generals who fell. There was also, in the middle of the stratum, a trench for funeral offerings about 30 ft. by 3; it contained bones of beasts, with ashes and fragments of vases. There can therefore be no doubt that the tumulus was piled up to commemorate the Athenians who fell in the battle, and that it marks the place where the carnage was thickest. A selection from the contents of the tumulus has been placed in the National Museum at Athens. (E.GR.)

See Herodotus vi. 102–117; W. M. Leake, *The Topography of Athens* (London, 1841), ii. 203–227; R. W. Macan, *Herodotus*, iv.–vi. (London, 1895), ii. 149–248; G. B. Grundy, *The Great Persian War* (London, 1901), pp. 145–194; J. A. Munro in *Journal of Hellenic Studies*, 1899, pp. 186–197. For the tumulus, 'Αρχαιολογικὸν Δελτίον 1891, pp. 67 sqq. See also MILTIADES.

MARAZION, a small seaport in the St Ives parliamentary division of Cornwall, England, on the shore of Mount's Bay, 2 m. E. of Penzance, served by the Great Western railway. Pop. (1901), 1251. A causeway of boulders and pebbles, thrown up by the sea and passable at low tide, unites Marazion with the insular St Michael's Mount (*q.v.*). The church of St Hilary, destroyed by fire in 1853, had a very fine spire, which has been faithfully reproduced in the restored building. Unusual archaeological interest attaches to the churchyard. Its inscribed stones date from the 4th century, one being in honour of Constantine the Great. Another has Cornish lettering, which can no longer be deciphered; and there are British and Roman crosses. Market gardening and fishing are the main industries.

The charter attributed to Robert count of Mortain, granting lands and liberties to St Michael's Mount, opposite Marazion, included a market on Thursdays. This appears to have been held from the first on the mainland. From it is probably derived the Marghasbigan (*Parvum Forum*) of the earlier and the Marghasyewe or Marketjew (*Forum Jovis*) of the later charters. It may be added that a Jewish origin has been ascribed to the place from the name Marketjew. It is certain that Richard king of the Romans provided that the three fairs, on the two feasts of St Michael and at Mid-Lent, and the three markets which had hitherto been held by the priors of St Michael's Mount on land not their own at Marghasbighan, should in future be held on their own land at Marchadyou. He transferred in fact the fairs and markets from the demesne lands of the Bloyous in Marazion to those of the prior. To remedy the loss incurred by this measure Ralph Bloyou in 1331 procured for himself and his heirs a market on Mondays and a fair on the vigil, feast and morrow of St Andrew at Marghasyon. In Leland's time the market was held at Marhasdeythyow (*Forum Jovis*), and both Norden (1582) and Carew (1602) tell us that Marcajewe signifies the Thursday's market, which, whether etymologically sound or not, shows that the prior's market had prevailed over its rival. In 1595 Queen Elizabeth granted to Marazion a charter of incorporation. This ratified the grant of St Andrew's fair, provided for another on the Feast of St Barnabas and established a market on Saturdays. The corporation was to consist of a mayor, 8 aldermen and 12 capital burgesses. This corporation continued to administer the affairs of the borough until it was dissolved under the Municipal Corporations Act in 1835, when the property belonging to it was vested in charity commissioners. The chairman of the commissioners retains possession of the regalia. Of the fairs only the Michaelmas fair has survived and all the markets have gone. It is frequently stated that Marazion had formerly the right of returning two members to parliament, but that owing to its inability to pay the members' expenses the right was lost. Under the Commonwealth an attempt was made to secure or recover the right, and two members are said to have been returned, but they were not allowed to take their seats. Remains of an ancient bronze furnace, discovered near the town, tend to prove that tin-smelting was practised here at an early period. Marazion was once a flourishing town, and owed its prosperity to the throng of pilgrims who came to visit St Michael's Mount. During the first half of the 16th century it was twice plundered; first by the French, and later by the Cornish rebels. The rise and progress of the neighbouring borough of Penzance in the 17th century was the undoing of Marazion.

MARBLE (from Lat. *marmor*, Gr. *μάρμαρος*, shining stone), a term applied to any limestone or dolomite which is sufficiently close in texture to admit of being polished. Many other ornamental stones—such as serpentine, alabaster and even granite—are sometimes loosely designated marble, but by accurate writers the term is invariably restricted to those crystalline and compact varieties of carbonate of lime (occasionally with carbonate of magnesia) which, when polished, are applicable to purposes of decoration. The crystalline structure is typically shown in statuary marble. A fractured surface of this stone displays a multitude of sparkling facets, which are the rhombohedral cleavage-planes of the component grains. The beautiful lustre of polished statuary marble is due to the light penetrating for a short distance into the rock and then suffering reflection at the surfaces of the deeper-lying crystals. The durability of marble in a dry atmosphere or when protected from rain renders it a valuable building stone (*q.v.*); on the other hand, when exposed to the weather or the acid atmosphere of large cities, its surface readily crumbles.

Statuary and Economic Marbles.—Among statuary marbles the first place may be assigned to the famous Pentelic marble, the material in which Pheidias, Praxiteles, and other Greek sculptors executed their principal works. The characteristics of this stone are well seen in the Elgin marbles, which were removed from the Parthenon at Athens, and are now at the British Museum. The marble was derived from the quarries of Mount Pentelicus in Attica. Several large buildings have recently been constructed with this marble in London. The neighbouring mountain of Hymettus likewise yielded marbles, but these were neither so pure in colour nor so fine in texture as those of Pentelicus. Parian marble, another stone much used by Greek sculptors and architects, was quarried in the isle of Paros, chiefly at Mount Marpessa. It is called by ancient writers *lychnites* (from the Gr. λύχνος, a lamp) in allusion to the fact that the quarries were worked by the light of lamps. The Venus de' Medici is a notable example of work in this material. Carrara marble is better known than any of the Greek marbles, inasmuch as it constitutes the stone invariably employed by the best sculptors of the present day. This marble occurs abundantly in the Apuan Alps, an offshoot of the Apennines, and is largely worked in the neighbourhood of Carrara, Massa and Serravezza. Stone from this district was employed in Rome for architectural purposes in the time of Augustus, but the finer varieties, adapted to the needs of the sculptor, were not discovered until some time later. It is in Carrara marble that the finest works of Michelangelo and of Canova are executed. The purest varieties of this stone are of snow-white colour and of fine saccharoidal texture. Silica is disseminated through some of the marble, becoming a source of annoyance to the workman; while occasionally it separates as beautifully pellucid crystals of quartz known as "Carrara diamonds." The geological age of the marbles of the Apuan Alps has been a subject of much dispute, some geologists regarding them as metamorphosed Triassic, Liassic or Rhaetic rocks. Much of the common marble is of a bluish colour, and therefore unfit for statuary purposes; when streaked with blue and grey veins the stone is known as *bardiglio*. Curiously enough, the common white marble of Tuscany comes to England as Sicilian marble—a name probably due to its having been formerly re-shipped from some port in Sicily.

Although crystalline marbles fit for statuary work are not found to any extent in Great Britain, the limestones of the Palaeozoic formations yield a great variety of marbles well suited for architectural purposes. The Devonian rocks of south Devon are rich in handsome marbles, presenting great diversity of tint and pattern. Plymouth, Torquay, Ipplepen, Babbacombe and Chudleigh may be named as the principal localities. Many of these limestones owe their beauty to the fossil corals which they contain, and are hence known as "madrepore marbles."

Of far greater importance than the marbles of the Devonian system are those of Carboniferous age. It is from the Carboniferous or Mountain Limestone that British marbles are mainly derived. Marbles of this age are worked in Derbyshire and Yorkshire, in the neighbourhood of Bristol, in North Wales, in the Isle of Man, and in various parts of Ireland. One of the most beautiful of these stones is the "encrinital marble," a material which owes its peculiarities to the presence of numerous encrinites, or stone-lilies. These fossils, when cut in various directions, give a characteristic pattern to the stone. The joints of the stems and arms are known from their shape as "wheel-stones," and the rock itself has been called "entrochal marble." The most beautiful varieties are those in which the calcareous fossils appear as white markings on a ground of grey limestone. In Belgium a black marble with small sections of crinoid stems is known as *petit granit*, while in Derbyshire a similar rock, crowded with fragments of minute encrinites, is termed "bird's-eye marble."

Perhaps the most generally useful marbles yielded by the Carboniferous system are the black varieties, which are largely employed for chimney-pieces, vases, and other ornamental objects. The colour of most black limestone is due to the presence of bituminous matter. Such limestone commonly emits a fetid odour when struck; and the colour, being of organic origin, is discharged on calcination. Black marbles, more or less dense in colour, are quarried in various parts of Ireland, especially at Kilkenny and near Galway, but the finest kind is obtained from near Ashford in Derbyshire. From Ashford is also derived a very beautiful stone known as "rosewood marble." This is a dense brown laminated limestone, displaying when polished a handsome pattern somewhat resembling the grain of rosewood; it occurs in very limited quantity, and is used chiefly for inlaid work. The black marble of Frosterley, Yorkshire, is another Carboniferous example which owes its "figure" or pattern to the presence of large corals.

With the rosewood marble may be compared the well-known "landscape marble" or Cotham stone, an argillaceous limestone with peculiar dendritic markings, due probably to the infiltration of water containing oxide of manganese. This limestone occurs in irregular masses near the base of the White Lias, or uppermost division of the Rhaetic series. It is found principally in the neighbourhood of Bristol. The arborescent forms depicted in bluish-grey upon this landscape marble form a marked contrast to the angular markings of warm brown colour which are seen on slabs of "ruin marble" from Florence—a stone occasionally known also as landscape stone, or *pietra paesina*.

British limestones of Secondary and Tertiary age are not generally compact enough to be used as marbles, but some of the shelly beds are employed to a limited extent for decorative purposes. "Ammonite marble" is a dark brown limestone from the Lower Lias of Somersetshire, crowded with ammonites, principally *A. planicostata*. Under the name of Forest marble, geologists recognize a local division of the Lower Oolitic series, so named by W. Smith from Wychwood Forest in Oxfordshire, where shelly limestones occur; and these, though of little economic value, are capable of being used as rough marbles. But the most important marbles of the Secondary series are the shelly limestones of the Purbeck formation. Purbeck marble was a favourite material with medieval architects, who used it freely for slender clustered columns and for sepulchral monuments. It consists of a mass of the shells of a fresh-water snail, *Paludina carinifera*, embedded in a blue, grey or greenish limestone, and is found in the Upper Purbeck beds of Swanage in Dorsetshire. Excellent examples of its use may be seen in Westminster Abbey and in the Temple Church, as well as in the cathedrals of Salisbury, Winchester, Worcester and Lincoln. Sussex marble is a very similar stone, occurring in thin beds in the Weald clay, and consisting largely of the shells of *Paludina*, principally *P. sussexiensis* and *P. fluviorum*. The altar stones and the episcopal chair in Canterbury Cathedral are of this material.

Certain calcareous metamorphic rocks frequently form stones which are sufficiently beautiful to be used for ornamental purposes, and are generally classed as marbles. Such serpentinous limestones are included by petrologists under the term "ophicalcite." The famous *verde antico* is a rock of this character. Mona marble is an ophicalcite from the metamorphic series of the Isle of Anglesey, while the "Irish green" of architects is a similar rock from Connemara in western Galway. It is notable that some of the "white marble" of Connemara has been found by W. King and T. H. Rowney to consist almost wholly of malacolite, a silicate of calcium and magnesium.

A beautiful marble has been worked to a limited extent in the island of Tiree, one of the Hebrides, but the quarry appears to be now exhausted. This Tiree marble is a limestone having a delicate carnelian colour diffused through it in irregular patches, and containing rounded crystals of sahlite, a green augitic mineral resembling malacolite in composition.

Many marbles which are prized for the variegated patterns they display owe these patterns to their formation in concentric zones—such marbles being in fact stalagmitic deposits of carbonate of lime, sometimes consisting of aragonite. One of the most beautiful stalagmitic rocks is the so-called onyx marble of Algeria. This stone was largely used in the buildings of Carthage and Rome, but the quarries which yielded it were not known to modern sculptors until 1849, when it was rediscovered near Oued-Abdallah. The stone is a beautifully translucent material, delicately clouded with yellow and brown, and is greatly prized by French workmen. Large deposits of a very fine onyx-like marble, similar to the Algerian stone, have been worked at Técali, about 35 miles from the city of Mexico. Among other stalagmitic marbles, mention may be made of the well-known Gibraltar stone, which is often worked into models of cannon and other ornamental objects. This stalagmite is much deeper in colour and less translucent than the onyx marbles of Algeria and Mexico. A richly tinted stalagmitic stone worked in California is known as Californian marble. It is worth noting that the "alabaster" of the ancients was stalagmitic carbonate of lime, and that this stone is therefore called by mineralogists "Oriental alabaster" in order to distinguish it from our modern "alabaster," which is a sulphate, and not a carbonate, of lime. Gypsum capable of taking a polish is found at Fauld in Staffordshire and in Italy and Spain.

The brown and yellow colours which stalagmitic marbles usually present are due to the presence of oxide of iron. This colouring matter gives special characters to certain stones, such as the *giallo antico*, or antique yellow marble of the Italian antiquaries. Siena marble is a reddish mottled stone obtained from the neighbourhood of Siena in Tuscany; and a somewhat similar stone is found in King's County, Ireland. True red marble is by no means common, but it does occur, of bright and uniform colour, though in very small quantity, in the Carboniferous limestone of Derbyshire and north-east Staffordshire. The red marble called *rosso antico* is often confounded with the *porfiro rosso antico*, which is really a mica-hornblende porphyrite owing its red colour to the mineral withamite.

Fire marble is the name given to a brown shelly limestone containing ammonites and other fossil shells, which present a brilliant display of iridescent colours, like those of precious opal. It occurs in rocks of Liassic age at the lead-mines of Bleiberg in Carinthia, and is worked into snuff-boxes and other small objects. By mineralogists it is often termed *lumachella*, an Italian name which may, however, be appropriately applied to any marble which contains small shells.

The quarries of France, Belgium, Italy and Spain, not to mention less important localities, yield a great diversity of marbles, and almost each stone bears a distinctive name, often of trivial meaning; but in this article it is impossible to enumerate the local names used by marble-workers in different countries to distinguish the various stones which pass under their hands.

America possesses some valuable deposits of marble, which in the eastern States have been extensively worked. The crystalline limestones of western New England furnish an abundance of white and grey marble, while a beautiful material fit for statuary work has been quarried near Rutland in Vermont. A grey bird's-eye marble is obtained from central New York, and the greyish clouded limestones of Thomaston in Maine have been extensively quarried. Of the variegated and coloured marbles, perhaps the most beautiful are those from the northern part of Vermont, in the neighbourhood of Lake Champlain. A fine brecciated marble is found on the Maryland side of the Potomac, below Point of Rocks. Among the principal localities for black marble may be mentioned Shoreham in Vermont and Glen Falls in New York. In 1908 the American States producing marble were, in order of value, Vermont, Georgia, Tennessee, New York, Massachusetts, Alabama, Pennsylvania, Maryland, California, Colorado, Alaska, N. Carolina, Kentucky, New Mexico, Utah, Missouri and Idaho. In Canada the crystalline limestones of the pre-Cambrian series yield beautiful marbles.

In India we find important quarries at Makrana in Rajputana,—a locality which is said to have yielded the marble for the famous Taj Mahal at Agra. In the valley of the Nerbudda, near Jabalpur, there is a large development of marble. The white marble which is used for the delicately pierced screens called *jalee* work is obtained from near Raialo, in Ulwar. (F. W. R.*)

Petrography.—Marbles are uniformly crystalline, and hence have no bedding or schistosity which would tend to make them fissile, but are entirely massive and free from grain. The microstructure of pure marble is comparatively simple. In thin sections they are seen to be built up of somewhat rounded grains of calcite, fitting closely together in a mosaic; very rarely do any grains show traces of crystalline form. They are colourless and transparent, and are usually traversed by a lattice-work of sharply defined cleavage cracks, which correspond to the rhombohedral faces. In polarized light the colours are pinkish or greenish white, or in very thin sections iridescent because the mineral has a very strong double refraction. They may also be crossed by bars or stripes, each of which indicates a twin plate, for the crystals are usually polysynthetic. This twinning may be produced by pressure acting either during the crystallization of the rock or at a later period.

The purest marbles generally contain some accessory minerals, and in many of these rocks they form a considerable proportion of the whole mass. The commonest are quartz in small rounded grains, scales of colourless or pale yellow mica (muscovite and phlogopite), dark shining flakes of graphite and small crystals of pyrites or iron oxides. Even fine Carrara marble leaves a residue of this sort when dissolved in acid. Many marbles contain other minerals which are usually silicates of lime or magnesia. The list of these accessories is a very large one. Augite is very frequent and may be white (malacolite) or pale green (coccolite, sahlite, diopside); hornblende occurs as white bladed tremolite or pale green actinolite; feldspars may be present also, such as orthoclase, or more frequently some plagioclase such as albite, labradorite and anorthite; scapolite (or wernerite); various kinds of garnet; vesuvianite, spinel, forsterite, periclase, brucite, talc, zoisite and epidote, chondrodite, biotite, datolite, sphene and apatite may be mentioned as typical accessory minerals. The presence of metalliferous minerals such as galena, grey or red silver ores, zinc blende, antimonite, chalcopyrite, molybdenite, cassiterite, usually indicates impregnation by ore-bearing solutions, especially if these substances occur in workable quantities. The rubies of Burma are found in crystalline limestones and are constantly accompanied by precious spinel (or balas-ruby).

These minerals represent impurities in the original limestone which crystallized at the time that the marble became crystalline. The silicates derive their silica mainly from sand or infiltrated siliceous deposits; the alumina represents an admixture of clay; the iron came from limonite or hematite in the original state of the rock. Where the silicates bulk largely because the original limestone was highly impure, all the carbonic acid may be driven out and replaced by silica during the process of recrystallization. The rock is then a calc-silicate rock, hard, tough, flinty and no longer readily soluble in acids. They are sometimes fine-grained hornstones (known as calc-silicate hornfelses). Where white minerals predominate (wollastonite, tremolite, feldspar) these rocks may have a close resemblance to marbles, but often they are green from the abundance of green augites and amphiboles, or brown (when garnet and vesuvianite are present in quantity) or yellow (with epidote, chondrodite or sphene). Decomposition induces further changes in colour owing to the formation of green or yellow serpentine, pale green talc, red hematite, and brown limonite. Most of the coloured or variegated crystalline marbles have originated in this manner. Often bands of calc-silicate rock alternate with bands of marble, and they may be folded or bent; in other cases, nodules and patches of silicates occur in a matrix of pure marble. Earth movements may shatter the rocks, producing fissures afterwards filled with veins of calcite; in this way the beautiful brecciated or veined marbles are produced. Sometimes the broken fragments are rolled and rounded by the flow of the marble under pressure and pseudo-conglomerates or "crush conglomerates" result. In other cases the banding of the marble indicates the original bedding of the calcareous sediments. Crystalline limestones which contain much mica may be called cipollins; in them quartz, garnet and hornblende often also occur. The ophicalcites are marbles containing much serpentine, which has been formed by the decomposition of forsterite, olivine or augite. The much-discussed *Eozoon*, at one time supposed to be the earliest known fossil and found in Archaean limestones in Canada, is now known to be inorganic and to belong to the ophicalcites.

Many marbles, probably all of them, are metamorphosed limestones. The passage of limestones rich in fossils into true marbles as they approach great crystalline intrusions of granite is a phenomenon seen in many parts of the world; occasionally the recrystallization of the rock has not completely obliterated the organic structures (*e.g.* at Carrara and at Bergen in Norway). The agencies which have induced the metamorphism are heat and pressure, the heat arising from the granite and the pressure from overlying masses of rock, for these changes took place before the granite cooled and while it was still deeply buried beneath the surface. In 1806 Sir James Hall described a series of experiments proving this. He enclosed chalk in a gun-barrel securely plugged and heated it to a high temperature in a furnace. Carbonic acid was given off by the chalk and produced a great pressure in the interior of the tube. After slow cooling the mass was found to have become converted into granular crystalline marble. As rocks which have undergone changes of this kind are commonest in the oldest and deepest layers of the earth's crust, most marbles are Palaeozoic or pre-Cambrian. They occur very often with mica schists, phyllites, &c., which were beds of clay alternating with the original limestone. Formerly it was supposed that some of these marbles were crystalline sediments or even igneous rocks, but the tendency of modern geology is to assume that they were ordinary limestones, many of which may have been fossiliferous. In regions where the sedimentary rocks have been converted into schists, gneisses and granulites, the limestones are represented by calc schists, cipollins and marbles. Often no granite or other intrusive rock is present which may be regarded as the cause of the metamorphism. The marbles are often banded or schistose, and under the microscope show crushing and deformation of the component crystals, such as would have been produced by the earth pressures which accompany rock-folding. These crush structures have been obtained experimentally in marbles subjected to great pressures in steel cylinders. In the recrystallization of these limestones the direct heating action of igneous intrusions may have played no part, but the rise of temperature and increase of pressure due to the folding of great rock masses have probably been the operating causes. This type of metamorphism has been distinguished by the name *marmarosis* (Sir A. Geikie, *Text Book of Geology*, 1882).

For descriptions of ancient marbles see F. Corsi, *Delle pietre antiche* (Rome, 1845); M. W. Porter, *What Rome was built with* (Oxford, 1907), and for marbles in general consult E. Hull, *Building and Ornamental Stones* (1872); G. P. Merrill, *Stones for Building and Decoration* (3rd ed., 1905, New York). (J. S. F.)

MARBLEHEAD, a township of Essex county, Massachusetts, U.S.A., occupying a rocky promontory on Massachusetts Bay, about 16 m. N. of Boston. Pop. (1890), 8202; (1900), 7582; (1905), 7209; (1910), 7338. Area, about 4 sq. m. Marblehead is served by the Boston & Maine railroad, and by electric railways connecting with Salem, Lynn and Boston. It is a quaint old town, with a number of houses dating back to the 17th and 18th centuries. Among the older buildings are the Lee mansion (1768), St Michael's church (P. E., 1714), and the old town-hall (1727), sometimes called Marblehead's "Cradle of Liberty." Abbot Hall (1877), the municipal building, also contains the public library and several noteworthy paintings, including "The Spirit of '76" or "Yankee Doodle" by Archibald M. Willard. The post office and custom-house was completed in 1904. There are several parks (Crocker, Fort Sewall, Seaside, and Fountain), and an old burying-ground, in which many of the early settlers and a number of soldiers of the War of Independence (including General John Glover) are buried; and a granite monument near the railway station commemorates the taking of the British supply and powder ship "Hope" off Marblehead in 1776 by Captain James Mugford, who was killed during the fight. The commodious harbour, nearly landlocked, is formed by a rocky peninsula known as Marblehead Neck. On this are the club-houses of the Eastern and Corinthian Yacht clubs; and Marblehead is a popular yachting centre. The manufacture of children's shoes is the principal industry. Shipbuilding, once important, has been superseded by yacht and launch construction.

Marblehead, originally a part of Salem, known as Marble Harbor, was settled about 1629 by English emigrants (probably mostly from Lincolnshire and Devonshire); later (after about 1700) many emigrants from the Channel Islands settled here, and to them the dialectical peculiarities of Marblehead have often (perhaps mistakenly) been attributed. Marblehead was separately incorporated as a town in 1649. In the colonial period Marblehead was an important commercial port, and at one time was one of the most populous places in Massachusetts. After the passage of the Boston Port Bill (1774) it was made the port of entry instead of Boston, but its merchants refused to take advantage of this opportunity and patriotically invited the Boston merchants to use their wharves and warehouses. During the War of Independence many "state cruisers" (chartered at the Continental expense) set out from this port, the most famous being the "Lee," commanded by John Manley[1] (1733–93); in November 1775 this cruiser captured the "Nancy" with military stores valued at £20,541, which were taken to the American army at Cambridge. The "Lee" was manned by fifty men of the "amphibious regiment," which under General John Glover (1732–1797) rendered invaluable services to

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[1] See Robert E. Peabody, "Naval Career of Captain John Manley of Marblehead," in *Essex Institute Historical Collections* (Salem, Mass.) for January 1909.

Washington in conveying his troops across the East River after the battle of Long Island, and later in ferrying them across the Delaware before the battle of Trenton. Marblehead furnished more than 1000 men to the Continental army. During the war of 1812 the sea fight between the "Chesapeake" and the "Shannon" took place (June 1, 1813) off the adjacent coast. Marblehead was the scene of Benjamin (nicknamed "Flood") Ireson's ride, immortalized by J. G. Whittier.

See Samuel Roads, jun., *The History and Traditions of Marblehead* (Boston, 1880; 3rd ed., Marblehead, 1897).

MARBLES, a children's game of great antiquity, wide distribution, and uncertain origin, played with small spheres of stone, glass, baked clay or other material, from one-third of an inch to two inches in diameter. The game was once popular with all classes. Tradition, both at Oxford and Cambridge, attests that the game was formerly prohibited among undergraduates on the steps of the Bodleian or the Senate House. There is a similar tradition at Westminster School that the boys were forbidden to play marbles in Westminster Hall on account of the complaints made by members of parliament and lawyers. An anonymous poem of the 17th century speaks of a boy about to leave Eton as

> "A dunce at syntax, but a dab at taw."

Rogers, in *The Pleasures of Memory*, recalls how

> "On yon grey stone that fronts the chancel-door,
> Worn smooth by busy feet, now seen no more,
> Each eve we shot the marble through the ring."

Defoe (1720) writes of the seer Duncan Campbell: "Marbles, which he used to call children's playing at bowls, yielded him mighty diversion; and he was so dexterous an artist at shooting that little alabaster globe from between the end of his forefinger and the knuckle of his thumb, that he seldom missed hitting plumb, as the boys call it, the marble he aimed at, though at the distance of two or three yards." The *locus classicus* on marbles in the 19th century is in the trial in *Pickwick*, where Serjeant Buzfuz pathetically says of Master Bardell that "his 'alley tors' and his 'commoneys' are alike neglected; he forgets the long familiar cry of 'knuckle down,' and at tip-cheese, or odd and even, his hand is out." Many similar passages might be adduced to prove the former popularity of marbles with the young of all classes. In some rural parts of Sussex Good Friday was known as "marble-day" till late in the 19th century, since on that day both old and young, including many who would never have thought of playing marbles at other times, took part in the game. There was some traditional reason for regarding marbles as a Lenten sport—perhaps, as the Rev. W. D. Parish suggests, "to keep people from more boisterous and mischievous enjoyments."

The origin of the game is concealed in the mists of antiquity. Marbles used by Egyptian and Roman children before the Christian era are to be seen in the British Museum. Probably some of the small stone spheres found among neolithic remains, which Evans (*Ancient Stone Implements*, 2nd ed., p. 420) admits to be too small for projectiles, are prehistoric marbles. It is commonly assumed that the game which the youthful Augustus, like other Roman children, played with nuts was a form of marbles, and that the Latin phrase of *relinquere nuces*, in the sense of putting away childish things, referred to this game. Strutt believed that nuts of the roundest sort were the original "marbles." The earliest unmistakable reference to marbles in literature seems to be in a French poem of the 12th century, quoted by Littré *s.v. Bille*.

The marbles with which various games are nowadays played are small spheres of stone, glass or baked clay. In the 18th century they were mostly made from chips of marble (whence the name) or other stone, which were ground into a roughly spherical shape by attrition in a special iron mill. Nuremberg was then the centre of the trade in marbles, though some were made in Derbyshire, and indeed wherever there was a stonemason's yard to afford raw material. The "alley taw," as its name indicates, was made of alabaster. In the first decade of the 20th century English marbles were all imported from central Germany, and the alleys, or most valuable marbles, used for shooting, were mostly made of coloured glass, sold retail from ten a penny to a penny each. Coloured stone marbles and so-called china marbles—really of baked clay—were sold at prices varying from forty to a hundred a penny, though even the cheapest of these were painted by hand with concentric rings. The well-made and highly valued alleys of earlier times were no longer procurable, owing to the decline in popularity of the sport. In the United States, however, much more expensive and accurately rounded marbles were still manufactured, the latest being of hollow steel.

There has never been any recognized authority on the game of marbles, and it is probable that, in the past as in the present, every parish and school and set of boys made its own rules. There are, however, three or four distinct games which are traditional, and may be found, with trifling variations, wherever the game is played. Strutt, writing at the end of the 18th century, describes these as follows: (1) "Taw, wherein a number of boys put each of them one or two marbles in a ring and shoot at them alternately with other marbles, and he who obtains the most of them by beating them out of the ring is the conqueror." The marbles placed in the ring—whence the game is often known as "ring-taw"—are usually of the cheaper kind known as "commoneys," "stoneys" or "potteys," and the marble with which the player shoots is a more valuable one, known as an "alley," or "alley taw," sometimes spelt "tor," as by Dickens. Usually it is necessary that the alley should emerge from the ring as well as drive out another marble; under other rules the ring is smaller, not more than a foot in diameter, and the player must be skilful enough to leave his alley inside it, whilst driving the object marble outside. (2) "Nine holes: which consists in bowling of marbles at a wooden bridge with nine arches." Each arch bears a number, and the owner of the bridge pays that number of marbles to the player who shoots through it, making his profit from the missing marbles, which he confiscates; or the game may simply be played so many up—usually 100. (3) "There is also another game of marbles where four, five or six holes, and sometimes more, are made in the ground at a distance from each other; and the business of every one of the players is to bowl a marble by a regular succession into all the holes, which he who completes in the fewest bowls obtains the victory." This primitive form of golf is played by Zulu adults with great enthusiasm, and is still popular among the car-drivers of Belfast. (4) "Boss out, or boss and span, also called hit and span, wherein one bowls a marble to any distance that he pleases, which serves as a mark for his antagonist to bowl at, whose business it is to hit the marble first bowled, or lay his own near enough to it for him to span the space between them and touch both marbles; in either case he wins, if not, his marble remains where it lay and becomes a mark for the first player, and so alternately until the game be won." In rural parts of England this was known as a "going-to-school game," because it helped the players along the road.

Mr F. W. Hackwood states that, in the middle of the 19th century, taverns in the Black Country had regular marble alleys, consisting of a cement bed 20 ft. long by 12 ft. wide and 18 in. from the ground, with a raised wooden rim to prevent the marbles from running off. Players knelt down to shoot, and had to "knuckle down" fairly—*i.e.* to place the knuckle of the shooting hand on the ground, so that the flip of the thumb was not aided by a jerk of the wrist. The game was usually ring-taw. But marbles is now obsolete in England as a game for adults (*Old English Sports*, London, 1907).

A writer in *Notes and Queries* (IX. ii. 314) thus describes the marbles used by English boys in the middle of the 19th century: "In ring-taw the player put only commoneys in the ring, and shot with the taws, which included stoneys, alleys and blood-alleys. Commoneys were unglazed; potteys glazed in the kiln. Stoneys were made from common pebbles such as were used for road-mending; alleys and blood-alleys out of marble. The blood-alleys were highly prized, and were called by this name because of the spots or streaks of red in them. In Derbyshire, where large numbers were made, they had relative values. The stoney was worth three commoneys or two potteys. An alley was worth six commoneys or four potteys. Blood-alleys were worth more, according to the depth and arrangement of colour—from twelve to fifty commoneys and stoneys in proportion." "A taw with a history was prized above rubies," another correspondent observes (IX. ii. 76). "All the best-made marbles were taws, and no commoneys or potteys were used for shooting with, either in ring-taw or the various hole-games." In Belfast, 1854–1858, the marble season extended from Easter to June, when the ground was usually dry and hard. The marbles were stoneys, of composition painted; crockeries, of slightly glazed stone-ware, dark brown and yellow; clayeys, of red brick clay baked in the fire; marbles, of white marble; china alleys, with white glaze and painted rings; and glass marbles. The two chief games were ring-taw and hole and taw; in the latter three holes were made in a line, 6 ft. to 12 ft. apart, and the player had to go three times up and down according to somewhat elaborate rules (*Notes and Queries*, IX. iii. 65). The stoneys and crockeries were sold at twenty a penny; the clayeys were cheaper and were not used as stakes; the marbles proper and china alleys, used as taws for shooting, cost a halfpenny and a farthing respectively. In other parts of the country the phraseology of marbles affords some interesting problems for the philologist. We hear of "alleys, barios, poppos and stoneys"; of "marididdles," home-made marbles of rolled and baked clay; in Scotland of "bools, whinnies, glassies, jauries"; of "Dutch alleys," and so forth. "Dubs, trebs and fobs," stand for twos, threes and fours. To be "mucked" is to lose all one's "mivvies" or marbles. When the taw stayed in the ring it was a "chuck." "Phobbo slips" was a phrase used to forbid the correction of an error.

The fullest account of the various games of marbles played by English children is to be found in Mrs Gomme's *Traditional Games of England, Scotland and Ireland* (London, 1898), under the headings Boss-out, Bridgeboard, Bun-hole, Cob, Ho-go, Holy Bang, Hundreds, Lag, Long-Tawl, Marbles, Nine-Holes, Ring-taw, Three-Holes. Other games are known as Plum-pudding, or Picking the Plums, in which one shoots at marbles in a row; Pyramids, in which the marbles are arranged in a pyramid; Bounce About, Bounce Eye, Conqueror, Die Shot, Fortifications, Handers, Increase Pound, Knock Out, Rising Taw, Spanners, Tip-shears; Strutt's *Sports and Pastimes*, ed. J. C. Cox (London, 1902). Much information will also be found in *Notes and Queries*, *passim*—especially the 9th series. For marbles in France see Larousse, *s.v. Billes*. See also SOLITAIRE. (W. E. G. F.)

MARBOT, JEAN BAPTISTE ANTOINE MARCELIN, BARON DE (1782–1854), French soldier, son of General Jean Antoine de Marbot (1754–1800), who died in the defence of Genoa under Masséna, was born at La Rivière (Corrèze), on the 18th of August 1782. He joined the republican army as a volunteer in 1799, rose rapidly to commissioned rank, and was aide-de-camp to Marshal Augereau, commanding the VII. corps, in the war against Prussia and Russia in 1806–7. After this he served with great distinction in the Peninsular War under Lannes and Masséna, and showed himself to be a dashing leader of light cavalry in the Russian War of 1812 and the German campaign of the following year. After a slow recovery from the wounds he had received at Leipzig and Hanau, he was promoted general of brigade by Napoleon during the Hundred Days, and took part in, and was wounded at, the battle of Waterloo. He was exiled at the second restoration and only returned to France in 1819, after which, however, his intimacy with the duke of Orleans secured him important military positions. After the July restoration he was made *maréchal-de-camp*, and in this rank he was present at the siege of Antwerp in 1832. He was promoted lieutenant-general in 1836. From 1835 to 1840 he served in various Algerian expeditions, and in 1845 he was made a member of the Chamber of Peers. Three years later, at the fall of Louis Philippe, he retired into private life. He died at Paris on the 16th of November 1854. Marbot wrote two pamphlets, *Remarques critiques sur l'ouvrage de M. le général Roguet, intitulé Considérations sur l'art de la guerre* (1820), and *La Nécessité d'augmenter les forces militaires de la France* (1825), but his fame rests chiefly, if not indeed wholly, on the fascinating *Memoirs of his Life and Campaigns* which were published in Paris in 1891 (Eng. trans., 1902). To ordinary readers and to students of history alike these give a picture of the Napoleonic age of warfare which for vividness and romantic interest has never been surpassed.

His elder brother, ANTOINE ADOLPHE MARCELIN DE MARBOT (1781–1844), was born at La Rivière, on the 22nd of March 1781, entered the army at an early age, obtained commissioned rank in the revolutionary wars and became aide-de-camp to Bernadotte. In 1802 he was arrested on the ground of being concerned in a plot of the Republicans against the Consulate, but he was released, though Napoleon continued to regard him as an opponent of the established régime. After a term of duty with the army in Santo Domingo he participated in the campaigns of 1806–7, and from 1808 to 1811 he was employed in the Peninsular War. In the Russian War of 1812 he was wounded and made prisoner. At the end of two years of captivity he returned to France at the general peace, was aide-de-camp to Marshal Davout during the Hundred Days, and thereafter passed into retirement, from which he did not emerge till 1830. He attained the rank of *maréchal-de-camp* under Louis Philippe, and died at Bra, near Tulle, on the 2nd of June 1844.

MARBURG, a town of Austria, in Styria, 41 m. S. of Graz by rail. Pop. (1900), 24,501. It is very picturesquely situated on the left bank of the river Drave, on a plain called the Pettauer-Feld, at the base of the well-wooded Bachergebirge. To the north of the town the train passes through the Leitersberg tunnel (725 yds. long), opened in 1846, while the Drave, which has here a width of 200 yds., is spanned by a magnificent iron bridge, built in 1845. The principal buildings are the cathedral, dating from the 16th century, the tower of which, erected in 1623, is 136 ft. high, and the old castle. Its situation in the midst of a fertile vine and fruit-growing district, connected by the navigable Drave with Hungary, and by railway with Vienna, Trieste, Tirol and Carinthia, makes it the centre of a considerable traffic in wine and grain. Its industrial products are leather, boots and shoes, iron and tin wares, liqueurs and sparkling wine, and it also contains the extensive workshops of the South Austrian railway. Marburg is the seat of the bishop of Lavant, and is the native town of the famous Austrian admiral, Baron Wilhelm of Tegetthoff (1827–1871). Near Marburg is the village of Mariarast, the church of which is a popular place of pilgrimage.

MARBURG, an ancient university town of Germany, in the Prussian province of Hesse-Nassau, situated on the slope of a hill on the right bank of the Lahn, 60 m. by rail N. of Frankfort-on-Main, on the main line to Cassel. Pop. (1905), 20,137. On the opposite bank of the river, here spanned by two bridges, lie the suburb of Weidenhausen and the railway station of the Prussian state railway. The hill on which the town lies is crowned by the extensive old Schloss, a fine Gothic building, the most noteworthy parts of which are the Rittersaal, dating from 1277–1312, and the beautiful little chapel. This Schloss was formerly the residence of the landgraves of Hesse, served afterwards as a prison, and is now the repository of the historically interesting and valuable archives of Hesse. The chief architectural ornament of Marburg is, however, the Elisabethenkirche, a veritable gem of the purest Early Gothic style, erected by the grand master of the Teutonic Order in 1235–1283, to contain the tomb of St Elizabeth of Hungary. The remains of the saint were deposited in a rich silver-gilt sarcophagus, which may still be seen, and were afterwards visited by myriads of pilgrims, until the Protestant zeal of Landgrave Philip the Generous caused him to remove the body to some unknown spot in the church. The church also contains the tombs of numerous Hessian landgraves and knights of the Teutonic Order. The Lutheran church is another good Gothic edifice, dating mainly from the 15th century. The town-hall, built in 1512, and several fine houses in the Renaissance style, also deserve mention. The university of Marburg, founded by Philip the Magnanimous in 1527, was the first university established without papal privileges, and speedily acquired a great reputation throughout Protestant Europe. It has a library of 140,000 volumes, is admirably equipped with medical and other institutes, which form some of the finest modern buildings in the town, and was attended, in 1905, by 1576 students. Marburg also possesses a gymnasium, a "Realschule," an agricultural school, a society of naturalists, a hospital, and an extensive lunatic asylum. It is the seat of a district court, and of superintendents of the Lutheran and Reformed Churches. Marburg pottery is renowned; and leather, iron wares and surgical instruments are also manufactured there. The environs are very picturesque.

Marburg is first historically mentioned in a document of the beginning of the 13th century, and received its municipal charter from the landgrave Louis of Thuringia in 1227. On his death it became the residence of his wife, Elizabeth of Hungary, who built a hospital there, and died in 1231, at the age of twenty-four, worn out with works of religion and charity. She was canonized in 1235 at the instance of the Teutonic Knights, who had settled in Marburg in 1233 and were zealous in promoting her cult. By 1247 Marburg had already become the second town of Hesse, and in the 15th and 16th centuries it alternated with Cassel as the seat of the landgraves. In 1529 the famous conference between Luther and Zwingli on the subject of Transubstantiation took place there in the Rittersaal of the Schloss (see MARBURG, COLLOQUY OF). During the Thirty Years' and Seven Years' Wars Marburg suffered considerably from sieges and famine. In 1806, and again in 1810, it was the centre of an abortive rising against the French, in consequence of which the fortifications of the castle were destroyed.

See Kolbe, *Marburg im Mittelalter* (Marb., 1879); Bücking, *Mittheilungen aus Marburgs Vorzeit* (Marb., 1886); Schoof, *Marburg die Perle des Hessenlandes* (2nd ed., 1903).

MARBURG, COLLOQUY OF (*Marburger Religionsgespräch*), the name given to a conference of divines held in 1529 in the interests of the unity of Protestant Germany. The circumstances in which it was held, the influence of the men who conducted its deliberations, and the result of its proceedings, combine to render it of no small importance for the history of the Reformation in Germany.

After the Imperial Diet of Spires in 1526 had decreed that all states of the empire should observe the Edict of Worms (1521), banning Luther and his adherents, in such a manner that they should not be afraid to answer it before God and the emperor, the reform movement had received such an access of strength that the Catholic party felt itself menaced in earnest, and in 1529 again passed a resolution at Spires, deigned not merely to preclude any further expansion of the Reformation, but even to prevent it from maintaining the ground already won. This decision was at once challenged, on the 19th of April, by the protest of the Evangelical states (whence the name Protestants); and the effect of this disclaimer was not small. Still, it was devoid of political significance, unless backed by the united force of all the princes and states subscribing to the Evangelical teaching; and this unity was wanting. The feud which raged round the doctrine of the Lord's Supper had already broken out before the first diet of Spires, and had aroused great and immediate excitement. At a very early period, however, efforts were made to allay the dissension. Strassburg pronounced for conciliation: but the most powerful and zealous champion of peace was to be found in the landgrave Philip of Hesse, who recognized the absolute necessity—from a political standpoint—of the union of all German Protestants. It is probable that he had invited Luther to a religious conference as early as the year 1527; but on that occasion he met with a refusal. True, the impression conveyed by the attitude of the Catholic party at the second Diet of Spires had served to awaken the feeling for solidarity among the Evangelicals there assembled; and on the 22nd of April they had even secured the basis for a provisional alliance in the shape of a formula drawn up by Bucer and dealing with the Lord's Supper. But it was obvious that a permanent coalition could not be expected unless some definite understanding on the debated point could be attained; and on the very same day the landgrave despatched to Zwingli an invitation to a colloquy, and received his prompt acquiescence. Melanchthon, who in the tension which prevailed at the synod had shown himself inclined to negotiation, became suspicious on his return, and endeavoured to influence the elector of Saxony and Luther in accordance with his views. The landgrave, however, was so far successful that the beginning of October (1529) saw the colloquy opened in the castle at Marburg. With Zwingli, who had arrived on the 27th of September, he had several interviews of considerable political importance before the Wittenberg divines made their appearance. These interviews settled the preliminaries of an alliance; but they rested on the assumption that the theological feud between Wittenberg and Zürich could be removed, or its violence at least abated.

The proceedings opened on the 1st of October with conferences between Luther and Oecolampadius, and Melanchthon and Zwingli: then on the two following days the discussion proper—confined almost entirely to Luther and Zwingli—was held before the landgrave and his guest Duke Ulrich of Württemberg, in the presence of more than fifty persons. As regards the main point of contention, *i.e.* the doctrine of the Lord's Supper, no agreement was found practicable; and the private conversations on the 4th of October, which formed the sequel of the debate, carried matters no farther. "You have another spirit," said Luther. Since the landgrave, however, was reluctant to see the colloquy brought to an absolutely fruitless close, he requested Luther to draw up a list of the most important points of doctrine on which it might yet be possible to arrive at some degree of unanimity. This was done on the 4th of October; and a few alterations were introduced to meet the wishes of the Swiss deputies. The *Articles of Marburg*, which thus came into being, contain the doctrine of the Trinity, of the personality of Christ, of faith and justification, of the Scriptures, of baptism, of good works, of confession, of government, of tradition, and of infant baptism. The fifteenth article, treating of the Lord's Supper, defines the ground common to both parties even in this debateable region, recognizing the necessity of participation in both kinds, and rejecting the sacrifice of the Mass. It then proceeds to fix the point of difference in the fact that no agreement had been reached on the question "whether the true body and blood of Christ are corporeally present in the bread and wine" ("Nit vergleicht haben wir uns, ob der war leib und plut Christi leiblich im brot und wein sey"). Nevertheless, the adherents of each doctrine are recommended to display Christian charity to those of the other. These articles were signed by the ten official members of the colloquy: Luther, Jonas, Melanchthon, Osiander, Agricola, Brenz, Oecolampadius, Bucer, Hedio and Zwingli. The personal contact between Luther and Zwingli led to no mental *rapprochement* between the two; but in the following year the Articles of Marburg did good service as one of the preliminaries to the Augsburg Confession, and remain a valuable document for the fundamental principles common to the Lutheran and Reformed Churches.

See T. Kolde, *s.v.* "Marburger Religionsgespräch," in *Realencyklopädie f. protestant. Theologie*, 3rd ed. xii. 248 seq. (C. M.)

MARCA, PIERRE DE (1594–1662), French prelate and historian, was born at Gan, near Pau, on the 24th of January 1594. His family was known among judicial circles in the 16th century, and maintained the Roman Catholic faith after the official introduction of the Reformed religion into Navarre. After having studied law at the university of Toulouse he practised successfully at Pau. But he was ambitious, and turned to a larger sphere. He ardently called for the armed intervention of King Louis XIII. in Béarn, and on this occasion published his first writing, *Discours d'un Béarnais, très fidèle sujet du roi, sur l'édit du rétablissement de l'exercice de la religion catholique dans tout le Béarn* (1618). After the easy campaign of 1620, the possessions which had been taken by the Protestants were given back to the Roman Catholic church; this task was performed, under his supervision, with judgment and moderation. During the siege of La Rochelle he performed a mission which brought him in touch with Richelieu, who shortly afterwards nominated him *intendant de justice* in Béarn (1631), and in 1639 summoned him to Paris with the title of counsellor of state. The following year, the question of the intervention of kings in the election of bishops having been raised in a pamphlet by Charles Hersent (*Optatus Gallus de cavendo schismate*, 1640), Marca defended what were then called the liberties of the Gallican Church, in his celebrated treatise *De concordia sacerdotii et imperii, seu de libertatibus ecclesiae gallicanae* (1641). He was soon rewarded for this service. Although he had not yet taken even the minor holy orders, he was nominated bishop of Couserans by the king on the 28th of December 1641, but the pope refused to give his sanction. It was only after Marca had formally denied those propositions contained in *De concordia* which were displeasing to Rome that he was proclaimed in the consistory (Jan. 13, 1648). During this time, and until 1651, he was governor of the province of Catalonia, then occupied by the French. After the Treaty of the Pyrenees, he was sent to direct the conference which had been formed to fix the limits of Roussillon, which had just been ceded to France (1660). Marca now interested himself in the fortunes of Mazarin, and remained faithful to him even during the

Fronde. As a recompense, he was nominated archbishop of Toulouse (May 28, 1652), but had to wait for the bulls of investiture till the 23rd of March 1654. It was difficult for him to please both pope and king. In the struggle against the Jansenists he used all the influence he had with the clergy to secure the passage of the apostolic constitution of the 31st of March 1653 (*Relation de ce qui s'est fait depuis 1653 dans les assemblées des évêques au sujet des cinq propositions*, 1657); but in the rebellion raised by Retz, archbishop of Paris, against the king, he took the part of the king against the pope. Michel Le Tellier having ordered him to refute a thesis of the college of Clermont on the infallibility of the pope, Marca wrote a treatise which was most Gallican in its ideas, but refused to publish it for fear of drawing down "the indignation of Rome." These tactics were successful, and when Retz, weary of a struggle without definite results, resigned the archbishopric, Marca became his successor (Feb. 26, 1662). He did not derive much profit from this new favour, as he died on the 29th of June following, without his nomination having been sanctioned by the pope.

Marca, clever and covetous, was also an historian of note. When very young he showed his interest in the past history of his native land, and in 1617, at the age of twenty-three, he had set to work looking through archives, copying charters, and corresponding with the principal men of learning of his time, the brothers Dupuy, André Duchesne and Jean Besly, whom he visited in Poitou. His *Histoire de Béarn* was published at Paris in 1640. It was not so well received as his *De concordia*, but is more appreciated by posterity. If Marca's criticism is too often undecided, both in the ancient epochs, where he supports the text by a certain amount of guesswork and in certain points where he touches on religion, yet he always gives the text correctly. A number of chapters end with an interesting collection of charters. It is to be regretted that this incomplete work does not go beyond 1300. During his long stay in Catalonia he made preparations for a geographical and historical description of this province, which was bound to France by so many political and literary associations. Baluze, who became his secretary in 1656, helped him with the work and finished it, adding clever appendices and publishing the whole in 1688 under the title *Marca hispanica*.

Marca married Marguerite de Forgues on the 4th of June 1618, and had one son and three daughters. His son, Galactoire, who was president of the parlement of Navarre, died on the 10th of February 1689.

Marca's biography was written in Latin by two of his intimate friends, Étienne Baluze, his secretary (*Epistola ad Samuelem Sorbierium, de vita, gestis et scriptis Petri de Marca*, Paris, 1663), and his cousin, Paul de Faget (at the beginning of a collection of Marca's theological pamphlets, first published by Paul de Faget in 1668). This contained four treatises on the Eucharist, the sacrifice of the Mass, the erection of the patriarchate of Constantinople (in Latin), and the sacrament of the Eucharist (in French). It was supposed to contain heretical propositions and caused a good deal of scandal, inciting Baluze against Faget, both of whom abused the other, to defend the memory of the prelate.

See Bayle's article in the *Dictionnaire historique et critique* (*s.v.* "Marca"), and the Vie de Marca in the *Histoire de Béarn* (vol. i., 1894) of V. Dubarat.

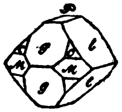
MARCANTONIO [MARCANTONIO RAIMONDI], the chief Italian master of the art of engraving in the age of the Renaissance, and the first who practised it in order to reproduce, not designs of his own invention, as earlier craftsmen had commonly done, but those of other artists almost exclusively. The date of his birth is uncertain, nor is there any good authority for assigning it, as is commonly done, approximately to the year 1488. He was probably born some years at least earlier than this, inasmuch as he is mentioned by a contemporary writer, Achillini, as being an artist of repute in 1504. His earliest dated plate, illustrating the story of Pyramus and Thisbe, belongs to the following year, 1505. Marcantonio received his training in the workshop of the famous goldsmith and painter of Bologna, Francesco Raibolini, usually called Francia. "Having more aptitude in design," says Vasari, "than his master, and managing the graver with facility and grace, he made waist-buckles and many other things in niello, such being then greatly in fashion, and made them most beautifully, as being in truth most excellent in that craft." The real fame, however, of Marcantonio was destined to be founded on his attainments, not in the goldsmith's art generally, but in that particular development of it which consists of engraving designs on metal plates for the purpose of reproduction by the printing press. This art was not new in Italy in the days of Marcantonio's apprenticeship. It had been practised, in a more or less elementary form, for not less than forty or fifty years in the workshops alike of Venetia, the Emilia, Tuscany and Lombardy. But the technical aim of the Italian engravers had not hitherto been directed, like that of Schongauer or Dürer north of the Alps, towards securing such freedom and precision in the use of the burin as should impart to the impressions taken from their engraved plates both a striking decorative effect and a power of suggesting to the eye a complex variety of natural objects and surfaces in light and shade. The Italian masters had been satisfied with much more rudimentary effects. The Florentine primitives had been content either with very simple cloudy patches of cross-hatching in fine straight lines, or with broad open shadings in the manner of a bold pen-drawing. Mantegna and Pollaiuolo, the two chief original masters who practised the art, had used the latter method with great power but at the same time great simplicity.

By the beginning of the 16th century a desire for a more complicated kind of effects was already arising among the followers of the art in Italy. Both backgrounds and passages of foreground detail were often imitated, inartificially enough, from the works of the northern masters. Marcantonio himself was among the foremost in this movement. About eighty engravings can be referred to the first five or six years of his career (1505–1511). Their subjects are very various, including many of pagan mythology, and some of obscure allegory, along with those of Christian devotion. The types of figures and drapery, and the general character of the compositions, bespeak for the most part the inspiration, and sometimes the direct authorship, of Francia. But the influence of German example is very perceptible also, particularly in the landscape backgrounds, and in the endeavour to express form by means of light and shadow with greater freedom than had been hitherto the practice of the southern schools. In a few subjects also the figures themselves correspond to a coarse Teutonic, instead of to the refined Italian, ideal. But so far we find Marcantonio only indirectly leaning on the north for the sake of self-improvement. It must have been for the sake of commercial profit that he by-and-by produced a series of direct counterfeits on copper from Albert Dürer's woodcuts. These facsimiles are sixty-nine in number, including seventeen of Dürer's "Life of the Virgin," thirty-seven of his "Little Passion," on wood, and a number of single pieces. According to Vasari, Dürer's indignation over those counterfeits was the cause of his journey to Venice; where he is said to have lodged a complaint against Marcantonio, and induced the Senate to prohibit the counterfeiting of his monogram, at any rate, upon any future imitations of the kind. Vasari's account must certainly be mistaken, inasmuch as Dürer's journey to Venice took place in 1506, and neither of the two series of woodcuts imitated by Marcantonio was published until 1511. The greater part of the designs for the "Life of the Virgin" had, it is true, been made and engraved seven years earlier than the date of their publication; and it is to be remarked that, whereas Marcantonio's copies of the "Little Passion" leave out the monogram of Dürer, it is inserted in his copies of the "Life of the Virgin"; whence it would, after all, seem possible that he had seen and counterfeited a set of impressions of this series at the time when they were originally executed, and before their publication But the real nature of the transaction, if transaction there was, which took place between Dürer and Marcantonio we cannot now hope to recover. Enough that the Bolognese engraver evidently profited, both in money and in education of the hand, by his work in imitating in a finer material the energetic characters of these northern woodcuts. He was soon to come under a totally different influence, and to turn the experience he had gained to account in interpreting the work of a master of a quite other stamp. Up till the year 1510 Marcantonio had lived entirely at Bologna, with the exception, it would appear, of a visit or visits to Venice. (A few of his early engravings are from drawings of the school of Giorgione.) Very soon afterwards he was attracted, for good and all, into the circle which surrounded Raphael at Rome. Where or when he had first made Raphael's acquaintance is uncertain. His passage to Rome by way of Florence has been supposed to be marked by an engraving, dated 1510, and known as "The Climbers," *Les Grimpeurs* (Bartsch, 487), in which he has reproduced a portion of the design of Michelangelo's cartoon of the Soldiers surprised bathing, and has added behind the figures a landscape imitated from the then young Dutch engraver Lucas of Leiden. Contemporary or somewhat earlier than this is a large engraving done by him from a design by Baldassare Peruzzi, a Sienese artist drawn about the same time into the Raphael circle. The piece in which he is recorded to have first tried his hand after Raphael himself is the Lucretia (Bartsch 192). From that time until he disappears in the catastrophe of 1527, Marcantonio was almost exclusively engaged in reproducing by means of engraving the designs of Raphael or of his immediate pupils. Raphael, the story goes, was so delighted with the print of the Lucretia that he personally trained and helped Marcantonio afterwards. A printing establishment was set up under the charge of Raphael's colour-grinder, Il Baviera, and the profits, in the early stage of the business, were shared between the engraver and the printer. The sale soon became very great; pupils gathered round about Marcantonio, of whom the two most distinguished were Marco Dente, known as Marco da Ravenna, and Agostino de' Musi, known as Agostino Veneziano; and he and they, during the last ten years of Raphael's life, and for several years following his death, gave forth a great profusion of engravings after the master's work—not copying, in most instances, his finished paintings, but working up, with the addition of simple backgrounds and accessories, his first sketches and trials, which often give the composition in a different form from the finished work, and are all the more interesting on that account.

The best of these engravings produced in the workshop of Marcantonio—those, namely, done by his own hand, and especially those done during the first few years after he had attached himself to Raphael—count among the most prized and coveted examples of the art. In them he enters into the genius of his master, and loses little of the chastened science and rhythmical purity of Raphael's contours, or of the inspired and winning sentiment of his faces; while in the parts where he is left to himself—the rounding and shading, the background and landscape—he manages his burin with all the skill and freedom which he had gained by the imitation of northern models, but puts away the northern emphasis and redundance of detail. His work, however, does not long remain at the height marked by pieces like the Lucretia, the Dido, the Judgment of Paris, the Poetry, the Philosophy, or the first Massacre of the Innocents. Marcantonio's engravings after the works of Raphael's later years are cold, ostentatious, and soulless by comparison. Still more so, as is natural, were those which he and his pupils produced after the designs of the degenerate scholars of Raphael and Michelangelo, of a Giulio Romano, a Polidoro, or a Bandinelli. Marcantonio's association with Giulio Romano was the cause of his first great disaster in life. He engraved a series of obscene designs by that painter in illustration of the *Sonnetti lussuriosi* of Pietro Aretino, and thereby incurred the anger of pope Clement VII., at whose order he was thrown into prison. Marcantonio's ruin was completed by the calamities attendant on the sack of Rome in 1527. He had to pay a heavy ransom in order to escape from the hands of the Spaniards, and fled from Rome, in the words of Vasari. "all but a beggar." It is said that he took refuge in his native city, Bologna; but he never again emerges from obscurity, and all we know with certainty is that in 1534 he was dead. (S. C.)

MARCASITE, a mineral with the same chemical composition as pyrites, being iron disulphide FeS_2, but crystallizing in the orthorhombic instead of in the cubic system. The name is of Arabic origin and was long applied to crystallized pyrites (*q.v.*); it was restricted to the present species by W. Haidinger in 1845. The mineral was known to G. Agricola in 1546 under the names *Wasserkies* or *Weisserkies* and *Leberkies*, and it has been variously known as white pyrites, hepatic pyrites, lamellar pyrites, radiated pyrites (German *Strahlkies*) and prismatic pyrites. The orthorhombic form of the crystals, as distinct from the cubic form of pyrites, was recognized by Romé de l'Isle in 1772, though later R. J. Haüy considered the crystals to be only distorted cubic forms.

The crystals are isomorphous with mispickel (*q.v.*), but only rarely are they distinctly developed and simple (fig.). Usually they are twinned on a prism plane, *M*, producing pentagonal stellate groups of five crystals; twinning on the plain *g*, in which the crystals intercross at angles of nearly 60°, is less common. This frequent twinning gives rise to characteristic forms, with many re-entrant angles, to which the names "spear pyrites" and "cockscomb pyrites" are applied. The commonest state of aggregation is that of radially arranged fibres, the external surface of the mass being globular, nodular or stalactitic in form.



Apart from crystalline form, the external characters of marcasite are very similar to those of pyrites, and when distinct crystals are not available the two species cannot always be easily distinguished. The colour is usually pale bronze-yellow, often rather lighter than that of pyrites; on freshly fractured surfaces of pure marcasite the colour is tin-white, but this rapidly tarnishes on exposure to air. The lustre is metallic and brilliant. The streak is greyish or brownish-black. The hardness (6–6½) is the same as that of pyrites, and the specific gravity (4·8–4·9) as a rule rather less. Arsenical varieties of marcasite, containing up to 5% of arsenic, are known as lonchidite and kyrosite.

Marcasite readily oxidizes on exposure to moist air, with the production of sulphuric acid and a white fibrous efflorescence of ferrous sulphate, and in course of time specimens in collections often became completely disintegrated. In nature it is frequently altered to limonite with the separation of native sulphur. Marcasite is thus the less stable of the two modifications of iron disulphide. Many experiments have been made with a view to determining the difference in chemical constitution of marcasite and pyrites, but with no very definite results. It is a noteworthy fact that whilst pyrites has been prepared artificially, marcasite has not.

Marcasite occurs under the same conditions as pyrites, but is much less common. Whilst pyrites is found abundantly in the older crystalline rocks and slates, marcasite is more abundant in clays, and has often been formed as a concretion around organic remains. It is abundant, for example, in the plastic clay of the Brown Coal formation at Littmitz, near Carlsbad, in Bohemia, at which place it has been extensively mined for the manufacture of sulphur and ferrous sulphate. In the Chalk of the south-east of England nodules of marcasite with a fibrous radiated structure are abundant, and in the Chalk Marl between Dover and Folkestone fine twinned groups of "spear pyrites" are common. The mineral is also met with in metalliferous veins, though much less frequently than pyrites; for example the "cockscomb pyrites" of the lead mines of Derbyshire and Cumberland. (L. J. S.)

MARCEAU-DESGRAVIERS, FRANÇOIS SÉVERIN (1769–1796), French general, was born at Chartres on the 1st of March 1769. His father was a law officer, and he was educated for a legal career, but at the age of sixteen he enlisted in the regiment of Savoy-Carignan. Whilst on furlough in Paris Marceau joined in the attack on the Bastille (July 14, 1789); after that event he took his discharge from the regular army and returned to Chartres, but the embarrassments of his family soon compelled him to seek fresh military employment. He became drill instructor, and afterwards captain in the departmental (Eure-et-Loire) regiment of the National Guard. Early in March 1792 he was elected lieutenant-colonel of one of the battalions of the Eure-et-Loire; he took part in the defence of Verdun in 1792, and it fell to his lot to bear the proposals of capitulation to the Prussian camp. The spiritless conduct of the defenders excited the wrath of the revolutionary authorities, and Marceau was fortunate in escaping arrest and finding re-employment as a captain in the regular service. Early in 1793 he became with other officers "suspect," and was for some time imprisoned. On his release he hurried to take part in the defence of Saumur against the Vendéan royalists, and distinguished himself at the combat of Saumur (June 10, 1793) by gallantly rescuing the representative Bourbotte from the hands of the insurgents. The Convention voted him the thanks of the country, and thenceforward his rise was rapid. His conduct at Chantonnay (Sept. 5) won him the provisional rank of general of brigade. On the 17th of October he bore a great part in the victory of Cholet, and on the field of this battle began his friendship with Kléber. For the victory of Cholet Kléber was made general of division and Marceau confirmed as general of brigade. Their advice was of the greatest value to the generals in command, and the military talents of each were the complement of the other's. Marceau, who became general of division (Nov. 10), succeeded to the chief command *ad interim*, and with his friend won important victories near Le Mans (Dec. 12–13) and Savenay (Dec. 23). After the battle of Le Mans, Marceau rescued and protected a young Royalist lady, Angélique des Mesliers. It is often supposed that he was in love with his prisoner; but the help even of the commander-in-chief did not avail to save her from the guillotine (Jan. 22, 1794). Marceau had already retired from the war, exhausted by the fatigues of the campaign, and he and Kléber were saved from arrest and execution only by the intervention of Bourbotte. Marceau became affianced about this time to Agathe Leprêtre de Châteaugiron, but his constant military employment, his broken health, and the opposition of the comte de Châteaugiron on the one hand and of Marceau's devoted half-sister "Emira," wife of the Republican politician Sergent, on the other, prevented the realization of his hopes. After spending the winter of 1793–1794 in Paris he took a command in the army under Jourdan, in which Kléber also served. He took part in the various battles about Charleroi, and at the final victory of Fleurus (June 26, 1794) he had a horse shot under him. He distinguished himself again at Jülich and at Aldenhoven, and stormed the lines of Coblenz on the 23rd of October. With the Army of the Sambre and Meuse he took his share in the campaign of 1795 on the Rhine and the Lahn, distinguishing himself particularly with Kléber in the fighting about Neuwied on the 18th and 19th of October, and at Sulzbach on the 17th of December. In the campaign of 1796 the famous invasion of Germany by the armies of Jourdan and Moreau ended in disaster, and Marceau's men covered Jourdan's retreat over the Rhine. He fought the desperate actions on the Lahn (Sept. 16 and 18), and at Altenkirchen on the 19th received a mortal wound, of which he died on the 21st, at the early age of twenty-seven. The Austrians vied with his own countrymen in doing honour to the dead general. His body was burned, and his ashes, which at the time were placed under a pyramid designed by Kléber, were transferred in 1889 to the Pantheon at Paris.

See Maze, *Le Général Marceau* (1889); Parfait, *Le Général Marceau* (1892); and T. C. Johnson, *Marceau* (London, 1896).

MARCEL, ÉTIENNE (d. 1358), provost of the merchants of Paris under King John II., belonged by birth to the wealthy Parisian *bourgeoisie*, being the son of a clothier named Simon Marcel and of Isabelle Barbou. He is mentioned as provost of the Grande-Confrérie of Notre Dame in 1350, and in 1354 he succeeded Jean de Pacy as provost of the Parisian merchants. His political career began in 1356, when John was made prisoner after the battle of Poitiers. In conjunction with Robert le Coq, bishop of Laon, he played a leading part in the states-general called together by the dauphin Charles on the 17th of October. A committee of eighty members, constituted on their initiative, pressed their demands with such insistence that the dauphin prorogued the states-general; but financial straits obliged him to summon them once more on the 3rd of February 1357, and the promulgation of a great edict of reform was the consequence. John the Good forbade its being put into effect, whereupon a conflict began between Marcel and the dauphin, Marcel endeavouring to set up Charles the Bad, king of Navarre, in opposition to him. The states-general assembled again on the 13th of January 1358, and on the 22nd of February the populace of Paris, led by Marcel, invaded the palace and murdered the marshals of Champagne and Normandy before the prince's eyes. Thenceforward Marcel was in open hostility to the throne. After vainly hoping that the insurrection of the Jacquerie might turn to his advantage, he next supported the king of Navarre, whose armed bands infested the neighbourhood of Paris. On the night of the 31st of July Marcel was about to open the gates of the capital to them, but Jean Maillart prevented the execution of this design, and killed him before the Porte Saint-Antoine. During the following days his adherents were likewise put to death, and the dauphin was enabled to re-enter Paris. Étienne Marcel married first Jeanne de Dammartin, and secondly Marguerite des Essars, who survived him.

See F. T. Perrens, *Étienne Marcel et le gouvernement de la bourgeoisie au xiv^{e} siècle* (Paris, 1860); P. Frémaux, *La Famille d'Étienne Marcel*, in the *Mémoires* of the *Société de l'histoire de Paris et de l'Île de France* (1903), vol. xxx.; and Hon. R. D. Denman, *Étienne Marcel* (1898). (J. V.*)

MARCELLINUS, ST, according to the Liberian catalogue, became bishop of Rome on the 30th of June, 296; his predecessor was Caius or Gaius. He is not mentioned in the *Martyrologium hieronymianum*, or in the *Depositio episcoporum*, or in the *Depositio martyrum*. The *Liber pontificalis*, basing itself on the Acts of St Marcellinus, the text of which is lost, relates that during Diocletian's persecution Marcellinus was called upon to sacrifice, and offered incense to idols, but that, repenting shortly afterwards, he confessed the faith of Christ and suffered martyrdom with several companions. Other documents speak of his defection, and it is probably this lapse that explains the silence of the ancient liturgical calendars. In the beginning of the 5th century Petilianus, the Donatist bishop of Constantine, affirmed that Marcellinus and his priests had given up the holy books to the pagans during the persecution and offered incense to false gods. St Augustine contents himself with denying the affair (*Contra litt. Petiliani*, ii. 202; *De unico baptismo*, 27). The records of the pseudo-council of Sinuessa, which were fabricated at the beginning of the 6th century, state that Marcellinus after his fall presented himself before a council, which refused to try him on the ground that *prima sedes a nemine iudicatur*. According to the *Liber pontificalis*, Marcellinus was buried, on the 26th of April 304, in the cemetery of Priscilla, on the Via Salaria, 25 days after his martyrdom; the Liberian catalogue gives as the date the 25th of October. The fact of the martyrdom, too, is not established with certainty. After a considerable interregnum he was succeeded by Marcellus, with whom he has sometimes been confounded.

See L. Duchesne, *Liber pontificalis*, I. lxxiii.–lxxiv. 162–163, and II. 563. (H. De.)

MARCELLO, BENEDETTO (1686–1739), Italian musical composer, was born in 1686, either on the 31st of July or on the 1st of August. He was of noble family (in his compositions he is frequently described as "Patrizio Veneto"), and although a pupil of Lotti and Gasparini, was intended by his father to devote himself to the law. In 1711 he was a member of the Council of Forty, and in 1730 went to Pola as Provveditore. His health having been impaired by the climate of Istria, he retired after eight years to Brescia in the capacity of Camerlengo, and died there on the 24th of July 1739.

Marcello is best remembered by his *Estro poetico-armonico* (Venice, 1724–1727), a musical setting for voices and strings of the first fifty Psalms, as paraphrased in Italian by G. Giustiniani. They were much admired by Charles Avison, who with John Garth brought out an edition with English words (London, 1757). Some extracts are to be found in Hawkins's *History of Music*. His other works are chiefly cantatas, either for one voice or several; the library of the Brussels conservatoire possesses some interesting volumes of chamber-cantatas composed for his mistress. Although he produced an opera, *La Fede riconosciuta*, at Vicenza in 1702, he had little sympathy with this form of composition, and vented his opinions on the state of musical drama at the time in the satirical pamphlet *Il Teatro alla moda*, published anonymously in Venice in 1720. This little work, which was frequently reprinted, is not only extremely amusing, but is also most valuable as a contribution to the history of opera.

A catalogue of his works is given in *Monatshefte für Musikgeschichte*, vol. xxiii. (1891).

MARCELLUS, the name of two popes.

Marcellus I. succeeded Marcellinus, after a considerable interval, most probably in May 308, under Maxentius. He was banished from Rome in 309 on account of the tumult caused by the severity of the penances he had imposed on Christians who had lapsed under the recent persecution. He died the same year, being succeeded by Eusebius. He is commemorated on the 16th of January.

Marcellus II. (Marcello Cervini), the successor of Julius III., was born on the 6th of May 1501, and was elected pope on the 9th of April 1555. He had long been identified with the rigorist party in the church, and as president of the Council of Trent had incurred the anger of the emperor by his jealous defence of papal prerogative. His motives were lofty, his life blameless, his plans for reform nobly conceived. But death removed him (April 30, 1555) before he could do more than give an earnest of his intentions. He was followed by Paul IV.

Contemporary lives are to be found in Panvinio, continuator of Platina, *De vitis pontiff. rom.*; and Ciaconius, *Vitae et res gestae summorum pontiff. rom.* (Rome, 1601–1602). P. Polidoro, *De gestis, vita et moribus Marcelli II.* (Rome, 1744), makes use of an unpublished biography of the pope by his brother, Alessandro Cervini. See also Brilli, *Intorno alla vita e alle azioni di Marcello II.* (Montepulciano, 1846); Ranke, *Popes* (Eng. trans., Austin), i. 284 seq.; A. von Reumont, *Gesch. der Stadt Rom*), iii. 2, 512, seq. (T. F. C.)

MARCELLUS, a Roman plebeian family belonging to the Claudian gens. Its most distinguished members were the following:—

1. Marcus Claudius Marcellus (*c.* 268–208 B.C.), one of the Roman generals during the Second Punic War and conqueror of Syracuse. He first served against Hamilcar in Sicily. In his first consulship (222) he was engaged, with Cn. Cornelius Scipio as colleague, in war against the Insubrian Gauls, and won the *spolia opima* for the third and last time in Roman history by slaying their chief Viridomarus or Virdumarus (Polybius ii. 34; Propertius v. 10, 39). In 216, after the defeat at Cannae, he took command of the remnant of the army at Canusium, and although he was unable to prevent Capua going over to Hannibal, he saved Nola and southern Campania. In 214 he was in Sicily as consul at the time of the revolt of Syracuse; he stormed Leontini and besieged Syracuse, but the skill of Archimedes repelled his attacks. After a two years' siege he gradually forced his way into the city and took it in the face of strong Punic reinforcements. He spared the lives of the inhabitants, but carried off their art treasures to Rome, the first instance of a practice afterwards common. Consul again in 210, he took Salapia in Apulia, which had revolted to Hannibal, by help of the Roman party there, and put to death the Numidian garrison. Proconsul in 209, he attacked Hannibal near Venusia, and after a desperate battle retired to that town; he was accused of bad generalship, and had to leave the army to defend himself in Rome. In his last consulship (208), he and his colleague, while reconnoitring near Venusia, were unexpectedly attacked, and Marcellus was killed. His successes have been exaggerated by Livy, but the name often given to him, the "sword of Rome," was well deserved.

Livy xxiii. 14–17, 41–46; xxiv. 27–32, 35–39; xxv. 5–7, 23–31; xxvi. 26, 29–32; xxvii. 1–5, 21–28; Polybius viii. 5–9, x. 32; Appian, *Hannib.* 50; Florus ii. 6.

2. M. Claudius Marcellus, an inveterate opponent of Julius Caesar. During his consulship (51 B.C.) he proposed to remove Caesar from his army in March 49, but this decision was delayed by Pompey's irresolution and the skilful opposition of the tribune C. Curio (see Caesar, Julius). In January 49 he tried to put off declaring war against Caesar till an army could be got ready, but his advice was not taken. When Pompey left Italy, Marcus and his brother Gaius followed, while his cousin withdrew to Liternum. After Pharsalus M. Marcellus retired to Mytilene, where he practised rhetoric and studied philosophy. In 46 his cousin and the senate successfully appealed to Caesar to pardon him, and Marcellus reluctantly consented to return. On this occasion Cicero's[1] speech *Pro Marcello* was delivered. Marcellus left for Italy, but was murdered in May by one of his own attendants, P. Magius Chilo, in the Peiraeus. Marcellus was a thorough aristocrat. He was an eloquent speaker (Cicero, *Brutus*, 71), and a man of firm character, although not free from avarice.

See Cicero, *Ad fam.* iv. 4, 7, 10, and *Ad Att.* v. 11 (ed. Tyrrell and Purser); Caesar, *B. C.* i. 2; Suetonius, *Caesar*, 29; G. Boissier, *Cicero and his Friends* (Eng. trans., 1897).

3. M. Claudius Marcellus (*c.* 43–23 B.C.), son of C. Marcellus and Octavia, sister of Augustus. In 25 he was adopted by the emperor and married to his daughter Julia. This seemed to mark him out as the heir to the throne, but Augustus, when attacked by a serious illness, gave his signet to M. Vipsanius Agrippa. In 23 Marcellus, then curule aedile, died at Baiae. Livia was suspected of having poisoned him to get the empire for her son Tiberius. Great hopes had been built on the youth, and he was celebrated by many writers, especially by Virgil in a famous passage (*Aeneid*, vi. 860). He was buried in the Campus Martius, and Augustus himself pronounced the funeral oration. The Theatrum Marcelli (remains of which can still be seen) was afterwards dedicated in his honour.

Horace, *Odes*, i. 12; Propertius iii. 18; Dio Cassius liii. 28, 30; Tacitus, *Annals*, ii. 41; Suetonius, *Augustus*, 63; Vell. Pat. ii. 93.

MARCESCENT (Lat. *marcescens*, withering), a botanical term for withering without falling off.

MARCH, EARLS OF, title derived from the "marches" or boundaries (1) between England and Wales, and (2) England and Scotland, and held severally by great feudal families possessed of lands in those border districts. The earls of March on the Welsh borders were descended from Roger de Mortemer (so called from his castle of Mortemer in Normandy), who was connected by marriage with the dukes of Normandy. His son Ralph (d. *c.* 1104) figures in Domesday as the holder of vast estates in Shropshire, Herefordshire and other parts of England, especially in the west; and his grandson Hugh de Mortimer, founder of the priory of Wigmore in Herefordshire, was one of the most powerful of the barons reduced to submission by Henry II., who compelled him to surrender his castles of Cleobury and Wigmore. The Mortimers, however, continued to exercise almost undisputed sway, as lords of Wigmore, over the western counties and the Welsh marches.

I. *Welsh Marches.*—Roger de Mortimer (*c.* 1286–1330), 8th baron of Wigmore and 1st earl of March, being an infant at the death of his father, Edmund, was placed by Edward I. under the guardianship of Piers Gaveston, and was knighted by Edward in 1306; Mortimer's mother being a relative of Edward's consort, Eleanor of Castile. Through his marriage with Joan de Joinville, or Genevill, Roger not only acquired increased possessions on the Welsh marches, including the important castle of Ludlow, which became the chief stronghold of the Mortimers, but also extensive estates and influence in Ireland, whither he went in 1308 to enforce his authority. This brought him into conflict with the De Lacys, who turned for support to Edward Bruce, brother of Robert Bruce, king of Scotland. Mortimer was appointed lord-lieutenant of Ireland by Edward II. in 1316, and at the head of a large army drove Bruce to Carrickfergus, and the De Lacys into Connaught, wreaking vengeance on their adherents whenever they were to be found. He was then occupied for some years with baronial disputes on the Welsh border until about 1318, when he began to interest himself in the growing opposition to Edward II. and his favourites, the Despensers; and he supported Humphrey de Bohun, earl of Hereford, in refusing to obey the king's summons to appear before him in 1321. Forced to surrender to the king at Shrewsbury in January 1322, Mortimer was consigned to the Tower of London, whence he escaped to France in August 1324. In the following year Isabella, wife of Edward II., anxious to escape from her husband, obtained his consent to her going to France to use her influence with her brother, Charles IV., in favour of peace. At the French court the queen found Roger Mortimer; she became his mistress soon afterwards, and at his instigation refused to return to England so long as the Despensers retained power as the king's favourites. The scandal of Isabella's relations with Mortimer compelled them both to withdraw from the French court to Flanders, where they obtained assistance for an invasion of England. Landing in England in September 1326, they were joined by Henry, earl of Lancaster; London rose in support of the queen; and Edward took flight to the west, whither he was pursued by Mortimer and Isabella. After wandering helplessly for some weeks in Wales, the king was taken on the 16th of November, and was compelled to abdicate in favour of his son. But though the latter was crowned as Edward III. in January 1327, the country was ruled by Mortimer and Isabella, who procured the murder of Edward II. in the following September. Rich estates and offices of profit and power were now heaped on Mortimer, and in September 1328 he was created earl of March. Greedy and grasping, he was no more competent than the Despensers to conduct the government of the country. The jealousy and anger of Lancaster having been excited by March's arrogance, Lancaster prevailed upon the young king, Edward III., to throw off the yoke of his mother's paramour. At a parliament held at Nottingham in October 1330 a plot was successfully carried out by which March was arrested in the castle, and, in spite of Isabella's entreaty to her son to "have pity on the gentle Mortimer," was conveyed to the Tower. Accused of assuming royal power and of various other high misdemeanours, he was condemned without trial and hanged at Tyburn on the 29th of November 1330, his vast estates being forfeited to the crown. March's wife, by whom he had four sons and eleven daughters, survived till 1356. The daughters all married into powerful families, chiefly of Marcher houses. His eldest son, Edmund, was father of Roger Mortimer (*c.* 1328–1360), who was knighted by Edward III. in 1346, and restored to his grandfather's title as 2nd earl of March.

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[1] The authorship of this speech has been disputed.

Edmund de Mortimer (1351–1381), 3rd earl of March, was son of Roger, 2nd earl of March, by his wife Philippa, daughter of William Montacute, 1st earl of Salisbury. Being an infant at the death of his father, Edmund, as a ward of the crown, was placed by Edward III. under the care of William of Wykeham and Richard Fitzalan, earl of Arundel. The position of the young earl, powerful on account of his possessions and hereditary influence in the Welsh marches, was rendered still more important by his marriage in 1368 to Philippa, only daughter of Lionel, duke of Clarence, third son of Edward III. Lionel's wife was Elizabeth, daughter and heiress of William de Burgh, 6th Lord of Connaught and 3rd earl of Ulster, and Lionel had himself been created earl of Ulster before his marriage. The earl of March, therefore, not only became the representative of one of the chief Anglo-Norman lordships in Ireland in right of his wife Philippa, but the latter, on the death of her father shortly after her marriage, stood next in succession to the crown after the Black Prince and his sickly son Richard, afterwards king Richard II. This marriage had, therefore, far-reaching consequences in the history of England, giving rise to the claim of the house of York to the crown of England, contested in the War of the Roses; Edward IV. being descended from the third son of Edward III. as great-great-grandson of Philippa, countess of March, and in the male line from Edmund, duke of York, fifth son of Edward III.

Mortimer, now styled earl of March and Ulster, became marshal of England in 1369, and was employed in various diplomatic missions during the next following years. He was a member of the committee appointed by the Peers to confer with the Commons in 1373—the first instance of such a joint conference since the institution of representative parliaments—on the question of granting supplies for John of Gaunt's war in France; and in the opposition to Edward III. and the court party, which grew in strength towards the end of the reign, March took the popular side, being prominent in the Good Parliament of 1376 among the lords who, encouraged by the Prince of Wales, concerted an attack upon the court party led by John of Gaunt. The Speaker of the Commons in this parliament was March's steward, Peter de la Mare; he firmly withstood John of Gaunt in stating the grievances of the Commons, in supporting the impeachment of several high court officials, and in procuring the banishment of the king's mistress, Alice Perrers. March was a member of the administrative council appointed by the same parliament after the death of the Black Prince to attend the king and advise him in all public affairs. On the accession of Richard II., a minor, in 1377, the earl became a member of the standing council of government; though as father of the heir-presumptive to the crown he wisely abstained from claiming any actually administrative office. The most powerful person in the realm was, however, John of Gaunt, duke of Lancaster, whose jealousy of March led to the acceptance by the latter of the lieutenancy of Ireland in 1379. March succeeded in asserting his authority in eastern Ulster, but failed to subdue the O'Neills farther west. Proceeding to Munster to put down the turbulency of the chieftains of the south, March died at Cork on the 27th of December 1381. He was buried in Wigmore Abbey, of which he had been a benefactor, and where his wife Philippa who died about the same time was also interred. The earl had two sons and two daughters, the elder of whom, Elizabeth, married Henry Percy (Hotspur), son of the earl of Northumberland. His eldest son Roger succeeded him as 4th earl of March and Ulster. His second son Edmund (1376–1409) played an important part in conjunction with his brother-in-law Hotspur against Owen Glendower; but afterwards joined the latter, whose daughter he married about 1402.

Roger de Mortimer, 4th earl of March and Ulster (1374–1398), son of the 3rd earl, succeeded to the titles and estates of his family when a child of seven, and a month afterwards he was appointed lord-lieutenant of Ireland, his uncle Sir Thomas Mortimer acting as his deputy. Being a ward of the Crown, his guardian was the earl of Kent, half-brother to Richard II.; and in 1388 he married Kent's daughter, Eleanor. The importance which he owed to his hereditary influence and possessions, and especially to his descent from Edward III., was immensely increased when Richard II. publicly acknowledged him as heir-presumptive to the crown in 1385. In 1394 he accompanied Richard to Ireland, but notwithstanding a commission from the king as lieutenant of the districts over which he exercised nominal authority by hereditary right, he made little headway against the native Irish chieftains. March enjoyed great popularity in England though he took no active part in opposing the despotic measures of the king; in Ireland he illegally assumed the native Irish costume. In August 1398 he was killed in fight with an Irish clan, and was buried in Wigmore Abbey. March's daughter Anne married Richard earl of Cambridge, son of Edmund duke of York, fifth son of Edward III.; their son Richard, duke of York, was father of King Edward IV., who thus derived his title to the crown and acquired the estates of the house of Mortimer.

Edmund de Mortimer (1391–1425), 5th earl of March and Ulster, son of the 4th earl, succeeded to his father's claim to the crown as well as to his title and estates on the death of the latter in Ireland in 1398. In the following year Richard II. was deposed and the crown seized by Henry of Lancaster. The young earl of March and his brother Roger were then kept in custody by Henry IV., who, however, treated them honourably, until March 1405, when they were carried off from Windsor Castle by the opponents of the Lancastrian dynasty, of whom their uncle Sir Edmund Mortimer (see above) and his brother-in-law Henry Percy (Hotspur) were leaders in league with Owen Glendower. The boys were recaptured, and in 1409 were committed to the care of the prince of Wales. On the accession of the latter as Henry V., in 1413, the earl of March was set at liberty and restored to his estates, his brother Roger having died some years previously; and he continued to enjoy the favour of the king in spite of a conspiracy in 1415 to place him on the throne, in which his brother-in-law, the earl of Cambridge, played the leading part. March accompanied Henry V. throughout his wars in France, and on the king's death in 1422 became a member of the council of regency. He died in Ireland in 1425, and as he left no issue the earldom of March in the house of Mortimer became extinct, the estates passing to the last earl's nephew Richard, who in 1435 was officially styled duke of York, earl of March and Ulster, and baron of Wigmore. Richard's son Edward having ascended the throne in 1461 as Edward IV., the earldom of March became merged in the crown.

See Thomas Rymer, *Foedera*, &c. (London, 1704-1732); T. F. Tout, *The Political History of England*, vol. iii., ed. by William Hunt and R. L. Poole (London, 1905); Sir William Dugdale, *Monasticon anglicanum* (3 vols., London, 1655-1673); William Stubbs, *Constitutional History of England*, vol. ii.

II. *Scottish Marches.*—The Scottish earls of March were descended from Crinan, whose son Maldred married Algitha, daughter of Ughtred, earl of Northumberland, by Elgiva, daughter of the Saxon king Æthelred. Maldred's son Cospatrick, or Gospatrick, was made earl of Northumberland by William the Conqueror; but being soon afterwards deprived of this position he fled to Scotland, where Malcolm Canmore, king of Scotland, welcomed him and granted him Dunbar and the adjoining lands. Two generations of Cospatricks followed in lineal succession, bearing the title of earl, but without territorial designation. Cospatrick II. witnessed the charter of Alexander I. founding the abbey of Scone in 1115. The 3rd earl, also named Cospatrick, a liberal benefactor of Melrose Abbey, died in 1166, leaving two sons, the younger of whom was the ancestor of the earls of Home. The elder son, Waltheof, was the first of the family to be styled "Comes de Dunbar," about the year 1174. His importance is proved by the fact that he was one of the hostages for the performance of the Treaty of Falaise for the liberation of William the Lion in 1175. Waltheof's son Patrick Dunbar (the name Dunbar, derived from the family estates, now becoming an hereditary surname), styled 5th earl of Dunbar, although his father had been the first to adopt the territorial designation, was keeper of Berwick Castle, and married Ada, natural daughter of William the Lion. His grandson Patrick, 7th earl, headed the party that liberated King Alexander III. in 1255 from the Comyns, and in the same year was nominated guardian of the king and queen by the Treaty of Roxburgh. He signed the Treaty of Perth (July 6, 1266) by which Magnus VI. of Norway ceded the Isle of Man and the Hebrides to Scotland. His wife was Christian, daughter of Robert Bruce, the competitor for the crown of Scotland.

Patrick Dunbar, 8th earl of Dunbar and 1st earl of March, claimed the crown of Scotland in 1291 as descendant of Ada, daughter of William the Lion. He was one of the "seven earls of Scotland," a distinct body separate from the other estates of the realm, who claimed the right to elect a king in cases of disputed succession, and whose authority was, perhaps, to be traced to the seven provinces of the Pictish kingdom. He was the first of the earls of Dunbar to appear in the records as "comes de Marchia," or earl of March. Like most of his family in later times, he was favourable to the English interest in Scottish affairs, and he did homage to Edward I. of England. His wife Marjory, daughter of Alexander Comyn, earl of Buchan, took the other side and held the castle of Dunbar for Baliol, but was forced to surrender it to Edward in 1296. In 1298 he was appointed the English king's lieutenant in Scotland.

Patrick Dunbar (1285-1369), 9th earl of Dunbar and 2nd earl of March, son of the preceding, gave refuge to Edward II. of England after Bannockburn, and contrived his escape by sea to England. Later, he made peace with Robert Bruce, and by him was appointed governor of Berwick Castle, which he held against Edward III. until the defeat of the Scots at Halidon Hill (July 19, 1333) made it no longer tenable. His countess, known in Scottish history and romance as "Black Agnes," daughter of Thomas Randolph, earl of Moray (Murray), and grandniece of Robert Bruce, is famous for her defence of Dunbar Castle against the English under the earl of Salisbury in 1338, Salisbury being forced to abandon the attempt after a fierce siege lasting nineteen weeks. This lady succeeded to the estates and titles of her brother, John Randolph, 3rd earl of Moray. The earldom of Moray passed after her death to her second son, John Dunbar, who married Marjory, daughter of King Robert II. Black Agnes also bore to the earl of March two daughters, the elder of whom, Agnes, after being the mistress of King David II., married Sir James Douglas, lord of Dalkeith, from whom were descended the first three earls of Morton; the younger, Elizabeth, married John Maitland of Lethington, ancestor of the duke of Lauderdale, whose second title was marquess of March.

George Dunbar (d. 1420), 10th earl of Dunbar and 3rd earl of March, great-nephew of the 8th earl and warden of the marches, accompanied Douglas in his foray into England in 1388, and commanded the Scots after Otterburn. He afterwards quarrelled with the Douglases, because his daughter was passed over in favour of a daughter of Archibald, "the Grim Earl of Douglas," as wife for David, duke of Rothesay, son of Robert III. When Douglas seized March's lands the latter fled to England, where he was welcomed by Henry IV., to whom he was related. He fought on the English side at Homildon Hill; and, having revealed to Henry the defection of the Percies, who were in league with Douglas and Owen Glendower, he fought against those allies at the battle of Shrewsbury (July 23, 1403). Becoming reconciled with Douglas, he returned to Scotland in 1409, and was restored to his earldom by the regent Albany. He died in 1420.

George Dunbar, 11th earl of Dunbar and 4th earl of March, was one of the negotiators for the release of James I. of Scotland in 1423 from his captivity in England, and was knighted at that king's coronation. In 1434, however, on the ground that the regent had had no power to reverse his father's forfeiture for treason, March was imprisoned and his castle of Dunbar seized by the king; and the parliament at Perth declared his lands and titles forfeited to the crown. The earl, being released, retired to England with his son Patrick, whose daughter and heiress Margaret was ancestress of Patrick, 5th earl of Dumfries, now represented by the marquess of Bute.

The earldom of March in the house of Dunbar having thus been forfeited to the crown, James II. in 1455 conferred the title, together with that of warden of the marches, on his second son Alexander, duke of Albany; but this prince entered into treasonable correspondence with Edward IV. of England, and in 1487 the earldom of March and the barony and castle of Dunbar were again declared forfeited and annexed to the crown of Scotland.

The title of earl of March was next held by the house of Lennox. In 1576 the earldom of Lennox became extinct on the death without male issue of Charles (father of Lady Arabella Stuart), 5th earl of Lennox; and it was then revived in favour of Robert Stuart, a grand-uncle of King James VI., second son of John, 3rd earl of Lennox. But in 1579 Esmé Stuart, a member of a collateral branch which in 1508 had inherited the lordship of Aubigny in France, came to Scotland and obtained much favour with James VI. The earldom of Lennox (soon afterwards raised to a dukedom) was taken from Robert and conferred upon Esmé; and Robert was compensated by being created earl of March and baron of Dunbar (1582). Robert died without legitimate issue in 1586, when the earldom of March again reverted to the crown. In 1619 Esmé, 3rd duke of Lennox, was created earl of March; and his son James was created duke of Richmond in 1641. On the death without issue of Charles, 6th duke of Lennox and 3rd duke of Richmond, in 1672, his titles devolved upon King Charles II. as nearest collateral heir-male. In 1675 Charles conferred the titles of duke of Richmond and Lennox and earl of March on Charles Lennox, his natural son by Louise de Keroualle, duchess of Portsmouth, from whom the earldom of March has descended to its present holder the duke of Richmond and Gordon. (See RICHMOND, EARLS AND DUKES OF; and LENNOX.)

The title of earl of March in the peerage of Scotland, by another creation, was conferred in 1697 on William Douglas, second son of William, 1st duke of Queensberry. His grandson William, 3rd earl of March, became 4th duke of Queensberry on the death without surviving male issue of his cousin Charles, 3rd duke of Queensberry, in 1778. Dying unmarried in 1810, the several titles of the duke passed to different branches of the house of Douglas. The earldom of March is stated by Sir Bernard Burke and other authorities to have devolved upon Francis, 8th earl of Wemyss, great-great-grandson of David, 3rd earl of Wemyss, whose wife was Anne, daughter of the 1st duke of Queensberry and sister of the 1st earl of March; and the title is now assumed by the earl of Wemyss. On the other hand, Francis, 8th earl of Wemyss, not having been an heir of the body of the 1st earl of March, Sir Robert Douglas says in *The Peerage of Scotland* that on the death of the 4th duke of Queensberry in 1810 "the earldom of March, it is supposed, became extinct."

See Andrew Lang, *History of Scotland* (4 vols., London, 1900–1907); Sir Bernard Burke, *A Genealogical History of Dormant and Extinct Peerages* (London, 1866); Sir Robert Douglas, *The Peerage of Scotland* (2 vols., Edinburgh 1813); Lady Elizabeth Cust, *Some Account of the Stuarts of Aubigny in France* (London, 1891). (R. J. M.)

MARCH, AUZIAS (*c.* 1395–1458), Catalan poet, was born at Valencia towards the end of the 14th century. Little is known of his career except that he was twice married—first to Na Ysabel Martorell, and second to Na Johanna Scorna—that he died on the 4th of November 1458, and that he left several natural children. Inheriting an easy fortune from his father, the treasurer to the duke of Gandia, and enjoying the powerful patronage of Prince Carlos de Viana of Aragon, March was enabled to devote himself to poetical composition. He is an undisguised follower of Petrarch, carrying the imitation to such a point that he addresses his *Cants d'amor* to a lady whom he professes to have seen first in church on Good Friday; so far as the difference of language allows, he reproduces the rhythmical cadences of his model, and in the *Cants de mort* touches a note of brooding sentiment peculiar to himself. Though his poems are disfigured by obscurity and a monotonous morbidity, he was fully entitled to the supremacy which he enjoyed among his contemporaries, and the success of his innovation no doubt encouraged Boscán to introduce the Italian metres into Castilian.

His verses were first printed in Catalan in 1543, but they had already become known through the Castilian translation published by Baltasar de Romani in 1539.

MARCH, FRANCIS ANDREW (1825–), American philologist and educationalist, was born on the 25th of October 1825 in Millbury, Massachusetts. He graduated in 1845 at Amherst, where his attention was turned to the study of Anglo-Saxon by Noah Webster. He was a teacher at Swanzey, New Hampshire, and at the Leicester Academy, Massachusetts, in 1845–1847, and attempted the philological method of teaching English "like Latin and Greek," later described in his *Method of Philological Study of the English Language* (1865); at Amherst in 1847–1849; at Fredericksburg, Virginia, in 1852–1855; and in 1855 became a tutor at Lafayette College, where he became adjunct professor of belles-lettres and English literature in 1856, and professor of English language and comparative philology—the first chair of the kind established—in 1857. He lectured on constitutional and public law and Roman law in 1875–1877, and also taught subjects as diverse as botany and political economy. In 1907 he became professor emeritus. At Lafayette he introduced the first carefully scientific study of English in any American college, and in 1870 published *A Comparative Grammar of the Anglo-Saxon Language, in which its Forms are Illustrated by Those of the Sanskrit, Greek, Latin, Gothic, Old Saxon, Old Friesic, Old Norse and Old High German*, and *An Anglo-Saxon Reader*; he was editor of the "Douglass Series of Christian Greek and Latin Classics," to which he contributed *Latin Hymns* (1874); he was chairman of the Commission of the State of Pennsylvania on Amended Orthography; and was consulting editor of the *Standard Dictionary*, and in 1879–1882 was director of the American readers for the Philological Society's (New Oxford) *Dictionary*. He was president of the American Philological Association in 1873–1874 and in 1895–1896, of the Spelling Reform Association after 1876, and of the Modern Language Association in 1891–1893. Among American linguistic scholars March ranks with Whitney, Child and Gildersleeve; and his studies in English, though practically pioneer work in America, are of undoubted value. His article "On Recent Discussions of Grimm's Law" in the *Transactions and Proceedings* of the American Philological Association for 1873 in large part anticipated Verner's law. With his son, Francis Andrew March, jun. (b. 1863), adjunct-professor of modern languages in 1884–1891 and subsequently professor of English literature at Lafayette, he edited *A Thesaurus Dictionary of the English Language* (1903).

See *Addresses in Honor of Professor Francis A. March, LL.D., L.H.D.*, delivered at Easton, Pennsylvania, on the 24th of October 1895.

MARCH, a market town in the Wisbech parliamentary division of Cambridgeshire, England, 30 m. N. by W. of Cambridge. Pop. of urban district (1901), 7565. It lies in the midst of the flat fen country, on the old course of the river Nene. It is an important junction on the Great Eastern railway and the starting-point of a line worked by that company jointly with the Great Northern to Lincoln and Doncaster. The church of St Wendreda, in Early English and later styles, is remarkable for a magnificent Perpendicular timber roof, beautifully carved. There are agricultural implement and engineering works, and corn mills.

MARCH, the third month of the modern calendar, containing thirty-one days. It was the Romans' first month until the adoption of the Julian calendar, 46 B.C., and it continued to be the beginning of the legal year in England until the 18th century. In France it was reckoned the first month of the year until 1564, when, by an edict of Charles IX., January was decreed to be thenceforth the first month. Scotland followed the example of France in 1599; but in England the change did not take place before 1752. The Romans called the month *Martius*, a name supposed to have been conferred on it by Romulus in honour of his putative father, Mars, the god of war; but Ovid declares the month to have existed before the time of Romulus, though in a different position in the calendar. The Anglo-Saxons called March *Hlyd-monath*, "loud or stormy month," or *Lencten-monath*, "lengthening month," in allusion to the fact that the days then rapidly become longer. There is an old saying, common to both England and Scotland—which has its equivalent among the Basques and many European peoples—representing March as borrowing three days from April; the last three days of March being called the "borrowing" or the "borrowed days." As late as the end of the 18th century the first three days of March were known in Devonshire as "Blind Days," and were deemed so unlucky that no farmer would sow seed then.

The chief festival days of March are the 1st, St David; the 12th, St Gregory; the 17th, St Patrick; and the 25th, Lady Day, one of the quarter days in England.

MARCH (1) (from Fr. *marcher*, to walk; the earliest sense in French appears to be "to trample," and the origin has usually been found in the Lat. *marcus*, hammer; Low Lat. *marcare*, to hammer; hence to beat the road with the regular tread of a soldier: cf. "beat," of a policeman's round), the movement of military troops with regular rhythmical steps, often with the time marked by the beat of drum, the sound of pipes or bugles or the music of a military band; hence the advance or movement of a body of troops from one point to another, and the distance covered in so doing. The word is also naturally applied to the music composed for marching to, and to the steady regular advance or progress of non-military bodies or persons, or of events, &c. In the military sense, "marching" is walking in formed bodies of troops, either during drill evolutions on parade or on the "line of march" from one place to another. In both senses the word is used with mounted troops as well as with dismounted men. Formerly all evolutions were carried out at the so-called "parade-march" pace of about 75–80 paces to the minute, and in one or two armies of the 18th century the parade step cadence was as slow as 60. These cadences are now, however, reserved in all armies for ceremonial occasions, and the usual manœuvre and marching pace ("quick march") is about 120, the "double" march pace (*pas gymnastique*) about 180. The "quick" march, translated into miles and hours, is about 3½ or 3⅝ miles an hour in all armies, though a few special bodies of light troops such as the Italian *Bersaglieri* are trained to move at a much faster rate for hours together, either by alternate "quick" and "double" marching or by an unvarying "jog-trot." The paces recognized for cavalry are the walk, the trot, the canter and the gallop; the usual practice on the line of march being to alternate the walk and the trot, which combination gives a speed of about 5 miles an hour for many hours together. A "day's march," or more simply a "march," is usually reckoned to be 15–16 miles for a large body of troops, a "forced" march being one of 20 miles or over, or one in which, from whatever cause, the troops are on foot for more than about seven hours. For large bodies of troops the rate of movement on the line of march rarely exceeds 3 miles an hour. The immense assistance afforded by music to marching troops has been recognized from the earliest times of organized armies, and a great deal of special march-music has been written for military bands, formerly often in $\frac{3}{4}$ or $\frac{6}{8}$ time (one bar representing one pace with the foot), but now almost invariably in common or $\frac{2}{4}$ time, which is more suitable for the "quick march." The music itself is usually a combination of simple, lively melody and well-marked accents for the drums, with little attempt at contrapuntal writing. The fife or piccolo, the natural bugle (in Italy and elsewhere the chromatic key-bugle is used), and the drum are the principal instruments, the "band," as distinct from the "drums" and "bugles," having in addition to drum and fifes clarinets (saxophones in France and Belgium) and saxhorns of all types. In Scottish regiments, and in a few isolated cases elsewhere, bagpipes provide the marching music. The importance of music on the march is attested further by the almost universal practice of singing or whistling marching songs, and even playing them on concertinas, &c., in the absence of the band and drums.

2. From *marche*, the French form of a common Teutonic word represented in English by "mark" (*q.v.*), a boundary or frontier region between two countries or districts. The word appears to have been first used in this sense in the 8th century, and the earliest "mark" or "march" districts were tracts of land on the borders of the Carolingian Empire. Wherever Charlemagne pushed forward the frontiers of the Frankish realm he provided for the security of his lands, new and old alike, by establishing mark districts on the borders. The defence and oversight of these were entrusted to special officers, afterwards called margraves, or counts of the mark, who usually enjoyed more extensive powers than fell to the lot of an ordinary count. It is at this time that we hear first of the Spanish mark (*marca hispanica*) and the Bavarian mark (*marca bajoariae*). These mark districts were practically obliterated during the reigns of the feeble sovereigns who succeeded Charlemagne, but the system was revived with the accession of Henry the Fowler to the German throne early in the 10th century and with a renewal of the work of conquering and colonizing the regions east of the Elbe, and in eastern Germany generally. Under Henry and his son, Otto the Great, marks were again set upon the borders of Germany, and this time the organization was more lasting. The mark districts increased in size and strength, especially those which fell under the dominion of an able and energetic ruler, and some of them became powerful states, retaining the name mark long after the original significance of the word had been forgotten. It is interesting to note that the two most important of the modern German states, Austria and Prussia, both had their origin in mark districts, the mark of Brandenburg, the nucleus of the kingdom of Prussia, being at first a border district to the east of the duchy of Saxony, and the east mark, or mark of Austria, being a border district of the duchy of Bavaria. In Italy march districts made their appearance about the same time as in other parts of the Frankish Empire. The best known of these is the march of Ancona, which with other marches and adjoining districts, was known later as the Marches, a province lying about the centre of Italy between the Apennines and the Adriatic Sea. After forming part of the states of the Church the Marches were united with the kingdom of Italy in 1860 (see MARCHES, THE).

In England in the same connexion the plural word "marches" was the form commonly adopted, and soon after the Norman Conquest the disturbed districts on the borders of Wales began to be known as the Welsh marches. Lands therein were granted to powerful nobles on condition that they undertook the defence of the neighbouring counties of England. These lords of the marches, or lords marcher, as they were often called, had special privileges, but they were generally so fully occupied in fighting against each other and in seeking to increase their own wealth and power that the original object of their appointment was entirely forgotten. The condition of the marches grew worse and worse, and during disturbed reigns, like those of Henry III. and Edward II., lawlessness was rampant and rebellion was centred therein. A more satisfactory condition of affairs, however, prevailed after the conclusion of the Wars of the Roses; and the establishment by Henry VIII. in 1542 of a council of Wales and the marches was followed by a notable diminution of disorder in this region. About the time of Elizabeth the Welsh marches ceased to have any but an historical importance. In 1328 Roger Mortimer, a member of one of the most powerful of the marcher families, was created earl of March (*comes de marchia Waliae*), and in the reign of Edward III. (1354) the marches were declared to be no part of the principality, but directly subject to the English crown. It is difficult to define the boundaries of the Welsh marches, as their extent varied considerably from time to time, but under Edward I. and again under the Lancastrian kings the marcher lordships included more than half of the area of Wales; they embraced practically the whole of the principality except the counties of Anglesea, Carnarvon and Merioneth in the north and Carmarthen and Cardigan in the south, together with parts of the English border counties, Monmouth, Hereford and Shropshire.

The debateable ground between England and Scotland was also known as the marches, although its condition began to attract the attention of the southern kingdom somewhat later than was the case with Wales. Arrangements were made for garrisoning them and at one time they were divided into three sections: the east, the west, and the middle marches, the oversight of each being entrusted to a warden. Roughly speaking, they embraced the modern counties of Northumberland and Cumberland, together with a tract on the Scottish side of the border. The need for protecting them ceased soon after the accession of James VI. of Scotland to the English throne, and they have now only an historical and legendary significance. About 1290 Patrick de Dunbar, earl of Dunbar, called himself earl of March, taking the name from the merse, or march, a tract of land in Berwickshire.

In France under the *ancien régime* there was a county of La Marche, and in north-east Germany there was the county of La Marck, now part of the kingdom of Prussia.

MARCHE, or LA MARCHE, one of the former provinces of France. It owes its name to its position, it having been in the 10th century a march or border district between the duchy of Aquitaine and the domains of the Frankish kings in central

France. Sometimes it was called the *Marche Limousine*, and originally it was a small district cut partly from Limousin and partly from Poitou. Its area was increased during the 13th century, after which, however, it remained unaltered until the time of the Revolution. It was bounded on the N. by Berry; on the E. by Bourbonnais and Auvergne; on the S. by Limousin; and on the W. by Poitou. It embraced the greater part of the modern department of Creuse, a considerable part of Haute Vienne, and a fragment of Indre. Its area was about 1900 sq. m.; its capital was Charroux and later Guéret, and among its other principal towns were Dorat, Bellac and Confolens.

Marche first appears as a separate fief about the middle of the 10th century when William III., duke of Aquitaine, gave it to one of his vassals named Boso, who took the title of count. In the 12th century it passed to the counts of Limousin, and this house retained it until the death of the childless Count Hugh in 1303, when it was seized by the French king, Philip IV. In 1316 it was made a duchy for Prince Charles, afterwards King Charles IV., and a few years later (1327) it passed into the hands of the family of Bourbon. The family of Armagnac held it from 1435 to 1477, when it reverted to the Bourbons, and in 1527 it was seized by Francis I. and became part of the domains of the French crown. It was divided into Haute Marche and Basse Marche, the estates of the former being in existence until the 17th century. From 1470 until the Revolution the province was under the jurisdiction of the parlement of Paris.

See A. Thomas, *Les États provinciaux de la France centrale* (1879).

MARCHE, a town of Belgium in the province of Luxemburg, 33 m. S.W. of Liége and about 28 m. S.E. of Namur. Pop. (1904), 3540. It dates from the 7th century, when it was the chief town of the *pagus falmiensis*, as it still is of the same district now called Famène. Formerly it was fortified, and a treaty was signed there in 1577 between Philip II. and the United Provinces. In 1792 Lafayette was taken prisoner by the Austrians in a skirmish near it.

MARCHENA, a town of southern Spain, in the province of Seville, on the Cordova-Utrera and Marchena-La Roda railways. Pop. (1900), 12,468. Marchena occupies a sandy valley near the river Corbones, a left-hand territory of the Guadalquivir. Formerly it was surrounded with walls and towers, a large portion of which still remains. Among the principal buildings is the palace of the dukes of Arcos, within the enclosure of which is an ancient Moorish building, now the church of Santa Maria de la Mota. At the eastern end of the town is a sulphur spring. There is some trade in wheat, barley, olives, oil and wine. Marchena (perhaps the *Castra Gemina* of Pliny) was taken from the Moors by St Ferdinand in 1240.

MARCHENA RUIZ DE CASTRO, JOSÉ (1768–1821?), Spanish author, was born at Utrera on the 18th of November 1768 and studied with distinction at the university of Seville. He took minor orders and was for some time professor at the seminary of Vergara, but he became a convert to the doctrines of the French *philosophes*, scandalizing his acquaintances by his professions of materialism and his denunciations of celibacy. His writings being brought before the Inquisition in 1792, Marchena escaped to Paris, where he is said to have collaborated with Marat in *L'Ami du peuple*; at a later date he organized a revolutionary movement at Bayonne, returned to Paris, avowed his sympathies with the Girondists, and refused the advances of Robespierre. He acted as editor of *L'Ami des lois* and other French journals till 1799, when he was expelled from France; he succeeded, however, in obtaining employment under Moreau, upon whose fall in 1804 he declared himself a Bonapartist. In 1808 he accompanied Murat to Spain as private secretary; in this same year he was imprisoned by the Inquisition, but was released by Joseph Bonaparte, who appointed him editor of the official *Gaceta*. In 1813 Marchena retired to Valencia, and thence to France, where he supported himself by translating into Spanish the works of Montesquieu, Rousseau, Voltaire and Volney. The Liberal triumph of 1820 opened Spain to him once more, but he was coldly received by the revolutionary party. He died at Madrid shortly before the 26th of February 1821. The interest of his voluminous writings is almost wholly ephemeral, but they are excellent specimens of trenchant journalism. His *Fragmentum Petronii* (Basel, 1802), which purports to reconstruct missing passages in the current text of Petronius, is a testimony to Marchena's fine scholarship; but, by the irony of fate, Marchena is best known by his ode to Christ Crucified, which breathes a spirit of profound and tender piety.

MARCHES, THE (It. *Le Marche*), a territorial division of Italy, embracing the provinces of Pesaro and Urbino, Ancona, Macerata, and Ascoli Piceno; with an area of 3763 sq. m., and a population of 1,088,763 in 1901. It is bounded by the Emilia on the N., the Adriatic on the E., the Abruzzi on the S., and Umbria and Tuscany on the W. The four provinces follow one another in the order given from north to south and have a certain amount of coast-line. The chief rivers, all of which run into the Adriatic eastwards and north-eastwards, are the Metauro (anc. *Metaurus*, *q.v.*) and the Tronto (anc. *Truentus*), the latter forming the southern boundary of the *compartimento* for some distance. Except for the river valleys and the often very narrow coast strip, the general level is more than 500 ft. above the sea. The lower hills are very largely composed of loose, clayey, unstable earth, while the Apennines are of limestone. The province of Pesaro and Urbino falls within the boundaries of the ancient Umbria (*q.v.*), while the territory of the other three belonged to Picenum (*q.v.*). The railway from Bologna to Brindisi runs along the coast-line of the entire territory. At Ancona it is joined by the main line from Foligno and Rome; at Porto Civitanova is a branch to Macerata, San Severino and Fabriano (a station on the line from Ancona to Rome and the junction for Urbino); at Porto S. Giorgio is a branch to Fermo and, at Porto d'Ascoli, a branch to Ascoli Piceno. But, with the exception of the railway along the coast, there is no communication north and south, owing to the mountainous nature of the country, except by somewhat devious roads.

Owing largely to the *mezzadria* or *métayer* system, under which products are equally divided between the owners and the cultivators of the land, the soil is fairly highly cultivated, though naturally poor in quality. The silk industries, making of straw-plait and straw hats, rearing of silkworms and cocoons, with some sugar-refining, tobacco, terra-cotta manufacture, brickworks and ironworks, furnish the chief occupations of the people next after agriculture and pastoral pursuits. Another important branch of activity is the paper industry, especially at Fabriano. Chiaravalle possesses one of the largest tobacco factories of the Italian *régie*. Limestone quarries and sulphur mines supply building stone and sulphur to the regions of central Italy; chalk and petroleum are also found. As regards maritime trade the province possesses facilities in the port of Ancona (the only really good harbour, where are also important shipbuilding works), the canal ports of Senegallia (Sinigaglia), Pesaro, Fano and other smaller harbours chiefly used by fishing boats. Fishing is carried on by the entire coast population, which furnishes a large contingent of sailors to the Italian navy.

For the early history of the territory of the Marches see PICENUM. From the Carolingian period onwards the name Marca begins to appear—first the Marca Fermana for the mountainous part of Picenum, the Marca Camerinese for the district farther north, including a part of Umbria, and the Marca Anconitana for the former Pentapolis. In 1080 the Marca Anconitana was given in investiture to Robert Guiscard by Gregory VII., to whom the countess Matilda ceded the Marches of Camerino and of Fermo. In 1105 we find the emperor Henry IV. investing Werner with the whole territory of the three marches under the name of March of Ancona. It was afterwards once more recovered by the Church and governed by papal legates. It became part of the kingdom of Italy in 1860.

The pictorial art of the Marches from the 13th century onwards has become the object of considerable interest since the important exhibition held at Macerata in 1905, when many interesting works, scattered all over the district in small towns and villages, were brought together. The result was something of a revelation, for, though the influence of Umbria was always considerable, there were many independent elements (see F. M. Perkins in *Rassegna d' Arte*, 1906, 49 sqq.). (T. As.)

MARCHMONT, EARLS OF. The 1st earl of Marchmont was Sir Patrick Hume or Home (1641–1724), son of Sir Patrick Hume, bart. (d. 1648), of Polwarth, Berwickshire, and a descendant of another Sir Patrick Hume, a supporter of the Reformation in Scotland. A member of the same family was Alexander Hume (*c.* 1560–1609), the Scottish poet, whose *Hymns and Sacred Songs* were published in 1599 (new ed. 1832). Polwarth, as Patrick Hume was usually called, became a member of the Scottish parliament in 1665. Here he was active in opposing the harsh policy of the earl of Lauderdale towards the Covenanters, and for his contumacy he was imprisoned. After his release he went to London, where he associated himself with the duke of Monmouth. Suspected of complicity in the Rye House plot, he remained for a time in hiding and then crossed over to the Netherlands, where he took part in the deliberations of Monmouth, the earl of Argyll and other exiles about the projected invasion of Great Britain. Although he appeared to distrust Argyll, Polwarth sailed to Scotland with him in 1685, and after the failure of the rising he escaped to Utrecht, where he lived in great poverty until 1688. He accompanied William of Orange to England, and in 1689 he was again a member of the Scottish parliament. In 1690 he was made a peer as Lord Polwarth; in 1696 he became lord high chancellor of Scotland, and in 1697 was created earl of Marchmont. When Anne became queen in 1702 he was deprived of the chancellorship. He died on the 2nd of August 1724. His son Alexander, the 2nd earl (1676–1740), took the name of Campbell instead of Hume after his marriage in 1697 with Margaret, daughter and heiress of Sir George Campbell of Cessnock, Ayrshire. He was a lord of session from 1704 to 1714; ambassador to Denmark from 1715 to 1721, and lord clerk register from 1716 to 1733. His son Hugh Hume, 3rd earl (1708–1794), who entered parliament in 1734 at the same time as his twin brother Alexander (d. 1756), afterwards lord clerk register of Scotland, was keeper of the great seal of Scotland, one of Bolingbroke's most intimate friends and one of Pope's executors. His two sons having predeceased their father, the earldom became dormant, Marchmont House, Berwickshire, and the estates passing to Sir Hugh Purves, bart., a descendant of the 2nd earl, who took the name of Hume-Campbell. The 3rd earl had, however, three daughters, one of whom, Diana (d. 1827), married Walter Scott of Harden, Berwickshire; and in 1835 her son Hugh Hepburne-Scott (1758–1841) successfully claimed the Scottish barony of Polwarth. In 1867 his grandson, Walter Hugh (b. 1838), became 6th Lord Polwarth.

See *The Marchmont Papers*, ed. Sir G. H. Rose (1831).

MARCHPANE, or MARZIPAN, a sweetmeat made of sweet almonds and sugar pounded and worked into a paste, and moulded into various shapes, or used in the icing of cakes, &c. The best marchpane comes from Germany, that from Königsberg being celebrated. The origin of the word has been much discussed. It is common in various forms in most European languages, Romanic or Teutonic; Italian has *marzapane*, French *massepain*, and German *marzipan*, which has in English to some extent superseded the true English form "marchpane." Italian seems to have been the source from which the word passed into other languages. In Johann Burchard's *Diarium curiae romanae* (1483–1492) the Latin form appears as *martiapanis* (Du Cange, *Glossarium s.v.*), and Minshseu explains the word as *Martius panis*, bread of Mars, from the "towers, castles and such like" that appeared on elaborate works of the confectioner's art made of this sweatmeat. Another derivation is that from Gr. *μάζα*, barley cake, and Lat. *panis*. A connexion has been sought with the name of a Venetian coin, *matapanus* (Du Cange, *s.v.*), on which was a figure of Christ enthroned, struck by Enrico Dandolo, doge of Venice (1192–1205). From the coin the word was applied to a small box, and hence apparently to the sweetmeat contained in it.

MARCIAN (*c.* 390–457), emperor of the East (450–457), was born in Thrace or Illyria, and spent his early life as an obscure soldier. He subsequently served for nineteen years under Ardaburius and Aspar, and took part in the wars against the Persians and Vandals. Through the influence of these generals he became a captain of the guards, and was later raised to the rank of tribune and senator. On the death of Theodosius II. he was chosen as consort by the latter's sister and successor, Pulcheria, and called upon to govern an empire greatly humbled and impoverished by the ravages of the Huns. Marcian repudiated the payment of tribute to Attila; he reformed the finances, checked extravagance, and repeopled the devastated districts. He repelled attacks upon Syria and Egypt (452), and quelled disturbances on the Armenian frontier (456). The other notable event of his reign is the Council of Chalcedon (451), in which Marcian endeavoured to mediate between the rival schools of theology.

See Gibbon, *The Decline and Fall of the Roman Empire* (ed. Bury, London, 1896), iii. 384, iv. 444–445; J. Bury, *The Later Roman Empire* (London, 1889), i. 135–136.

MARCIANUS (*c.* A.D. 400), Greek geographer, was born at Heraclea in Pontus. Two of his works have been preserved in a more or less mutilated condition. In the first, the *Periplus of the Outer Sea*, in two books, in which he proposed to give a complete description of the coasts of the eastern and western oceans, his chief authority is Ptolemy; the distances from one point to another are given in stades, with the object of rendering the work easier for the ordinary student. In this he follows Protagoras, who, according to Photius (cod. 188), wrote a sketch of geography in six books. The work contains nothing that cannot be learned from Ptolemy, whom he follows in calling the promontory of the Novantae (*Mull of Galloway*) the most northern point of Britain. Improving on Ptolemy, he makes the island of Taprobane (*Ceylon*) twenty times as large as it is in reality. The second, the *Periplus of the Inner Sea* (the Mediterranean), is a meagre epitome of a similar work by Menippus of Pergamum, who lived during the times of Augustus and Tiberius. It contains a description of the southern coast of the Euxine from the Thracian Bosporus to the river Iris in Pontus. A few fragments remain of an epitome by Marcianus of the eleven books of the *Geographumena* of Artemidorus of Ephesus.

See J. Hudson, *Geographiae veteris scriptores graeci minores*, vol. i. (1698), with Dodwell's dissertation; C. W. Müller, *Geographici graeci minores*, vol. i. pp. cxxix., 515–573; E. Miller, *Périple de Marcien d'Héraclée* (1839); S. F. G. Hoffmann, *Marciani Periplus* (1841); E. H. Bunbury, *Hist. of Ancient Geography* (1879), ii. 660; A. Forbiger, *Handbuch der alten Geographie*, vol. i. (1842).

MARCION and **THE MARCIONITE CHURCHES.** In the period between 130 and 180 A.D. the varied and complicated Christian fellowships in the Roman Empire crystallized into close and mutually exclusive societies—churches with fixed constitutions and creeds, schools with distinctive esoteric doctrines, associations for worship with peculiar mysteries, and ascetic sects with special rules of conduct. Of ecclesiastical organizations the most important, next to Catholicism, was the Marcionite community. Like the Catholic Church, this body professed to comprehend everything belonging to Christianity. It admitted all believers without distinction of age, sex, rank or culture. It was no mere school for the learned, disclosed no mysteries for the privileged, but sought to lay the foundation of the Christian community on the pure gospel, the authentic institutes of Christ. The pure gospel, however, Marcion found to be everywhere more or less corrupted and mutilated in the Christian circles of his time. His undertaking thus resolved itself into a reformation of Christendom. This reformation was to deliver Christendom from false Jewish doctrines by restoring the Pauline conception of the gospel,—Paul being, according to Marcion, the only apostle who had rightly understood the new message of salvation as delivered by Christ. In Marcion's own view, therefore, the founding of his church—to which he was first driven by opposition—amounts to a reformation of Christendom through a return to the gospel of Christ and to Paul; nothing was to be accepted beyond that. This of itself shows that it is a mistake to reckon Marcion among the Gnostics. A dualist he certainly was, but he was not a Gnostic. For he ascribed salvation, not to "knowledge" but to "faith"; he appealed openly to the whole Christian world; and he nowhere consciously added foreign elements to the revelation given through Christ. It is true that in many features his Christian system—if we may use the expression—resembles the so-called Gnostic systems; but the first duty of the historian is to point out what Marcion plainly aimed at; only in the second place have we to inquire how far the result corresponded with those purposes.

The doctrines of Marcion and the history of his churches from the 2nd to the 7th century are known to us from the controversial works of the Catholic fathers. From Justin onwards, almost every eminent Church teacher takes some notice of Marcion, while very many write extensive treatises against him. The most important of those which have come down to us are the controversial pieces of Irenaeus (in his great work against heretics), Tertullian (*Adv. Marc.* i.–v.), Hippolytus, Pseudo-Origen Adamantius, Epiphanius, and the Armenian Esnik.[1] From these works the contents of the Marcionite Gospel, and also the text of Paul's epistles in Marcion's recension, can be settled with tolerable accuracy. His opponents, moreover, have preserved some expressions of his, with extracts from his principal work; so that our knowledge of Marcion's views is in part derived from the best sources.

Marcion was a wealthy shipowner, belonging to Sinope in Pontus. He appears to have been a convert from Paganism to Christianity, although it was asserted in later times that his father had been a bishop. That report is probably as untrustworthy as another, that he was excommunicated from the Church for seducing a virgin. What we know for certain is that after the death of Hyginus, bishop of Rome (or *c.* 139 A.D.), he arrived, in the course of his travels, at Rome, and made a handsome donation of money to the local church. Even then, however, the leading features of his peculiar system must have been already thought out. At Rome he tried to gain acceptance for them in the college of presbyters and in the church; indeed he had previously made similar attempts in Asia Minor. But he now encountered such determined opposition from the majority of the congregation that he found it necessary to withdraw from the great church and establish in Rome a community of his own. This was about the year 144. The new society increased in the two following decades; and very soon numerous sister-churches were flourishing in the east and west of the empire. Marcion took up his residence permanently in Rome, but still undertook journeys for the propagation of his opinions. In Rome he became acquainted with the Syrian Gnostic Cerdo, whose speculations influenced the development of the Marcionite theology. Still Marcion seems never to have abandoned his design of gaining over the whole Church to his gospel. The proof of this is found, partly in the fact that he tried to establish relations with Polycarp of Smyrna, from whom he got a sharp rebuff, partly in a legend to the effect that towards the end of his life he sought readmission to the Church. Such, presumably, was the construction put in after times on his earnest endeavour to unite Christians on the footing of the "pure gospel." When he died is not known, but his death can scarcely have been much later than the year 165.

The distinctive teaching of Marcion originated in a comparison of the Old Testament with the gospel of Christ and the theology of the apostle Paul. Its motive was not cosmological or metaphysical, but religious and historical. In the gospel he found a God revealed who is goodness and love, and who desires faith and love from men. This God he could not discover in the Old Testament; on the contrary, he saw there the revelation of a just, stern, jealous, wrathful and variable God, who requires from his servants blind obedience, fear and outward righteousness. Overpowered by the majesty and novelty of the Christian message of salvation, too conscientious to rest satisfied with the ordinary attempts at the solution of difficulties, while prevented by the limitations of his time from reaching an historical insight into the relation of Christianity to the Old Testament and to Judaism, he believed that he expressed Paul's view by the hypothesis of two Gods: the just God of the law (the God of the Jews, who is also the Creator of the world), and the good God, the Father of Jesus Christ. Paradoxes in the history of religion and revelation which Paul draws out, and which Marcion's contemporaries passed by as utterly incomprehensible, are here made the foundation of an ethico-dualistic conception of history and of religion. It may be said that in the 2nd century only one Christian—Marcion—took the trouble to understand Paul; but it must be added that he misunderstood him. The profound reflections of the apostle on the radical antithesis of law and gospel, works and faith, were not appreciated in the 2nd century. Marcion alone perceived their decisive religious importance, and with them confronted the legalizing, and in this sense judaizing, tendencies of his Christian contemporaries. But the Pauline ideas lost their truth under his treatment; for, when it is denied that the God of redemption is at the same time the almighty Lord of heaven and earth, the gospel is turned upside down.

The assumption of two Gods necessarily led to cosmological speculations. Under the influence of Cerdo, Marcion carried out his ethical dualism in the sphere of cosmology; but the fact that his system is not free from contradictions is the best proof that all along religious knowledge, and not philosophical, had the chief values in his eyes. The main outlines of his teaching are as follows. Man is, in spirit, soul and body, a creature of the just and wrathful god. This god created man from ὕλη (matter),[2] and imposed on him a strict law. Since no one could keep this law, the whole human race fell under the curse, temporal and eternal, of the Demiurge. Then a higher God, hitherto unknown, and concealed even from the Demiurge, took pity on the wretched, condemned race of men. He sent his Son (whom Marcion probably regarded as a manifestation of the supreme God Himself)[3] down to this earth in order to redeem men. Clothed in a visionary body, in the likeness of a man of thirty years old, the Son made his appearance in the fifteenth year of Tiberius, and preached in the synagogue at Capernaum. But none of the Jewish people understood him. Even the disciples whom he chose did not recognize his true nature, but mistook him for the Messiah promised by the Demiurge through the prophets, who as warrior and king was to come and set up the Jewish empire. The Demiurge himself did not suspect who the stranger was; nevertheless he became angry with him, and, although Jesus had punctually fulfilled his law, caused him to be nailed to the cross. By that act, however, he pronounced his own doom. For the risen Christ appeared before him in his glory, and charged him with having acted contrary to his own law. To make amends for this crime, the Demiurge had now to deliver up to the good God the souls of those who were to be redeemed; they are, as it were, purchased from him by the death of Christ. Christ then proceeded to the underworld to deliver the spirits of the departed. It was not the Old Testament saints, however, but only sinners and malefactors like Cain, Esau and Saul, who obeyed his summons. The prophets and patriarchs, having been often deceived by the Demiurge, suspected a trick and would not avail themselves of the promised salvation, remaining content with the bliss of being in Abraham's bosom. Then, to gain the living, Christ raised up Paul as his apostle. He alone understood the gospel, and recognized the difference between the just God and the good. Accordingly, he opposed the original apostles with their Judaistic doctrines, and founded small congregations of true Christians. But the preaching of the false Jewish Christians gained the upper hand; nay, they even falsified the evangelical oracles and the letters of Paul. Marcion himself was the next raised up by the good God, to proclaim once more the true gospel. This he did by setting aside the spurious gospels, purging the real gospel (the Gospel of Luke) from supposed judaizing interpolations, and restoring the true text of the Pauline epistles.[1] He likewise composed a book, called the *Antitheses*,[2] in which he proved the disparity of the two Gods, from a comparison of the Old Testament with the evangelical writings.

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[1] Esnik's presentation of the Marcionite system is a late production, and contains many speculations that cannot be charged upon Marcion himself.

[2] On the relation of matter to the Creator, Marcion himself seems not to have speculated, though his followers may have done so.

[3] Marcion's teaching at this point forestalls the patripassian christology of Noetus and Praxeas (see Neander, *Church Hist.* ii. 143).—[ED.]

On the basis of these writings Marcion proclaimed the true Christianity, and founded churches. He taught that all who put their trust in the good God, and his crucified Son, renounce their allegiance to the Demiurge, and approve themselves by good works of love, shall be saved. But he taught further—and here we trace the influence of the current gnosticism on Marcion—that only the spirit of man is saved by the good God; the body, because material, perishes. Accordingly his ethics also were thoroughly dualistic. By the "works of the Demiurge," which the Christian is to flee, he meant the whole "service of the perishable." The Christian must shun everything sensual, and especially marriage, and free himself from the body by strict asceticism. The original ethical contrast of "good" and "just" is thus transformed into the cosmological contrast of "spirit" and "matter." The good God appears as the god of spirit, the Old Testament God as the god of matter. That is Gnosticism; but it is at the same time illogical. For, since, according to Marcion, the spirit of man is derived, not from the good, but from the just God, it is impossible to see why the spiritual should yet be more closely related to the good God than the material. There is yet another direction in which the system ends with a contradiction. According to Marcion, the good God never judges, but everywhere manifests His goodness—is, therefore, not to be feared, but simply to be loved, as a father. But here the question occurs, What becomes of the men who do not believe the gospel? Marcion answers, The good God does not judge them, but merely removes them from His presence. Then they fall under the power of the Demiurge, who—rewards them for their fidelity? No, says Marcion, but, on the contrary—punishes them in his hell! The contradiction here is palpable; and at the same time the antithesis of "just" and "good" ultimately vanishes. For the Demiurge now appears as an inferior being, who in reality executes the purposes of the good God. It is plain that dualism here terminates in the idea of the sole supremacy of the good God.

It is not surprising, therefore, that even in the 2nd century the disciples of Marcion diverged in several directions. Rigorous asceticism, the rejection of the Old Testament, and the recognition of the "new God" remained common to all Marcionites, who, moreover, like the Catholics, lived together in close communities ruled by bishops and presbyters (although their constitution was originally very loose, and sought to avoid every appearance of "legality"). Some, however, accepted three first principles (the evil, the just, the good); others held by two, but regarded the Demiurge as the god of evil, *i.e.* the devil; while a third party, like Apelles, the most distinguished of Marcion's pupils, saw in the Demiurge only an apostate angel of the good God—thus returning to monotheism. The golden age of the Marcionite churches falls between the years 150 and 250. During that time they were really dangerous to the great Church; for in fact they maintained certain genuine Christian ideas, which the Catholic Church had forgotten. The earliest inscription (A.D. 318) on a Christian place of worship is Marcionite, and was found on a stone which had stood over the doorway of a house in a Syrian village. From the beginning of the 4th century they began to die out in the West, or rather they fell a prey to Manichaeism. In the East also many Marcionites went over to the Manichaeans; but there they survived much longer. They can be traced down to the 7th century, and then they seem to vanish. But it was unquestionably from Marcionite impulses that the new sects of the Paulicians and Bogomils arose, and in so far as the western Cathari, and the antinomian and anticlerical sects of the 13th century are connected with these, they also may be included in the history of Marcionitism.

See A. Harnack, *History of Dogma*, i. 266, 286; F. Loofs, *Dogmengeschichte* pp. 111–114; G. Krüger, *Early Christian Literature*, and art. in Hauck-Herzog's *Realencyklopädie für prot. Theol. und Kirche*, xii.; F. J. Foakes Jackson's *Christian Difficulties of the Second and Twentieth Centuries*, is a study of Marcion and his relation to modern thought. (A. Ha.)

MARCOMANNI (*i.e.* men of the mark, or border), the name of a Suevic tribe. With kindred peoples they were often in conflict with the Roman Empire, and gave their name to the Marcomannic War, a struggle waged by the emperor Marcus Aurelius against them and the Quadi. The Marcomanni disappeared from history during the 4th century, being probably merged in the Baiouarii, the later Bavarians.

See Suebi; also F. M. Wittmann, *Die älteste Geschichte der Markomannen* (Munich, 1855), and E. Devrient, "Hermunduren und Markomannen" in *Neues Jahrb. f. das klassische Altertum* (1901), 51.

MARCOS DE NIZA (*c.* 1495–1558), a Franciscan friar born in Nice about 1495. He went to America in 1531, and after serving his order zealously in Peru, Guatemala and Mexico, was chosen to explore the country north of Sonora, whose wealth was pictured in the hearsay stories of Alvar Nuñez Cabeza de Vaca. Preceded by Estevanico, the negro companion of Cabeza de Vaca in his wanderings and the "Black Mexican" of Zuñi traditions, Fray Marcos left Culiacan in March 1539, crossed south-eastern Arizona, penetrated to Zuñi or the "Seven Cities of Cibola," and in September returned to Culiacan. He saw Zuñi only from a distance, and his description of it as equal in size to the city of Mexico was probably exact; but he embodied much mere hearsay in his report, the *Descubrimiento de las siete ciudades*, which led F. V. de Coronado to make his famous expedition next year to Zuñi, of which Fray Marcos was the guide; and the realities proved a great disappointment. Fray Marcos was made Provincial of his order for Mexico before the second trip to Zuñi, and returned in 1541 to the capital, where he died on the 25th of March 1558.

The *Descubrimiento* is one of the world's famous narratives of travel. It may be found in J. F. Pacheco's *Documentos* (vol. iii.) and Hakluyt's *Voyages* (vol. iii.); also in G. Ramusio, *Navigazione* (vol. iii.) and H. Ternaux-Compans, *Voyages* (vol. iii.). See A. F. A. Bandelier, *The Gilded Man* (*El Dorado*), (New York, 1893); H. H. Bancroft, *Arizona and New Mexico* (San Francisco, 1888), and, for critical opinions, G. P. Winship, "The Coronado Expedition," in *U.S. Bureau of Ethnology, Fourteenth Annual Report* (for 1892–1893), (Washington, 1896).

MARCOU, JULES (1824-1898), an eminent Swiss-American geologist, was born at Salins, in the department of Jura, in France, on the 20th of April 1824. He was educated at Besançon and at the college of St Louis, Paris. He worked in early years with J. Thurmann (1804–1855) on the geology of the Jura mountains. In 1847 he went to North America as travelling geologist for the *Jardin des Plantes*, and in the following year in Boston he joined Agassiz, whom he had met in Switzerland, and accompanied him to the Lake Superior region. Marcou spent two years in studying the geology of various parts of the United States and Canada, and returned to Europe for a short time in 1850. In 1853 he published a *Geological Map of the United States, and the British Provinces of North America*. In 1855 he became professor of geology and palaeontology at the polytechnic school of Zurich, but relinquished this office in 1859, and in 1861 again returned to the United States, when he assisted Agassiz in founding the Museum of Comparative Zoology. In 1861 he published his *Geological Map of the World* (2nd ed. 1875). Of his published papers the more noteworthy are those on the Jura-Cretaceous formations of the Jura, on the "Dyas" (Permian) of Nebraska, and on the Taconic rocks of Vermont and Canada. His other works include *Lettres sur les roches du Jura et leur distribution géographique dans les deux hémisphères* (1857–1860) and *Geology of North America* (1858). Marcou died at Cambridge, Mass., on the 17th of April 1898.

MARCUS AURELIUS ANTONINUS (121–180), Roman emperor and Stoic philosopher, was born in Rome A.D. 121, the date of his birth being variously stated as the 6th, 21st and 26th of April.

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[1] Marcion was the earliest critical student of the New Testament canon and text. It is noteworthy that he refused to admit the genuineness of the Pastoral Epistles and said that the letter to the Ephesians was really addressed to the Laodiceans (Tertullian, *Adv. Marc.* v. 11, 21).—(Ed.)

[2] Some have seen a reference to this work in 1 Tim. vi. 20.—(Ed.)

His original name was Marcus Annius Verus.[1] His mother Domitia Calvilla (or Lucilla) was a lady of consular rank, and the family of his father Annius Verus (prefect of the city and thrice consul), originally Spanish, had received patrician rank from Vespasian. Marcus was three months old when his father died, and was thereupon adopted by his grandfather. The moral training which he received from his grandfather and his mother must have been all but perfect. The noble qualities of the child attracted the attention of Hadrian, who, playing upon the name "Verus," said that it should be changed to "Verissimus" (ΒΗΡΙССΙΜΟС on medals). Hadrian adopted, as his successor, Titus Antoninus Pius (uncle of Marcus), on condition that he in turn adopted both Marcus (then seventeen) and Lucius Ceionius Commodus, the son of Aelius Caesar, who had originally been intended by Hadrian as his successor, but had died before him. Marcus had been, at the age of fifteen, betrothed to Fabia, the sister of Commodus; the engagement was broken off by Antoninus Pius, and he was betrothed to Faustina, the daughter of the latter. In 139 the title of Caesar was conferred upon him and he dropped the name of Verus. The full name he then bore was Marcus Aelius Aurelius Antoninus, Aelius coming from Hadrian's family, and Aurelius being the original name of Antoninus Pius. In 140 he was made consul.

The education of Aurelius in his youth was minute (see *Medit.* i. 1–16). A better guardian than Antoninus Pius could not be conceived. Marcus himself says, "To the gods I am indebted for having good grandfathers, good parents, a good sister, good teachers, good associates, good kinsmen and friends, nearly everything good." He was educated, not at school, but by tutors, Herodes Atticus and M. Cornelius Fronto (*q.v.*) in the usual curriculum of rhetoric and poetry; but at the age of eleven he became acquainted with Diognetus the painter and Stoic philosopher (*Hist. script. aug.* i. 305, notes), was fascinated by the philosophy he taught, assumed the dress of his sect, and ultimately abandoned rhetoric and poetry for philosophy and law, having among his teachers of the one Sextus of Chaeronea, grandson of Plutarch, and later Q. Junius Rusticus, and of the other L. Volusius Maecianus (or Metianus), a distinguished jurist. He went thoroughly into the practice as well as the theory of Stoicism, and lived so abstemious and laborious a life that he injured his health. From his Stoic teachers he learned to work hard, to deny himself, to avoid listening to slander, to endure misfortunes, never to deviate from his purpose, to be grave without affectation, delicate in correcting others, "not frequently to say to any one, nor to write in a letter, that I have no leisure," nor to excuse the neglect of duties by alleging urgent occupations. Through all his Stoical training Aurelius preserved the natural sweetness of his nature.

During the reign of Antoninus Pius (138 to 161), the concord between him and Aurelius was complete; Capitolinus (*c.* 7) says "nec praeter duas noctes per tot annos mansit diversis vicibus." The two were associated in the administration and in the simple country occupations of the seaside villa of Lorium, the birthplace of Pius, to which he loved to retire. It has been assumed on the strength of a passage in Capitolinus that Aurelius married Faustina in 146, but the passage is not clear, and other evidence points strongly to 140; at all events it seems certain that a daughter was born to him in 140. Antoninus Pius died in 161, having recommended as his successor Aurelius, then forty years of age, without mentioning Commodus, his other adopted son, commonly called Lucius Verus. It is believed that the senate urged Aurelius to take the sole administration. But he showed the magnanimity of his nature by at once admitting Verus as his partner, giving him the tribunician and proconsular powers, and the titles Caesar and Augustus. This was the first time that Rome had two emperors as colleagues. Verus, a weak, self-indulgent man, had a high respect for his adoptive brother, and deferred uniformly to his judgment. In the first year of his reign Faustina gave birth to twins, one of whom became the emperor Commodus.

The early part of the reign of Aurelius was clouded by national misfortunes. An inundation of the Tiber swept away a large part of Rome, destroying fields, drowning cattle, and causing a famine (162); then came earthquakes, fires and plagues of insects; the soldiers in Britain tried to induce their general Statius Priscus to proclaim himself emperor; finally, the Parthians under Vologaeses III. resumed hostilities, annihilated the Roman forces under Severianus at Elegia in Cappadocia, and devastated Syria. Verus, originally a man of considerable courage and ability, was sent to oppose the Parthians, but gave himself up to sensual excesses, and the Roman cause in Armenia would have been lost, and the empire itself, perhaps, imperilled, had not Verus had under him able generals,[2] the chief of whom was Avidius Cassius (see CASSIUS, AVIDIUS). By them the Parthian War was brought to a conclusion in 165, but Verus and his army brought back with them a terrible pestilence, which spread through the whole empire. The people seem to have thought that the last days of the empire had come. The Parthians had at the best been beaten, not subdued; the Britons threatened revolt; there were signs that various tribes beyond the Alps intended to break into Italy. Indeed, the bulk of the reign of Aurelius was spent in efforts to ward off the attacks of the barbarians. He went himself to the wars with Verus in 167, first to Aquileia and then on into Pannonia and Noricum, wintering at Sirmium in Pannonia. Ultimately the Marcomanni, the fiercest of the tribes that inhabited the country between Illyria and the sources of the Danube, sued for peace in 168. In January or February 169 Verus died at Altinum, apparently of apoplexy, though some ventured to say that he was poisoned by Aurelius.

Aurelius was thenceforth indisputed master of the empire, during one of the most troubled periods of its history. His reign is well described by F. W. Farrar (*Seekers after God*): "He regarded himself as being, in fact, the servant of all. The registry of the citizens, the suppression of litigation, the elevation of public morals, the care of minors, the retrenchment of public expenses, the limitation of gladiatorial games and shows, the care of roads, the restoration of senatorial privileges, the appointment of none but worthy magistrates, even the regulation of street traffic, these and numberless other duties so completely absorbed his attention that, in spite of indifferent health, they often kept him at severe labour from early morning till long after midnight. His position, indeed, often necessitated his presence at games and shows, but on these occasions he occupied himself either in reading, in being read to, or in writing notes. He was one of those who held that nothing should be done hastily, and that few crimes were worse than the waste of time." The comprehensiveness of his legal and judicial reforms is very striking. Slaves, heirs, women and children, were benefited, and he made serious attempts to deal with the steady fall in the birth-rate of legitimate children.

In the autumn of 169 two of the German tribes, the Quadi and the Marcomanni, with their allies the Vandals, Iazyges and Sarmatians, renewed hostilities and, for three years, Aurelius resided almost constantly at Carnuntum. In the end the Marcomanni were driven out of Pannonia, and were almost destroyed in their retreat across the Danube. In 174 Aurelius gained over the Quadi a decisive victory, which is commemorated by one of the sculptures on the column of Antonine. The story is that the Romans, entangled in a defile, were suffering from thirst. A sudden storm gave abundance of rain, while hail and thunder confounded their enemies, and enabled the Romans to gain an easy and complete victory. This triumph was universally considered at the time, and for long afterwards, to have been a miracle, and bore the title of "The Miracle of the Thundering Legion." The pagan writers (*e.g.* Dio Cassius, lxx. 8–10) ascribed the victory to the magic arts of an Egyptian named Arnuphis who prevailed on Mercury and other gods to give relief, while the Christians attributed it to the prayers of their brethren in a legion to which, they affirmed, the emperor then gave the name of "The Thundering." Dacier, however, and others who adhere to the Christian view of the miracle, admit that the appellation of "Thundering" or "Lightning" (*κεραυνοβόλος*, or *κεραυνοφόρος*) was given to the legion because there was a figure of lightning on their shields. It has also been virtually proved that it had the title even in the reign of Augustus.

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[1] Capitolinus states that he was originally called Catilius Severus after his mother's grandfather; if so the name was early discarded.

[2] Aurelius has been severely criticized for sending Verus. Among various reasons, the most convincing is that the presence of Aurelius was required in Rome; moreover, the real leader was evidently Cassius.

Aurelius next marched to Germany. There news reached him that Avidius Cassius, the commander of the Roman troops in Asia, had revolted and proclaimed himself emperor (175). But after three months Cassius was assassinated, and his head was brought to Aurelius, who with characteristic magnanimity persuaded the senate to pardon all the family of Cassius. It is a proof of the wisdom of Aurelius's clemency that he had little or no trouble in pacifying the provinces which had been the scene of rebellion. He treated them all with forbearance, and it is said that when the correspondence of Cassius was brought him he burnt it without reading it. During his journey of pacification, Faustina, who had borne him eleven children, died. Dio Cassius and Capitolinus charge Faustina with the most shameless infidelity to her husband, who is even blamed for not paying heed to her crimes. But none of these stories rests on trustworthy evidence; on the other hand, there can be no doubt that Aurelius trusted her while she lived, and mourned her loss.

After the death of Faustina and the pacification of Syria, Aurelius proceeded, on his return to Italy, through Athens, and was initiated in the Eleusinian mysteries, the reason assigned for his doing so being that it was his custom to conform to the established rites of the countries he visited. He gave large sums of money for the endowment of chairs in philosophy and rhetoric, with a view to making the schools the resort of students from all parts of the empire. Along with his son Commodus he entered Rome in 176, and obtained a triumph for victories in Germany. In 177 occurred that persecution of Christians, the share of Aurelius in which has been the subject of so much controversy. Meanwhile the German War continued, and the two Quintilii, who had been left in command, begged Aurelius once more to take the field. In this campaign Aurelius, after a series of successes, was attacked, according to some authorities, by an infectious disease, of which he died after a seven days' illness, either in his camp at Sirmium (Mitrovitz), on the Save, in Lower Pannonia, or at Vindobona (Vienna), on the 17th of March 180, in the fifty-ninth year of his age. Other accounts are: (1) that he was poisoned in the interests of Commodus (Dio. Cass. lxxi. 33, 4), (2) that he died of a chronic stomachic disease; the latter is perhaps the most likely. His ashes (according to some authorities, his body) were taken to Rome. By common consent he was deified and all those who could afford the cost obtained his statue or bust; for a long time his statues held a place among the penates of the Romans. Commodus, who was with his father when he died, erected to his memory the Antonine column (now in the Piazza Colonna at Rome), round the shaft of which are sculptures in relief commemorating the miracle of the Thundering Legion and the various victories of Aurelius over the Quadi and the Marcomanni. A bronze equestrian statue was set up in the Forum, now on the Capitol.

Aurelius throughout his reign was hostile to Christianity. The Christians suffered from systematic persecution, and many historians, with a strange lack of historical insight, have poured denunciation upon him for an attitude which was the natural outcome of his convictions. During his reign the atmosphere of Roman society was heavily charged with the popular Greek philosophy to which, ethics apart, Christianity was diametrically opposed. Under Antoninus the "pursuit" of Christians was unknown; under Trajan and Hadrian it was forbidden (cf. Keim, *Aus dem Urchrist*, p. 99). But Aurelius was an eager patriot and a man of logical mind. From his earliest youth he had learned to identify the ritual of the Roman religion with the very essence of the imperial idea. He became a Salian priest at the age of eight, and soon knew by heart all the forms and liturgical order of the official worship, and even the sacred music. In the earliest statue we have he is a youth offering incense, he is a priest at the sacrificial altar in the latest triumphal reliefs. Naturally he felt that the prevalence of Christianity was incompatible with his ideal of Roman prosperity, and therefore that the policy of the Flavian emperors was the only logical solution of an important problem. Neumann argued that the recrudescence of active persecution was initiated by a deliberate *ad hoc* rescript issued probably in A.D. 176. Sir W. M. Ramsay, however, doubts this (*The Church in the Roman Empire*, London, 1893), and argues that it was due to a long series of instructions to provincial governors (*mandata*, not *decreta*) who interpreted their duty largely in conformity with the attitude of the reigning emperor. In other words the governors were ordered merely to punish sacrilege, and, under Aurelius, Christianity was regarded as such. In the second place, though it is true that the persecutions indicated by Celsus (Origen, *Celsus*, viii. 69), Justin, Melito (in Eusebius, *H.E.*, iv. 26), Athenagoras (*Libellus pro Christianis*) and the *Acts of Martyrs*, were greatly in excess of those recorded in previous reigns, it must not be forgotten that it was only in this period that the Christians began to keep records. Thirdly, there can be no doubt that the Christians had recently assumed a much bolder attitude, and thus segregated themselves from the mass of those unorthodox sects which the Roman could afford to despise. Like the Druids in Gaul (cf. T. Mommsen, *Prov. Rom. Emp.*, Eng. trans. i. 105, and V. Duruy, *Rev. archéol.*, Apr. 1880), the Christians were particularly dangerous, inasmuch as they taught a unity which transcended that of the Roman Empire, and must, therefore, have been regarded as antagonistic to the existing political and social organism.

When, therefore, we remember that Aurelius knew little of the Christians, that the only mention of them in the *Meditations* is a contemptuous reference to certain fanatics of their number whom even Clement of Alexandria compares for their thirst for martyrdom to the Indian gymnosophists, and finally that the least worthy of them were doubtless the most prominent, we cannot doubt that Aurelius was acting unquestionably in the best interests of a perfectly intelligible ideal. He was "Roman in resolution and repression, Roman in civic nobility and pride, Roman in tenacity of imperial aim, Roman in respect for law, Roman in self-effacement for the service of the State" (G. H. Rendall).

Philosophy.—The book which contains the philosophy of Aurelius is known by the title of his *Reflections*, or *Meditations*, although that is not the name which he gave to it himself (Τὰ *εἰς ἑαυτόν*). Of the genuineness of the work no doubts are now entertained. It is believed that he wrote also an autobiography, which has perished. The *Meditations* were written, it is evident, as occasion offered—in the midst of public business, and on the eve of battles on which the fate of the empire depended—hence their fragmentary appearance, but hence also much of their practical value and even of their charm. It is believed by many critics that they were intended for the guidance of Aurelius's son, Commodus (*q.v.*); at all events they are generally considered as one of the most precious of the legacies of antiquity. Renan even called them "the most human of all books," and they are described by J. S. Mill in his *Utility of Religion* as almost equal in ethical elevation to the Sermon on the Mount.

Aurelius throughout his life adhered to the Stoical philosophy. But, as Tenneman says, he imparted to it "a character of gentleness and benevolence, by making it subordinate to a love of mankind, allied to religion." His thoughts represent a transitional movement, and it is difficult to discover in them anything like a systematic philosophy. From the manner, however, in which he seeks to distinguish between matter and cause or reason, and from the earnestness with which he advises men to examine all the impressions on their minds, it may be inferred that he held the view of Anaxagoras—that God and matter exist independently, but that God governs matter. There can be no doubt that Aurelius believed in a deity, although Schultz is probably right in maintaining that all his theology amounts to this—the soul of man is most intimately united to his body, and together they make one animal which we call man; and so the deity is most intimately united to the world or the material universe, and together they form one whole. We find in the *Meditations* no speculations on the absolute nature of the deity, and no clear expressions of opinion as to a future state.

We may also observe here that, like Epictetus, he is by no means so decided on the subject of suicide as the older Stoics. Aurelius is, above all things, a practical moralist. The goal in life to be aimed at, according to him, is not happiness, but tranquillity, or equanimity. This condition of mind can be obtained only by "living conformably to nature," that is to say, one's whole nature, and as a means to that man must cultivate the four chief virtues, each of which has its distinct sphere—wisdom, or the knowledge of good and evil; justice, or the giving to every man his due; fortitude, or the enduring of labour and pain; and temperance, or moderation in all things. It is no "fugitive and cloistered virtue" that Aurelius seeks to encourage; on the contrary, man must lead the "life of the social animal," must "live as on a mountain"; and "he is an abscess on the universe who withdraws and separates himself from the reason of our common nature through being displeased with the things which happen." While the prime principle in man is the social, "the next in order is not to yield to the persuasions of the body, when they are not conformable to the rational principle which must govern." This divinity "within a man," this "legislating faculty," which, looked at from one point of view, is conscience, and from another is reason, must be implicitly obeyed. He who thus obeys it will attain tranquillity of mind; nothing can irritate him, for everything is according to nature, and death itself "is such as generation is, a mystery of nature, a composition out of the same elements, and a decomposition into the same, and altogether not a thing of which any man should be ashamed, for it is not contrary to the nature of a reasonable animal, and not contrary to the reason of our constitution."

The morality of Marcus Aurelius cannot be said to have been new when it was given to the world. Its charm lies in its exquisite accent and its infinite tenderness. But above all, what gives the sentences of Marcus Aurelius their enduring value and fascination, and renders them superior to the utterances of Epictetus and Seneca, is that they are the gospel of his life. His precepts are simply the records of his practice. To the saintliness of the cloister he added the wisdom of the man of the world; he was constant in misfortune, not elated by prosperity, never "carrying things to the sweating-point," but preserving, in a time of universal corruption, unreality and self-indulgence, a nature sweet, pure, self-denying, unaffected.

BIBLIOGRAPHY.—P. B. Watson's *M. Aurelius Antoninus* (1884) contains a general account—life, character, philosophy, relations with Christianity—as well as a bibliography; see also art. in Pauly-Wissowa, *Realencyclopädie*, *s.v.* "Annius" (No. 94), col. 2279. For special points see: (1) *Historical*: Authorities under ROME: *Ancient History*; S. Dill, *Roman Society from Nero to M. Aurelius* (London, 1904). (2) *Relations to Christianity*: Sir W. M. Ramsay, *op. cit.*; W. Moeller, *History of the Christian Church*, A.D. 1–600 (Eng. trans., A. Rutherford, 1892); W. E. Addis, *Christianity and the Roman Empire* (1893); E. G. Hardy, *Christianity and the Roman Government* (1894), pp. 145 sqq., which criticizes both Neumann and Ramsay; Leonard Alston, *Stoic and Christian of the 2nd century* (1906); J. Dartigue-Peyrou, *Marc-Aurèle dans ses rapports avec le christianisme* (Paris, 1897). (3) *Philosophical*: Besides article STOICS, E. Renan, *Marc. Antoninus et la fin du monde antique* (Paris, 1882; Eng. trans., W. Hutchinson, 1904); W. Pater, *Marius the Epicurean* (London, 1888); Matthew Arnold's *Essays*; C. H. W. Davis, *Greek and Roman Stoicism* (1903); editions of the *Meditations* (5, below). (4) *Military*: E. Napp, *De rebus imperat. M. Aurel. Anton. in oriente gestis* (Bonn, 1879); Conrad, *Mark Aurels Markomannenkrieg* (1889); Th. Mommsen, *Provinces of the Roman Empire* (Eng. trans., W. P. Dickson, London, 1886); for the Aurelius column, E. Petersen, A. von Domaszewski, and G. Calderini, *Die Marcussäule* (Munich, 1896), with historical introduction by Th. Mommsen. (5) The *Meditations* were published by Xylander in 1558; the best critical edition is that of J. Stich in the Teubner series (Leipzig, 1882; 2nd ed., 1903); textual emendations also in *Journal of Philology*, xxiii. 116-160 (G. H. Rendall); *Classical Review*, xix. (1905), pp. 18 sqq. (Herbert Richards), ibid., pp. 301 sqq. (A. J. Kronenberg). Translations exist in almost every language; that of George Long (London, 1862, re-edited 1900) has been superseded by those of G. H. Rendall (London, 1898, with valuable introduction) and J. Jackson (Oxford, 1906, with introduction by Charles Bigg). (6) For a full account of the correspondence of Aurelius and Fronto, see Robinson Ellis, *Correspondence of Fronto and M. Aurelius* (Oxford, 1904). (J. M. M.)

MARCY, WILLIAM LEARNED (1786–1857), American statesman, was born in Southbridge (then part of Sturbridge), Massachusetts, on the 12th of December 1786. He graduated at Brown University in 1808, studied law, was admitted to the bar in Troy, New York, and began practice there in 1810. During the War of 1812 he served first as a lieutenant and afterwards as a captain of volunteers, and on the 22nd of October 1812 took part in the storming of the British post at St Regis, Canada. In 1816 he became recorder of Troy, but as he sided with the Anti-Clinton faction of the Democratic-Republican Party, known as the "Bucktails," he was removed from office in 1818 by his political opponents. As editor of the Troy *Budget* (daily) he was a vigorous supporter of Martin Van Buren, and when Van Buren's followers acquired control of the legislature in 1821 Marcy was made adjutant-general of the New York militia. From 1823 to 1829 Marcy was comptroller of the state, an office then especially important on account of the large expenditures for internal improvements, and during this period he became the leading member of the famous "Albany Regency," a group of able Democratic politicians who exerted a powerful influence throughout the state by their control of the party patronage and machinery. He was one of the associate justices of the New York Supreme Court from 1829 to 1831, presiding over the trial of the alleged murderers of William Morgan and in other important cases; and was a member of the United States Senate from December 1831 to July 1832, when he resigned to become governor of New York. In a speech in the Senate defending Van Buren against an attack by Henry Clay, Marcy made the unfortunate remark that "to the victors belong the spoils of the enemy," and thereby became widely known as a champion of the proscription of political opponents. He served as governor of New York for six years (Jan. 1, 1833 to Dec. 31, 1838), but was defeated in 1838 by the Whig candidate, William H. Seward. As governor he checked the issue of bank charters by the legislature and secured the enactment, in 1838, of a general banking law, which abolished the monopoly features incident to the old banking system. In 1839–1842 Marcy was a member of a commission appointed by President Van Buren, in accordance with the treaty of 1839 between the United States and Mexico to "examine and decide upon" certain claims of citizens of the United States against Mexico. In 1843 he presided over the Democratic state convention at Syracuse, and in 1844–1845 he was recognized as one of the leaders of the "Hunkers," or regular Democrats in New York, and an active opponent of the "Barnburners." He was secretary of war under President Polk from 1845 to 1849, and as such discharged with ability the especially onerous duties incident to the conduct of the Mexican War; he became involved, however, in controversies with Generals Scott and Taylor, who accused him, it seems very unjustly, of seeking to embarrass their operations in the field because they were political opponents of the administration. In the Democratic convention at Baltimore, in 1852, Marcy was a prominent candidate for the presidential nomination, and from 1853 to 1857 he was secretary of state in the cabinet of President Pierce. Few cabinet officers in time of peace have had more engrossing duties. His circular of the 1st of June 1853 to American diplomatic agents abroad, recommending that, whenever practicable, they should "appear in the simple dress of an American citizen," created much discussion in Europe; in 1867 his recommendation was enacted into a law of Congress. One of the most important matters with which he was called upon to deal was the "Koszta Affair";[1] his "Hülsemann letter" (1853), is an important state paper, and the principles it enunciates have been approved by leading authorities on international law. In the same year he secured the negotiation of the Gadsden Treaty (see GADSDEN, JAMES), by which the boundary dispute between Mexico and the United States was adjusted and a large area was added to the Federal domain; and in June 1854 he concluded with Lord Elgin, governor-general of Canada, acting for the British Government, a treaty designed to settle the fisheries question and providing for tariff reciprocity (as regards certain enumerated commodities) between Canada and the United States. In 1854 Marcy had to deal with the complications growing out of the bombardment of San Juan del Norte (Greytown), Nicaragua, by the United States sloop-of-war "Cyane" for insults offered the American minister by its inhabitants and for their refusal to make restitution for damages to American property. The expedition of William Walker (*q.v.*) to Nicaragua in 1855 further complicated the Central American question. The Crimean War, on account of the extensive recruiting therefor by British consuls in several American cities, in violation of American neutrality, led to a diplomatic controversy with Great Britain, and in May 1856 the British minister, John F. T. Crampton (1805–1886), received his passports, and the exequaturs of the British consuls at New York, Philadelphia and Cincinnati were revoked. The incident created great excitement in England, but in 1857 the British government sent Sir Francis Napier to Washington to take Crampton's place. To the Declaration of Paris of 1856, prescribing certain rules of naval warfare, Marcy on behalf of his government refused to subscribe, because Great Britain had rejected his proposed amendment exempting from seizure in time of war all private property not contraband. The diplomatic relations of the United States and Spain furnished, perhaps, the most perplexing of Marcy's problems. Upon the seizure (on Feb. 28, 1854) of the American vessel "Black Warrior," the confiscation of her cargo, and the fining of her captain by the Cuban authorities, on the ground that this vessel had violated the customs regulations of the port of Havana, slavery propagandists sought to force the administration into an attitude that would lead to war with Spain and make possible the seizure of Cuba; and it was largely due to Marcy's influence that war was averted, Spain restoring the confiscated cargo and remitting the captain's fine.[1] The secretary, however, was not averse to increasing his popularity and his chances for the presidency by obtaining Cuba in an honourable manner, and it was at his suggestion that James Buchanan, J. Y. Mason and Pierre Soulé, the ministers respectively to Great Britain, France and Spain, met at Ostend and Aix-la-Chapelle in October 1854 to discuss the Cuban question. But the remarkable "Ostend Manifesto" (see BUCHANAN, JAMES), the outcome of their conference, was quite unexpected, and Marcy promptly disavowed the document. Marcy died at Ballston Spa, New York, on the 4th of July 1857, a short time after the close of Pierce's administration. In domestic affairs Marcy was a shrewd, but honest partisan; in diplomacy he exhibited the qualities of a broad-minded, patriotic statesman, endowed, however, with vigour, rather than brilliancy, of intellect.

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[1] The "Koszta Affair" involved an interesting question of international law—*i.e.* the right of an alien domiciled in any country to the protection of that country—and has served as a precedent for the American government in somewhat similar cases that have arisen. Martin Koszta, a Hungarian revolutionist of 1848, had emigrated to the United States and had there taken the preliminary step for naturalization by formally declaring his intention to become a citizen of the United States. In 1853 he went on personal business to Smyrna, where he secured a passport from the American consul; the Austrian consul, however, caused him to be seized and detained on an Austrian brig-of-war. Soon afterward Captain Duncan N. Ingraham (1802–1891), in command of a United States sloop-of-war, arrived at Smyrna, and threatened to attack the Austrian vessel unless Koszta were released; and as a compromise Koszta was placed in the custody of the French consul. To Chevalier Hülsemann, then representing Austria at Washington, who had demanded from the United States the disavowal of the acts of its agents, the complete surrender of Koszta, and "satisfaction proportionate to the magnitude of the outrage," Marcy wrote on the 26th of September 1853, that Koszta "when seized and imprisoned was invested with the nationality of the United States" and had a right to the protection of the United States government, and added: "Whenever by the law of nations an individual becomes clothed with our national

For his early career, consult J. S. Jenkins, *Lives of the Governors of New York* (Auburn, New York, 1851), and for his work as secretary of state, see James Ford Rhodes, *History of the United States* (vols. i. and ii., New York, 1892), and an article by Sidney Webster, "Mr Marcy, the Cuban Question, and the Ostend Manifesto," in vol. viii. of the *Political Science Quarterly* (New York, 1893).

MARDIN, the chief town of a sanjak of the Diarbekr vilayet of Asiatic Turkey. It is a military station on the Diarbekr-Mosul road. It occupies a remarkable site on the south side of a conical hill of soft limestone, and the houses rise tier above tier.

character—he can claim the protection of this government, and it may respond to that claim without being obliged to explain its conduct to any foreign power; for it is its duty to make its nationality respected by other nations and respectable in every quarter of the globe." Eventually Koszta was released and returned to the United States. The Hülsemann letter was published and greatly increased Marcy's popularity.

The streets are narrow and paved in steps, while often the roadway runs along the roof of the house in the tier below. The hill is almost surrounded by old walls, while on the summit are the remains of the famous castle of the Kaleh Shubha (Lat. *Maride* or *Marde*,) which from Roman times has played an important part in history. The Arab geographers considered it impregnable, and from its steep approaches and well-arranged defences it was able to offer a protracted resistance to the Mongolian conqueror Hulagu and to the armies of Timur. It was also for several centuries the residence of more or less independent princes of the Ortokid Turkoman dynasty. The climate is healthy and dry, and fruit grows well, but water is sometimes scanty in the summer. Mardin is the centre of a good corn-growing district, and is important chiefly as a border town for the Kurds on the north and the Arab tribes to the south. It is the chief centre of the Jacobite Christians, who have many villages in the Tor Abdin hills to the north-east, and whose patriarch lives at Deir Zaferan, a Syrian monastery of the 9th century not far off in the same direction. The population is estimated at 27,000, of whom about one-half are Christians of the Armenian, Chaldean, Jacobite, Protestant and Roman Catholic communities. Besides many mosques and churches there are three monasteries (Syrian, Franciscan and Capuchin), and an important American Mission station, with church, schools and a medical officer.

MARDUK (Bibl. MERODACH[2]), the name of the patron deity of the city of Babylon, who, when Babylon permanently became the political centre of the united states of the Euphrates valley under Khammurabi (*c.* 2250 B.C.), rose to the position of the head of the Babylonian pantheon. His original character was that of a solar deity, and he personifies more specifically the sun of the spring-time who conquers the storms of the winter season. He was thus fitted to become the god who triumphs over chaos that reigned in the beginning of time. This earlier Marduk, however, was effaced by the reflex of the political development through which the Euphrates valley passed and which led to imbuing him with traits belonging to gods who at an earlier period were recognized as the heads of the pantheon. There are more particularly two gods—Ea and Bel—whose powers and attributes pass over to Marduk. In the case of Ea the transfer proceeds pacifically and without involving the effacement of the older god. Marduk is viewed as the son of Ea. The father voluntarily recognizes the superiority of the son and hands over to him the control of humanity. This association of Marduk and Ea, while indicating primarily the passing of the supremacy once enjoyed by Eridu to Babylon as a religious and political centre, may also reflect an early dependence of Babylon upon Eridu, not necessarily of a political character but, in view of the spread of culture in the Euphrates valley from the south to the north, the recognition of Eridu as the older centre on the part of the younger one. At all events, traces of a cult of Marduk at Eridu are to be noted in the religious literature, and the most reasonable explanation for the existence of a god Marduk in Eridu is to assume that Babylon in this way paid its homage to the old settlement at the head of the Persian Gulf.

While the relationship between Ea (*q.v.*) and Marduk is thus marked by harmony and an amicable abdication on the part of the father in favour of his son, Marduk's absorption of the power and prerogatives of Bel of Nippur was at the expense of the latter's prestige. After the days of Khammurabi, the cult of Marduk eclipses that of Bel (*q.v.*), and although during the five centuries of Cassite control in Babylonia (*c.* 1750–1200 B.C), Nippur and the cult of the older Bel enjoy a period of renaissance, when the reaction ensued it marked the definite and permanent triumph of Marduk over Bel until the end of the Babylonian empire. The only serious rival to Marduk after 1200 B.C. is Assur (*q.v.*) in Assyria. In the south Marduk reigns supreme, and his supremacy is indicated most significantly by making him the *Bel*, "the lord," *par excellence*.

The old myths in which Bel of Nippur was celebrated as the hero were transformed by the priests of Babylon in the interest of the Marduk cult with the chief rôle assigned to their favourite. The hymns once sung in the temple of Bel were re-edited and adapted to the cult of Babylon. In this process the older Bel was deliberately set aside, and the climax was reached when the conquest of the monster Tiamat, symbolizing the chaos prevailing in primeval days, was ascribed to Marduk instead of, as in the older form of the epic, to Bel. With this stroke Marduk became the creator of the world, including mankind—again setting aside the far older claims of Bel to this distinction.

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[1] See Henry L. James, "The Black Warrior Affair" in the *American Historical Review*, vol. xii. (1907).

[2] The name Mordecai denotes "belonging to Maduk."

Besides absorbing the prerogatives of Ea and Bel, Marduk was also imbued with the attributes of other of the great gods, such as Adad, Shamash, Nergal and Ninib, so that, more particularly as we approach the days of the Neo-Babylonian Empire, the impression is created that Marduk was the only real deity recognized, and that the other gods were merely the various forms under which he manifested himself. So far as one can speak of a monotheistic tendency in Babylonia it connects itself with this conception that was gradually crystallized in regard to the old solar deity of Babylon.

The history of the city of Babylon can now be traced back to the days of Sargon of Agade (before 3000 B.C.) who appears to have given the city its name. There is every reason to assume, therefore, that the cult of Marduk existed already at this early period, though it must always be borne in mind that, until the days of Khammurabi, his jurisdiction was limited to the city of which he was the patron and that he was viewed solely as a solar deity.

On monuments and cylinders he is represented as armed with the weapon with which he despatched the monster Tiamat. At times this monster is also depicted lying vanquished at his feet, and occasionally the monster with the lance or the lance alone is reproduced instead of the god himself.

In the astral-theological system, Marduk is identified with the planet Jupiter. As the creator of the world, the New Year's festival, known as Zagmuk and celebrated at the time of the vernal equinox, was sacred to him. The festival, which lasted for eleven days, symbolized the new birth of nature—a reproduction therefore of the creation of the world. The arbiter of all fates, Marduk, was pictured as holding an assembly of the gods during the New Year's festival for the purpose of deciding the lot of each individual for the year to come. The epic reciting his wonderful deed in despatching the monster Tiamat and in establishing law and order in the world in the place of chaos was recited in his temple at Babylon known as E-Saggila, "the lofty house," and there are some reasons for believing that the recital was accompanied by a dramatical representation of the epic.

The meaning of the name Marduk is unknown. By a species of word-play the name was interpreted as "the son of the chamber," with reference perhaps to the sacred chamber of fate in which he sat in judgment on the New Year's festival. Ideographically he is represented by two signs signifying "child of the day" (or "of the sun") which is a distinct allusion to his original solar character. Other ideographic signs describe him as the "strong and universal ruler." The name of his consort was Sarpanit, *i.e.* the shining or brilliant one—again an allusion to Marduk's solar traits—and this name was playfully twisted by the Babylonian priests to mean "the seed-producing" (as though compounded of *zēr*, seed, and *bānit*, producing, which was regarded as an appropriate appellation for the female counterpart of the creator of mankind and of life in general. The punning etymology betrays the evident desire of the priests to see in Marduk's consort a form or manifestation of the great mother-goddess Ishtar (*q.v.*), just as in Assyria Ishtar frequently appears as the consort of the chief god of Assyria, known as Assur (*q.v.*). (M. JA.)

MARE, the English term for the female of any animal of the family *Equidae*, of the ass, or zebra, but particularly of the horse. It is also used of the camel. To find a "mare's nest" is an old proverbial saying for a purely imaginary discovery. In "night-mare," an oppressive or terrifying dream, the termination is a word appearing as *mar*, *maer* and *mara* in various Teutonic languages for a goblin, supposed to sit on a sleeper's chest and cause these dreams: cf. elf. This Teutonic word also appears in the French *cauchemar*, the first part being from *caucher*, to tread or trample upon, Lat. *calcare*.

MARE CLAUSUM and **MARE LIBERUM** (Lat. for "closed sea" and "free sea"), in international law, terms associated with the historic controversy which arose out of demands on the part of different states to assert exclusive dominion over areas of the open or high sea. Thus Spain laid claim to exclusive dominion over whole oceans, Great Britain to all her environing narrow seas and so on. These claims gave rise to vigorous opposition by other powers and led to the publication of Grotius's work (1609) called *Mare liberum*. In *Mare clausum* (1635) John Selden endeavoured to prove that the sea was practically as capable of appropriation as territory. Owing to the conflict of claims which grew out of the controversy, maritime states had to moderate their demands and base their pretensions to maritime dominion on the principle that it extended seawards from land.

A formula was found by Bynkershoek in his *De dominio maris* (1702) for the restriction of dominion over the sea to the actual distance to which cannon range could protect it. This became universally adopted and developed into the three-mile belt (see TERRITORIAL WATERS). In recent times controversies have arisen in connexion with the Baltic, the Black Sea and more especially the Bering Sea. In the latter case the United States, after the purchase of Alaska, vainly attempted to assert dominion beyond the three-mile limit. Still more recently the hardship of treating the greater part of Moray Firth as open sea to the exclusion of British and to the advantage of foreign fishermen has been raised (see NORTH SEA FISHERIES CONVENTION; TERRITORIAL WATERS).

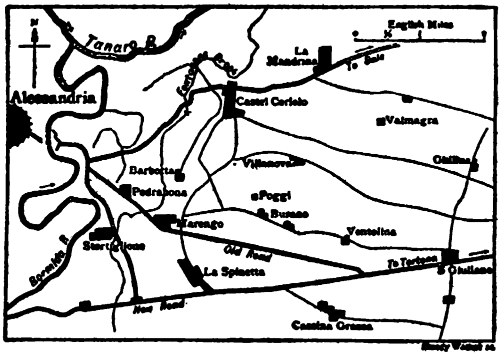
Conventions for the suppression of the slave trade, including the Brussels General Act of 1885, and the North Sea Fisheries Convention, have placed restrictions on the freedom of the high sea, and possibly, in the general interest, other agreements will bring it further under control, on the principle that what is the property of all nations must be used without detriment to its use by others (see HIGH SEAS). (T. BA.)

MAREE, LOCH, a fresh-water lake in the county of Ross and Cromarty, Scotland. Its name—of which Maroy and Mourie are older variants—does not, as is often supposed, commemorate the Virgin, but St Maelrubha, who came from Bangor in Ireland in 671 and founded a monastery at Applecross and a chapel (now in ruins) on Isle Maree. Trending in a south-easterly to north-westerly direction, the lake has a length of 13½ m. from Kinlochewe at the head of the dam erected in the 16th century (or earlier) by the iron-smelters of the Cheardach Ruardh, or Red Smiddy, on the short but impetuous river Ewe by which it drains to the sea. It lies at a height of 32 ft. above sea-level; the greatest breadth is just over 2 m. at Slattadale, the mean breadth being $\frac{9}{10}$ of a mile; and the greatest depth, 367 ft., occurs in the upper basin, the mean depth being 125 ft. Its waters cover an area of fully 11 sq. m., and its islands nearly 1 sq. m., while the drainage area is 171 sq. m. A remarkable feature is the large number (more than 30) and considerable area of the islands. Excepting Loch Crôcach, a small lake in the Assynt district of Sutherlandshire, its insularity (*i.e.* the ratio of the total area of the islands to that of the water surface) is higher than that of any other lake in Great Britain, Loch Lomond coming next. Nearly all the islands lie north and east of Slattadale, the largest being Eilean Subhainn, or St Swithin's Isle, which contains a small lake 750 ft. long, 300 ft. broad and 64 ft. deep. For two-thirds of its length the loch is flanked by magnificent mountains. On the north-east the principal heights are Ben Slioch (3217 ft.), whose sugar-loaf form dominates the landscape, Ben Lair (2817) and Ben Airidh-a-Char (2593), and, on the south-west, the peaks of Ben Eay, four of which exceed 3000 ft.

MAREMMA (a corruption of *Marittima*, "situated on the sea"), a marshy region of Tuscany, Italy, extending from the mouth of the Cecina to Orbetello and varying in breadth from 15 to 20 m. In Etruscan and Roman times the Maremma was a populous and fertile coast plain, with considerable towns situated on the hills—Populonia, Russellae, Cosa, &c., and was drained by a complete system of subterranean canals which were brought to light by the excavations made in connexion with the railways passing through the district. But the decline of agriculture at the end of the Republic led to a conversion of the land to pasture, and later the unsettled state of affairs consequent on the fall of the Roman Empire resulted in neglect of the watercourses. Leopold II. of Tuscany (1822–1844) made the first successful efforts to counteract the malaria which has affected the district, by drainage, the filling up of swamps, and the establishment of new farms, and since his time continuous efforts have been made with considerable success.

MARENGO, a village of north Italy, on the road between Alessandria and Tortona, and 4½ m. E.S.E. of the gates of the former. It is situated on the Fontanone brook, a small affluent of the Tanaro which marks the western edge of the plain of Marengo, the scene of the great victory won by Napoleon over the Austrians under Baron Melas (1729–1806) on the 14th of June 1800. The antecedents of the battle are described under French Revolutionary Wars).

The French army, in ignorance of its opponent's position, had advanced westward from the Scrivia towards Alessandria on the 12th, and its outposts had reached the Bormida on the evening of the 13th. But contact with the main Austrian army was not obtained, and on the assumption that it was moving towards either Valenza or Genoa Napoleon weakened his army by considerable detachments sent out right and left to find the enemy and to delay his progress. Unknown, however, to Napoleon Melas's army was still at Alessandria, and on the morning of the 14th of June it filed out of the fortress and began its advance into the great plain of Marengo, one of the few favourable cavalry battle-grounds in north Italy.



The dispersion of the French army allowed only a fragmentary, though most energetic, resistance to be offered to the Austrian onset. The latter, considerably delayed at first by the crossing of the river Bormida, broke up into two columns,[1] which advanced, the right by the main road on Marengo, the left on Castel Ceriolo. The former, personally commanded by Melas, was 20,000 strong, and General Victor, its immediate opponent, about 10,000, or including some 5000 of Lannes' corps who fought on his right, about 15,000 strong; the Austrians were, moreover, greatly superior in guns and cavalry. The French disputed every yard of ground, holding their first line until they had by fire and counter-attack forced practically the whole of the Austrian right to deploy, and two hours passed before the Austrians managed to reach the Fontanone brook. But Victor's troops, being disorganized and short of ammunition, had then to retire more rapidly across the plain. The retreat was orderly, according to Victor's report, and made in échelon from the centre, and it is certain that at any rate the regiments held together, for the 6000 Austrian sabres found no opportunity to charge home. Many guns and wagons were, however, abandoned.

On the French right, opposed to the column of Lieut.-Field-Marshal Ott, was Lannes, with some 4000 men (excluding Watrin's division which was with Victor) against 7500. He too was after a time forced to retire, with heavy losses. Thus, about 11 a.m. the First Consul, who was at some distance from the field, was at last convinced that he had to deal with Melas's army. At once he sent out his staff officers to bring back his detachments, and pushed forward his only reserve, Monnier's division, to support Lannes and Victor. But before this help arrived Lannes had been driven out of Castel Ceriolo, and Victor and Watrin forced back almost to San Giuliano. A little after 2 p.m. Monnier's division (3500) came into action, and its impetuous advance drove the Austrians out of Castel Ceriolo. But after an hour it was forced back in its turn, and by 3 p.m. therefore, the 20,000 French troops, disordered and exhausted, and in one line without reserves,[2] held a ragged line of battle to the right and left of San Giuliano. The best that could be expected was a prolongation of the struggle till nightfall and a fairly orderly retreat. The Austrian general, believing that the battle was won, returned to Alessandria, leaving a younger man, his chief of staff Zach, to organize the pursuit.

Then followed one of the most dramatic events in military history. Of the two detachments sent away by Napoleon in search of the enemy, one only received its orders of recall. This was Boudet's division of Desaix's corps, away to the south at Rivalta and at noon heading for Pozzolo-Formigaro on the Alessandria-Genoa road. At 1 p.m. a brief message, "Revenez, au nom de Dieu!" altered the direction of the column, and between 4 and 5, after a forced march, the division, headed by Desaix, came on to the battle-field. It was deployed as a unit and moved forward at the word of command along the main road Alessandria-Tortona, the sight of their closed line giving fresh courage to the men of Lannes and Victor. Then, while on the other side Zach was arraying a deep column of troops to pursue along the main road, Napoleon and Desaix, themselves under fire, hastily framed a plan of attack. All arms were combined. First, Marmont with eight of Boudet's guns and ten others (the rest had been abandoned in the retirement) came into action on the right of the road, replying to the fire of the Austrian guns and checking their advanced infantry; close in rear of the artillery was Desaix's infantry with the remnants of Lannes' and Victor's troops rallying on its right and left; on Lannes' right, still facing Ott's column, was Monnier, supported by the Consular Guard of horse and foot; lastly 400 sabres of Kellermann's cavalry brigade, which had already been engaged several times and had lost heavily, formed up on the right of Desaix. About 5 p.m. Desaix advanced against the head of the Austrian main column formed by Zach. He himself fell in the attack, but the onset of his intact troops drove back the leading Austrians upon their supports, and at the critical moment when the attack of Boudet's single weak division had almost spent its force, Kellermann with his 400 sabres sallied out of the French line. Marmont had brought up two guns to assist the infantry, and as he fired his last round of case-shot the cavalry raced past him to the front, wheeled inwards against the flank of the great column, and rode through and through it. Zach was taken prisoner with more than 2000 men, and Kellermann, rallying some of his troopers, flung himself upon the astonished Austrian cavalry and with the assistance of the Consular Guard cavalry defeated it. The "will to conquer" spread along the whole French line, while the surprise of the Austrians suddenly and strangely became mere panic. Lannes, Victor and Monnier advanced afresh, pushing the Austrians back on Marengo. A few Austrian battalions made a gallant stand at that place, while Melas himself, as night came on, rallied the fugitives beyond. Next day the completely exhausted, but victorious,

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[1] A third column was sent out to the extreme right (3000 under O'Reilly). This destroyed a small French detachment on the extreme left, but took little or no part in the main battle.

[2] The Austrians, too, fighting in "linear" formation had few reserves. About one-third only of the imperial forces in Italy was actually engaged in the battle.

French army extorted from the dazed Austrians a convention by which all Italy up to the Mincio was evacuated by them. The respective losses were: French about 4000, Austrians 9500.

See the French official *Campagne de l'armée de réserve*, vol. ii., by C. de Cugnac.

MAREOTIS (Arabic *Mariut*), the most westerly of the lakes in the Delta of Egypt. On the narrow strip of land separating the lake from the Mediterranean the city of Alexandria is built. (See EGYPT; and ALEXANDRIA.)

MARE'S-TAIL, in botany, the popular name for an aquatic herb known botanically as *Hippuris vulgaris* (natural order Haloragaceae). It grows on margins of lakes, ponds and similar localities, and has a submerged stout creeping rootstock from which spring many-jointed cylindrical stems bearing numerous narrow leaves close-set in whorls. The minute greenish flowers are borne in the leaf-axils. Like many fresh-water plants it has a wide distribution, occurring in arctic and temperate regions in the northern hemisphere and reappearing in antarctic South America.

MARET, HUGUES-BERNARD, DUC DE BASSANO (1763–1839), French statesman and publicist, was born at Dijon. After receiving a sound education, he entered the legal profession and became advocate at the King's Council at Paris. The ideas of the French Revolution profoundly influenced him, and wholly altered his career. The interest aroused by the debates of the first National Assembly suggested to him the idea of publishing them, conjointly with Méjean, in the *Bulletin de l'Assemblée*. The publicist Charles Joseph Panckoucke (1736–1798), owner of the *Mercure de France* and publisher of the famous *Encyclopédie* (1781), persuaded him to merge this in a larger paper, the *Moniteur universel*, which gained a wide repute for correctness and impartiality. He was a member of the moderate club, the Feuillants; but after the overthrow of the monarchy on the 10th of August 1792 he accepted an office in the ministry of foreign affairs, where he sometimes exercised a steadying influence. On the withdrawal of the British legation from Paris Maret went on a mission to London, where he had a favourable interview with Pitt on the 2nd of December 1792. All hope of an accommodation was, however, in vain. After the execution of Louis XVI. (Jan. 21, 1793), the chief French diplomatic agent, Chauvelin, was ordered to leave England, while the French Convention declared war (Feb. 1, 1793). These events precluded the possibility of success attending a second mission of Maret to London in January. After a space, in which he held no diplomatic post, he became ambassador of the French Republic at Naples; but, while repairing thither with De Sémonville he was captured by the Austrians and was kept in durance by them for some thirty months, until, at the close of 1795, the two were set free in return for the liberation of the daughter of Louis XVI. For a time Maret betook himself to journalism; but he played a useful part in the negotiations for a peace with Great Britain which went on at Lille during the summer of 1797, until the victory of the Jacobins at Paris in the *coup d'état* of Fructidor (Sept. 1797) frustrated the hopes of Pitt for peace and inflicted on Maret another reverse of fortune. On the return of Bonaparte from Egypt in 1799 Maret joined the general's party which came to power with the *coup d'état* of Brumaire (Nov. 9–10, 1799).

Maret now became one of the First Consul's secretaries and shortly afterwards secretary of state. In this position his moderation, industry, good sense, knowledge of men and of affairs, made his services of great value. The *Moniteur*, which became the official journal of the state in 1800, was placed under his control. He sometimes succeeded in toning down the hard, abrupt language of Napoleon's communications, and in every way proved a useful intermediary. It is known that he had a share in the drawing up of the new constitutions for the Batavian and Italian Republics. In 1804 he became Minister; in 1807 he was named count, and in 1809 he received the title of duc de Bassano, an honour which marked the sense entertained by Napoleon of his strenuous toil, especially in connexion with the diplomatic negotiations and treaties of this period. His personal devotion to the emperor was of that absolute unwavering kind which Napoleon highly valued; it is seen in the attempt to defend the unworthy artifices adopted by the great man in April–May 1808 in order to make himself master of the destinies of Spain. Maret also assisted in drawing up the constitution destined for Spain, which the Spaniards at once rejected.

Maret accompanied Napoleon through most of his campaigns, including that of 1809; and at its close he expressed himself in favour of the marriage alliance with the archduchess Marie Louise of Austria, which took place in 1810. In the spring of 1811, the duc de Bassano replaced Champagny, duc de Cadore, as minister of Foreign Affairs. In this capacity he showed his usual industry and devotion, concluding the treaties between France and Austria and France and Prussia, which preceded the French invasion of Russia in 1812. He was with Napoleon through the greater part of that campaign; and after its disastrous conclusion helped to prepare the new forces with which Napoleon waged the equally disastrous campaign of 1813. But in November 1813 Napoleon replaced him by Caulaincourt, duc de Vicence, who was thought to be more devoted to the cause of peace and personally grateful to the emperor Alexander I. of Russia. Maret, however, as private secretary of the emperor, remained with his master through the campaign of 1814, as also during that of 1815. After the second restoration of the Bourbons he was exiled, and retired to Grätz where he occupied himself with literary work. In 1820 he was allowed to return to France, and after the Revolution of 1830, Louis Philippe, king of the French, made him a peer of France; he also held two high offices for a few days. He died at Paris in 1839. He shares with Daru the honour of being the hardest worker and most devoted supporter in Napoleon's service; but it has generally been considered that he carried devotion to the length of servility, and thus often compromised the real interests of France. This view has been contested by Baron Ernouf in his work *Maret, duc de Bassano*, which is the best biography.

For Maret's mission to England in 1792 and his work at Lille in 1797, see Augustus W. Miles, *Letters on the French Revolution*; J. H. Rose, *The Life and Times of William Pitt*, and for other incidents of Maret's career, the memoirs of Bourrienne, Pasquier, Méneval and Savary (duc de Rovigo), may be consulted. Thiers's account of Maret is in general hostile to him. (J. Hl. R.)

MARGARET (Fr. *Marguerite*, It. *Margherita*, Ger. *Margareta*, and *Margarete*, with dim. *Grete*, *Gretchen*, *Meta*, fr. Lat. *margarita*, Gr. *μαργαρίτης*, a pearl), a female proper name, which became very popular in all Christian countries as that of the saint noticed below. Biographies of some who have borne it are arranged below in the following order: saints, queens of Scotland, queens of other countries, princesses and duchesses.

MARGARET, ST (SANCTA MARGARITA), virgin and martyr, is celebrated by the Church of Rome on the 20th of July. According to the legend, she was a native of Antioch, daughter of a pagan priest named Aedesius. She was scorned by her father for her Christian faith, and lived in the country with a foster mother keeping sheep. Olybrius, the "praeses orientis," offered her marriage as the price of her renunciation of Christianity. Her refusal led to her being cruelly tortured, and after various miraculous incidents, she was put to death. Among the Greeks she is known as Marina, and her festival is on the 17th of July. She has been identified with St Pelagia (*q.v.*)—Marina being the Latin equivalent of Pelagia—who, according to a legend, was also called Margarito. We possess no historical documents on St Margaret as distinct from St Pelagia. An attempt has been made, but without success, to prove that the group of legends with which that of St Margaret is connected is derived from a transformation of the pagan divinity Aphrodite into a Christian saint. The problem of her identity is a purely literary question. The cult of St Margaret was very widespread in England, where more than 250 churches are dedicated to her.

See *Acta sanctorum*, July, v. 24–45; *Bibliotheca hagiographica Latina* (Brussels, 1899), n. 5303–5313; Frances Arnold-Forster, *Studies in Church Dedications* (London, 1899), i. 131–133 and iii. 19. (H. De.)

MARGARET, ST (*c.* 1045–1093), the queen of Malcolm III. Canmore king of Scotland, was the daughter of the English prince Edward, son of Edmund Ironside, and sister of Edgar Ætheling, and was probably born in Hungary. In 1067 the widow and children of Edward fled from Northumberland with a large number of followers and sought the protection of the Scottish king. The marriage of Malcolm and Margaret soon took place and was followed by several invasions of Northumberland by the Scottish king, probably in support of the claims of his brother-in-law Edgar. These, however, had little result beyond the devastation of the province. Far more important were the effects of this alliance upon the history of Scotland. A considerable portion of the old Northumbrian kingdom had been reduced by the Scottish kings in the previous century, but up to this time the English population had little influence upon the ruling element of the kingdom. Malcolm's marriage undoubtedly improved the condition of the English to a great extent, and under Margaret's sons, Edgar, Alexander I. and David I., the Scottish court practically became anglicized. Margaret died on the 17th of November 1093, four days after her husband and her eldest son Edward, who were slain in an invasion of Northumberland. She rebuilt the monastery of Iona, and was canonized in 1251 on account of her great benefactions to the Church.

See *Chronicles of the Picts and Scots* (Edinburgh, 1867), edited 1876, by W. F. Skene; and W. F. Skene, *Celtic Scotland* (Edinburgh).

MARGARET (1489–1541), queen of Scotland, eldest daughter of Henry VII., king of England, by his wife Elizabeth, daughter of Edward IV., was born at Westminster on the 29th of November 1489. Before she was six years old negotiations were opened, which dragged on for several years, for marrying the princess to James IV. of Scotland, whose support of the pretender Perkin Warbeck it was hoped to avert by such an alliance. Eventually the marriage was celebrated in Edinburgh on the 8th of August 1503. The avaricious Henry VII. gave his daughter a scanty dowry and quarrels on this head embittered the relations between the two kingdoms, which the marriage, although accompanied by a treaty of perpetual peace, did nothing to heal. The whole of Margaret's life after her marriage with James IV. was an unending series of intrigues, first with one political faction then with another; at one time in favour of her native country, at another in hostility to it, her conduct being mainly influenced at all times by considerations affecting her pocket.

Margaret was crowned at Edinburgh in March 1504. Until 1507 she had no children; between that date and 1510 two sons and a daughter were born, all of whom died in infancy; in 1512 she gave birth to a son who succeeded his father as James V.; in 1514 she bore a posthumous son, Alexander, created duke of Ross, who died in the following year. A dispute with her brother Henry VIII. over a legacy claimed by Margaret was a contributory cause of the war which ended at Flodden, where James IV. was killed on the 9th of September 1513, having by his will appointed Margaret sole guardian of her infant son, now King James V. Scotland was divided mainly into two parties, one in favour of alliance with England, and the other with France. The leader of the latter was John Stewart, duke of Albany, next heir to the crown of Scotland after Margaret's sons; Margaret herself for the most part inclined to the English faction; and when Albany returned to Scotland from France on the invitation of the Scottish parliament in the spring of 1514, the conflict grew almost to civil war. Various projects for Margaret's remarriage had already been started, Louis XII. of France and the emperor Maximilian being proposed as suitable husbands for the young widow, when the queen privately married Archibald Douglas, earl of Angus, on the 6th of August 1514. The consequences of this marriage were to alienate many of the most powerful of the nobility, especially the earls of Arran and Home, and to make Margaret entirely dependent on the house of Douglas; while it furnished the council with a pretext for removing her from the regency and guardianship of the king in favour of Albany in July 1515. Albany had to blockade Margaret in Stirling Castle before she would surrender her sons. After being obliged to capitulate, Margaret returned to Edinburgh, and being no longer responsible for the custody of the king she fled to England in September, where a month later she bore to Angus a daughter, Margaret, who afterwards became countess of Lennox, mother of Lord Darnley and grandmother of James I. of England.

In the summer of 1516 Margaret went to her brother's court in London, while Angus, much to his wife's displeasure, returned to Scotland, where he made his peace with Albany and was restored to his estates. The rivalry between the French and English factions in Scotland was complicated by private feuds of the Hamiltons and Douglases, the respective heads of which houses, Arran and Angus, were contending for the supreme power in the absence of Albany in France, where at the instance of Henry VIII. he was detained by Francis I. Margaret, quarrelling with her husband over money matters, sided at first with Arran and began to agitate for a divorce from Angus. In this she was probably aided by Albany, who had been in Rome, and who found an unexpected ally in the queen-mother, Margaret being temporarily alienated from the English party by her brother Henry's opposition to her divorce. When Albany returned to Scotland in 1521 his association with Margaret gave rise to the accusation that it was with the intention of marrying her himself that he favoured her divorce from Angus, and it was even suggested that she was Albany's mistress. As Albany was strongly supported by the Scottish parliament, Angus found it necessary to withdraw to France till 1524. During these years there was constant warfare between the English and the Scots on the border, but in May 1524 Albany was obliged to retire to France. Henry VIII. continually aimed at securing the person of his nephew, the king of Scots; while Margaret veered from faction to faction without any settled policy, unless it were the "erection" of her son, *i.e.* his proclamation as a reigning sovereign, which she successfully brought about in July 1524. The queen-mother had at this time fallen in love with Henry Stewart, second son of Lord Avondale, whom she married immediately after obtaining her divorce from Angus in 1527. Margaret and her new husband, who was created Lord Methven, now became for a time the ruling influence in the counsels of James V. But when her desire to arrange a meeting between James and Henry VIII. in 1534 was frustrated by the opposition of the clergy and the council, Margaret in her disappointment revealed certain secrets to Henry which led to her being accused by her son of betraying him for money and of acting as an English spy. In 1537 she was anxious to obtain a divorce from Methven, and her desire was on the point of being realized when it was defeated by the intervention of James. Two years later she was reconciled to her husband, by whom she had no children; and, continuing to the end to intrigue both in Scotland and England, she died at Methven Castle on the 18th of October 1541.

See Andrew Lang, *History of Scotland*, vol. i. (London, 1900); Mary A. E. Green, *Lives of the Princesses of England* (6 vols., London, 1849–1855); *The Hamilton Papers*, ed. by J. Bain (2 vols., Edinburgh, 1890); John Leslie, *History of Scotland*, ed. by T. Thompson (4 vols., Edinburgh, 1830); Sir H. Ellis, *Original Letters Illustrative of English History* (London, 1825–1846). (R. J. M.)

MARGARET (1283–1290), titular queen of Scotland, and generally known as the "maid of Norway," was the daughter of Eric II. king of Norway, and Margaret, daughter of Alexander III. king of Scotland. Her mother died soon after Margaret's birth, and in 1284 the estates of Scotland decided that if Alexander died childless the crown should pass to his granddaughter, In March 1286 Alexander was killed and Margaret became queen. The English king Edward I. was closely watching affairs in Scotland, and in 1289 a marriage was arranged between the infant queen and Edward's son, afterwards Edward II. Margaret sailed from Norway and reached the Orkneys, where she died about the end of September 1290. The news of this occurrence was first made known in a letter dated the 7th of October 1290. Some mystery, however, surrounded her death, and about 1300 a woman from Leipzig declared she was Queen Margaret. The impostor, if she were such, was burned as a witch at Bergen.

See A. Lang, *History of Scotland*, vol. i. (Edinburgh, 1904).

MARGARET (1353–1412), queen of Denmark, Norway and Sweden, the daughter of Valdemar IV. of Denmark, was born in 1353 and married ten years later to King Haakon VI. of Norway. Her first act, after her father's death (1375), was to procure the election of her infant son Olaf as king of Denmark. Olaf died in 1387, having in 1380 also succeeded his father; and in the following year Margaret, who had ruled both kingdoms in his name, was chosen regent of Norway and Denmark. She had already given proofs of her superior statesmanship by recovering possession of Schleswig from the Holstein counts, who had held it absolutely for a generation, and who now received it back indeed as a fief (by the compact of Nyborg 1386), but under such stringent conditions that the Danish crown got all the advantage of the arrangement. By this compact, moreover, the chronically rebellious Jutish nobility lost the support they had hitherto always found in Schleswig-Holstein, and Margaret, free from all fear of domestic sedition, could now give her undivided attention to Sweden, where the mutinous nobles were already in arms against their unpopular king, Albert of Mecklenburg. At a conference held at Dalaborg Castle, in March 1388, the Swedes were compelled to accept all Margaret's conditions, elected her "Sovereign Lady and Ruler," and engaged to accept from her any king she chose to appoint. On the 24th of February 1389, Albert, who had returned from Mecklenburg with an army of mercenaries, was routed and taken prisoner at Aasle near Falköping, and Margaret was now the omnipotent mistress of three kingdoms. Stockholm then almost entirely a German city, still held out; fear of Margaret induced both the Mecklenburg princes and the Wendish towns to hasten to its assistance; and the Baltic and the North Sea speedily swarmed with the privateers of the *Viktualien brödre* or *Vitalianer*, so called because their professed object was to revictual Stockholm. Finally the Hansa intervened, and by the compact of Lindholm (1395) Albert was released by Margaret on promising to pay 60,000 marks within three years, the Hansa in the meantime to hold Stockholm in pawn. Albert failing to pay his ransom within the stipulated time, the Hansa surrendered Stockholm to Margaret in September 1398, in exchange for very considerable commercial privileges.

It had been understood that Margaret should, at the first convenient opportunity, provide the three kingdoms with a king who was to be her nearest kinsman, and in 1389 she proclaimed her infant cousin, Eric of Pomerania, king of Norway. In 1396 homage was rendered to him in Denmark and Sweden likewise, Margaret reserving to herself the office of regent during his minority. To weld the united kingdoms still more closely together, Margaret summoned a congress of the three councils of state to Kalmar in June 1397; and on Trinity Sunday, the 17th of June, Eric was solemnly crowned king of Denmark, Norway and Sweden. The proposed act of union divided the three *Rigsraads*, but the actual deed embodying the terms of the union never got beyond the stage of an unratified draft. Margaret revolted at the clauses which insisted that each country should retain exclusive possession of its own laws and customs, and be administered by its own dignitaries, as tending in her opinion to prevent the complete amalgamation of Scandinavia. But with her usual prudence she avoided every appearance of an open rupture.

A few years after the union of Kalmar, Eric, now in his eighteenth year, was declared of age and homage was rendered to him in all his three kingdoms, but during her lifetime Margaret was the real ruler of Scandinavia. So long as the union was insecure, Margaret had tolerated the presence near the throne of "good men" from all three realms (the *Rigsraad*, or council of state, as these councillors now began to be called); but their influence was always insignificant. In every direction the royal authority remained supreme. The offices of high constable and earl marshal were left vacant, the *Danehoffer* or national assemblies fell into desuetude, and the great queen, an ideal despot, ruled through her court officials acting as superior clerks. But law and order were well maintained; the licence of the nobility was sternly repressed; the kingdoms of Sweden and Norway were treated as integral parts of the Danish state, and national aspirations were frowned upon or checked, though Norway, as being more loyal, was treated more indulgently than Sweden. Margaret also recovered for the Crown all the landed property which had been alienated during the troublous days of Valdemar IV. This so-called "reduktion," or land-recovery, was carried out with the utmost rigour, and hundreds of estates fell into the Crown. Margaret also reformed the Danish currency, substituting good silver coins for the old and worthless copper tokens, to the great advantage both of herself and the state. She had always large sums of money to dispose of, and a considerable proportion of this treasure was dispensed in works of charity. Margaret's foreign policy was sagaciously circumspect, in sharp contrast with the venturesomeness of her father's. The most tempting offer of alliance, the most favourable conjunctures, could never move her from her system of neutrality. On the other hand she spared no pains to recover lost Danish territory. Gotland she purchased from its actual possessors, Albert of Mecklenburg and the Livonian Order, and the greater part of Schleswig was regained in the same way.

Margaret died suddenly on board her ship in Flensborg harbour on the 28th of October 1412. We know very little of her private character. Contemporary records are both scanty and hostile to a sovereign who squeezed the utmost out of the people. Craft and wiliness are the qualities most generally attributed to her, coupled with the cynical praise that "in temporal matters she was very lucky."

See *Danmarks riges historie, den senere Middelalder*, pp. 358–412 (Copenhagen, 1897–1905); Erslev, *Danmarks historie under dronning Margrethe* (Copenhagen, 1882–1901); Hill, *Margaret of Denmark* (London, 1898). (R. N. B.)

MARGARET OF ANJOU (1430–1482), queen of England. daughter of René of Anjou, titular king of Naples and Jerusalem, was born on the 23rd of March 1430. When just fourteen she was betrothed to Henry VI. king of England, and in the following year was brought to England and married at Titchfield Abbey, near Southampton, on the 23rd of April 1445. On the 28th of May she was welcomed at London with a great pageant, and two days later crowned at Westminster. Margaret's marriage had been negotiated by William de la Pole, duke of Suffolk, and when she came to England, Suffolk and his wife were her only friends. Naturally she fell under Suffolk's influence, and supported his policy. This, added to her French origin and sympathies, made her from the start unpopular. Though clever and good-looking, she was self-willed and imperious, and without the conciliatory manners which her difficult position required. In almost everything she was the opposite of her gentle husband, but entered into his educational schemes, and gave her patronage to the foundation of Queen's College, Cambridge. Margaret's really active share in politics began after Suffolk's fall in 1450. She not only supported Edmond Beaufort, duke of Somerset, in his opposition to Richard of York, but concerned herself also in the details of government, seeking not over-wisely pecuniary benefits for herself and her friends. But as a childless queen her influence was limited; and when at last her only son, Edward, was born on the 13th of October 1453, her husband was stricken with insanity From this time she was the ardent champion of her husband's and son's rights; to her energy the cause of Lancaster owed its endurance, but her implacable spirit contributed to its failure. When York's protectorate was ended by Henry's recovery in January 1455, Margaret, not content with the restoration of Somerset and her other friends to liberty and office, pushed her politics to extremes. The result was the defeat of the Lancastrians at St Albans, and for a year Margaret had to acquiesce in York's power. Yet at this time one wrote of her: "The queen is a great and strong laboured woman, for she spareth no pain to sue her things to an intent and conclusion to her power" (*Paston Letters*, i. 378). All the while she was organizing her party; and ultimately, in October 1456 at Coventry, procured some change in the government. Though formally reconciled to York in March 1458, she continued to intrigue with her partisans in England, and even with friends in France, like Pierre de Brezé, the seneschal of Normandy. After the Yorkist failure at Ludlow in 1459, it was Margaret's vindictiveness that embittered the struggle by a wholesale proscription of her opponents in the parliament at Coventry. She was not present with her husband at Northampton on the 10th of July 1460. After romantic adventures, in which she owed her safety to the loyalty of a boy of fourteen, her only companion, she escaped with her little son to Harlech. Thence after a while she made her way to Scotland. From Mary of Gelderland, the queen regent, she purchased the promise of help at the price of surrendering Berwick. Margaret was still in Scotland at the date of Wakefield, so was not, as alleged by hostile writers, responsible for the barbarous treatment of York's body. But she at once joined her friends, and was with the northern army which defeated Warwick at St Albans on the 17th of February 1461; for the executions which followed she must bear the blame. After Towton Margaret with her husband and son once more took refuge in Scotland.

A year later she went to France, and with help from her father and Louis XI. equipped an expedition under Pierre de Brezé. She landed in Northumberland in October, and achieved some slight success; but when on the way to seek further help from Scotland the fleet was overwhelmed in a storm, and Margaret herself barely escaped in an open boat to Berwick. In the spring she was again trying to raid Northumberland, meeting with many hardships and adventures. Once she owed her escape from capture to the generosity of a Yorkist squire, who carried her off on his own horse; finally she and her son were brought to Bamburgh through the compassionate help of a robber, whom they had encountered in the forest. Thence in August 1463 she crossed to Sluys in Flanders. She was almost destitute, but was courteously treated by Charles the Bold, then count of Charolais, and so made her way to her father in France. For seven years she lived at Saint-Michel-en-Barrois, educating her son with the help of Sir John Fortescue, who wrote at this time: "We be all in great poverty, but yet the queen sustaineth us in meat and drink. Her highness may do no more than she doth" (*Works*, ii. 72, ed. Clermont). Margaret never lost her hopes of her son's restoration. But when at last the quarrel between Warwick and Edward IV. brought her the opportunity, it was with difficulty that she could consent to be reconciled to so old and bitter an enemy. After Warwick's success and Henry's restoration Margaret still remained in France. When at last she was ready to sail she was delayed by contrary winds. So it was only on the very day of Warwick's defeat at Barnet (14th of April) that Margaret and Edward landed at Weymouth. Three weeks later the Lancastrians were defeated at Tewkesbury, and Edward was killed. Margaret was not at the battle; she was captured a few days after, and brought to London on the 21st of May. For five years she remained a prisoner, but was treated honourably and for part at least of the time was in charge of her old friend the duchess of Suffolk. Finally Louis XI. ransomed her under the Treaty of Pecquigny, and she returned to France on the 29th of January 1476. Margaret lived for six years at different places in Bar and Anjou, in poverty and dependent for a pension on Louis, who made her surrender in return her claims to her father's inheritance. She died on the 25th of April 1482 and was buried at Angers Cathedral. René, whom she probably never saw after 1470, had died in the previous year. During her last years Chastellain wrote for her consolation his *Temple de Bocace* dealing with the misfortunes of contemporary princes.

As the courageous champion of the rights of her son and her husband, Margaret must command a certain sympathy. But she was politically unwise, and injured their cause by her readiness to purchase foreign help at the price of English interests. Comines wrote well of her that she would have done more prudently if she had endeavoured to adjust the disputes of the rival factions instead of saying "I am of this party, and will maintain it" (*Mémoires* vi. ch. 13). Her fierce partisanship embittered her enemies, and the Yorkists did not hesitate to allege that her son was a bastard. This, like the scandal concerning Margaret and Suffolk, is baseless; the tradition, however, continued and found expression in the *Mirror for Magistrates* and in Drayton's *Heroical Epistles*, as well as in Shakespeare's *Henry VI.*

BIBLIOGRAPHY.—For contemporary English authorities see under HENRY VI. French authorities and especially the *Chroniques* of George de Chastellain, and the *Mémoires* of Philippes de Comines contain much that is of value. The *Letters of Margaret of Anjou* (Camden Soc., 1863) have small historical importance. There have been numerous biographies, the chief is Mrs Hookham's *Life of Margaret of Anjou* (1872). But the best modern accounts are to be found in G. du Fresne de Beaucourt's *Histoire de Charles VII.*, Dr Gairdner's Introductions to the *Paston Letters*, Sir James Ramsay's *Lancaster and York* (1892), and *The Political History of England*, vol. iv. (1906), by Professor C. Oman. Dr Karl Schmidt's *Margareta von Anjou, vor und bei Shakespeare* (Palaestra, liv., Berlin, 1906) is a useful digest of authorities. (C. L. K.)

MARGARET OF AUSTRIA (1480–1530), duchess of Savoy and regent of the Netherlands from 1507 to 1530, daughter of the archduke Maximilian of Austria, afterwards the emperor Maximilian I., was born at Brussels on the 10th of January 1480. At two years of age she was betrothed to the dauphin Charles, son of Louis XI. of France, and was brought up at the French court. In 1489, however, Charles, now king as Charles VIII., to prevent Maximilian taking as his second wife the duchess Anne of Brittany, threw over Margaret and married the Breton heiress himself. Her ambitious father now sought for Margaret another throne, and in April 1497 she was married at Burgos to the Infant John, heir to the throne of Castile and Aragon. She was left a widow, however, a few months later. In 1501 Margaret became the wife of Philibert II., duke of Savoy, who only survived until 1504. The sudden death of her brother the archduke, Philip the Handsome (Sept 25, 1506), opened out to her a new career. In 1507 she was appointed by her father regent of the Netherlands and guardian of her nephew Charles, afterwards the emperor Charles V. Charles came of age in 1515, but he entrusted Margaret with the regency, as the vast extent of his dominions permitted him but seldom to visit the Netherlands, and she continued to hold the post until her death in 1530. She was a wise and prudent ruler, of masculine temper and intrepidity, and very capable in affairs.

See E. Münch, *Margaretha von Österreich* (Leipzig, 1883); Th. Juste, *Charles-Quint et Marguérite d'Autriche* (Brussels, 1858); A. Le Glay, *Maximilien I. et Marguérite d'Autriche* (with correspondence, Paris, 1839); De Quinsonas, *Matériaux pour servir à l'histoire de Marguérite d'Autriche* (Paris, 1855), and E. E. Tremayne, *The First Governors of the Netherlands: Margaret of Austria* (1908).

MARGARET OF AUSTRIA (1522–1586), duchess of Parma and regent of the Netherlands from 1559 to 1567, was a natural daughter of Charles V. Her mother, Margaret van Ghent, was a Fleming. She was brought up by her aunts Margaret of Austria and Maria of Hungary, who were successively regents of the Netherlands from 1507 to 1530 and from 1530 to 1555. In 1533 she was married to Alexander de' Medici, duke of Florence, who was assassinated in 1537, after which she became the wife of Ottavio Farnese, duke of Parma, in 1542. The union proved an unhappy one. Like her aunts, who had trained her, she was a woman of masculine abilities, and Philip II., when he left the Netherlands in 1559 for Spain, acted wisely in appointing her regent. In ordinary times she would probably have proved as successful a ruler as her two predecessors in that post, but her task was very different from theirs. She had to face the rising storm of discontent against the Inquisition and Spanish despotism, and Philip left her but nominal authority. He was determined to pursue his own arbitrary course, and the issue was the revolt of the Netherlands. In 1567 Margaret resigned her post into the hands of the duke of Alva and retired to Italy. She had the satisfaction of seeing her son Alexander Farnese appointed to the office she had laid down, and to watch his successful career as governor-general of the Netherlands. She died at Ortona in 1586.

See L. P. Gachard, *Correspondance de Marguérite d'Autriche avec Phillippe II. 1554–1568* (Brussels, 1867–1887); R. Fruin, *Het voorspel van den tachtig jarigen vorlog* (Amsterdam, 1856); E. Rachfahl, *Margaretha von Parma, Statthalterin der Niederlande, 1559–1567* (Munich, 1895); also bibliography in *Cambridge Modern History*, iii. 795–809 (1904).

MARGARET OF PROVENCE (1221–1295), queen of France, was the daughter of Raymond Berenger V., count of Provence. She was married to Saint Louis at Sens on the 27th of May 1234, and was crowned the next day. Blanche of Castile, the queen-mother, arranged the marriage to win over to the cause of France the powerful count of Provence, but treated her daughter-in-law most unkindly, and her jealousy of the energetic young queen was naturally shared by Louis, whose coldness towards and suspicion of his wife are well known. Margaret did not lack courage, she followed the king on his crusade, and bore herself heroically at Damietta. But her ambition and strong personal prejudices often led her to actions injurious to the realm. This is most noticeable in her hostility to her brother-in-law Charles of Anjou, who had married her sister Beatrice, and her devotion to Henry III. of England, who had married her other sister Eleanor. Aspiring during the reign of her son to the same rôle which she had seen Blanche of Castile play, she induced, in 1263, the young Philip, heir to the throne, to promise to obey her in everything up to the age of thirty; and Saint Louis was obliged to ask for a bull from Urban IV. which would release the prince from his oath. After Saint Louis' death, Margaret continued obstinately to claim her rights on the county of Provence against Charles of Anjou. She sought to employ force of arms, calling upon her son, her nephew Edward II. of England, and the German king Rudolph of Habsburg. She did not give up her claim until after the death of Charles of Anjou (1285), when Philip the Bold succeeded in getting her to accept an income from the county of Anjou in exchange for her rights in Provence. She died on the 31st of December 1295.

See E. Boutaric, *Marguérite de Provence*, in *Revue des questions historiques* (1867), pp. 417–458.

MARGARET MAULTASCH (1318–1369), countess of Tirol, who received the name of Maultasch (pocket-mouth) on account of the shape of her mouth, was the daughter and heiress of Henry, duke of Carinthia and count of Tirol. When Henry died in 1335 Carinthia passed to Albert II., duke of Austria; but Tirol was inherited by Margaret and her young husband, John Henry, son of John, king of Bohemia, whom she had married in 1330. This union was not a happy one, and the Tirolese disliked the government of Charles, afterwards the emperor Charles IV., who ruled the county for his brother. The result was that John Henry was driven from Tirol, and Margaret's cause was espoused by the emperor Louis IV., who was anxious to add the county to his possessions. Declaring her marriage dissolved on the ground that it had not been consummated, Louis married Margaret in 1342 to his own son Louis, margrave of Brandenburg. But as this action on the emperor's part entrenched on the privileges of the Church, Pope Clement VI. placed father and son under the ban, from which they were not released until 1359. In 1361 Margaret's husband died, followed two years later by her only son, Meinhard, when she handed over Tirol to Rudolph IV., duke of Austria, and retired to Vienna, where she died on the 3rd of October 1369. She lived long in the memory of the people of Carinthia, who regarded her as an amazon, and called her the *Wicked Grell*.

See A. Huber, *Geschichte der Vereinigung Tirols mit Oesterreich* (Innsbruck, 1864).

MARGARINE, the name, first given by Chevreul, to an artificial substitute for butter, made from beef and other animal fats, and sometimes mixed with real butter. The name of "butterine" has also been used. Artificial butter, or "margarine-mouries," was for some years manufactured in Paris according to a method made public by the eminent chemist Mège-Mouries. Having surmised that the formation of butter contained in milk was due to the absorption of fat contained in the animal tissues, he was led to experiment on the splitting up of animal fat. The process he ultimately adopted consisted in heating finely minced beef suet with water, carbonate of potash, and fresh sheep's stomach cut up into small fragments. The mixture be raised to a temperature of 45° C. (113° F.). The influence of the pepsine of the sheep's stomach with the heat separated the fat from the cellular tissue; he removed the fatty matter, and submitted it when cool to powerful hydraulic pressure, separating it into stearin and oleomargarin, which last alone he used for butter-making. Of this fat about the proportions of 10 lb with 4 pints of milk, and 3 pints of water were placed in a churn, to which a small quantity of anatto was added for colouring, and the whole churned together. The compound so obtained when well washed was in general appearance, taste and consistency like ordinary butter, and when well freed from water it was found to keep a longer time. Margarine is a perfectly wholesome butter-substitute, and is now largely used, but the ease with which it may be passed off as real butter has led to much discussion and legislative action. (See ADULTERATION.)

MARGARITA, an island in the Caribbean Sea belonging to Venezuela, about 12 m. N. of the peninsula of Araya, and constituting, under the constitution of 1904,—with Tortuga, Cubagua and Coche—a political division called the Eastern Federal District. The island is about 40 m. long from east to west, has an area of 400 sq. m., and consists of two mountainous extremities, nearly separated by the Laguna Grande on the south, but connected by a low, narrow isthmus. The highest elevation on the island is the peak of Macanao, 4484 ft., in the western part, the highest point in the eastern part being the peak of Copei, 4170 ft. The higher valleys of the interior are highly fertile and are well adapted to grazing and stock-raising. The principal industries are fishing and the making of salt. The pearl fisheries, which were so productive in the 16th and 17th centuries, are no longer important. A domestic industry of the women is that of making coarse straw hats, which are sold on the mainland. The products of Margarita, however, are insufficient to support its population, and large numbers periodically emigrate to the mainland, preventing the increase in population which its healthful climate favours. The population was estimated in 1904 at 40,000, composed in great part of half-caste Guayqueri Indians. The capital is Asunción (pop. about 3000), on the east side of the island, and its principal port is Pompatar on the south coast. The two small ports of Puebla de la Mar (*Porlamar*) and Puebla del Norte are merely open roadsteads.

The island of Margarita (from Span. *Margarita*, pearl) was discovered by Columbus in 1498, and was bestowed in 1524 upon Marceto Villalobos by Charles V. In 1561 the freebooter Lope de Aguirre ravaged the island, and in 1662 the town of Pompatar was destroyed by the Dutch. For a long time Margarita was attached to Cumana, but in the eighteenth century it was made administratively independent. Its traders and sailors rendered invaluable assistance to the revolutionists in the war of independence, and the Spanish general, Morillo, was driven from its shores in 1817; in recognition of this it was made a separate state and was renamed Nueva Esparta (New Sparta). In 1904–1909 it was a part of the Federal District with Asunción as its capital. The first Spanish settlement in South America was Nueva Cadiz, founded in 1515 on the barren island of Cubagua; but the place was abandoned when pearl-fishing and slave-trading ceased to be profitable.

MARGATE, a municipal borough and seaside resort in the Isle of Thanet parliamentary division of Kent, England, 74 m. E. by S. of London by the South Eastern & Chatham railway. Pop. (1891), 18,662; (1901), 23,118. It lies on the north coast of Thanet, and is practically contiguous with Westgate on the west and with Broadstairs on the south-east, owing to the modern extension of these popular watering-places. An electric tramway connects Margate with Broadstairs and Ramsgate, and during the season it is served by numerous pleasure steamers from London. An esplanade faces the sea along nearly the entire front of the town, and is lined with hotels, shops and dwelling-houses. A jetty exceeding a quarter of a mile in length permits the approach of vessels at all tides. It was built in 1854 and subsequently enlarged, but a pier was constructed by John Rennie in 1815, and is now chiefly used by fishermen and colliers. The church of St John the Baptist, founded in 1050, contains some portions of Norman architecture, the remainder being Decorated and Perpendicular. It is rich in ancient brasses and monuments, including a brass to Sir John Daundelyon (1443), whose family occupied a manor in the neighbourhood as early as the 13th century. The manor house of Daundelyon, or Dent de Lion, with its gateway of the early part of the 15th century, remains between Margate and Westgate. Charitable institutions include a deaf and dumb asylum (1875-1886), the Metropolitan infirmary for children (1841), and the royal sea-bathing infirmary, established in 1791 and enlarged through the munificence of Sir Erasmus Wilson in 1882. Dane Park (33 acres) was opened in 1898.

Margate (Meregate, Mergate), formerly a small fishing village, was an ancient and senior non-corporate member of Dover. In 1347 it contributed 15 ships of small tonnage at the time of the siege of Calais. Throughout the 14th century references are made to Margate in crown regulations regarding fisheries and shipping. A pier existed before 1500, but by the reign of Henry VIII. it was in a decayed condition. The amount of corn shipped was evidently small, the droits being insufficient to keep the pier in repair. Under Elizabeth Margate was still an obscure fishing village employing about 20 small vessels ("hoys") in the coasting and river trades, chiefly in the conveyance of grain, on which in 1791 it chiefly subsisted. The droits increased, but were not properly collected until 1724. In 1777 the pier was rebuilt. It was about this time that Margate first began to be known as a bathing-place owing to its fine stretch of firm sand. In 1835 Margate was still a liberty of Dover and no right of citizenship could be acquired. In 1857 it was incorporated. In 1777 a weekly market was granted on Wednesday and Saturday. It is now held daily, but principally on those two days.

MARGGRAF, ANDREAS SIGISMUND (1709-1782), German chemist, was born at Berlin on the 3rd of March 1709. After studying chemistry at Berlin and Strassburg, medicine at Halle, and mineralogy and metallurgy at Freiberg, he returned to his native city in 1735 as assistant to his father, Henning Christian Marggraf, chief apothecary at the court. Three years later he was elected to the Berlin Academy of Sciences, which in 1754 put him in charge of its chemical laboratory and in 1760 appointed him director of its physics class. He died in Berlin on the 7th of August 1782. His name is especially associated with the discovery of sugar in beetroot. In 1747 he published an account of experiments undertaken with the definite view of obtaining true sugar from indigenous plants, and found that for this purpose the first place is taken by beetroot and carrot, that in those plants sugar like that of cane exists ready formed, and that it may be extracted by boiling the dried roots in alcohol, from which it is deposited on cooling. This investigation is also memorable because he detected the minute sugar-crystals in the roots by the help of the microscope, which was thus introduced as an adjunct to chemical inquiry. In another research dealing with the nature of alum he showed that one of the constituents of that substance, alumina, is contained in common clay, and further that the salt cannot be prepared by the action of sulphuric acid on alumina alone, the addition of an alkali being necessary. He explained and simplified the process of obtaining phosphorus from urine, and made some admirable observations on phosphoric acid; but though he noted the increase in weight that attends the conversion of phosphorus into phosphoric acid he was content to remain an adherent of the phlogistic doctrine. For his time he was a skilful chemical analyst; he knew how to distinguish potash and soda by the different colorations they produce in flame, and how to test for iron with prussiate of potash: he was aware that sulphate of potash, gypsum and heavy spar, in spite of their different appearances, all contain sulphuric acid; and he recognized that there are different varieties of urinary calculi. In metallurgy he devised improved methods for the manufacture of zinc and the purification of silver, tin and other metals.

His papers, mostly written in French, were presented to the Berlin Academy, and with the exception of a few of the latest were collected in two volumes of *Chymische Schriften* in 1761-1767.

MARGHELAN, or Marghilan, a town of Asiatic Russia, situated in 40° 28′ N. and 71° 45′ E., the administrative centre of the province of Ferghana. Pop. (1900), 42,855, mostly Sarts, with Tajiks and Jews. It is a very old town, with high earthen walls and twelve gates, commanded by a fort. It lies in a beautiful, extraordinary fertile and well irrigated district. The heat in summer is excessive. The principal industry is the manufacture of silk; camels' hair and woollen fabrics are also made. The new Russian town, founded in 1877, is 10 m. distant to the south-east, and has a population (1897) of 8977.

MARGRAVE (Ger. *Markgraf*), a German title meaning literally "count of the March" (Lat. *marchio*, *comes marchae*, *marchisus*). The margraves had their origin in the counts established by Charlemagne and his successors to guard the frontier districts of the empire, and for centuries the title was always associated with this function. The margraves had within their own jurisdiction the authority of dukes, but at the outset they were subordinate to the dukes in the feudal army of the empire. In the 12th century, however, the margraves of Brandenburg and Austria (the north and east marks) asserted their position as tenants-in-chief of the empire; with the break-up of the great duchies the others did the same; and the margraves henceforward took rank with the great German princes. The title of margrave very early lost its original significance, and was borne by princes whose territories were in no sense frontier districts, *e.g.* by Hermann, a son of Hermann, margrave of Verona, who assumed in 1112 the title of margrave of Baden. Thus, too, when the elector Albert Achilles of Brandenburg in 1473 gave Bayreuth and Ansbach as apanages to his sons and their descendants these styled themselves margraves. The title, however, retained in Germany its sovereign significance, and has not, like "marquis" in France and "marchese" in Italy, sunk into a mere title of nobility; it is not, therefore, in its present sense the equivalent of the English title "marquess." The German margraviates have now all been absorbed into other sovereignties, and the title margrave is borne only as a subsidiary title in the full style of their sovereigns.

MARGUERITE, the popular name for the plant known botanically as *Pyrethrum* (or *Chrysanthemum*) *frutescens* (natural order Compositae), a shrubby perennial with smooth leaves cut pinnately into narrow segments and flower-heads two to three inches across produced singly in summer and autumn on slender erect stalks. The white ray-florets surround a yellow disk. It is a native of the Canary Isles, and a favourite for decoration and for greenhouse cultivation, window-boxes and open ground in the summer. The yellow marguerite (*étoile d'or*) has somewhat larger pale yellow flowers and glaucous leaves. The plant is propagated from cuttings taken in autumn from old plants and placed in sandy loamy soil in cold frames. By pruning the shoots in autumn the plants may be grown into very large specimens in the course of a few seasons.

MARGUERITE DE VALOIS. The name Marguerite was common in the Valois dynasty, and during the 16th century there were three princesses, all of whom figure in the political as well as in the literary history of the time, and who have been not unfrequently confounded. The first and last are the most important, but all deserve some account.

I. MARGUERITE D'ANGOULÊME (1492–1549). This, the most celebrated of the Marguerites, bore no less than four surnames. By family she was entitled to the name of Marguerite de Valois, as the daughter of Charles d'Orléans, count d'Angoulême, she is more properly, and by careful writers almost invariably, called Marguerite d'Angoulême. From her first husband she took, during no small part of her life, the appellation Marguerite d'Alençon, and from her second, Henri d'Albret, king of Navarre, that of Marguerite de Navarre. She was born at Angoulême on the 11th of April 1492, and was two years older than her brother Francis I. She was betrothed early to Charles, duke d'Alençon, and married him in 1509. She was not very fortunate in this first marriage, but her brother's accession to the throne made her, next to their mother Louise of Savoy, the most powerful woman of the kingdom. She became a widow in 1525, and was sought in marriage by many persons of distinction, including, it is said, Charles V. and Henry VIII. In 1527 she married Henri d'Albret, titular king of Navarre, who was considerably younger than herself, and whose character was not faultless, but who seems on the whole, despite slander, to have both loved and valued his wife. Navarre was not reconquered for the couple as Francis had promised, but ample apanages were assigned to Marguerite, and at Nérac and Pau miniature courts were kept up, which yielded to none in Europe in the intellectual brilliancy of their frequenters. Marguerite was at once one of the chief patronesses of letters that France possessed, and the chief refuge and defender of advocates of the Reformed doctrines. Round her gathered C. Marot, Bonaventure Des Périers, N. Denisot, J. Peletier, V. Brodeau, and many other men of letters, while she protected Rabelais, E. Dolet, &c. For a time her influence with her brother, to whom she was entirely devoted, and whom she visited when he was imprisoned in Spain, was effectual, but latterly political rather than religious considerations made him discourage Lutheranism, and a fierce persecution was begun against both Protestants and freethinkers, a persecution which drove Des Périers to suicide and brought Dolet to the stake. Marguerite herself, however, was protected by her brother, and her personal inclinations seem to have been rather towards a mystical pietism than towards dogmatic Protestant sentiments. Nevertheless bigotry and the desire to tarnish the reputation of women of letters have led to the bringing of odious accusations against her character, for which there is not the smallest foundation. Marguerite died at Odot-en-Bigorre on the 21st of September 1549. By her first husband she had no children, by her second a son who died in infancy, and a daughter, Jeanne d'Albret, who became the mother of Henry IV. Although the poets of the time are unwearied in celebrating her charms, she does not, from the portraits which exist, appear to have been regularly beautiful, but as to her sweetness of disposition and strength of mind there is universal consent.

Her literary work consists of the *Heptameron*, of poems entitled *Les Marguerites de la marguerite des princesses*, and of *Letters*. The *Heptameron*, constructed, as its name indicates, on the lines of the *Decameron* of Boccaccio, consists of seventy-two short stories told to each other by a company of ladies and gentlemen who are stopped in the journey homewards from Cauterets by the swelling of a river. It was not printed till 1558, ten years after the author's death, and then under the title of *Les Amants fortunés*. Internal evidence is strongly in favour of its having been a joint work, in which more than one of the men of letters who composed Marguerite's household took part. It is a delightful book, and strongly characteristic of the French Renaissance. The sensuality which characterized the period appears in it, but in a less coarse form than in the great work of Rabelais; and there is a poetical spirit which, except in rare instances, is absent from *Pantagruel*. The *Letters* are interesting and good. The *Marguerites* consist of a very miscellaneous collection of poems, mysteries, farces, devotional poems of considerable length, spiritual and miscellaneous songs, &c. The *Dernières poésies*, not printed till 1896 (by M. A. Lefranc), are interesting and characteristic, consisting of verse-epistles, *comédies* (pieces in dramatic form on the death of Francis I., &c.), *Les Prisons*, a long allegorical poem of amorous-religious-historical tenor; some miscellaneous verse chiefly in dizains, and a later and remarkable piece, *Le Navire*, expressing her despair at her brother's death. Of the other works, never yet completely edited, the best editions are, for the *Heptameron*, Leroux de Lincy (1855); for the *Lettres*, Genin (1841–1842), and for the *Marguerites*, &c., Frank (1873). English translations of the *Heptameron* are rather numerous: one appeared in 1887 by A. Machen, with an introduction by Miss A. M F Robinson (Mme Darmesteter) and another (anonymous) in 1894, with an essay by G. Saintsbury. The religious poem, *Le Miroir de l'âme pécheresse* was translated by Queen Elizabeth. Books on Marguerite and her court are also many There may be noted Durand's *Marguerite de Valois et la cour de François Ier* (1848), La Ferrière's *Marguerite d'Angoulême* (1891), Lotheissen's *Königin Margareta von Navarra* (1885); Miss Edith Sichel's *Women and Men of the French Renaissance* (1901), and P. Courtault's *Marguerite de Navarre* (1904).

II. The second MARGUERITE (1523–1574), daughter of Francis I., was born on the 5th of June, 1523, at St Germain-en-Laye, and, at an age the lateness of which caused lampoons, married Emmanuel Philibert, duke of Savoy, in 1559. Like her aunt and her niece she was a good scholar and strongly interested in men of letters. She is noteworthy as having given the chief impulse at the court of her brother Henry II. to the first efforts of the Pléiade (see RONSARD). and as having continued her patronage of literature at Turin. The poet Marc Antonio Flaminio, for instance, congratulates himself in pretty Latin verses on her singing his poems.

Her *Letters* have been published by A. G. Spinelli.

III. The third MARGUERITE (1553–1615), called more particularly Marguerite de Valois, was great-niece of the first and niece of the second, being daughter of Henry II. by Catherine de' Medici. She was born on the 14th of May 1553. When very young she became famous for her beauty, her learning, and the looseness of her conduct. She was married, after a liaison with the duke of Guise, to Henry of Navarre, afterwards Henry IV., on the eve of St Bartholomew's Day. Both husband and wife were extreme examples of the licentious manners of the time, but they not unfrequently lived together for considerable periods, and nearly always on good terms. Later, however, Marguerite was established in the castle of Usson in Auvergne, and after the accession of Henry the marriage was dissolved by the pope. But Henry and Marguerite still continued friends; she still bore the title of queen; she visited Marie de' Medici on equal terms; and the king frequently consulted her on important affairs, though his somewhat parsimonious spirit was grieved by her extravagance. Marguerite exhibited during the rest of her life, which was not a short one, the strange Valois mixture of licentiousness, pious exercises, and the cultivation of art and letters, and died in Paris on the 27th of March 1615. She left letters and memoirs the latter of which are admirably written, and rank among the best of the 16th century. She was the idol of Pierre de Bourdeille Brantôme, and is the "Reine Margot" of anecdotic history and romance.

The *Mémoires* are contained in the collection of Michaud and Poujoulat, and have been published separately by Guessard (the best, 1842), Lalanne, Caboche, &c. An English translation with introduction by Violet Fane appeared in 1892. Her character, and still more her circumstances, made the pen very unamiably busy with her in her lifetime, the chief of many lampoons being the famous *Divorce satirique*, variously attributed to Agrippa d'Aubigné, Palma Cayet, and others. The chief recent book on her is Saint Poucy's *Histoire de Marguerite de Valois* (1887).

(G. Sa.)

MARGUERITTE, PAUL (1860–) and **VICTOR** (1866–), French novelists, both born in Algeria, were the sons of General Jean Auguste Margueritte (1823–1870), who after an honourable career in Algeria was mortally wounded in the great cavalry charge at Sedan, and died in Belgium, on the 6th of September 1870. An account of his life was published by Paul Margueritte as *Mon père* (1884; enlarged ed., 1897). The names of the two brothers are generally associated, on account of their collaboration. Paul Margueritte, who has given a picture of his home in Algiers in *Le Jardin du passé* (1895), was sent to the military school of La Flèche for the sons of officers, and became in 1880 clerk to the minister of public instruction. He designed two pantomimes, *Pierrot assassin de sa femme* (Théâtre Libre, 1882), and *Colombine pardonnée* (Cercle funambulesque, 1888), in which the traditional Pierrot, played by Margueritte himself, became a nervous, tragic creature. He resigned his clerkship in 1889 to devote himself entirely to literature, producing in rapid succession a series of novels, among which were *Tous quatre* (1885), *La Confession posthume* (1886), *Maison ouverte* (1887), *Pascal Géfosse* (1887), *Jours d'épreuve* (1889), *Amants* (1890),*La Force des choses* (1891), *Sur le retour* (1892), *La Tourmente* (1893), *Ma grande* (1892), *Âme d'enfant* (1894) and *L'Eau qui dort* (1896). Paul Margueritte had begun as a realistic novelist, but he was one of the five writers who signed a manifesto against Zola's *La Terre*, and he made his reputation by delicate, sober studies of the by-ways of sentiment. His brother Victor entered his father's regiment, the 1st chasseurs d'Afrique, in 1888, and served in the army until 1896, when he resigned his commission. He was already known by some volumes of poetry, and by a translation from Calderon (*La Double méprise*, played at the Odéon, 1898) when he began to collaborate with his brother. From the time of this collaboration Paul Margueritte's work gained in colour and force.

Among the books written in common by the brothers, the most famous is the series known under the collective title, *Une Époque*, dealing with the events of 1870–1871, and including the novels *Le Désastre* (1898), *Les Tronçons du glaive* (1900), *Les Braves gens* (1901), *La Commune* (1904). They also collaborated in an *Histoire de la guerre de 1870–1871*(1903). These books were founded on a mass of documentary and verbal information, amassed with great care and arranged with admirable art; the authors are historians rather than novelists. The disasters and humiliations of the campaigns are faithfully described, but are traced to defects of organization and leadership; while the courage and patriotism of the army itself is made the basis of an assured confidence in the destinies of France. *La Commune* is a bold indictment of the methods adopted by the victorious party. The novelists also attacked the laws governing marriage and divorce and the abuses entailed by the dowry demanded from the bride, in pamphlets and in the novels, *Femmes nouvelles* (1899), *Les Deux vies* (1902), and *Le Prisme* (1905). Their literary partnership was dissolved in 1907. Paul Margueritte was one of the original members of the Académie de Goncourt.

See *P. et V. Margueritte* (1905) by E. Pilon, in the series of *Célébrités d'aujourd'hui*, and A. France, *La Vie littéraire* (4th series, 1892).

MARHEINEKE, PHILIP KONRAD (1780–1846), German Protestant divine, was born at Hildesheim, Hanover, on the 1st of May 1780. He studied at Göttingen, and in 1805 was appointed professor extraordinarius of philosophy at Erlangen; in 1807 he moved to Heidelberg. In 1811 he became professor ordinarius at Berlin, where from 1820 he was also preacher at Trinity Church and worked with Schleiermacher. When he died, on the 31st of May 1846, he was a member of the supreme consistorial council. At first influenced by Schelling, Marheineke found a new master in Hegel, and came to be regarded as the leader of the Hegelian Right. He sought to defend and explain all the orthodox doctrines of the Church in an orthodox way in the terms of Hegel's philosophy. The dogmatic system that resulted from this procedure was inevitably more Hegelian than Christian; it was in fact an essentially new form of Christianity. Marheineke's developed views on dogmatics are given in the third edition (1847) of his *Die Grundlehren der christlichen Dogmatik als Wissenschaft*. When he published the first edition (1819) he was still under the influence of Schelling; the second edition (1827) marked his change of view. His works on symbolics show profound scholarship, keen critical insight, and rare impartiality. The *Christliche Symbolik* (1810–1814) has been pronounced his masterpiece.

His other works include *Institutiones symbolicae* (1812; 3rd ed., 1830), *Geschichte der deutschen Reformation* (1816; 2nd ed., 1831–1834); *Die Reformation, ihre Entstehung und Verbreitung in Deutschland* (1846; 2nd ed., 1858), and the posthumous *Theol. Vorlesungen* (1847–1849).

See F. Lichtenberger, *History of German Theology* (1889); A. Weber, *Le Système dogmatique de Marheineke* (1857); and cf. O. Pfleiderer, *Development of Theology in Germany* (1890).

MARIANA, JUAN DE (1536–1624), Spanish historian, was born at Talavera. He studied at the university of Alcalá, and was admitted at the age of seventeen into the Society of Jesus. In 1561 he went to teach theology in Rome, reckoning among his pupils Robert Bellarmine, afterwards cardinal; then passed into Sicily; and in 1569 he was sent to Paris, where his expositions of the writings of Thomas Aquinas attracted large audiences. In 1574, owing to ill health, he obtained permission to return to Spain; the rest of his life being passed at the Jesuits' house in Toledo in vigorous literary activity. He died at Madrid, on the 17th of February 1624.

Mariana's great work, *Historiae de rebus Hispaniae*, first appeared in twenty books at Toledo in 1592; ten books were subsequently added (1605), bringing the work down to the accession of Charles V. in 1519, and in a still later abstract of events the author completed it to the accession of Philip IV. in 1621. It was so well received that Mariana was induced to translate it into Spanish (the first part in 1601; completed, 1609; Eng. trans., by J. Stevens, 1699). Mariana's *Historiae*, though in many parts uncritical, is justly esteemed for its research, accuracy, sagacity and style. Of his other works the most interesting is the treatise *De rege et regis institutione* (Toledo, 1598). In its sixth chapter the question whether it is lawful to overthrow a tyrant is freely discussed and answered in the affirmative, a circumstance which brought much odium upon the Jesuits, especially after the assassination of Henry IV. of France, in 1610. A volume entitled *Tractatus VII. theologici et historici* (published by Mariana at Cologne, in 1609, containing in particular a tract, "*De morte et immortalitate*," and another, "*De mutatione monetae*") was put upon the index expurgatorius, and led to the confinement of its author by the Inquisition. During his confinement there was found among his papers a criticism upon the Jesuits, which was printed after his death as *Discursus de erroribus qui in forma gubernationis societatis Jesu occurrunt* (Bordeaux, 1625), and was reprinted by order of Charles III. when he banished the Jesuits from Spain.

See L. von Ranke, *Zur Kritik neuerer Geschichtsschreiber* (Leipzig, 1874), and Cirot, *Études sur les historiographes espagnols; Mariana, historien* (Bordeaux, 1905).

MARIANAO, a city of the province of Havana, Cuba, 6 m. W. by S. of the city of Havana, with which it is connected by the Marianao railway. Pop. (1899), 5416; (1907), 9332. Marianao is on a range of hills about 1500 ft. above the sea, is noted for its salubrious climate, and is mainly a place of residence for the families of prosperous business men of Havana. On the neighbouring coast is Marianao Beach, a popular bathing resort. The city dates from about 1830.

MARIANAS, MARIANNES, or LADRONES (Ger. *Marianen*), an archipelago in the north-western Pacific Ocean, in about 12° to 21° N. and 145° E. With the exception of the island of Guam (United States) it belongs to Germany, and administratively forms part of the New Guinea protectorate. It consists of two groups—a northern of ten volcanic main islands, of which only four (Agrigan, Anatahan, Alamagan and Pagan) are inhabited; and a southern of five coralline limestone islands (Rota, Guam, Aguijan, Tinian and Saypan), all inhabited save Aguijan. In the volcanic group an extreme elevation of about 2700 ft. is reached, and there are craters showing signs of activity, while earthquakes are not uncommon. Coral reefs fringe the coasts of the southern isles, which are of slight elevation. The total area, excluding Guam, is about 245 sq. m. and the population 2500, mostly descendants of the Tagal immigrants from the Philippines. All the islands except Farallon de Medinilla and Urracas or Mangs (in the northern group) are more or less densely wooded, and the vegetation is luxuriant, much resembling that of the Carolines, and also of the Philippines, whence many species of plants have been introduced. Owing to the humidity of the soil cryptogams are numerous, as also most kinds of grasses. Coco-nut and areca palms, yams, sweet potatoes, manioc, coffee, cocoa, sugar, cotton, tobacco and mother-of-pearl are the chief products, and copra is the principal export. Agriculture is neglected, in spite of the exceptional advantages offered by the climate and soil. On most of the islands there is a plentiful supply of water. The native population known to the early Spanish colonists as Chamorros has died out as a distinct people, though their descendants have intermarried with the immigrant Tagals and natives of the Carolines. At the Spanish occupation in 1668 the Chamorros were estimated at 40,000 to 60,000, but less than a century later only 1800 remained. They were typical Micronesians, with a considerable civilization. In the island of Tinian are some remarkable remains attributed to them, consisting of two rows of massive square stone columns, about 5 ft. 4 in. broad and 14 ft. high, with heavy round capitals. According to early Spanish accounts cinerary urns were found imbedded in the capitals.

The fauna of the Marianas, though inferior in number and variety, is similar in character to that of the Carolines, and certain species are indigenous to both colonies. Swine and oxen run wild, and are hunted when required: the former were known to the earlier inhabitants; the latter with most other domestic animals were introduced by the Spaniards. The climate though damp is healthy, while the heat, being tempered by the trade winds, is milder than that of the Philippines; the variations of temperature are not great.

The discovery of this archipelago is due to Magellan, who on the 6th of March 1521 observed the two southernmost islands, and sailed between them (O. Peschel, *Geschichte des Zeitalters der Entdeckungen*, Stuttgart, 1877). The name *Islas de los Ladrones* (or "Islands of the Thieves") was given them by the ship's crew of Magellan on account of the thieving propensity of the inhabitants; and the islands are still commonly called the Ladrones. Magellan himself styled them *Islas de las Velas Latinas* ("Islands of the Lateen Sails"). San Lazarus archipelago, Jardines and Prazeres are among the names applied to them by later navigators. They received the name *Las Marianas* in 1668 in honour of Maria Anna of Austria, widow of Philip IV. of Spain. Research in the archipelago was carried out by Commodore Anson, who in August 1742 landed upon the island of Tinian (George, Lord Anson, *Voyage round the World*, bk. iii., 1748). The Ladrones were visited by Byron in 1765, Wallis in 1767 and Crozet in 1772. The entire archipelago (except Guam) together with the Caroline and Pelew Islands was sold by Spain to Germany for £837,500 in 1899.

See Anson, *op. cit.*; L. de Freycinet, *Voyage autour du monde* (Paris, 1826–1844); "The Marianas Islands" in *Nautical Magazine*, xxxiv., xxxv. (London, 1865–1866); O. Finsch, *Karolinen und Marianen* (Hamburg, 1900); Costenoble, "*Die Marianen*" in Globus, lxxxviii. (1905).

MARIANAS, or **Maranhas,** a tribe of South American Indians on the river Jutahy, north-western Brazil. They wear small pieces of wood in their ears and lips, but are not tattooed. Marianas are also found on the upper reaches of the Putumayo across to the Yapurá.

MARIANUS SCOTUS (1028–1082 or 1083), chronicler (who must be distinguished from his namesake Marianus Scotus, d. 1088, abbot of St Peter's, Regensburg), was an Irishman by birth, and called Moelbrigte, or servant of Bridget. He was educated by a certain Tigernach, and having become a monk he crossed over to the continent of Europe in 1056, and his subsequent life was passed in the abbeys of St Martin at Cologne and of Fulda, and at Mainz. He died at Mainz, on the 22nd of December 1082 or 1083.

Marianus wrote a *Chronicon*, which purports to be a universal history from the creation of the world to 1082. The *Chronicon* was very popular during the middle ages, and in England was extensively used by Florence of Worcester and other writers. It was first printed at Basel in 1559, and has been edited with an introduction by G. Waitz for the *Monumenta Germaniae historica. Scriptores* (Bd. v.). See also W. Wattenbach, *Deutschlands Geschichtsquellen* (Bd. ii., 1894).

MARIA STELLA, the self-styled legitimate daughter of Philip, duke of Orleans. According to her, Louis Philippe was not the son of Philip duke of Orleans, but a suppositious child, his father being one Lorenzo Chiappini, constable at the village of Modigliana in Tuscany. The story is that the duke and duchess of Orleans, travelling under the incognito of Comte and Comtesse de Joinville, were at this village in April 1773, when the duchess gave birth to a daughter; and that the duke, desiring a son in order to prevent the rich Penthièvre inheritance from reverting to his wife's relations in the event of her death, bribed the Chiappinis to substitute their newly-born male child for his own.

Maria Stella, the supposed daughter of Chiappini, went on the stage at Florence, where her putative parents had settled, and there at the age of thirteen became the wife of the first Lord Newborough, after whose death she married the Russian Count Ungern-Sternberg. On the death of her putative father in 1821 she received a letter, written by him shortly before his death, in which he confessed that she was not his daughter, adding "Heaven has repaired my fault, since you are in a better position than your real father, though he was of almost similar rank" (*i.e.* a French nobleman). Maria Stella henceforward devoted her time and fortune to establishing her identity. Her first success was the judgment of the episcopal court at Faenza, which in 1824 declared that the Comte Louis de Joinville exchanged his daughter for the son of Lorenzo Chiappini, and that the Demoiselle de Joinville had been baptized as Maria Stella, "with the false statement that she was the daughter of L. Chiappini and his wife." The discovery that Joinville was a countship of the Orleans family, and a real or fancied resemblance of Louis Philippe to Chiappini, convinced her that the duke of Orleans was the person for whose sake she had been cheated of her birthright, a conviction strengthened by the striking resemblance which many people discovered in her to the princesses of the Orleans family. In 1830 she published her proofs under the title *Maria Stella ou un échange d'une demoiselle du plus haut rang contre un garçon de plus vile condition* (reprinted 1839 and 1849). This coincided with the advent of Louis Philippe to the throne, and her claim became a weapon for those who wished to throw discredit and ridicule on the "bourgeois monarch." He for his part treated the whole thing with amused contempt, and Baroness Newborough-Sternburg de Joinville, or Marie Étoile d'Orléans, as she called herself, was suffered to live in Paris until on the 23rd of December 1843 she died in poverty and obscurity.

In spite of much discussion and investigation, the case of Maria Stella remains one of the unsolved problems of history. Sir Ralph Payne Gallwey's *Mystery of Maria Stella, Lady Newborough* (London, 1907), is founded on her own accounts and argues in favour of her point of view. More convincing, however, is Maurice Vitrac's *Philippe-Égalité et M. Chiappini* (Paris, 1907), which is based on unpublished material in the *Archives nationales*. M. Vitrac seeks to overthrow Maria Stella's case by an *alibi*. The duke and duchess of Chartres could not have been at Modigliana in April 1773, for the simple reason that they can be proved at that time to have been in Paris. On the 8th of April the duke, according to the official *Gazette de France*, took part in the Maundy Thursday ceremonies at Versailles; from the 7th to the 14th he was in constant attendance at the lodge of Freemasons of which he had just been elected grand master. Moreover, it was impossible for the first prince of the blood royal to leave France without the royal permission, and his absence would certainly have been remarked. Lastly, the duchess's accouchement, a semi-public function in the case of royal princesses, did not take place till the 6th of October. M. Vitrac identifies the real father of Maria Stella with Count Carlo Battaglini of Rimini, who died in 1796 without issue; the case being not one of substitution, but of ordinary "farming out" to avoid a scandal.

MARIA THERESA (1717–1780), archduchess of Austria, queen of Hungary and Bohemia, and wife of the Holy Roman emperor Francis I., was born at Vienna on the 13th of May 1717. She was the eldest daughter of the Emperor Charles VI. (*q.v.*) and his wife Elizabeth of Brunswick-Wolfenbüttel. On the 12th of February 1736 she was married to her cousin Francis of Lorraine (*q.v.*), then grand duke of Tuscany, and afterwards emperor. Five sons and eleven daughters were born of this marriage. From the date of her father's death on the 20th of October 1740, till her own death in 1780, Maria Theresa was one of the central figures in the wars and politics of Europe. But unlike some sovereigns, whose reigns have been agitated, but whose personal character has left little trace, Maria Theresa had a strong and in the main a noble individuality. Her great qualities were relieved by human traits which make her more sympathetic. It must be allowed that she was fairly open to the criticism implied in a husbandly jest attributed to Francis I. While they were returning from the opera house at Vienna she said to him that the singer they had just heard was the greatest actress who had ever lived, and he answered "Next to you, Madam." Maria Theresa had undoubtedly an instinctive histrionic sense of the perspective of the theatre, and could adopt the appropriate attitude and gesture, passionate, dignified or pathetic, required to impress those she wished to influence. But there was no affectation in her assumption of a becoming bearing or in her picturesque words. The common story, that she appeared before the Hungarian magnates in the diet at Pressburg in 1741 with her infant son, afterwards

Joseph II., in her arms, and so worked on their feelings that they shouted *Moriamur pro rege nostro Maria Theresia*, is only mythically true. But during the delicate negotiations which were required to secure the support of the Hungarian nobles she undoubtedly did appeal to them with passionate eloquence, and, we may believe, with a very pardonable sense of the advantage she obtained from her youth, her beauty and her sex. Her beauty, inherited from her mother, was of an open and noble German type. The official portrait by Muytens, engraved by Petit, gives a less convincing impression that an excellent chalk drawing of the head by Gabriel Mattei. In the conflict between her sense of what was morally just and her sense of duty to the state she laid herself open to the scoffing taunt of Frederick of Prussia, who said that in the first partition of Poland *elle pleurait et prenait toujours*. But the king of Prussia's taunt is deprived of its sting by the almost incredible candour of her own words to Kaunitz, that if she was to lose her reputation before God and man for respecting the rights of others it must not be for a small advantage—if, in fact, Austria was to share in the plunder of Poland, she was to be consoled for the distress caused to her feelings by the magnitude of her share of the booty. There was no hypocrisy in the tears of the empress. Her intellectual honesty was as perfect as Frederick's own, and she was as incapable as he was of endeavouring to blind herself to the quality of her own acts. No ruler was ever more loyal to a conception of duty. Maria Theresa considered herself first and foremost as the heiress of the rights of the house of Austria. Therefore, when her inheritance was assailed at the beginning of her reign, she fought for it with every weapon an honest woman could employ, and for years she cherished the hope of recovering the lost province of Silesia, conquered by Frederick. Her practical sense showed her the necessity of submitting to spoliation when she was overpowered. She accepted the peace of Berlin in 1742 in order to have a free hand against her Bavarian enemy, the emperor Charles VII. (*q.v.*). When Frederick renewed the war she accepted the struggle cheerfully, because she hoped to recover her own. Down to the peace of Aix-la-Chapelle in 1748 she went on fighting for Silesia or its equivalent. In the years following the peace she applied herself to finding allies in France and Russia who would help her to recover Silesia. Here, as later in the case of Poland, she subordinated her feelings to her duty to the state. Though she denied that she had ever written directly to Madame de Pompadour, it is certain that she allowed her ministers to make use of the favourite's influence over the French king. When fate decided against her in the Seven Years' War she bowed to the inevitable, and was thenceforward a resolute advocate of peace.

In her internal government she showed herself anxious to promote the prosperity of her people, and to give more unity to an administration made up by the juxtaposition of many states and races with different characters and constitutions. Her instincts, like those of her enemy Frederick and her son Joseph II., were emphatically absolutist. She suspended the meetings of the estates in most parts of her dominions. She was able to do so because the mass of her subjects found her hand much lighter than that of the privileged classes who composed these bodies. Education, trade, religious toleration, the emancipation of the agricultural population from feudal burdens—all had her approval up to a certain point. She would favour them, but on the distinct condition that nothing was to be done to weaken the bonds of authority. She took part in the suppression of the Jesuits, and she resisted the pope in the interest of the state. Her methods were those of her cautious younger son, Leopold II., and not of her eldest son and immediate successor, Joseph II. She did not give her consent even to the suppression of torture in legal procedure without hesitation, lest the authority of the law should be weakened. Her caution had its reward, for whatever she did was permanently gained, whereas her successor in his boundless zeal for reform brought his empire to the verge of a general rebellion.

In her private life Maria Theresa was equally the servant of the state and the sovereign of all about her. She was an affectionate wife to her husband Francis I.; but she was always the queen of Hungary and Bohemia and archduchess of Austria, like her ancestress, Isabella the Catholic, who never forgot, nor allowed her husband to forget, that she was "proprietary queen" of Castile and Leon. She married her daughters in the interest of Austria, and taught them *not* to forget their people and their father's house. In the case of Marie Antoinette (*q.v.*), who married the dauphin, afterwards Louis XVI., she gave an extraordinary proof of her readiness to subordinate everything to the reason of state. She instructed her daughter to show a proper respect to her husband's grandfather, Louis XV., by behaving with politeness to his mistresses, in order that the alliance between the two courts might run no risk. The signing of the peace of Teschen, which averted a great war with Prussia, on the 13th of May 1779, was the last great act of her reign, and so Maria Theresa judged it to be in a letter to Prince Kaunitz; she said that she had now finished her life's journey and could sing a *Te Deum*, for she had secured the repose of her people at whatever cost to herself. The rest, she said, would not last long. Her fatal illness developed in the autumn of the following year, and she died on the 28th of November 1780. When she lay painfully on her deathbed her son Joseph said to her, "You are not at ease," and her last words were the answer, "I am sufficiently at my ease to die."

See A. von Arneth, *Geschichte Maria Theresas* (Vienna, 1863–1879) and J. F. Bright, *Maria Theresa* (London, 1897); also the article AUSTRIA.

MARIAZELL, a village of Austria, in Styria, 89 m. N. of Graz. Pop. (1900), 1499. It is picturesquely situated in the valley of the Salza, amid the north Styrian Alps. Its entire claim to notice lies in the fact that it is the most frequented sanctuary in Austria, being visited annually by about 200,000 pilgrims. The object of veneration is a miracle-working image of the Virgin, carved in lime-tree wood, and about 18 in. high. This was presented to the place in 1157, and is now enshrined in a chapel lavishly adorned with objects of silver and other costly materials. The large church of which the chapel forms part was erected in 1644 as an expansion of a smaller church built by Louis I., king of Hungary, after a victory over the Turks in 1363. In the vicinity of Mariazell is the pretty Alpine lake of Erlafsee.

See M. M. Rabenlehrer, *Mariazell, Österreichs Loreto* (Vienna, 1891); and O. Eigner, *Geschichte des aufgeshobenen Benedictinerstiftes Mariazell* (Vienna, 1900).

MARIE AMÉLIE THÉRÈSE (1782–1866), queen of Louis Philippe, king of the French, was the daughter of Ferdinand IV., king of Naples, and the archduchess Maria Carolina, daughter of the empress Maria Theresa, and belonged to the house of Bourbon. She was born at Caserta, on the 26th of April 1782, and received a careful education which developed the naturally pious and honourable disposition that earned for her in the family circle the nickname of La Santa. Driven from Naples in 1798, the Neapolitan royal family fled to Palermo, and the years from 1800 to 1802 were spent by Marie Amélie with her mother at the Austrian court. In 1806 they were again in flight before the armies of Masséna, and it was during the second residence of her father's court at Palermo that she met the exiled Louis Philippe, then duke of Orleans, whom she married in November 1809. Returning to France in 1814, the duke and duchess of Orleans had barely established themselves in the Palais Royal in Paris when the Hundred Days drove them into exile. Marie Amélie took refuge with her four children in England, where she spent two years at Orleans House, Twickenham. Again in France in 1817, her life at Neuilly until 1828 was the happiest period of her existence. Neither then nor at any other time did she take any active share in politics; but she was not without indirect influence on affairs, because her strong royalist and legitimist traditions prevented the court from including her in the suspicion with which her husband's liberal views were regarded. Her attention was absorbed by the care and education of her numerous family, even after the revolution of 1830 had made her queen of the French, a position accepted by her with forebodings of disaster justified by her early experience of revolutions. During her second exile, from 1848 to the end of her life, she lived at Claremont, where her charity and piety endeared her to the many English friends of the Orleans family. Marie Amélie died at Claremont, on the 24th of March 1866.

See A. Trognon, *Vie de Marie Amélie* (1872); A. L. Baron Imbert de St Amand, *La Jeunesse de Marie Amélie* (1891), *Marie Amélie au Palais Royal* (1892), *Marie Amélie et la cour de Palerme* (1891), *Marie Amélie et la cour des Tuileries* (1892), *Marie Amélie et l'apogée de règne de Louis Philippe* (1893), *Marie Amélie et la société française en 1847* (1894), and *Marie Amélie et la duchesse d'Orleans* (1893).

MARIE ANTOINETTE (1755–1793), queen of France, ninth child of Maria Theresa and the emperor Francis I., was born at Vienna, on the 2nd of November 1755. She was brought up under a simple and austere régime and educated with a view to the French marriage arranged by Maria Theresa, the abbé Vermond being appointed as her tutor in 1769. Her marriage with the dauphin, which took place at Versailles on the 16th of May 1770, was intended to crown the policy of Choiseul and confirm the alliance between Austria and France. This fact, combined with her youth and the extreme corruption of the French court, made her position very difficult. Madame du Barry, whose influence over Louis XV. was at that time supreme, formed the centre of a powerful anti-Choiseul cabal, which succeeded in less than a year after the dauphin's marriage in bringing about the fall of Choiseul and seriously threatening the stability of the Austrian alliance. Thus the young princess was surrounded by enemies both at court and in the dauphin's household, and came to rely almost entirely upon the Austrian ambassador, the comte de Mercy-Argenteau, whom Maria Theresa had instructed to act as her mentor, at the same time arranging that she herself should be kept informed of all that concerned her daughter, so that she might at once advise her and safeguard the alliance. Hence arose the famous secret correspondence of Mercy-Argenteau, an invaluable record of all the details of Marie Antoinette's life from her marriage in 1770 till the death of Maria Theresa in 1780.

Marie Antoinette soon won the affection and confidence of the dauphin and endeared herself to the king, but her position was precarious, and both Mercy and Maria Theresa had continually to urge her to conquer her violent dislike for the favourite and try to conciliate her.

The accession of the young king and queen on the death of Louis XV. (May 10, 1774), was hailed with great popular enthusiasm. But her first steps brought Marie Antoinette into open hostility with the anti-Austrian party. She was urgent in obtaining the dismissal of d'Aiguillon, and did all in her power to secure the recall of Choiseul, though without success. Thus from the very first she appeared in the light of a partisan, having against her all the enemies of Choiseul and of the Austrian alliance, and was already given the nickname of "l'autrichienne" by mesdames the king's aunts. At the same time her undisguised impatience of the cumbrous court etiquette shocked many people, and her taste for pleasure led her to seek the society of the comte d'Artois and his young and dissolute circle. But the greatest weakness in her position lay in her unsatisfactory relations with her husband. The king, though affectionate, was cold and apathetic, and it was not till seven years after her marriage that there was any possibility of her bearing him an heir. This fact naturally decreased her popularity, and as early as September 1774, was made the subject of offensive pamphlets and the like, as in the case of the *affaire Beaumarchais*. (See BEAUMARCHAIS.)

The end of the period of mourning for the late king was the signal for a succession of gaieties, during which the queen displayed a passion for amusement and excitement which led to unfortunate results. Being childless, and with a husband who could not command her respect, her longing for affection led her to form various intimate friendships, above all with the princesse de Lamballe and the comtesse Jules de Polignac, who soon obtained such an empire over her affections that no favour was too great for them to ask, and often to obtain. Thus for the benefit of Madame de Lamballe the queen revived the superfluous and expensive office of superintendent of her household, which led to constant disagreements and jealousies among her ladies and offended many important families. In frequenting the salons of her friends the queen not only came in contact with a number of the younger and more dissipated courtiers, whose high play and unseemly amusements she countenanced, but she fell under the influence of various ambitious intriguers, such as the baron de Bésenval, the comte de Vaudreuil, the duc de Lauzun and the comte d'Adhémar, whose interested manœuvres she was induced to further by her affection for her favourites. Thus she was often led to interfere for frivolous reasons in public affairs, sometimes with serious results, as in the case of the trial of the comte de Guines (1776), when her interference was responsible for the fall of Turgot. At the same time her extravagance in dress, jewelry and amusements (including the gardens and theatricals at Trianon, of the cost of which such exaggerated reports were spread about) and her presence at horse-races and masked balls in Paris without the king, gave rise to great scandal, which was seized upon by her enemies, among whom were Mesdames, the count of Provence, and the duke of Orleans and the Palais Royal clique.

At this critical period her brother, the emperor Joseph II., decided to visit France. As the result of his visit he left with the queen a memorandum in which he pointed out to her in plain terms the dangers of her conduct.[1] He also took advantage of his visit to advise the king, with such success that at last, in 1778, the queen had the hope of becoming a mother. For a time the emperor's remonstrances had some effect, and after the birth of her daughter, Marie Thérèse Charlotte (afterwards duchesse d'Angoulême) in December 1778, the queen lived a more quiet life. The death of Maria Theresa (Nov. 29, 1780) deprived her of a wise and devoted friend, and by removing all restraint on the rashness of Joseph II. was bound to increase the dislike of the Austrian alliance and cause embarrassment to Marie Antoinette. Her position was very much strengthened by the birth (Oct. 22, 1781) of a dauphin, Louis Joseph Xavier François, and on the death of Maurepas, which left the king without a chief minister, she might have exerted a considerable influence in public affairs had she taken a consistent interest in them; but her repugnance to serious matters triumphed, and she preferred to occupy herself with the education of her children, to whom she was a wise and devoted mother,[2] and with her friends and amusements at Trianon. Personal motives alone would lead her to interfere in public affairs, especially when it was a question of obtaining places or favours for her favourites and their friends. The influence of the Polignacs was now at its height, and they obtained large sums of money, a dukedom, and many nominations to places. It was Madame de Polignac who obtained the appointment of Calonne as controller-general of the finances,[3] and who succeeded Madame de Guéménée as "governess of the children of France" after the bankruptcy of the prince de Guéménée in 1782.[4] Again, in response to Mercy and Joseph II.'s urgent representations, Marie Antoinette exerted herself on behalf of Austria in the affairs of the opening of the Scheldt (1783–1784) and the exchange of Bavaria (1785), in which, though she failed to provoke active interference on the part of France, she succeeded in obtaining the payment of considerable indemnities to Austria, a fact which led to the popular legend of her having sent millions to Austria, and aroused much indignation against her. Later, on the recommendation of Mercy and Vermond, she supported the nomination of Loménie de Brienne in 1787, an appointment which, though widely approved at the time, was laid to the queen's blame when it ended in failure.

Two more children were born to her; Louis Charles, duke of Normandy, afterwards dauphin, on the 27th of March 1785, and Sophie Hélène Beatrix (d. June 19, 1787), on the 9th of July 1786. In 1785–1786 the affair of the Diamond Necklace (*q.v.*)

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[1] See Arneth, *Marie Antoinette, Joseph II. and Leopold II.*, pp. 1–18.

[2] v. the *Instructions données à la marquise de Tourzel*, governess of the children of France, dated the 24th of July, 1789, in la Rocheterie and Beaucourt, *Lettres de Marie Antoinette*, ii. 131.

[3] But see Arneth and Flammermont, i. 228, foot-note.

[4] This had reflected discredit on the queen, Madame de Guéménée having been one of her intimate friends.

revealed the depth of the hatred which her own follies and the calumnies of her enemies had aroused against her. The public held her responsible for the bankrupt state of the country; and though in 1788, following the popular outcry, she prevailed upon the king to recall Necker, it was impossible for him to avert the Revolution. The year 1789 was one of disaster for Marie Antoinette; on the 10th of March her brother Joseph II. died, and on the 4th of June her eldest son. The same year saw the assembling of the States-general, which she had dreaded, the taking of the Bastille, and the events leading to the terrible days of the 5th and 6th of October at Versailles and the removal of the royal family to the Tuileries. Then began the negotiations with Mirabeau, whose high estimate of the queen is well-known (*e.g.* his famous remark, "The king has only one man on his side, and that is his wife"). But the queen was violently prejudiced against him, believing him among other things to be responsible for the events of the 5th and 6th of October, and he never gained her full confidence. She was naturally incapable of seeing the full import of the Revolution, and merely temporised with Mirabeau. She dreaded the thought of civil war; and even when she had realized the necessity for decisive action the king's apathy and indecision made it impossible for her to persuade him to carry into effect Mirabeau's plan of leaving Paris and appealing to the provinces. Her difficulties were increased by the departure of Mercy for the Hague in September 1790, for Montmorin who now took his place in the negotiations had not her confidence to the same extent. Feeling herself helpless and almost isolated in Paris, she now relied chiefly on her friends outside France—Mercy, Count Axel Fersen, and the baron de Breteuil; and it was by their help and that of Bouillé that after the death of Mirabeau, on the 8th of April 1791, the plan was arranged of escaping to Montmédy, which ended in the flight to Varennes (June 21, 1791).

After the return from Varennes the royal family were closely guarded, but in spite of this they still found channels of communication with the outside world. The king being sunk in apathy, the task of negotiation devolved upon the queen; but in her inexperience and ignorance of affairs, and the uncertainty of information from abroad, it was hard for her to follow any clear policy. Her courageous bearing during the return from Varennes had greatly impressed Barnave, and he now approached her on behalf of the Feuillants and the constitutional party. For about a year she continued to negotiate with them, forwarding to Mercy and the emperor Leopold II. letters and memoranda dictated by them, while at the same time secretly warning her friends not to accept these letters as her own opinions, but to realize that she was dependent on the Constitutionals.[1] She agreed with their plan of an armed congress, and on this idea both she and Fersen insisted with all their might, Fersen leaving Brussels and going on a mission to the emperor to try and gain support and checkmate the *émigrés*, whose desertion the queen bitterly resented, and whose rashness threatened to frustrate her plans and endanger the lives of her family.

As to the acceptance of the constitution (Sept. 1791), "tissue of absurdities" though the queen thought it, and much as she would have preferred a bolder course, she considered that in the circumstances the king was bound to accept it in order to inspire confidence.[2] Mercy was also in correspondence with the Constitutionals, and in letter after letter to him and the emperor, the queen, strongly supported by Fersen, insisted that the congress should be formed as soon as possible, her appeals increasing in urgency as she saw that Barnave's party would soon be powerless against the extremists. But owing to the lengthy negotiations of the powers the congress was continually postponed. On the 1st of March 1792 Leopold II. died, and was succeeded by the young Francis II. Marie Antoinette's actions were now directed entirely by Fersen, for she suspected Mercy and the emperor of sacrificing her to the interests of Austria (*Fersen*, i. 251; Arneth, pp. 254, 256, &c.). The declaration of war which the king was forced to make (April 20) threw her definitely into opposition to the Revolution, and she betrayed to Mercy and Fersen the plans of the French generals (Arneth, p. 259; *Fersen*, ii. 220, 289, 308, 325, 327). She was now certain that the life of the king was threatened, and the events of the 20th of June added to her terrors. She considered their only hope to lie in the intervention of the powers and in the appeal to force, and endorsed the suggestion of a threatening manifesto[3] which should hold the National Assembly and Paris responsible for the safety of the king and royal family. Immediately after Brunswick's manifesto followed the storming of the Tuileries and the removal of the royal family to the Temple (Aug. 10). During all these events and the captivity in the Temple Marie Antoinette showed an unvarying courage and dignity, in spite of her failing health and the illness of her son. After the execution of the king (Jan. 17, 1793) several unsuccessful attempts were made by her friends to rescue her and her children, among others by Jarjayes, Toulan and Lepître, and the "baron de Batz," and negotiations for her release or exchange were even opened with Danton; but as the allied armies approached her trial and condemnation became a certainty. She had already been separated from her son, the sight of whose ill-treatment added terribly to her sufferings; she was now parted from her daughter and Madame Elizabeth, and removed on the 1st of August 1793 to the Conciergerie. Even here, where she was under the closest guard and subjected to the most offensive espionnage, attempts were made to rescue her, among others Michonis' "Conspiration de l'oeillet."

On the 14th of October began her trial, her defence being entrusted to Chauveau-Lagarde and Tronson-Ducourdray. Her noble attitude, even in the face of the atrocious accusations of Fouquier-Tinville, commanded the admiration even of her enemies, and her answers during her long examination were clear and skilful. The following were the questions finally put to the jury:—

(1) Is it established that manœuvres and communications have existed with foreign powers and other external enemies of the republic, the said manœuvres, &c., tending to furnish them with assistance in money, give them an entry into French territory, and facilitate the progress of their armies?

(2) Is Marie Antoinette of Austria, the widow Capet, convicted of having co-operated in these manœuvres and maintained these communications?

(3) Is it established that a plot and conspiracy has existed tending to kindle civil war within the republic, by arming the citizens against one another?

(4) Is Marie Antoinette, the widow Capet, convicted of having participated in this plot and conspiracy?

The jury decided unanimously in the affirmative, and on the 16th of October 1793 Marie Antoinette was led to the guillotine, leaving behind her a touching letter to Madame Elizabeth, known as her "Testament."

As to the justice of these charges, we have seen how the queen was actually guilty of betraying her country, though it was only natural for her to identify the cause of the monarchy with that of France. To civil war she was consistently opposed, and never ceased to dissociate herself from the plans of the *émigrés*, but here again her very position made her an enemy of the republic. In any case, all her actions had as their aim—firstly, the safeguarding of the monarchy and the king's position, and later, when she saw this to be impossible, that of securing the safety of her husband and her son.

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[1] Letters of 31st July 1791 to Mercy. Arneth, p. 193 and 194, and letter of 1st August.

[2] Arneth, pp. 196, 203; Klinckowström, *Fersen*, i. 192.

[3] H. Belloc, *Marie-Antoinette*, pp. 311–312, states that clause VIII. of Brunswick's manifesto was "drafted" by Marie Antoinette, *i.e.* that the idea of holding Paris responsible for the safety of the royal family was first suggested by her. He bases this statement entirely upon the queen's letters of July 3rd to Fersen, of July 4th to Mercy, the reception of which Fersen notes in his Journal on July 8th and 9th (Fersen ii. 21). But these letters were obviously the answer to Fersen's letter of June 30th to the queen (Fersen ii. 315), in which he tells her the terms of the manifesto. Moreover, the suggestion of holding the Assembly responsible is to be found as early as in the memo. of the Constitutionals of September the 8th, 1791, and is included in the Instructions of Mallet du Pan (Mems. ed. Sayous, i. 281, and appendix 445). Fersen (*Fersen* ii. 329, 337, 18th July and 28th July to the queen, and p. 338, 29th July to Taube) states that it was he who drew up the manifesto by means of the marquis de Limon.

For a bibliographical study see: M. Tourneux, *Marie Antoinette devant l'histoire. Essai bibliographique* (2nd ed., Paris, 1901); id. *Bibliogr. de la ville de Paris* . . . (vol. iv. 1906), nos. 20980–21338; also *Bibliogr. de femmes célèbres* (Turin and Paris, 1892, &c.). The most important material for her life is to be found in her letters and in the correspondence of Mercy-Argenteau, but a large number of forgeries have found their way into certain of the collections, such as those of Paul Vogt d'Hunolstein (*Correspondance inédite de Marie Antoinette*, (3rd ed., Paris, 1864), and F. Feuillet des Conches *Louis XVI., Marie Antoinette et Madame Élisabeth, lettres et documents inédits* (6 vols., Paris, 1864–1873), while most of the works on Marie Antoinette published before the appearance of Arneth's publications (1865, &c.) are based partly on these forgeries. For a detailed examination of the question of the authenticity of the letters see the introduction to *Lettres de Marie Antoinette. Recueil des lettres authentiques de la reine, publié pour la société d'histoire contemporaine, par M. de la Rocheterie et le marquis de Beaucourt* (2 vols., Paris, 1895–1896); also A. Geffroy, *Gustave III. et la cour de France* (2 vols., Paris, 1869), vol. ii., appendix. Of the highest importance are the letters from the archives of Vienna published by Alfred von Arneth and others: A. von Arneth, *Maria Theresia und Marie Antoinette, ihr Briefwechsel* 1770–1780 (Paris and Vienna, 1865); id., *Marie Antoinette, Joseph II. und Leopold II. ihr Briefwechsel* (Leipzig, Paris and Vienna, 1866); id. and A. Geffroy, *Correspondance secrète de Marie-Thérèse et du comte de Mercy-Argenteau* (3 vols., Paris, 1874); id. and J. Flammermont, *Correspondance secrète du comte de Mercy-Argenteau avec Joseph II. et le prince de Kaunitz* (2 vols., Paris, 1889–1891); for further letters see Comte de Reiset, *Lettres de la reine Marie Antoinette à la landgrave Louise de Hesse-Darmstadt* (1865); id. *Lettres inédites de Marie Antoinette et de Marie-Clotilde, reine de Sardaigne* (1877). See also *Correspondance entre le comte de Mirabeau et le comte de la Marck, 1789–1791, recueillie . . . par F. de Bacourt* (3 vols., Paris, 1857), and Baron R. M. de Klinckowström, *Le Comte de Fersen et la cour de France* (2 vols., Paris, 1877–1878). *Memoirs*: See most contemporary memoirs, *e.g.* those of the prince de Ligne, Choiseul, Ségur, Bouillé, Dumouriez, &c. Some, such as those of Madame Campan, Weber, Cléry, Mme de Tourzel, are prejudiced in her favour; others, such as those of Besenval, Lauzun, Soulavie, are equally prejudiced against her. M. Tourneux (*op. cit.*) discusses the authenticity of the memoirs of Tilly, Cléry, Lauzun, &c. The chief of these memoirs are: Mme Campan, *Mémoires sur la vie privée de Marie Antoinette* (5th ed., 2 vols., Paris, 1823, Eng. trans. 1887), the inaccuracy of which is clearly demonstrated by J. Flammermont in *Études critiques sur les sources de l'histoire du xviii^e siècle: Les Mémoires de Mme Campan*, in the *Bulletin de la Faculté des lettres de Poitiers* (4th year, 1886, pp. 56, 109); J. Weber, *Mémoires concernant Marie Antoinette* (3 vols., London, 1804–1809; Eng. trans., 3 vols., London, 1805–1806); *Mémoires de M. le baron de Besenval* (3 vols., Paris, 1805); *Mémoires de M. le duc de Lauzun* (2nd ed., 2 vols., Paris, 1822); E. Bavoux, *Méms. secrets de J. M. Augeard, secrétaire des commandements de la reine M. Antoinette* (Paris, 1866); Mme Vigée-Le-Brun, *Mes souvenirs* (2 vols., Paris, 1867); *Mémoires de Mme la duchesse de Tourzel*, ed. by the duc de Cars (2 vols., Paris, 1883); *Mémoires de la baronne d'Oberkirch* (2 vols., Paris, 1853).

GENERAL WORKS:—See the general works on the period and on Louis XVI., and bibliographies to articles LOUIS XVI. and FRENCH REVOLUTION. A. Sorel, *L'Europe et la Rév. fr.* (ii. *passim*) contains a good estimate of Marie Antoinette. See also E. and J. de Goncourt, *Histoire de Marie Antoinette* (Paris, 1859); P. de Nolhac, *Marie Antoinette, dauphine* (Paris, 1897); id. *La Reine Marie Antoinette* (8th ed., 1898), which gives good descriptions of Versailles, Trianon, &c.; M. de la Rocheterie, *Histoire de Marie Antoinette* (2 vols., Paris, 1890); A. L. Bicknell, *The Story of Marie Antoinette*; R. Prölss, *Königin Marie Antoinette, Bilder aus ihrem Leben* (Leipzig, 1894); G. Desjardins, *Le Petit-Trianon* (Versailles, 1885). For her trial and death, see E. Campardon, *Marie Antoinette à la Conciergerie* (1863). H. Belloc's *Marie Antoinette* (London, 1909) is very biassed and sometimes misleading. (C. B. P.)

MARIE DE FRANCE (*fl. c.* 1175–1190), French poet and fabulist. In the introduction (*c.* 1240) to his *Vie Seint Edmund le Rey*[1] Denis Pyramus says she was one of the most popular of authors with counts, barons and knights, but especially with ladies. She is also mentioned by the anonymous author of the *Couronnement Renart*. Her lays were translated into Norwegian[2] by order of Haakon IV.; and Thomas Chestre, who is generally supposed to have lived in the reign of Henry VI., gave a version of *Lanval*.[3] Very little is known about her history, and until comparatively recently the very century in which she lived remained a matter of dispute. In spite of her own statement in the epilogue to her fables: "Marie ai num, si suis de France," generally interpreted to mean that Marie was a native of the Île de France, she seems to have been of Norman origin, and certainly spent most of her life in England. Her language, however, shows little trace of Anglo-Norman provincialism. Like Wace, she used a literary dialect which probably differed very widely from common Norman speech. The manuscripts in which Marie's poems are preserved date from the late 13th or even the 14th century, but the language fixes the date of the poems in the second half of the 12th century. The *Lais* are dedicated to an unknown king, who is identified as Henry II. of England; and the fables, her *Ysopet*, were written according to the *Epilogus* for a Count William, generally recognized to be William Longsword, earl of Salisbury. The author of *Couronnement Renart*, says that Marie had dedicated her poem to the count William to whom the unknown poet addresses himself. This is William of Dampierre (d. 1251), the husband of the countess Margaret of Flanders, and his identification with Marie's count William is almost certainly an error. Marie lived and wrote at the court of Henry II., which was very literary and purely French. Queen Eleanor was a Provençal, and belonged to a family in which the patronage of poetry was a tradition. There is no evidence to show whether Marie was of noble origin or simply pursued the profession of a *trouvère* for her living.

The origin of the *lais* has been the subject of much discussion. Marie herself says that she had heard them sung by Breton minstrels. It seems probable that it is the lesser or French Brittany from which the stories were derived, though something may be due to Welsh and Cornish sources. Gaston Paris (*Romania*, vol. xv.) maintained that Marie had heard the stories from English minstrels, who had assimilated the Celtic legends. In any case the Breton lays offer abundant evidence of traditions from Scandinavian and Oriental sources. The *Guigemar* of Marie de France presents marked analogies with the ordinary Oriental romance of escape from a harem, for instance, with details superadded from classical mythology. Marie seems to have contented herself with giving new literary form to the stories she heard by turning them into Norman octosyllabic verse, and apparently made few radical changes from her originals. Joseph Bédier thinks that the lays of the Breton minstrels were prose recitals interspersed with short lyrics something after the manner of the cante-fable of *Aucassin et Nicolette*. Marie's task was to give these cante-fables a narrative form destined to be read rather than sung or recited.

The *Lais* which may be definitely attributed to Marie are: *Guigemar*, *Equitan*, *Le Frêne*, *Le Bisclavret* (the werewolf), *Les Deux amants*, *Laustic*, *Chaitivel*, *Lanval*, *Le Chèvrefeuille*, *Milon*, *Yonec* and *Eliduc*. The other similar lays are anonymous except the *Lai d'Ignaure* by Renant and the *Lai du cor* of Robert Biket, two authors otherwise unknown. They vary in length from some twelve thousand lines to about a hundred. *Le Chèvrefeuille*, a short episode of the Tristan story, telling how Tristan makes known his presence in the wood to Iseult, is the best known of them all. Laustic[4] (*Le Rossignol*) is almost as short and simple. In *Yonec* a mysterious bird visits the lady kept in durance by an old husband, and is turned into a valiant knight. The lover is killed by the husband, but in due time is avenged by his son. The scene of the story is partly laid in Chester, but the fable in slightly different forms occurs in the folk-lore of many countries.[5] *Lanval*[6] is a fairy story, and the hero vanishes eventually with his fairy princess to the island of Avallon or Avilion. *Eliduc* is more elaborately planned than any of these, and the action is divided between Exeter and Brittany. Here again the story of the man with two brides is not new, but the three characters of the story are so dealt with that each wins the reader's sympathy. The resignation of the wife of Eliduc and her reception of the new bride find a parallel in another of the lays,

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[1] Cotton MS. Domit. A xi. (British Museum), edited for the Rolls Series by Thomas Arnold in 1892.

[2] Edited by R. Keyser and C. R. Unger as *Strengleikar eða Lioðabok* (Christiania, 1850).

[3] Chestre's *Sir Launfal* was printed by J. Ritson in *Ancient English Metrical Romances* (1802); and by L. Erling (Kempten, 1883).

[4] The *soi-disant* Breton folk-song "Ann Eostik" on the same subject translated by La Villemarque in his *Barzaz-Breiz* (1840) is rejected by competent authorities. Similar stories in which the nightingale is slain by an angry husband occur in *Renard contrefait* and in the *Gesta Romanorum*.

[5] Cf. the *Oiseau bleu* of Mme d'Aulnoy.

[6] Sir Lambewell in Bishop Percy's Folio MS. (ed. Hales and Furnivall, vol. ii., 1867), is another version of *Lanval*, and differs from Chestre's. For the relations between *Lanval* and the *Lai de Graelent*, wrongly ascribed to Marie by Roquefort, see W. H. Schofield, "The Lays of Graelent and Lanval, and the story of Wayland," in the *Publications* of the Mod. Lang. Assoc. of America, vol. xv. (Baltimore, 1900).

Le Frêne. The story is in both cases more human and less repugnant than the, in some respects, similar story of Griselda.

Marie's *Ysopet* is translated from an English original which she erroneously attributed to Alfred the Great, who had, she said, translated it from the Latin. The collection includes many fables that have come down from Phaedrus, some Oriental stories derived from Jewish sources, with many popular apologues that belong to the Renard cycle, and differ from those of older origin in that they are intended to amuse rather than to instruct. Marie describes the misery of the poor under the feudal régime, but she preaches resignation rather than revolt. The popularity of this collection is attested by the twenty-three MSS. of it that have been preserved.

Another poem attributed to Marie de France is *L'Espurgatoire Seint Patriz*, a translation from the *Tractatus de purgatorio S. Patricii* (*c.* 1185) of Henri de Salterey, which brings her activity down almost to the close of the century.

See *Die Fabeln der Marie de France* (1898), edited by Karl Warnke with the help of materials left by Eduard Mall; and *Die Lais der Marie de France* (2nd ed., 1900), edited by Karl Warnke, with comparative notes by Reinhold Köhler; the two works being vols. vi. and iii. of the *Bibliotheca Normannica* of Hermann Suchier; also an extremely interesting article by Joseph Bédier in the *Revue des deux mondes* (Oct. 1891); another by Alice Kemp-Welch in the *Nineteenth Century* (Dec. 1907). For an analysis of the *Lais* see *Revue de philologie française*, viii. 161 seq.; Karl Warnke, *Die Quellen der Esope der Marie de France* (1900). The *Lais* were first published in 1819 by B. de Roquefort. *L'Espurgatoire Seint Patriz* was edited by T. A. Jenkins (Philadelphia, 1894). Some of the *Lays* were paraphrased by Arthur O'Shaughnessy in his *Lays of France* (1872).

MARIE DE' MEDICI (1573–1642), queen consort and queen regent of France, daughter of Francis de' Medici, grand duke of Tuscany, and Joanna, an Austrian archduchess, was born in Florence on the 26th of April 1573. After Joanna's death in 1578 duke Francis married the notorious Bianca Capello, and the grand-ducal children were brought up away from their father at the Pitti Palace in Florence, where after the death of her brother and sister and the marriage of her elder sister Eleonora, duchess of Mantua, a companion was chosen for Marie, this being Leonora Dori, afterwards known as Leonora Galigaï. She received a good education in company with her half-brother Antonio. After many projects of marriage for Marie had failed Henry IV. of France, who was under great monetary obligations to the house of Medici, offered himself as a suitor although his marriage with Marguerite de Valois was not yet dissolved; but the marriage was not celebrated until October 1600. Her eldest son, the future Louis XIII., was born at Fontainebleau in September of the next year; the other children who survived were Gaston duke of Orleans; Elizabeth queen of Spain; Christine duchess of Savoy; and Henrietta Maria queen of England. During her husband's lifetime Marie de' Medici showed little sign of political taste or ability; but after his murder in 1610 when she became regent, she devoted herself to affairs with unfailing regularity and developed an inherited passion for power. She gave her confidence chiefly to Concini, the husband of Leonora Galigaï, who squandered the public money and secured a series of important charges with the title of Maréchal d'Ancre. Under the regent's lax and capricious rule the princes of the blood and the great nobles of the kingdom revolted; and the queen, too weak to assert her authority, consented at Sainte Menehould (May 15, 1614) to buy off the discontented princes. In 1616 her policy was strengthened by the accession to her councils of Richelieu, who had come to the front at the meeting of the states general in 1614; but Louis XIII., who was now sixteen years old, was determined to throw off the tutelage of his mother and Concini. By his orders Concini was murdered, Leonora Galigaï was tried for sorcery and beheaded, Richelieu was banished to his bishopric, and the queen was exiled to Blois. After two years of virtual imprisonment she escaped in 1619 and became the centre of a new revolt. Louis XIII. easily dispersed the rebels, but through the mediation of Richelieu was reconciled with his mother, who was allowed to hold a small court at Angers, and resumed her place in the royal council in 1621. But differences between her and the cardinal rapidly arose, and the queen mother intrigued to drive Richelieu again from court. For a single day the *journée des dupes*, the 12th of November 1630, she seemed to have succeeded; but the triumph of Richelieu was followed by her exile to Compiègne, whence she escaped in 1631 to Brussels. From that time till her death at Cologne on the 3rd of July 1642 she intrigued in vain against the cardinal.

Among contemporary authorities for the history of Marie de' Medici, see Mathieu de Morgues, *Deux faces de la vie et de la mort de Marie de Médicis* (Antwerp, 1643); J. B. Matthieu, *Éloge historial de Marie de Médicis* (Paris, 1626); Florentin du Ruau, *Le Tableau de la régence de Marie de Médicis* (Poitiers, 1615); F. E. Mézeray, *Histoire de la mère et du fils, ou de Marie de Médicis et de Louis XIII.* (Amsterdam, 1730); and A. P. Lord, *The Regency of Marie de Médicis* (London, 1904). For the political history see the bibliographies to HENRY IV. and LOUIS XIII.

There are lives by Thiroux d'Arconville (3 vols., Paris, 1774) by Miss J. S. H. Pardoe (London, 1852, and again 1890); and by B. Zeller, *Henri IV. et Marie de Médicis* (Paris, 1877). There is a technical discussion of the causes of her death in A. Masson's *La Sorcellerie et la science des poisons au xvii^{e} siècle* (Paris, 1904), and the minutest details of her private life are in L. Batiffol's *La Vie intime d'une reine de France* (Paris, 1906; Eng. trans., 1908).

MARIE GALANTE, an island in the French West Indies. It lies in 15° 55′ N. and 61° 17′ W., 16 m. S.E. of Guadeloupe, of which it is a dependency. It is nearly circular in shape and 55 sq. m. in area. A rocky limestone plateau, rising in the east to a height of 675 ft., occupies the centre of the island, and from it the land descends in a series of well-wooded terraces to the sea. The shores are rocky, there are no harbours, and the roadstead off Grand Bourg is difficult of access, owing to the surrounding reefs. The climate is healthy and the soil rich; sugar, coffee and cotton being the chief products. The largest town is Grand Bourg (pop. 6901) on the south-west coast. The island was discovered by Columbus in 1493, and received its name from the vessel on which he was sailing. The French who settled here in 1648 suffered numerous attacks both from the Dutch and the British, but since 1766, except for a short period of British rule in the early part of the 19th century, they have held undisturbed possession.

MARIE LESZCZYNSKA (1703–1768), queen consort of France, was born at Breslau on the 23rd of June 1703, being the daughter of Stanislas Leszczynski (who in 1704 became king of Poland) and of Catherine Opalinska. During a temporary flight from Warsaw the child was lost, and eventually discovered in a stable; on another occasion she was for safety's sake hidden in an oven. In his exile Stanislas found his chief consolation in superintending the education of his daughter. Madame de Prie first suggested the Polish princess as a bride for Louis duke of Bourbon, but she was soon betrothed not to him but to Louis XV., a step which was the outcome of the jealousies of the houses of Condé and Orléans, and was everywhere regarded as a *mésalliance* for the French king. The marriage took place at Fontainebleau on the 5th of September 1725. Marie's one attempt to interfere in politics, an effort to prevent the disgrace of the duke of Bourbon, was the beginning of her husband's alienation from her; and after the birth of her seventh child Louise, Marie was practically deserted by Louis, who openly avowed his *liaison* with Louise de Nesle, comtesse de Mailly, who was replaced in turn by her sisters Pauline marquise de Vintimille, and Marie Anne, duchess de Châteauroux, and these by Madame de Pompadour. In the meantime the queen saw her father Stanislas established in Lorraine, and the affectionate intimacy which she maintained with him was the chief consolation of her harassed life. After a momentary reconciliation with Louis during his illness at Metz in 1744, Marie shut herself up more closely with her own circle of friends until her death at Versailles on the 24th of June 1768.

See V. des Diguières, *Lettres inédites de la reine Marie Leczinska et de la duchesse de Luynes au Président Hénault* (1886); Marquise des Réaux, *Le Roi Stanislas et Marie Leczinska* (1895); P. de Raynal, *Le Mariage d'un roi* (Paris, 1887); H. Gauthier Villars, *Le Mariage de Louis XV. d'après des documents nouveaux* (1900); P. de Nolhac, *La Reine Marie Leczinska* (1900) and *Louis XV. et Marie Leczynska* (1900); P. Boyé, *Lettres du roi Stanislas à Marie Leszczynska* 1754–1766 (Paris and Nancy, 1901); and C. Stryienski's book on Marie Joséphs de Saxe (*La Mère des trois derniers Bourbons*, Paris, 1902). See also the memoirs of Président Hénault and of the duc de Luynes (ed. Dussieux and Soulié, 1860, &c.).

MARIE LOUISE (1791–1847), second wife of Napoleon I., was the daughter of Francis I., emperor of Austria, and of the princess Theresa of Naples, and was born on the 12th of December 1791. Her disposition, fresh and natural but lacking the qualities that make for distinction, gave no promise of eminence until reasons of state brought Napoleon shortly after his divorce of Josephine to sue for her hand (see NAPOLEON and JOSEPHINE). It is probable, though not quite certain, that the first suggestions as to this marriage alliance emanated secretly from the Austrian chancellor, Metternich. The prince de Ligne claimed to have been instrumental in arranging it. In any case the proposal was well received at Paris both by Napoleon and by his ministers; and though there were difficulties respecting the divorce, of Josephine, yet these were surmounted in a way satisfactory to the emperor and the prelates of Austria. The marriage took place by proxy in the church of St Augustine, Vienna, on the 11th of March 1810. The new empress was escorted into France by Queen Caroline Murat, for whom she soon conceived a feeling of distrust. The civil and religious contracts took place at Paris early in April, and during the honeymoon, spent at the palace of Compiègne, the emperor showed the greatest regard for his wife. "He is so evidently in love with her," wrote Metternich "that he cannot conceal his feelings, and all his customary ways of life are subordinate to her wishes." His joy was complete when on the 20th of March 1811 she bore him a son who was destined to bear the empty titles of "king of Rome" and "Napoleon II." The regard of Napoleon for his consort was evidenced shortly before the birth of this prince, when he bade the physicians, if the lives of the mother and of the child could not both be saved, to spare her life. Under Marie Louise the etiquette of the court of France became more stately and the ritual of religious ceremonies more elaborate. Before the campaign of 1812 she accompanied the emperor to Dresden; but after that scene of splendour misfortunes crowded upon Napoleon. In January 1814 he appointed her to act as regent of France (with Joseph Bonaparte as lieutenant-general) during his absence in the field.

At the time of Napoleon's first abdication (April 11, 1814), Joseph and Jerome Bonaparte tried to keep the empress under some measure of restraint at Blois; but she succeeded in reaching her father the emperor Francis while Napoleon was on his way to Elba. She, along with her son, was escorted into Austria by Count von Neipperg, and refused to comply with the entreaties and commands of Napoleon to proceed to Elba; and her alienation from him was completed when he ventured to threaten her with a forcible abduction if she did not obey. During the Hundred Days she remained in Austria and manifested no desire for the success of Napoleon in France. At the Congress of Vienna the Powers awarded to her and her son the duchies of Parma, Piacenza and Guastalla, in conformity with the terms of the treaty of Fontainebleau (March, 1814); in spite of the determined opposition of Louis XVIII. she gained this right for herself owing largely to the support of the emperor Alexander, but she failed to make good the claims of her son to the inheritance (see NAPOLEON II.). She proceeded alone to Parma, where she fell more and more under the influence of the count von Neipperg, and had to acquiesce in the title "duke of Reichstadt" accorded to her son. Long before the tidings of the death of Napoleon at St Helena reached her she was living in intimate relations with Neipperg at Parma, and bore a son to him not long after that event. Napoleon on the other hand spoke of her in his will with marked tenderness, and both excused and forgave her infidelity to him. Thereafter Neipperg became her morganatic husband; and they had other children. In 1832, at the time of the last illness of the duke of Reichstadt, she visited him at Vienna and was there at the time of his death; but in other respects she shook off all association with Napoleon. Her rule in Parma, conjointly with Neipperg, was characterized by a clemency and moderation which were lacking in the other Italian states in that time of reaction. She preserved some of the Napoleonic laws and institutions; in 1817 she established the equality of women in heritage, and ordered the compilation of a civil code which was promulgated in January 1820. The penal code of November 1821 abolished many odious customs and punishments of the old code, and allowed publicity in criminal trials. On the death of Neipperg in 1829 his place was taken by Baron Werklein, whose influence was hostile to popular liberty. During the popular movements of 1831 Marie Louise had to take refuge with the Austrian garrison at Piacenza; on the restoration of her rule by the Austrians its character deteriorated, Parma becoming an outwork of the Austrian empire. She died at Vienna on the 18th of December 1847.

See *Correspondance de Marie Louise 1799–1847* (Vienna, 1887); J. A. Baron von Helfert, *Marie Louise* (Vienna, 1873); E. Wertheimer, *Die Heirath der Erzherzogin Marie Louise mit Napoléon I.* (Vienna, 1882); and *The Duke of Reichstadt* (Eng. ed., London, 1905). See also the *Memoirs* of Bausset, Mme Durand Méneval and Metternich; and Max Billard, *The Marriage Ventures of Marie Louise*, English version by Evelyn duchess of Wellington (1910).

MARIENBAD, a town of Bohemia, Austria, 115 m. W. of Prague by rail. Pop. (1900), 4588. It is one of the most frequented watering-places of Europe, lying on the outskirts of the Kaiserwald at an altitude of 2093 ft., and is 40 m. S.W. of Carlsbad by rail. Marienbad is enclosed on all sides except the south by gently sloping hills clad with fragrant pine forests, which are intersected by lovely walks. The principal buildings are: the Roman Catholic church, which was completed in 1851; the English church, the theatre, the *Kurhaus*, built in 1901, and several bathing establishments and hospitals. The mineral springs, which belong to the adjoining abbey of Tepl, are eight in number, and are used both for bathing and drinking, except the Marienquelle, which is used only for bathing. Some of them, like the Kreuzbrunnen and the Ferdinandsbrunnen, contain alkaline-saline waters which resemble those of Carlsbad, except that they are cold and contain nearly twice the quantity of purgative salts. Others, like the Ambrosiusbrunnen and the Karolinenbrunnen, are among the strongest iron waters in the world, while the Rudolfsbrunnen is an earthy-alkaline spring. The waters are used in cases of liver affections, gout, diabetes and obesity; and the patients must conform during the cure to a strictly regulated diet. Besides the mineral water baths there are also *moor* or mud-baths, and the peat used for these baths is the richest in iron in the world. About 1,000,000 bottles of mineral water are exported annually.

Amongst the places of interest round Marienbad is the basaltic rock of Podhorn (2776 ft.), situated about 3 m. to the east, from which an extensive view of the Böhmerwald, Fichtelgebirge and Erzgebirge is obtained. About 7 m. in the same direction lies the old and wealthy abbey of Tepl, founded in 1193. The actual building dates from the end of the 17th and the beginning of the 18th century, and contains a fine library with a collection of rare manuscripts and incunabula; near it is the small and old town of Tepl (pop. 2789). To the north-east of Marienbad lies the small watering-place of Königswart; near it is a castle belonging since 1618 to the princes of Metternich, which contains an interesting museum, created by the famous Austrian statesman in the first part of the 19th century. It contains, besides a fine library, a collection of the presents he received during his long career; numerous autographs, and other historical relics, a collection of rare coins, armour, portraits and various minerals.

Marienbad is among the youngest of the Bohemian watering-places, although its springs were known from of old. They appear in a document dating from 1341, where they are called "the Auschowitzer springs belonging to the abbey of Tepl;" but it was only through the efforts of Dr Josef Nehr, the doctor of the abbey, who from 1779 until his death in 1820 worked hard to demonstrate the curative properties of the springs, that the waters began to be used for medicinal purposes. The place obtained its actual name of Marienbad in 1808; became a watering-place in 1818, and received its charter as a town in 1868.

See Lang, *Führer durch Marienbad und Umgebung* (Marienbad, 1902); and Kisch, Marienbad, seine Umgebung und Heilmittel (Marienbad, 1895).

MARIENBERG, a town of Germany, in the kingdom of Saxony 16 m. S.E. of Chemnitz on the Flöha-Reitzenhain railway.

Pop. (1905), 7603. It has an Evangelical church, a Roman Catholic church, a non-commissioned officers' school and a preparatory school; and the industries comprise wool-spinning, flax-dressing, the making of lace, toys and cigars, and silver-mining.

MARIENBURG (Polish, *Malborg*), a town of Germany, in the Prussian province of West Prussia, 30 m. by rail to the S.E. of Danzig in a fertile plain on the right bank of the Nogat, a channel of the Vistula, here spanned by a handsome railway bridge and by a bridge of boats. Pop. (1905), 13,095. Marienburg contains large chemical wool-cleaning works and several other factories, carries on a considerable trade in grain, wood, linen, feathers and brushes, and is the seat of important cattle, horse and wool markets. Its educational institutions include a gymnasium and a Protestant normal school. In the old market-place, many of the houses in which are built with arcades, stands a Gothic town-hall, dating from the end of the 14th century. The town is also embellished with a fine statue of Frederick the Great, who added this district to Prussia, and a monument commemorating the war of 1870–71. Marienburg is chiefly interesting from its having been for a century and a half the residence of the grand masters of the Teutonic order. The large castle of the order here was originally founded in 1274 as the seat of a simple commandery against the pagan Prussians, but in 1309 the headquarters of the grand master were transferred hither from Venice, and the "Marienburger Schloss" soon became one of the largest and most strongly fortified buildings in Germany. On the decline of the order in the middle of the 15th century, the castle passed into the hands of the Poles, by whom it was allowed to fall into neglect and decay. It came into the possession of Prussia in 1772, and was carefully restored at the beginning of the 19th century. This interesting and curious building consists of three parts, the Alt- or Hochschloss, the Mittelschloss, and the Vorburg. It is built of brick, in a style of architecture peculiar to the Baltic provinces, and is undoubtedly one of the most important secular buildings of the middle ages in Germany.

Of the numerous monographs published in Germany on the castle of Marienburg, it will suffice to mention here Büsching's *Schloss der deutschen Ritter zu Marienburg* (Berlin, 1828); Voigt's *Geschichte von Marienburg* (Königsberg, 1824); Bergau's *Ordenshaupthaus Marienburg* (Berlin, 1871); and Steinbrecht, *Schloss Marienburg in Preussen* (8th ed., Berlin, 1905).

MARIENWERDER, a town of Germany, in the Prussian province of West Prussia, 3 m. E. of the Vistula, 23 m. S. of Marienburg by rail. Pop. (1905), 10,258. The town was founded in the year 1233 by the Teutonic order. It has a cathedral of the same century, a triple Gothic edifice, restored in 1874 and containing the tombs of several grand masters of the Teutonic order; a (Gothic) town-hall (1880); a Roman Catholic basilica (1858); a non-commissioned officers' school; a monument of the war of 1870–71 (1897); an archaeological collection; and a seminary for female teachers. The industries include iron-foundries, saw-mills, sugar-refineries, breweries and printing-works.

MARIE THÉRÈSE (1638–1683), queen consort of France, was born on the 10th of September 1638 at the Escurial, being the daughter of Philip IV. of Spain and Elizabeth of France. By pretending to seek a bride for his master in Margaret of Savoy, Mazarin had induced the king of Spain to make proposals for the marriage of his daughter with Louis XIV., and the treaty of the Pyrenees in 1659 stipulated for her marriage with the French king, Marie renouncing any claim to the Spanish succession. As the treaty, however, hinged on the payment of her dowry, which was practically impossible for Spain, Mazarin could evade the other terms of the contract. Marie Thérèse was married in June 1660, when Philip IV. with his whole court accompanied the bride to the Isle of Pheasants in the Bidassoa, where she was met by Louis. The new queen's amiability and her undoubted virtues failed to secure her husband's regard and affection. She saw herself neglected in turn for Louise de la Vallière, Mme. de Montespan and others; but Marie Thérèse was too pious and too humble openly to resent the position in which she was placed by the king's avowed infidelities. With the growing influence of Madame de Maintenon over his mind and affections he bestowed more attention on his wife, which she repaid by lavishing kindness on the mistress. She had no part in political affairs except in 1672, when she acted as regent during Louis XIV.'s campaign in Holland. She died on the 30th of July 1683 at Versailles, not without suspicion of foul play on the part of her doctors. Of her six children only one survived her, the dauphin Louis, who died in 1711.

See the funeral oration of Bossuet (Paris, 1684), E. Ducéré, *Le Mariage de Louis XIV. d'après les contemporains et des documents inédits* (Bayonne, 1905); Dr Cabanès, *Les Morts mystérieuses de l'histoire* (1900), and the literature dealing with her rivals Louise de la Vallière, Madame de Montespan and Madame de Maintenon.

MARIETTA, a city and the county-seat of Cobb county, Georgia, U.S.A., in the N.W. of the state, about 17 m. N.W. of Atlanta. Pop. (1890), 3384; (1900), 4446, of whom 1928 were negroes; (1910), 5949. The city is served by the Louisville & Nashville, the Nashville, Chattanooga & St. Louis, and the Western & Atlantic railways, and is connected with Atlanta by an electric line. Marietta is situated about 1118 ft. above the sea, has a good climate, and is both a summer and a winter resort. The principal industries are the manufacture of chairs and paper, and the preparation of marble for the markets; there are also locomotive works, planing mills, a canning factory, a knitting mill, &c. At Marietta there is a national cemetery, in which more than 10,000 Federal soldiers are buried, and at Kenesaw Mountain (1809 ft.), about 2½ m. west of the city, one of the fiercest battles of the Civil War was fought. After the Confederate retreat from Dalton in May 1864, General William T. Sherman, the Federal commander, made Marietta his next intermediate point in his Atlanta campaign, and the Confederate commander, General Joseph E. Johnston, established a line of defence west of the town. After several preliminary engagements Sherman on the 26th and 27th of June made repeated unsuccessful attempts to drive the Confederates from their defences at Kenesaw Mountain; he then resorted to a flanking movement which forced the Confederate general to retire (July 2) toward Atlanta. Marietta was settled about 1840, and was chartered as a city in 1852.

MARIETTA, a city and the county-seat of Washington county, Ohio, U.S.A., on the Ohio River, at the mouth of the Muskingum, about 115 m. S.E. of Columbus. Pop. (1890), 8273; (1900), 13,348, including 679 foreign-born and 361 negroes; (1910), 12,923. It is served by the Pennsylvania (Marietta Division), the Baltimore & Ohio (Marietta & Parkersburg, Marietta & Zanesville, and Ohio River divisions) and the Marietta, Columbus & Cleveland railways, and by steamboat lines to several river ports; a bridge across the Ohio connects it with Williamstown, West Virginia. The city is in a hilly country of much natural beauty, and is of considerable historic interest. On the banks of the Muskingum is a public park, facing which stood the oldest church in the state; this was burned in 1905, but was subsequently rebuilt in the old style. Near by are some 18th century buildings, some interesting earthworks of the "mound-builders," and a cemetery in which are buried many soldiers who fought in the War of Independence. Marietta is the seat of Marietta College, dating from 1830, which in 1908 had more than 500 students. It possesses a library of 60,000 volumes, including some rare collections, especially the Stimson collection of books bearing on the history of the North-West Territory. Petroleum, coal, and iron-ore abound in the neighbouring region, and the city has a considerable trade in these and in its manufactures of chairs, leather, flour, carriages, wagons, boats, boilers, bricks and glass. In 1905 the factory products were valued at $2,599,287.

Marietta, named in honour of Marie Antoinette, is the oldest settlement in the state and in the North-west Territory. It was founded in 1788 by a company of Revolutionary officers from New England under the leadership of General Rufus Putnam, and in the same year the North-West Territory was formally organized here. The pseudo-classicism of the period of Marietta's foundation is indicated by the names—*Capitolium* for one of the public squares, *Sacra Via* for one of the principal streets, and *Campus Martius* for the fortification. The settlement was incorporated as a town in 1800 and chartered as a city in 1852. In 1890 the village of Harmar, including the site on which Fort Harmar was built in 1785, was annexed.

See Henry Howe, *Historical Collections of Ohio* (Columbus, 1891).

MARIETTE, AUGUSTE FERDINAND FRANÇOIS (1821–1881), French Egyptologist, was born on the 11th of February 1821 at Boulogne, where his father was town clerk. Educated at the Boulogne municipal college, where he distinguished himself and showed much artistic talent, he went to England in 1839 when eighteen as professor of French and drawing at a boys' school at Stratford-on-Avon. In 1840 he became pattern-designer to a ribbon manufacturer at Coventry; but weary of ill-paid exile he returned the same year to Boulogne, and in 1841 took his degree at Douai. He now became a professor at his old college, and for some years supplemented his salary by giving private lessons and writing on historical and archaeological subjects for local periodicals. Meanwhile his cousin Nestor L'Hôte, the friend and fellow-traveller of Champollion, died, and upon Mariette devolved the task of sorting the papers of the deceased savant. He thenceforth became passionately interested in Egyptology, devoted himself to the study of hieroglyphs and Coptic, and in 1847 published a *Catalogue analytique* of the Egyptian Gallery of the Boulogne Museum; in 1849, being appointed to a subordinate position in the Louvre, he left Boulogne for Paris. Entrusted with a government mission for the purpose of seeking and purchasing Coptic, Syriac, Arabic and Ethiopic MSS. for the national collection, he started for Egypt in 1850; and soon after his arrival he made his celebrated discovery of the ruins of the Serapeum and the subterraneous catacombs of the Apisbulls. His original mission being abandoned, funds were now advanced for the prosecution of his researches, and he remained in Egypt for four years, excavating, discovering and despatching archaeological treasures to the Louvre, of which museum he was on his return appointed an assistant conservator. In 1858 he accepted the position of conservator of Egyptian monuments to the ex-khedive, Ismail Pasha, and removed with his family to Cairo. His history thenceforth becomes a chronicle of unwearied exploration and brilliant success. The museum at Bula was founded immediately. The pyramid-fields of Memphis and Sakkara, and the necropolis of Meydum, and those of Abydos and Thebes were examined; the great temples of Dendera and Edfu were disinterred; important excavations were carried out at Karnak, Medinet-Habu and Deir el-Bahri; Tanis (the Zoan of the Bible) was partially explored in the Delta; and even Gebel Barkal in the Sudan. The Sphinx was bared to the rock-level, and the famous granite and alabaster monument miscalled the "Temple of the Sphinx" was discovered. Mariette was raised successively to the rank of bey and pasha in his own service. Honours and orders were showered on him: the Legion of Honour and the Medjidie in 1852; the Red Eagle (first class) of Prussia in 1855; the Italian order of SS. Maurice and Lazarus in 1857; and the Austrian order of Francis-Joseph in 1858. In 1873 the Academy of Inscriptions decreed to him the biennial prize of 20,000 francs, and in 1878 he was elected a member of the Institute. He was also an honorary member of most of the learned societies of Europe. In 1877 his health broke down through overwork. He lingered for a few years, working to the last, and died at Cairo on the 19th of January 1881.

His chief published works are: *Le Sérapéum de Memphis* (1857 and following years); *Dendérah*, five folios and one 4to (1873–1875); *Abydos*, two folios and one 4to (1870–1880); *Karnak*, folio and 4to (1875); *Deir el-Bahari*, folio and 4to (1877); *Listes géographiques des pylônes de Karnak*, folio (1875); *Catalogue du Musée de Boulaq* (six editions 1864–1876); *Aperçu de l'histoire d'Égypte* (four editions, 1864–1874, &c.); *Les Mastabas de l'ancien empire* (edited by Maspero) (1883). See "Notice biographique," by Maspero in *Auguste Mariette. Œuvres diverses* (tome 1, Paris, 1904), and art. EGYPT: *Exploration and Research.*

MARIGNAC, JEAN CHARLES GALISSARD DE (1817–1894), Swiss chemist, was born at Geneva on the 24th of April 1817. When sixteen years old he began to attend the École Polytechnique in Paris, and from 1837 to 1839 studied at the École des Mines. Then, after a short time in Liebig's laboratory at Giessen, and in the Sèvres porcelain factory, he became in 1841 professor of chemistry in the academy of Geneva. In 1845 he was appointed professor of mineralogy also, and held both chairs till 1878, when ill-health obliged him to resign. He died at Geneva on the 15th of April 1894. Marignac's name is well known for the careful and exact determinations of atomic weights which he carried out for twenty-eight of the elements. In undertaking this work he had, like J. S. Stas, the purpose of testing Prout's hypothesis, but he remained more disposed than the Belgian chemist to consider the possibility that it may have some degree of validity. Throughout his life he paid great attention to the "rare earths" and the problem of separating and distinguishing them; in 1878 he extracted ytterbia from what was supposed to be pure erbia, and two years later found gadolinia and samaria in the samarskite earths. In 1858 he pointed out the isomorphism of the fluostannates and the fluosilicates, thus settling the then vexed question of the composition of silicic acid; and subsequently he studied the fluosalts of zirconium, boron, tungsten, &c., and prepared silicotungstic acid, one of the first examples of the complex inorganic acids. In physical chemistry he carried out many researches on the nature and process of solution, investigating in particular the thermal effects produced by the dilution of saline solutions, the variation of the specific heat of saline solutions with temperature and concentration, and the phenomena of liquid diffusion.

A memorial lecture by P. T. Cleve, printed in the *Journal of the London Chemical Society* for 1895, contains a list of Marignac's papers.

MARIGNAN, BATTLE OF, fought on the 13th and 14th of September 1515 between the French army under Francis I. and the Swiss. The scene of the battle—which was also that of a hard fought engagement in 1859 (see ITALIAN WARS)—was the northern outskirts of the village of Melegnano, on the river Lambro, 10 m. S.E. of Milan. The circumstances out of which the battle of Marignan arose, almost inconceivable to the modern mind, were not abnormal in the conditions of Italian warfare and politics then prevailing. The young king of France had gathered an army about Lyons, wherewith to overrun the Milanese; his allies were the republics of Venice and Genoa. The duke of Milan, Maximilian Sforza, had secured the support of the emperor, the king of Spain, and the pope, and also that of the Swiss cantons, which then supplied the best and most numerous mercenary soldiers in Europe. The practicable passes of the Alps and the Apennines were held by Swiss and papal troops. Francis however boldly crossed the Col de l'Argentière (Aug. 1515) by paths that no army had hitherto used, and Marshal de La Palisse surprised and captured a papal corps at Villafranca near Pinerolo, whereupon the whole of the enemy's troops fell back on Milan. The king then marching by Vercelli, Novara and Pavia, joined hands with Alviano, the Venetian commander, and secured a foothold in the Milanese. But in order to avoid the necessity of besieging Milan itself, he offered the Swiss a large sum to retire into their own country. They were about to accept his offer, not having received their subsidies from the pope and the king of Spain, when a fresh corps of mercenaries descended into Italy, desirous both of gaining booty and of showing their prowess against their new rivals the French and Lower Rhine "lansquenets" (Landsknechts) and against the French gendarmerie, whom (alluding to the "Battle of the Spurs" at Guinegatte in 1513) they called "hares in armour." The French took position at Melegnano to face the Swiss, the Venetians at Lodi to hold in check the Spanish army at Piacenza. Alviano, who was visiting the king when the Swiss appeared before Melegnano, hurried off to bring thither his own army. Meantime the French and the Swiss engaged in an incredibly fierce struggle.

The king's army was grouped in front of the village, facing in the direction of Milan, with a small stream separating it from the oncoming Swiss. On either side of the Milan road was a large body of landsknechts, a third being in reserve. The French and Gascon infantry (largely armed with arquebuses) was on the extreme right, the various bodies of gendarmerie in the centre. In front of all was the French artillery. The battle opened in the afternoon of the 13th of September. As the Swiss advanced in three huge columns, the French guns fired into them with terrible effect, but the assailants reached the intersected ground bordering the stream, and thus protected from the rush of the French gendarmerie, they debouched on the other side, and fell upon the landsknechts. The crowd of combatants, the gathering darkness, and the dust, prevented any general direction being given to the battle by the leaders of either side. Francis himself at the head of two hundred gendarmes charged and drove back two large bodies of Swiss which were pressing the landsknechts hard. The battle went on by moonlight till close on midnight, when the Swiss retired a short distance. Both sides spent the rest of the night on the battlefield, reorganizing their broken corps. Francis and his gendarmes were the outpost line of the French army, and remained all night mounted, lance in hand and helmet on head. Next morning at sunrise, the battle was renewed. The Swiss now left their centre inactive opposite the king and with two strong corps attempted to work round his flanks. That on the left made for the French baggage, but found it strongly guarded by landsknechts, who drove them back. The nearest French gendarmerie joined in the pursuit, but a detachment from the Swiss centre fell upon these and destroyed them. This detachment in turn followed up its advantage until as Francis himself expressed it, " the whole camp turned out " to aid the landsknechts and " hunted out " the Swiss. Meantime the Swiss left attack had closed with the French infantry bands and the " aventuriers" (afterwards the famous corps of Picardie and Piedmont), who were commanded on this day be the famous engineer Pedro Navarro. It was in the main struggle of arquebus against pike, but it was not the arquebus alone, or even principally, that gave the victory to the French. When the Swiss ranks had been disordered, the short pike and the sword came into play, and aided by the constable de Bourbon with a handful of the gendarmerie, the French right more than held its own until Alviano with the cavalry from Lodi rode on to the field and completed the rout of the Swiss. In the centre meanwhile the two infantries stood fast for eight hours, separated by the brook, while the artillery on both sides fired into it at short range. But the landsknechts, animated by the king, endured it as well as the Swiss; and at the last, Francis leading a final advance of his exhausted troops, the Swiss gave way and fled. Only 3000 Swiss escaped out of some 25,000 who fought. On the French side probably 8000 were killed or died of wounds. The battle lasted twenty-eight hours. Its tactical lesson was the efficacy of combining two arms against one. The French gendarmerie, burning to avenge the insult of " hares in armour," made more than thirty charges by squadrons, and they were admirably supported by their light artillery. The landsknechts retrieved their first day's defeat by their conduct on the second day. Nevertheless Marignan was in the main the work of the gendarmerie, the last and greatest triumph of the armoured lancer; and as a fitting close to the battle the young king was knighted by Bayard on the field.

MARIGNOLLI, GIOVANNI DE', a notable traveller to the Far East in the 14th century, born probably before 1290, and sprung from a noble family in Florence. The family is long extinct, but a street near the cathedral (Via de' Cerretani) formerly bore the name of the Marignolli. In 1338 there arrived at Avignon, where Benedict XII. held his court, an embassy from the great khan of Cathay (the Mongol-Chinese emperor), bearing letters to the pontiff from the khan himself, and from certain Christian nobles of the Alan race in his service. These latter represented that they had been eight years (since Monte Corvino's death) without a spiritual guide, and earnestly desired one. The pope replied to the letters, and appointed four ecclesiastics as his legates to the khan's court. The name of John of Florence, *i.e.* Marignolli, appears third on the letters of commission. A large party was associated with the four chief envoys; when in Peking the embassy still numbered thirty-two, out of an original fifty.

The mission left Avignon in December 1338; picked up the Tatar envoys at Naples; stayed nearly two months in Constantinople (Pera, May 1—June 24, 1339); and sailed across the Black Sea to Kaffa, whence they travelled to the court of Mahommed Uzbeg, khan of the Golden Horde, at Sarai on the Volga. The khan entertained them hospitably during the winter of 1339–1340 and then sent them across the steppes to Armalec, Almalig or Almaligh (Kulja), the northern seat of the house of Chaghatai, in what is now the province of Ili. " There," says Marignolli, " we built a church, bought a piece of ground . . . sung masses, and baptized several persons, notwithstanding that only the year before the bishop and six other minor friars had there undergone glorious martyrdom for Christ's salvation." Quitting Almaligh in 1341, they seem to have reached Peking (by way of Kamul or Hami) in May or June 1342. They were well received by the reigning khan, the last of the Mongol dynasty in China. An entry in the Chinese annals fixes the year of Marignolli's presentation by its mention of the arrival of the great horses from the kingdom of Fulang (*Farang* or Europe), one of which was 11 ft. 6 in. in length, and 6 ft. 8 in. high, and black all over.

Marignolli stayed at Peking or Cambalec three or four years, after which he travelled through eastern China to Zayton or Amoy Harbour, quitting China apparently in December 1347, and reaching Columbum (Kaulam or Quilon in Malabar) in Easter week of 1348. At this place he found a church of the Latin communion, probably founded by Jordanus of Séverac, who had been appointed bishop of Columbum by Pope John XXII. in 1330. Here Marignolli remained sixteen months, after which he proceeded on what seems a most devious voyage. First he visited the shrine of St Thomas near the modern Madras, and then proceeded to what he calls the kingdom of Saba, and identifies with the Sheba of Scripture, but which seems from various particulars to have been Java. Taking ship again for Malabar on his way to Europe, he encountered great storms. They found shelter in the little port of *Pervily or Pervilis* (Beruwala or Berberyn) in the south-west of Ceylon; but here the legate fell into the hands of " a certain tyrant Coya Jaan (Khoja Jahān), a eunuch and an accursed Saracen," who professed to treat him with all deference, but detained him four months, and plundered all the gifts and Eastern rarities that he was carrying home. This detention in *Seyllan* enables Marignolli to give a variety of curious particulars regarding Adam's Peak, Buddhist monasticism, the aboriginal races of Ceylon, and other marvels. After this we have only fragmentary notices, showing that his route to Europe lay by Ormuz, the ruins of Babel, Bagdad, Mosul, Aleppo and thence to Damascus and Jerusalem. In 1353 he arrived at Avignon, and delivered a letter from the great khan to Pope Innocent VI. In the following year the emperor Charles IV., on a visit to Italy, made Marignolli one of his chaplains. Soon after, the pope made him bishop of Bisignano; but he seems to have been in no hurry to reside there. He appears to have accompanied the emperor to Prague in 1354–1355; in 1356 he is found acting as envoy to the Pope from Florence; and in 1357 he is at Bologna. We know not when he died. The last trace of Marignolli is a letter addressed to him, which was found in the 18th century among the records in the Chapter Library at Prague. The writer is an unnamed bishop of Armagh, easily identified with Richard Fitz Ralph, a strenuous foe of the Franciscans, who had broken lances in controversy with Ockham and Burley. The letter implies that some intention had been intimated from Avignon of sending Marignolli to Ireland in connexion with matters then in debate—a project which stirs Fitz Ralph's wrath.

The fragmentary notes of Marignolli's Eastern travels often contain vivid remembrance and graphic description, but combined with an incontinent vanity, and an incoherent lapse from one thing to another. They have no claim to be called a narrative, and it is with no small pains that anything like a narrative can be pieced out of them. Indeed the mode in which they were elicited curiously illustrates how little medieval travellers thought of publication

The emperor Charles, instead of urging his chaplain to write a history of his vast journeys, set him to the repugnant task of recasting the annals of Bohemia; and he consoled himself by salting the insipid stuff by interpolations, *à propos de bottes*, of his recollections of Asiatic travel.

Nobody seems to have noticed the work till 1768, when the chronicle was published in vol. ii. of the *Monumenta hist. Bohemiae nusquam antehac edita* by Father Gelasius Dobner. But, though Marignolli was thus at last in type, no one seems to have read him till 1820, when an interesting paper on his travels was published by J. G. Meinert. Professor Friedrich Kunstmann of Munich also devoted to the subject one of his admirable series of papers on the ecclesiastical travellers of the middle ages.

See *Fontes rerum bohemicarum*, iii. 492–604 (1882, best text); G. Dobner's *Monumenta hist. boh.*, vol. ii. (Prague, 1768); J. G. Meinert, in *Abhandl. der k. böhm. Gesellsch. der Wissenschaften*, vol. vii.; F. Kunstmann, in *Historisch-politische Blätter von Phillips und Görres*, xxxviii. 701–719, 793–813 (Munich, 1859); Luke Wadding, *Annales minorum, A.D. 1338*, vii. 210–219 (ed. of 1733, &c.); Sbaralea, *Supplementum et castigatio ad scriptores trium ordinum S. Francisci a Waddingo*, p. 436 (Rome, 1806); John of Winterthur, in Eccard, *Corpus historicum medii aevi*, vol. i., 1852; Mosheim, *Historia Tartarorum ecclesiastica*, part i., p. 115; Henry Yule, *Cathay and the Way Thither*, ii. 309–394 (Hak. Soc., 1866); C. Raymond Beazley, *Dawn of Modern Geography*, iii. 142, 180–181, 184–185, 215, 231, 236, 288–309 (1906). (H. Y.; C. R. B.)

MARIGNY, ENGUERRAND DE (1260–1315), French chamberlain, and minister of Philip IV. the Fair, was born at Lyons-la-Forêt in Normandy, of an old Norman family of the smaller baronage called Le Portier, which took the name of Marigny about 1200. Enguerrand entered the service of Hugues de Bonville, chamberlain and secretary of Philip IV., as a squire, and then was attached to the household of Queen Jeanne, who made him one of the executors of her will. He married her god-daughter, Jeanne de St Martin. In 1298 he received the custody of the castle of Issoudun. After the death of Pierre Flotte and Hugues de Bonville at the battle of Mons-en-Pevèle in 1304, he became Philip's grand chamberlain and chief minister. In 1306 he was sent to preside over the exchequer of Normandy. He received numerous gifts of land and money from Philip as well as a pension from Edward II. of England. Possessed of an ingratiating manner, politic, learned and astute, he acted as an able instrument in carrying out Philip's plans, and received corresponding confidence. He shared the popular odium which Philip incurred by debasing the coinage. He acted as the agent of Philip in his contest with Louis de Nevers, the son of Robert count of Flanders, imprisoning Louis and forcing Robert to surrender Lille, Douay and Béthune. He obtained for his half-brother Philip de Marigny in 1301 the bishopric of Cambray, and in 1309 the archbishopric of Sens, and for his brother Jean in 1312 the bishopric of Beauvais. Still another relative, Nicolas de Fréauville, became the king's confessor and a cardinal. He addressed the estates general in 1314 and succeeded in getting further taxes for the Flemish war, incurring at the same time much ill will. This soon came to a head when the princes of the blood, eager to fight the Flemings, were disappointed by his negotiating a peace in September. He was accused of receiving bribes, and Charles of Valois denounced him to the king himself; but Philip stood by him and the attack was of no avail. The death of Philip IV. on the 29th of November 1314 was a signal for a reaction against his policy. The feudal party, whose power the king had tried to limit, turned on his ministers and chiefly on his chamberlain. Enguerrand was arrested by Louis X. at the instigation of Charles of Valois, and twenty-eight articles of accusation including charges of receiving bribes were brought against him. He was refused a hearing; but his accounts were correct, and Louis was inclined to spare him anything more than banishment to the island of Cyprus. Charles then brought forward a charge of sorcery which was more effectual. He was condemned at once and hanged on the public gallows at Montfaucon, protesting that in all his acts he had only been carrying out Philip's commands (April 30, 1315). Louis X. seems to have repented of his treatment of Marigny, and left legacies to his children. When his chief enemy, Charles of Valois, lay dying in 1325, he was stricken with remorse and ordered alms to be distributed among the poor of Paris with a request to "pray for the souls of Enguerrand and Charles." Marigny founded the collegiate church of Notre Dame d'Escouis near Rouen in 1313. He was twice married, first to Jeanne de St Martin, by whom he had three children, Louis, Marie and Isabelle (who married Robert, son of Robert de Tancarville); and the second time to Alips de Mons.

See contemporary chroniclers in vols. xx. to xxiii. of D. Bouquet, *Historiens de la France*; P. Clément, *Trois drames historiques* (Paris, 1857); Ch. Dufayard, *La Réaction féodale sous les fils de Philippe le Bel*, in the *Revue historique* (1894, liv. 241–272) and lv. 241–290.

MARIGNY, JEAN DE (d. 1350), French bishop, was a younger brother of the preceding. Entering the church at an early age, he was rapidly advanced until in 1313 he was made bishop of Beauvais. During the next twenty years he was one of the most notable of the members of the French episcopate, and was particularly in favour with King Philip VI. He devoted himself in 1335 to the completion of the choir of Beauvais Cathedral, the enormous windows of which were filled with the richest glass. But this building activity, which has left one of the most notable Gothic monuments in Europe, was broken into by the Hundred Years' War. Jean de Marigny, a successful administrator and man of affairs rather than a saintly churchman, was made one of the king's lieutenants in southern France in 1341 against the English invasion. His most important military operation, however, was when in 1346 he successfully held out in Beauvais against a siege by the English, who had overrun the country up to the walls of the city. Created archbishop of Rouen in 1347 as a reward for this defence, he enjoyed his new honours only three years; he died on the 26th of December 1350.

MARIGOLD. This name has been given to several plants, of which the following are the best known: *Calendula officinalis*, the pot-marigold; *Tagetes erecta*, the African marigold; *T. patula*, the French marigold; and *Chrysanthemum segetum*, the corn marigold. All these belong to the order Compositae; but *Caltha palustris*, the marsh marigold, belongs to the order Ranunculaceae.

The first-mentioned is the familiar garden plant with large orange-coloured blossoms, and is probably not known in a wild state. There are now many fine garden varieties of it. The florets are unisexual, the "ray" florets being female, the "disk" florets male. This and the double variety have been in cultivation for at least three hundred years, as well as a proliferous form, *C. prolifera*, or the "fruitful marigolde" of Gerard (*Herball*, p. 602), in which small flower-heads proceed from beneath the circumference of the flower. The figure of "the greatest double marigold," *C. multiflora maxima*, given by Gerard (*loc. cit.* p. 600) is larger than most specimens now seen, being 3 in. in diameter. He remarks of "the marigolde" that it is called *Calendula* "as it is to be seene to flower in the calends of almost euerie moneth." It was supposed to have several specific virtues, but they are non-existent. "The marigold, that goes to bed wi' the sun," is mentioned by Shakespeare, *Winter's Tale*, iv. 3.

Tagetes patula, and *T. erecta*, the French and African marigolds, are natives of Mexico, and are equally familiar garden plants, having been long in cultivation. Gerard figures five varieties of *Flos africanus*, of the single and double kind (*loc. cit.*, p. 609). Besides the above species the following have been introduced later, *T. lucida*, *T. signata*, also from Mexico, and *T. tenuifolia* from Peru.

Chrysanthemum segetum, the yellow corn marigold, is indigenous to Great Britain, and is frequent in corn-fields in most parts of England. When dried it has been employed as hay. It is also used in Germany for dyeing yellow. Gerard observes that in his day "the stalke and leaues of Corne Marigolde, as Dioscorides saith, are eaten as other potherbes are."

Caltha palustris, the marsh marigold, or king-cups, the "winking Mary-buds" of Shakespeare (*Cymb.*, ii. 3), is a common British plant in marshy meadows and beside water. It bears smooth heart-shaped leaves, and flowers with a golden yellow calyx but no corolla, blossoming in March and April. The flower-buds preserved in salted vinegar are a good substitute for capers. A double-flowered variety is often cultivated, and is occasionally found wild.

MARIINSK, a town of Russia, in West Siberia and the government of Tomsk, on the bank of the Kiya river and on the Siberian railway, 147 m. E.S.E. of Tomsk. Pop. (1897), 8300. It is built of timber, but has a stately cathedral. There are tanneries and soapworks; and Mariinsk is an entrepôt for the goldmines.

MARILLAC, CHARLES DE (*c.* 1510–1560), French prelate and diplomatist, came of a good family of Auvergne, and at the age of twenty-two was advocate at the parlement of Paris. Suspected, however, of sympathizing with the reformers, he deemed it prudent to leave Paris, and in 1535 went to the East with his cousin Jean de la Forêt, the first French ambassador at Constantinople. Cunning and ambitious, he soon made his mark, and his cousin having died during his embassy, Marillac was appointed his successor. He did not return from the East until 1538, when he was sent almost immediately to England, where he remained ambassador until 1543. He retained his influence during the reign of Henry II., fulfilling important missions in Switzerland and at the imperial court (1547–1551), and at the courts of the German princes (1553–1554). In 1555 he was one of the French deputies at the conferences held at Mark near Ardres to discuss peace with England. His two last missions were at Rome (1557) and at the Diet of Augsburg (1559). In 1550 he was given the bishopric of Vannes, and in 1557 the archbishopric of Vienne; he also became a member of the privy council. He distinguished himself as a statesman at the Assembly of Notables at Fontainebleau in 1560, when he delivered an exceedingly brilliant discourse, in which he opposed the policy of violence and demanded a national council and the assembly of the states general. Irritated by his opposition, the Guises compelled him to leave the court, and he died on the 2nd of December of the same year.

His works include: *Discours sur la rouptur de la Trefve en l'an 1556* (Paris, 1556), and "Sommaire de l'ambassade en Allemagne de feu M^{r}. l'archevesque de Vienne en l'an 1550," published in Ranke's *Deutsche Geschichte im Zeitalter der Reformation*, vol. vi. (Leipzig, 1882). See J. Kaulek, *Correspondance politique de Castillon et Marillac (1537–1542)* (Paris, 1885); P. de Vassière, *Charles de Marillac* (Paris, 1896).

MARINES (from Lat. *mare*, sea), the technical term for sea-soldiers, *i.e.* troops appropriated and specially adapted to the requirements of maritime war. This force—formerly (1694) styled "mariners"—is in origin, use and application peculiarly British. The only other nation possessing a special force discharging exactly similar functions is the United States (see below). In the armed forces of the great European Powers marines and marine artillery are mentioned, but these troops have little in common with British and American marines. In France their duties are to garrison military forts and colonies and take part in marine and other wars. In Germany they are used for coast defence. In Holland, Austria and Italy they have a military organization, but not as complements of sea-going ships.

The origin of the British marine force was an order in council 1664, directing "1200 Land souldgers to be forthwith rayzed to be in readiness to be distributed in His Majesty's fleete prepared for sea service." This body was named the "Admiral's regiment." At this period land warfare had developed a system and was waged by men organized, disciplined and trained. Sea warfare was left "to every man's own conceit." War-ships were built to be manned in a hurry, by "the press," when needed. Men were thus obtained by force and grouped without organization or previous training in ships. When no longer required they were turned adrift. The administration of England's fleet was "a prodigy of wastefulness, corruption and indolence; no estimate could be trusted, no contract was performed, no check was enforced." Such officers as had been "bred to the sea seemed a strange and savage race." They robbed the king and cheated the seamen. As regards land force, it was a violation of the law to keep at home in the king's pay "any other body of armed men, save as a guard for the royal person." On the other hand it was "illegal to land press men" in a foreign country, but soldiers "only required a little persuasion to land." Thus by thrusting into naval chaos and confusion a nucleus of disciplined, trained and organized land troops, an expedient was found which offered a solution of the many political and administrative difficulties of the time. This "Admiral's regiment." was the germ which by a constant process of evolution during a period of over 235 years has produced not merely the marine forces, but the royal navy, organized, disciplined and trained as it is to-day. In 1668 the experiment of the Admiral's regiment was extended. At a council held "to discourse about the fitness for entering men presently for manning the fleete," King Charles II. "cried very civilly, 'If ever you intend to man the fleet without being cheated by the captains and pursers, you may go to bed and resolve never to have it manned.'" This seems to throw some light on the council's order a few days later "to draw out and furnish such numbers of His Majesty's Foot Guards for His Majesty's service at sea this summer, as H.R.H. the duke of York, lord high admiral of England, shall from time to time desire." The men were to be paid and accounted for by their own officers. This maritime force subsequently disappeared, but two new regiments of "marines" were raised in 1694, the House of Commons directing they "were to be employed in the service of the navy only." One regiment only was to be on shore at a time, and to be employed in the dockyards with extra pay. None of the officers were to be sea commanders, save two colonels. The intention was to make these regiments feeders for the navy, captains being ordered to report periodically "the names of such soldiers as shall in any measure be made seamen, and how far each of them is qualified toward being an able seaman." In 1697 these regiments were disbanded, but early in the reign of Queen Anne a number of regiments of marines were raised, and independent companies of marines were also enlisted in the West Indies. At the peace of Utrecht (1713) the marines were disbanded, but reappeared in 1739 as part of the army; and in 1740 three regiments of marines were raised in America, the colonels being appointed by the crown, the captains by the provinces. In 1747 the marine regiments were transferred from the control of the secretary at war to that of the admiralty, and the next year once more wholly disappeared on the treaty of Aix-la-Chapelle (1748).

During the preceding period of fifty-four years the marine force appeared and disappeared with war. It was a military body, applied to naval purposes. Its main functions were threefold—(1) for fighting in ships; (2) for seizing and holding land positions necessary or advantageous to the naval operations of war; (3) for maintaining discipline of the ships, and by "expertness in handling arms to incite our seamen to the imitation of them." Incidentally the force came to be regarded as so good a feeder for the navy that Admiral Vernon (1739) urged "the necessity of converting most of our marching regiments into marines, and if, as they became seamen they were admitted to be discharged as such, that would make a good nursery for the breeding of them."

The organization of the force was purely military. Regiments were embarked in fleets, and distributed in the ships. The officers were interchangeable with those of the guards and line. John Churchill (afterwards duke of Marlborough) and George Rooke (afterwards Admiral Sir George Rooke) were together at one time ensigns of marines. During this period the marines were never regarded as a reserve for the fleet. The navy in peace did without them. The necessities of maritime war demanded a mobile military force adapted to naval conditions and at naval disposal, and so in all naval operations during these eighty-four years the marines played a conspicuous part. The navy had been slowly groping towards a system. For example, sea officers had been granted a uniform, and a naval academy (1729) had been established for the education of young gentlemen for the sea service. But in its main features the navy remained in 1748 as it was in 1664. The sailor was kidnapped and forced into ships, to become an outcast when no longer wanted. The marine when not in a ship was comfortably housed and looked after by his officers in barracks on shore.

In 1755 the marine force once more reappeared under the Admiralty, and from that date its history has been continuous.

But the regimental system was abandoned, and an entirely new principle of organization was applied. Companies were raised, and these companies were grouped into great depots, called divisions, at Portsmouth, Plymouth and Chatham. At these divisions this force could be increased and reduced at pleasure, without disturbing the basis of organization, and from them could be supplied as many or as few sea-soldiers as fleets or ships needed, while preserving in the varying units so provided all the essentials of uniformity of system, drill, training, ties of comradeship and *esprit de corps*. This force then and for ninety-eight years afterwards was the only continuously trained, disciplined and organized fighting force placed by the country at the disposal of naval officers. On the establishment of this new marine force the purchase of commissions was abolished, but interchange with the army was for a time permitted. When embarked, marines were under the naval code of discipline; when on shore, under the marine Mutiny Act, identical with that of the army. When the seamen of the fleet mutinied at the Nore, at the close of the 18th century, and turned their officers out of the ships, the marines, undaunted, stood firm by theirs.

Mutiny lurked beneath the deck of many a ship before and long years after that event. The control of admirals and captains over their own men was precarious in the extreme. This was the natural result of the country's neglect of its seamen. The discipline of the fleet in those days rested on the firm bayonets of the marines. What England owes to them may be gathered from Lord St Vincent's recorded testimony: "There never was an appeal made to them for honour, courage or loyalty, that they did not more than realize my highest expectation. If ever real danger should come to England, the marines will be found the country's sheet-anchor." At his earnest solicitation the marines were made a royal corps in 1802. It is worthy of note that in those days of masts, yards, sails and pure seamanship, this greatest of naval statesmen, this matchless naval strategist, whose practical experience of maritime war was unrivalled, strenuously advocated as the true policy for England what in these days of steam and mastless ships would be scouted and ridiculed. It was to make service afloat as marines a part of the duty of every regiment of the line in rotation.

Down to 1804 the marines were an infantry force; the improvement in artillery towards the close of the century had necessitated the occasional putting into the fleet of detachments of Royal Artillery. This, as regards gunnery duties in the fleet, was repeating on a smaller scale the expedient adopted in the time of Charles II. So much friction arose between the naval and the artillery officers that a special corps of Royal Marine Artillery was raised in 1804, on the recommendation of Nelson. This special corps fulfilled the expectations of its founders. It was charged with the care, equipment and working of the larger ordnance afloat and field-guns ashore, and was employed also as a body of gunnery instructors to the fleet. In 1831, a certain number of naval officers being thought to be sufficiently trained in gunnery, this corps, of which Napier wrote, "Never in my life have I seen soldiers like the Royal Marine Artillery," was, without warning, abolished. Then the marine force ceased to be composed of two corps, artillery and infantry, and it reverted to a single one of infantry. Very soon afterwards, however, the Admiralty began to build up what they had so suddenly and ruthlessly destroyed, by ordering the conversion of one company of each infantry marine division into artillery. The number of these artillery companies gradually increased, and were grouped in a separate depot. Just as the wars from Charles II. to George III. had demanded marines, so the Crimean War led to their increase. Thus in 1859 the artillery companies of marines were formed into a separate division, and in 1862 the old name of Royal Marine Artillery was restored.

The marines thus became once more and still remain two corps, the official designation of the whole being Royal Marine Forces. In 1855 the marine infantry corps became light infantry, and in 1869 the Woolwich division (added in 1805) was abolished; and more recently a marine depot, as a feeder of the other divisions, was established at Walmer. The headquarters of the R.M.A. are at Eastney, Southsea. The divisions R.M.L.I. are at Gosport, Chatham and Devonport. The uniform of the R.M.A. is blue with red facings, that of R.M.L.I. red with blue facings. The badge of both corps is the globe surrounded with the laurel wreath, with the motto "Per mare per terram." The Royal Marine Forces share with the 3rd Battalion Grenadier Guards, the East Kent Regiment (formerly the Buffs), and the Royal London Militia the privilege of marching through the city of London with colours flying, bands playing and bayonets fixed. This is due to a common original association with the London train bands.

War Services.—To describe these would be to review the wars waged by England by sea and by land for over 200 years. In every sea fight, great or small, marines have taken part, and on every continent they have served in big and little wars, sometimes as part of the army, sometimes with naval contingents, sometimes alone. Throughout the Napoleonic war the marines took part in every sort of operation afloat and ashore. During the Crimean War, mortar-boat flotillas in the Baltic and Black Sea were commanded and manned by R.M.A., while comrades in the same corps served with the Royal Artillery in the trenches before Sebastopol—a marine infantry brigade occupying the heights of Balaclava. During the Indian Mutiny, marines (artillery and infantry) served with the Naval Brigade under Peel. In the China wars batteries and brigades of the marine force played a prominent part, and likewise were represented in all the Egyptian and Sudan campaigns, 1881 to 1898. In one action the R.M.A. gunners came to the relief of the Royal Horse Artillery when exhausted, and fought their guns; in another the R.M.A., out of the débris of the enemy's Krupp guns captured, built up one complete gun and fought it with effect; in the final campaign gunboats were brought up in pieces, put together and fought by a detachment of the R.M.A.

In 1899 in the Boer War the marine artillery and infantry took part with the Naval Brigade, maintaining their historic reputation, and at the battle of Enslin their losses were exceptionally severe.

Characteristics of Marine System.—The recruit first goes to the depot at Walmer, and is trained as a soldier before joining his division to complete instruction as a marine. His division is his permanent military home, from which he goes on service and to which he returns at its conclusion. Restrictions on marriage, necessary under the army system, are not necessary in the marine forces. The permanent home of the wife and family is not broken up by the marine going abroad; the wife thus can continue any local goodwill in any business her industry may secure. This fixed home enables a marine to learn a trade in the workshops of his division which supply the clothing, &c., to the corps. Marines are enlisted for 12 years, and if of good character they can re-engage to complete 21 years, entitling to pension. The periods of service abroad for marines are shorter (generally 3 years), but more constantly recurrent than for the army. The administrative, as distinct from the instructional, staff necessary for a marine division is more simple and less expensive than that of a numerical army equivalent expressed in regiments. The system of pay and accounts is also less complex. The following table shows the relative proportions of marine forces to the whole navy at different periods up to the South African War of 1899:—

Year.	Navy proper. Officers and Men.	Marines. Officers and Men.	Grand Total.	Maritime. Peace or War.	Percent. Marines to Total Forces.	Nature of Ships.
1805	90,000	30,000	120,000	War (Trafalgar)	25	Sailing.
1838	23,165	9,000	32,165	Peace	28	Sailing.
1858	40,219	14,919	55,138		27	Sailing with auxiliary steam.
1878	42,046	13,727	55,773		24	Steam with auxiliary sail.
1898	78,441[1]	17,099	95,540		17	Steam and mastless ships.

The above table indicates a gradual change in naval policy and practice as regards marines. It will be observed that, concurrently with the gradual disappearance of masts, sails and yards, the proportion of marines has steadily declined. Down to very recent times the marine spent more time ashore than afloat. Now the reverse is the case.

By the introduction of the Continuous Service Act 1853, the blue-jacket was placed on exactly the same footing as the marine in respect of conditions of service and pension, and now the blue-jacket when not afloat is quartered in barracks. The main difference between the blue-jacket and marine is the dress and the pay. The blue-jacket is better paid than the marine. As regards opportunity of discipline, there is now no difference; and in short, all the reasons for the existence of a marine force have disappeared except as regards duties on shore incidental to naval operations of war, *e.g.* the holding of ports and the seizing of minor positions necessary to prosecution of maritime war. The facts that modern ships cannot now as formerly carry a supernumerary force sufficient for such purposes, and are more dependent on fixed bases of supply and repair than in old days, point to a different method of using and applying the marine force to the sole purpose for which they are now necessary as a distinct branch of the naval service. If employed at the headquarters of a naval station, their efficiency as marines could be preserved by occasional embarcation of the officers and men in rotation. The substitution of marine for army garrisons at coaling stations would also relieve the army of a class of duties incidental to naval warfare which the marine force formerly performed, and which prejudicially affects the organization and arrangement of the army as a mobile field force.

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[1] Including 22,289 of the engineer branch providing the locomotion of modern ships—just as seamen from 1805–1858 provided it for ships of the past.

Marine Corps, United States.—This dates from the establishment of the American navy. It is a wholly separate military body, though under the control of the Navy Department. It was formed in 1775, and it has a history of brilliant services rendered by land and sea in all the wars of America since that date. The headquarters of the corps are at Washington, and the strength of the corps was fixed by Act of Congress (March 3, 1899) at 211 officers and 5920 non-commissioned officers and men. Its organization and system are based on the British model, and the dress corresponds to that of the United States army. The corps is commanded by a brigadier-general who bears to the secretary a relation similar to that of a chief of bureau. Although the organization closely follows the army system, regimental or even permanent battalion organizations are impracticable, owing to their numerous and widely-separated stations. Practically all shore stations have barracks where marines are enlisted and drilled. At these places they also do sentry, police and orderly duties. From such stations they are sent to ships for sea duty. Nearly all ships carry a body of marines known as the guard, varying in size from a few men commanded by a sergeant, on small ships, to eighty or more, with one or more commissioned officers, on large vessels. It is customary to cause all marines to serve at sea three of the four years of each enlistment. On board ship they perform sentry and orderly duty, and assist in police duties. They are also instructed in many exercises pertaining to the navy, as rowing, naval signalling, gun drill, &c. In action they act as riflemen, and on many ships serve a portion of the guns. When circumstances require a force to be landed from ships present to guard American interests in foreign countries, legations, &c., the marine guard is usually sent, though, if numerically insufficient, sailors are landed also. Marines also garrison places beyond the territorial limits of the United States which are under navy control. Candidates for first enlistment must be between the ages of 21 and 35 and unmarried, must be citizens of the United States, be able to read, write and speak English, and pass a physical examination. Second lieutenants are appointed from civil life after examination or from the graduates of the Naval Academy. Promotion is by seniority as in the navy.

Admiral Farragut's opinion that "the marine guard is one of the great essentials of a man-of-war" is corroborated by that of Admiral Wilkes, who considered that "marines constituted the great difference between a man-of-war and a privateer." In the famous battles between the "Bonhomme Richard" and "Serapis" in 1777, and in that between the "Chesapeake" and "Shannon," the American marines displayed brilliant gallantry; and while on the one hand they at Derne in 1803 first planted the American flag on a fortress of the Old World, for which exploit "Tripoli" is inscribed on their colours, they on the other shared in the hard fighting of the Mexican War as well as all the important coast actions of the Civil War of 1861–65. A proposal to incorporate them with the army after the struggle met with universal condemnation from the authorities best qualified to judge of their value. A brigade of three battalions served in the Philippines in 1899. Their device is a globe resting on an anchor and surmounted by an eagle. "Ever faithful" is the title which Captain Luce. the historian of the force, appropriately applies to them. (J. C. R. C.)

MARINETTE, a city and the county-seat of Marinette county, Wisconsin, U.S.A., 162 m. N. of Milwaukee, on the W. shore of Green Bay, at the mouth of the Menominee River. Pop. (1890), 11,523; (1900), 16,195, of whom 5542 were foreign-born; (1905), 15,354; (1910), 14,610. It is served directly by the Wisconsin & Michigan, the Chicago, Milwaukee & St Paul, and the Chicago & North-Western railways, and by several steamboat lines connecting with lake ports; and is connected by ferry with Frankfort, Michigan (served by the Ann Arbor railroad). The city has a fine harbour and a considerable commerce in iron and lumber products. Five bridges connect Marinette with Menominee, Michigan, on the other side of the river. Marinette has a Federal building; the Stephenson public library, founded by Senator Isaac Stephenson (b. 1829), a local "lumber king"; a county agricultural school and training school for rural teachers, and three public parks. The Northern Chautauqua Assembly holds its annual summer session in Chautauqua Park, on the shore of Green Bay. The growth of Marinette began with the development of the neighbouring pine forests; and the manufacture of lumber and lumber products has always been its principal industry. The water-power of the Menominee River is largely utilized for the manufacture of paper and flour. Other manufactures are boxes, furniture and woodware, boats, boilers and agricultural machinery. In 1905 the factory products were valued at $3,633,399. The first white settlement was made here on the site of a Menominee Indian village in 1830, and the city was named in honour of the daughter of an Indian chief, Marinette (Jacobs), whose name was a composite of Marie and Antoinette. A city charter was granted in 1887.

MARINI (or MARINO), **GIAMBATTISTA** (1569–1625), Italian poet, was born at Naples on the 18th of October 1569. After a somewhat disreputable youth, during which he became known for his *Canzone de' baci*, he secured the powerful patronage of Cardinal Aldobrandini, whom he accompanied from Rome to Ravenna and Turin. An edition of his poems, *La Lira*, was published at Venice in 1602-1614. His ungoverned pen and disordered life compelled him to leave Turin and take refuge from 1615 to 1622 in Paris, where he was favourably recognized by Marie de' Medici. There his long poem *Adone* was published in 1623. He died at Naples on the 25th of March 1625. The licence, extravagance and conceits of Marini, the chief of the school of "Secentisti" (see ITALY: *Literature*), were characteristic of a period of literary decadence.

See M. Menghini, *G. B. Marini* (Rome, 1888).

MARINO, a town of Italy, in the province of Rome, 15 m. S.E. of it by rail, and also accessible by electric tramway. Pop. (1901), 7307. It is picturesquely situated on a spur of the Alban Hills, 1165 ft. above sea level, and occupies the site of the ancient Castrimoenium, a *municipium* of no great importance, though the surrounding district, which now produces much wine, is full of remains of ancient villas. The origin of the name is uncertain; perhaps it is derived from the medieval *Morena* (itself derived from the Latin *Murena*, from one of the Roman owners of the district), a name originally given to the lower ground between the 9th and 11th mile of the Via Latina. In the early 13th century it belonged to the Frangipani family, but passed into the hands of the Orsini in 1266. In 1378 a battle took place here between the partisans of Urban VI. and those of the anti-pope Clement VII. of Geneva (the Orsini having taken the side of the latter), who were, however, defeated; and in 1399 Marino was apparently under the Papacy. In 1408 it passed to the Colonna family, to whom it still belongs. There are some remains of the medieval fortifications.

See G. Tomassetti, *La Via latina nel medio evo* (Rome, 1886), p. 96 seq.; T. Ashby, in *Papers of the British School at Rome*, vol. iv. (1907). (T. As.)

MARINUS, the name of two popes. MARINUS I., sometimes called Martin II., pope from 882 to 884, was the son of a Tuscan priest, and entered the church at an early age, becoming a deacon about 862. Three successive popes sent him as legate to Constantinople, his mission in each case having reference to the controversy excited by Photius (*q.v.*); and having become an archdeacon and a bishop, he also negotiated on behalf of pope John VIII. with the emperor Charles the Fat. About the end of December 882 he succeeded John VIII. as pope, but his election did not pass unchallenged either in eastern or in western Europe. However, having secured his position, Marinus restored Formosus, cardinal-bishop of Porto, and anathematized Photius. This pope was on friendly terms with the English king, Alfred the Great. He died in May 884, and was succeeded by Adrian III.

MARINUS II., sometimes called Martin III., pope from 942 to 946, was merely the puppet of Alberic (d. 954), prince and senator of the Romans. He died in May 946, and was succeeded by Agapetus II.

MARINUS, neo-Platonist philosopher, was born in Palestine and was early converted to the old Greek religion. He came to Athens at a time when, with the exception of Proclus, there was a great dearth of eminent men in the neo-Platonic school. It was for this reason rather than for any striking ability of his own that he succeeded to the headship of the school on the death of Proclus. During this period the professors of the old Greek religion suffered severe persecution at the hands of the Christians and Marinus was compelled to seek refuge at Epidaurus. His chief work was a biography of Proclus, which is extant. It was first published with the works of Marcus Antoninus in 1559; it was republished separately by Fabricius at Hamburg in 1700, and re-edited in 1814 by Boissonade with emendations and notes. Other philosophical works are attributed to him, including commentaries on Aristotle and on the *Philebus*. It is said that he destroyed the latter because Isidore, his successor, expressed disapproval of it.

MARINUS OF TYRE, geographer and mathematician, the founder of mathematical geography, flourished in the 2nd century A.D. He lived before Ptolemy, who acknowledges his great obligations to him. His chief merits were that he assigned to each place its proper latitude and longtitude, and introduced improvements in the construction of his maps. He also carefully studied the works of his predecessors and the diaries of travellers. His geographical treatise is lost.

See A. Forbiger, *Handbuch der alten Geographie*, vol. i. (1842); E. H. Bunbury, *Hist. of Ancient Geography* (1879), ii. p. 519; and especially E. H. Berger, *Geschichte der wissenschaftlichen Erdkunde der Griechen* (1903).

MARIO, GIUSEPPE, COUNT OF CANDIA (1810–1883), Italian singer, the most famous tenor of the 19th century, son of General di Candia, was born at Cagliari in 1810. His career as a singer was the result of accidental circumstances. While serving as an officer in the Sardinian army he was imprisoned at Cagliari for some trifling offence. When his period of confinement was over, he resigned his commission. His resignation was refused, and he fled to Paris. There his success as an amateur vocalist produced an offer of an engagement at the Opera. He studied singing for two years under M. Ponchard and Signor Bordogni, and made his début in 1838 as the hero of Meyerbeer's *Robert le Diable*. His success was immediate and complete, but he did not stay long at the Opera. In 1839 he joined the company of the Théâtre Italien, which then included Malibran, Sontag, Persiani and Grisi, Rubini, Tamburini and Lablache. His first appearance here was made in the character of Nemorino in Donizetti's *Elisir d'Amore*. He sang in London for the first time in the same year. His success in Italian opera far surpassed that which he had won in French, and in a short time he acquired a European reputation. He had a handsome face and a graceful figure, and his voice, though less powerful than that of Rubini or that of Tamberlik, had a velvety softness and richness which have never been equalled. Experience gave him ease as an actor, but he never excelled in tragic parts. He was an ideal stage lover, and he retained the grace and charm of youth long after his voice had begun to show signs of decay. He created very few new parts, that of Ernesto in *Don Pasquale* (1843) being perhaps the only one deserving of mention. Among the most successful of his other parts were Otello in Rossini's opera of that name, Gennaro in *Lucrezia Borgia*, Alamviva in *Il Barbiere di Siviglia*, Fernando in *La Favorita*, and Manrico in *Il Trovatore*. Mario made occasional appearances in oratorio singing at the Birmingham Festival of 1849 and at the Hereford Festival of 1855, and undertook various concert tours in the United Kingdom, but his name is principally associated with triumphs in the theatre. In 1856 he married Giulia Grisi, the famous soprano, by whom he had five daughters. Mario bade farewell to the stage in 1871. He died at Rome in reduced circumstances on the 11th of December 1883.

MARION, FRANCIS (1732–1795), American soldier, was born in 1732, probably at Winyah, near Georgetown, South Carolina, of Huguenot ancestry. In 1759 he settled on Pond Bluff plantation near Eutaw Springs, in St John's parish, Berkeley county. In 1761 he served as a lieutenant under William Moultrie in a campaign against the Cherokees. In 1775 he was a member of the South Carolina Provincial Congress; and on the 21st of June was commissioned captain in the 2nd South Carolina regiment under W. Moultrie, with whom he served in June 1776 in the defence of Fort Sullivan (Fort Moultrie), in Charleston Harbor. In September 1776 the Continental Congress commissioned him a lieutenant-colonel. In the autumn of 1779 he took part in the siege of Savannah, and early in 1780, under General Benjamin Lincoln, was engaged in drilling militia. After the capture of Charleston (May 12, 1780) and the defeats of General Isaac Huger at Monk's Corner (Berkeley county, South Carolina) and Lieut.-Colonel Abraham Buford at the Waxhaws (near the North Carolina line, in what is now Lancaster county), Marion organized a small troop—which usually consisted of between 20 and 70 men—the only force then opposing the British in the state. Governor John Rutledge made him a brigadier-general of state troops, and in August 1780 Marion took command of the scanty militia, ill equipped and ill fed. With this force he was identified for almost all the remainder of the war in a partisan warfare in which he showed himself a singularly able leader of irregular troops. On the 20th of August he captured 150 Maryland prisoners, and about a score of their British guard; and in September and October repeatedly surprised larger bodies of Loyalists or British regulars. Colonel Banastre Tarleton, sent out to capture him, despaired of finding the "old swamp fox," who eluded him by following swamp paths. When General Nathanael Greene took command in the south, Marion and Colonel Henry Lee were ordered in January 1781 to attack Georgetown, but they were unsuccessful. In April, however, they took Fort Watson and in May Fort Motte, and they succeeded in breaking communications between the British posts in the Carolinas. On the 31st of August Marion rescued a small American force hemmed in by Major C. Fraser with 500 British; and for this he received the thanks of Congress. He commanded the right wing under General Greene at Eutaw Springs. In 1782, during his absence as state senator at Jacksonborough, his brigade deteriorated and there was a conspiracy to turn him over to the British. In June of the same year he put down a Loyalist uprising on the banks of the Pedee river; and in August he left his brigade and returned to his plantation. He served several terms in the state Senate, and in 1784, in recognition of his services, was made commander of Fort Johnson, practically a courtesy title with a salary of £500 per annum. He died on his estate on the 27th of February 1795. Marion was small, slight and sickly-looking. As a soldier he was quick, watchful, resourceful and calm, the greatest of partisan leaders in the bitter struggle in the Carolinas.

See the *Life* (New York, 1844) by W. G. Simms; Edward McCrady, *South Carolina in the Revolution* (New York, 1901–1902); and a careful study of Marion's ancestry and early life by "R. Y." in vols. i. and ii. of the *Southern and Western Monthly Magazine and Review* (Charleston, 1845).

MARION, HENRI FRANÇOIS (1846–1896), French philosopher and educationalist, was born at Saint-Parize-en-Viry (Nièvre) on the 9th of September 1846. He studied at Nevers, and at the École Normale, where he graduated in 1868. After occupying several minor positions, he returned to Paris in 1875 as professor of the Lycée Henri IV., and in 1880 he became *docteur-ès-lettres.* In the same year he was elected a member of the Council of Public Instruction, and devoted himself to improving the scheme of French education, especially in girls' schools. He was largely instrumental in the foundation of *écoles normales* in provincial towns, and himself gave courses of lectures on psychology and practical ethics in their early days. He died in Paris on the 5th of April 1896.

His chief philosophical works were an edition of the *Théodicée* of Leibnitz (1874), a monograph on Locke (1878), *Devoirs et droits de l'homme* (1880), *Glissonius utrum Leibnitio de natura substantiae cogitanti quidquam tribuerit* (1880); *De La solidarité morale* (4th ed., 1893). His lectures at Fontenoy have been published in two volumes entitled *Leçons de psychologie appliquée à l'éducation*, and *Leçons de morale*; those delivered at the Sorbonne are collected in *L'Éducation dans l'université* (1892).

MARION, a city and the county-seat of Grant county, Indiana, U.S.A., about 60 m. N.E. of Indianapolis, on the Mississinewa River. Pop. (1910), 19,359. It is served by the Chicago, Cincinnati & Louisville, the Cleveland, Cincinnati, Chicago & St Louis, the Pittsburgh, Cincinnati, Chicago & St Louis, and the Toledo, St Louis & Western railways, and by interurban electric lines connecting with Indianapolis, Muncie, Fort Wayne, Kokomo and many other towns and cities. The city is the seat of the Marion Normal College and Business University, and has a Carnegie library. Marion lies in a good farming country and in the centre of the state's natural gas region. Among the manufactures are glass, stoves, iron bedsteads, foundry and machine-shop products, steel, planing-mill products, paper and pulp, and leather. The total value of the factory products in 1905 was $4,290,166, the value of the glass product alone being $1,042,057, or 24.3% of the total. Marion was settled in 1832, and was named in honour of General Francis Marion.

MARION, a city and the county-seat of Marion county, Ohio, U.S.A., 44 m. N. by W. of Columbus. Pop. (1900), 11,862, including 782 foreign-born and 112 negroes; (1910), 18,232. Marion is served by the Pennsylvania, the Erie, the Cleveland, Cincinnati, Chicago & St. Louis, and the Hocking Valley railways, and by interurban electric railway to Columbus. It is the trade centre of a rich farming district. Limestone is abundant, and the city has various manufactures, including lime, foundry and machine-shop products, agricultural implements, planing-mill products, engines, steam shovels, dredges, pianos and silks. In 1905 the value of factory products was $3,227,712, being 33.1% greater than in 1900. Marion was laid out in 1821, and was chartered as a city in 1890.

MARIONETTES (probably from Ital. *morio*, a fool or buffoon, but also said to be derived from the *mariolettes*, or little figures of the Virgin Mary), FANTOCCINI (from *fantino*, a child) or PUPPETS (Fr. *poupée* Lat. *pupa*, a baby or doll), the names given to figures, generally below life-size, suspended by threads or wires and imitating with their limbs and heads the movements of living persons.

The high antiquity of puppets appears from the fact that figures with movable limbs have been discovered in the tombs of Egypt and among the remains of Etruria; they were also common among the Greeks, from whom they were imported to Rome. Plays in which the characters are represented by puppets or by the shadows of moving figures, worked by concealed performers who deliver the dialogue, are not only popular in India and China, but during several centuries past maintained an important position among the amusements of the people in most European countries. Goethe and Lessing deemed them worthy of attention; and in 1721 Le Sage wrote plays for puppets to perform.

The earliest performances in English were drawn or founded upon Bible narratives and the lives of the saints, in the same vein as the "morality" plays which they succeeded. Popular subjects in the 16th century were *The Prodigal Son* and *Nineveh, with Jonah and the Whale*. And in a pamphlet of 1641, describing Bartholomew Fair, we read, "Here a knave in a fool's coat, with a trumpet sounding or a drum beating, invites you to see his puppets. Here a rogue like a wild woodman, or in an antic shape like an incubus, desires your company to view his motion." In 1667 Pepys recorded how at Bartholomew Fair he found "my Lady Castlemaine at a puppet play, Patient Grizill." Besides *The Sorrows of Griselda*, other puppet plays of the period were *Dick Whittington, The Vagaries of Merry Andrew*, and *The Humours of Bartholomew Fair*. Powell's noted marionette show was the subject of an article in *The Tatler*, 1709, and again in *The Spectator*, 1711. The latter refers also to Pinkethman, a "motion-maker," in whose scenes the divinities of Olympus ascended and descended to the strains of music. An idea of the class of representation may be gathered from an advertisement of Crawley, a rival of Pinkethman, which sets forth—"The Old Creation of the World, with the addition of Noah's Flood," also several fountains playing water during the time of the play. The best scene represented "Noah and his family coming out of the ark, with all the animals two by two, and all the fowls of the air seen in a prospect sitting upon trees; likewise over the ark is the sun rising in a gorgeous manner; moreover a multitude of angels in a double rank," the angels ringing bells. "Likewise machines descending from above, double, with Dives rising out of hell and Lazarus seen in Abraham's bosom; besides several figures dancing jiggs, sarabands, and country dances, with the merry conceits of Squire Punch and Sir John Spendall." Yates showed a moving picture of a city, with an artificial cascade, and a temple—with mechanical birds in which attention was called to the exact imitation of living birds, the quick motion of the bills, just swelling of the throat, and fluttering of the wings. The puppets were wax figures 5 ft. in stature. Toward the end of the 18th century, Flockton's show presented five hundred figures at work at various trades. Brown's Theatre of Arts showed at country fairs, from 1830 to 1840, the battle of Trafalgar, Napoleon's army crossing the Alps, and the marble palace of St Petersburg; and at a still later date Clapton's similar exhibition presented Grace Darling rescuing the crew of the "Forfarshire" steamer wrecked on the Fern Islands, with many ingenious moving figures of quadrupeds, and, in particular, a swan which dipped its head into imitation water, opened its wings, and with flexible neck preened and trimmed its plumage. In these mechanical scenes the figures, painted upon a flat surface and cut out, commonly of pasteboard, are slid along grooves arranged transversely in front of the set scenery, the actions of legs and arms being worked by wires from the hands of persons below the stage, though sometimes use is made of clockwork. In recent days the literature for the marionette stage has had an important literary recruit in the person of the Belgian author Maurice Maeterlinck.

Marionettes proper, and the dolls exhibited in puppet shows (not including Punch and his companion actors), are constructed of wood or of pasteboard, with faces of composition, sometimes of wax; and each figure is suspended by a number of threads to a short bar of wood which is commonly held in one hand of the hidden performer while the finger of his other hand poses the figure or gives action to it by means of the threads. In the mode of constructing the joints, and the greater elaboration with which the several parts of the limbs are supported and moved, and especially in the fine degrees of movement given to the heads, marionettes have been so improved as to present very exact imitations of the gestures of actors and actresses, and the postures and evolutions of acrobats; and, in addition, ingenious exhibitors such as Theodon, who introduced many novelties in the 'sixties of the 19th century, have employed mechanical arrangements for accomplishing the tricks of pantomime harlequinade. Among the puppet personages presented in the small street shows are generally included a sailor who dances a hornpipe, a hoop-dancer, a dancer of the Highland fling, a wooden-legged pensioner, a vaulter on a pole also balancing two chairs, a clown playing with a butterfly, a dancing figure without head until the head rises out of the body, gradually displaying an enormously long neck, and a skeleton, seen at first in scattered parts lying about the stage, but piece successively flying to piece, the body first sitting up, then standing, and finally capped by the skull, when the completed figure begins to dance.

Ombres Chinoises are performances by means of the shadows of figures projected upon a stretched sheet of thin calico or a gauze scene painted as a transparency. The cardboard flat figures are held behind this screen, illuminated from behind—the performer supporting each figure by a long wire held in one hand while wires from all the movable parts terminate in rings in which are inserted the fingers of his other hand.

See also C. Magnin, *Histoire des marionettes* (1852; 2nd ed., 1862); L. de Neuville, *Histoire des marionettes* (1892).

MARIOTTE, EDME (*c.* 1620–1684), French physicist, spent most of his life at Dijon, where he was prior of St Martin sous Beaune. He was one of the first members of the Academy of Sciences founded at Paris in 1666. He died at Paris on the 12th of May 1684. The first volume of the *Histoire et mémoires de l'Académie* (1733) contains many original papers by him upon a great variety of physical subjects, such as the motion of fluids, the nature of colour, the notes of the trumpet, the barometer, the fall of bodies, the recoil of guns, the freezing of water, &c.

His *Essais de physique*, four in number, of which the first three were published at Paris between 1676 and 1679, are his most important works, and form, together with a *Traité de la percussion des corps*, the first volume of the *Œuvres de Mariotte* (2 vols., Leiden, 1717). The second of these essays (*De La nature de l'air*) contains the statement of the law that the volume of a gas varies inversely as the pressure, which, though very generally called by the name of Mariotte, had been discovered in 1660 by Robert Boyle. The fourth essay is a systematic treatment of the nature of colour, with a description of many curious experiments and a discussion of the rainbow, halos, parhelia, diffraction, and the more purely physiological phenomena of colour. The discovery of the blind spot is noted in a short paper in the second volume of his collected works.

MARIPOSAN, or YOKUTS, a linguistic stock of North American Indians, including some 40 small tribes. Its former territory was in southern California, around Tulare lake. The Mariposans were fishers and hunters. Their villages consisted of a single row of wedge-shaped huts, with an awning of brush along the front. In 1850 they numbered some 3000; in 1905 there were 154 on the Tule river reservation.

MARIS, JACOB (1837–1899), Dutch painter, first studied at the Antwerp Academy, and subsequently in Hébert's studio during a stay in Paris from 1865 till 1871. He returned to Holland when the Franco-Prussian War broke out, and died there in August 1899. Though he painted, especially in early life, domestic scenes and interiors invested with deeply sympathetic feeling, it is as a landscape painter that Maris will be famous. He was the painter of bridges and windmills, of old quays, massive towers, and level banks; even more was he the painter of water, and misty skies, and chasing clouds. In all his works, whether in water or oil colour, and in his etchings, the subject is always subordinate to the effect. His art is suggestive rather than decorative, and his force does not seem to depend on any preconceived method, such as a synthetical treatment of form or gradations of tone. And yet, though his means appear so simple, the artist's mind seems to communicate with the spectator's by directness of pictorial instinct, and we have only to observe the admirable balance of composition and truthful perspective to understand the sure knowledge of his business that underlies such purely impressionist handling. Maris has shown all that is gravest or brightest in the landscape of Holland, all that is heaviest or clearest in its atmosphere—for instance, in the "Grey Tower, Old Amsterdam," in the "Landscape near Dordrecht," in the "Sea-weed Carts, Scheveningen," in "A Village Scene," and in the numerous other pictures which have been exhibited in the Royal Academy, London, in Edinburgh (1885), Paris, Brussels and Holland, and in various private collections. "No painter," says M. Philippe Zilcken, "has so well expressed the ethereal effects, bathed in air and light through floating silvery mist, in which painters delight, and the characteristic remote horizons blurred by haze; or again, the grey yet luminous weather of Holland, unlike the dead grey rain of England or the heavy sky of Paris."

See Max Rooses, *Dutch Painters of the Nineteenth Century* (London, 1899); R. A. M. Stevenson, "Jacob Maris," *Magazine of Art* (1900); Ph. Zilcken, *Peintres Hollandais modernes* (Amsterdam, 1893); Jan Veth, "Een Studie over Jacob Maris," *Onze Kunst* (Antwerp, 1902).

MARITIME PROVINCE (Russ., *Primorskaya Oblast*), a province of Russia, in East Siberia. It consists of a strip of territory along the coast of the Pacific from Korea to the Arctic Ocean, including also the peninsula of Kamchatka, part of the island of Sakhalin, and several small islands along the coast. Its western boundary stretches northwards from a point S.W. of Peter the Great Bay (42° 40′ N.) by Lake Hanka or Khanka and along the Usuri, then goes due north from the mouth of the Usuri as far as 52° N., runs along the Stanovoi watershed, crosses the spurs of this plateau through barren *tundras*, and finally reaches the Arctic Ocean at Chaun Bay (70° N.). Area, 715,735 sq. m.

The northern part lies between the Arctic Ocean and the Seas of Bering and Okhotsk, and has the character of a barren plateau 1000 to 2000 ft. high, deeply indented by the rivers of the Anadyr basin and by long fiords, such as Kolyuchin Bay (the wintering-place of Nordenskjöld's "Vega"), the Gulf of Anadyr, and the Bays of Penzhina and Ghizhiga. To the north this plateau is bordered by a chain of mountains, several summits of which reach 8000 ft (Makachinga peak), while the promontories by which the Asiatic continent terminates towards Bering Strait run up to 1000 to 2000 ft. Only lichens and mosses, with a few dwarf species of Siberian trees, grow in this district. The fauna, however, is far richer than might be expected. A few American birds and mammals cross the strait when it is frozen. This country, and the seas which surround it, have for the last two centuries supplied Siberian trade with its best furs. The blue fox and black sable have been nearly exterminated, and the whale has become very rare. The sea-otter is rapidly becoming extinct, as well as the sea-lion (*Otaria stelleri*); while the sea-cow (*Rhytina stelleri*) was completely extirpated in the course of forty years. The sea-bear (*Otaria ursina*), which at one time seemed likely to meet with the same fate, is now nearly domesticated, and multiplies rapidly. The middle part of the province is a narrow strip (40 to 60 m. wide) along the Sea of Okhotsk, including the basin of the Uda in the south. This area is occupied by rugged mountains, 4000 to 7000 ft. high, forming the eastern border of the high plateau of East Siberia. Thick forests of larch clothe the mountains half way up, as well as the deep valleys. The undulating hills of the basin of the Uda, which is a continuation to the south-west, between the Stanovoi and Bureya mountains, of the deep indentation of the Sea of Okhotsk, are covered with forests and marshes.

The southern part of the province includes two distinct regions. From the north-eastern extremity of the Bureya, or Little Khingan range, of which the group of the Shantar Islands is a continuation, a wide, deep depression runs south-west to the confluence of the Amur and the Usuri, and thence to the lowlands of the lower Sungari. This is for the most part less than 500 ft. above sea-level. The region on the right banks of the Amur and the Usuri, between these rivers and the coast, is occupied by several systems of mountains, usually represented as a single range, the Sikhota-alin. The summits reach 5150 ft. (Golaya Gora), and the average elevation of the few passes is about 2500 ft. There is, however, one depression occupied by Lake Kidzi, which may have been at one time an outflow of the Amur to the sea. The Sikhota-alin mountains are covered with impenetrable forests. The flora and fauna of this region (especially in the Usuri district) exhibit a striking combination of species of warm climates with those of subarctic regions; the wild vine clings to the larch and the cedar-pine, and the tiger meets the bear and the sable. The quantity of fish in the rivers is immense, and in August the Amur and the Usuri swarm with salmon.

The best part of the Maritime Province is at its southern extremity in the valley of the Suifeng river, which enters the Pacific in the Gulf of Peter the Great, and on the shores of the bays of the southern coast. But even there the climate is very harsh. The warm sea-current of the Kuro-Siwo does not reach the coasts of Siberia, while a cold current originating in the Sea of Okhotsk brings its icy water and chilling fogs to the coasts of Sakhalin, and flows along the Pacific shore to the eastern coast of Korea. The high mountains of the sea-coast and the monsoons of the Chinese Sea produce in the southern parts of the Maritime Province cold winters and wet summers. Accordingly, at Vladivostok (on the Gulf of Peter the Great), although it has the same latitude as Marseilles, the average yearly temperature is only 39·5° F., and the harbour is frozen for nearly three months in the year; the Amur and the Usuri are frozen in November. Towards the end of summer the moist monsoons bring heavy rains, which destroy the harvests and give rise to serious inundations of the Amur. The sea-coast farther north has a continental and arctic climate. At Nikolayevsk, temperatures as low as −41·5° F. are observed in winter, and as high as 94·6° in summer, the average yearly temperature being below zero (−0·9°). At Ayan (56° 27′ N.) the average temperature of the year is 25·5° (−0·4° in winter and 50·5° in summer), and at Okhotsk (59° 21′ N.) it is 23° (−6° in winter and 52·5° in summer).

Russian settlements occur throughout the whole of the province, but, with the exception of those on the banks of the Amur and the Usuri, and the southern ports of the sea-coast, they are mere centres of administration.

Okhotsk is one of the oldest towns of East Siberia, having been founded in 1649. Nikolayevsk, on the left bank of the Amur, was formerly the capital of the Maritime Province; but the difficulties of navigation and of communication with the interior, and the complete failure of the governmental colonization of the Amur, caused the seat of government to be transferred to Khabarovsk. Since the loss (1905) of Port Arthur to the Japanese, Vladivostok on Peter the Great Bay has again become the chief naval station of Russia on the Pacific. The trade is in the hands of the Chinese, who export stags' horns, seaweed and mushrooms, and of the Germans, who import groceries and spirits.

The total population was 209,516 in 1897, of whom 57·7% were Russians, the others being Tunguses, Golds, Orochons, Lamuts, Chuvantses, Chukchis, Koryaks, Ghilyaks and Kamchadales. Their chief occupations are hunting and fishing; the Russians carry on agriculture and trade in furs. Active measures were taken in 1883–1897 for increasing the Russian population in the South Usuri district, the result being that over 29,000 immigrants, chiefly Little Russian peasants, settled there; while Cossacks from the Don and Orenburg came to settle among the Usuri Cossacks. Agriculture is gradually developing in the South Usuri region. Gold-mining has been started on the Amguñ, a tributary of the Amur. Coal is found near Vladivostok, as well as in Kamchatka. Roads exist only in the South Usuri district. A railway runs from Vladivostok to Nikolsk (69 m.), and thence to Khabarovsk along the right bank of the Usuri (412 m.). At Nikolsk the Manchurian railway begins.
(P. A. K.; J. T. Be.)

MARITIME TERRITORY, a term used in international law to denote coastal waters which are not Territorial Waters though in immediate contact with the sea. In the case of Territorial Waters (*q.v.*) the dominion of the adjacent state is subject to a limitation. Dominion over maritime territory is not subject to any limitation. Thus any strait through which the right of passage of foreign vessels can be forbidden (as the Solent or the Inland Sea of Japan), or bays so land-locked that they cannot be held to form part of any ocean-highway, are maritime territory.

MARIUPOL, a seaport of Russia, on the north shore of the Sea of Azov, at the mouth of the Kalmius, in the government of Ekaterinoslav, 67 m. W. of Taganrog. Pop. (1900), 52,770, including the inhabitants of two suburbs, Mariinsk and Kara-su. The place is said to have been inhabited in remote times under the name of Adamakha; the present town was built only in 1779, by Greek emigrants from the Crimea. Its inhabitants are engaged in agriculture, cattle-breeding, fishing, and the manufacture of leather, agricultural implements, iron goods and bricks. In export trade Mariupol ranks next to Taganrog among the ports of the Sea of Azov; but its harbour is open to the south-east and shallow, though it is being gradually deepened by systematic dredging. The principal articles of export are cereals, with some oilcake, phosphate and coal; but the total value is only about £2,000,000 annually. The imports do not reach a quarter of a million sterling.

MARIUS OF AVENCHES (or Aventicum) (d. 593 or 594), chronicler and ecclesiastic, was born in the neighbourhood of Autun probably in 530, and became bishop of Avenches about 573. In addition to being a good bishop, Marius was a clever goldsmith; he was present at the council of Mâcon in 585, and transferred the seat of his bishopric from Avenches to Lausanne. He died on the 31st of December 593 or 594. As a continuation of the *Chronicon* of Prosper of Aquitaine, Marius wrote a short *Chronicon* dealing with the period from 455 to 581; and although he borrowed from various sources his work has some importance for the history of Burgundy. Regarding himself and his land as still under the authority of the Roman empire, he dates his *Chronicon* according to the years of the Roman consuls and of the East Roman emperors.

The only extant manuscript of the *Chronicon* is in the British Museum. Among several editions may be mentioned the one in the *Monumenta Germaniae historica, chronica minora*, Band II. (1893), with introduction by T. Mommsen. See also W. Arndt, *Bischof Marius von Aventicum* (Leipzig, 1875); and W. Wattenbach, *Deutschlands Geschichtsquellen*, Bd. I. (1904).

MARIUS, GAIUS (155–86 B.C.), Roman general, of plebeian descent, the son of a small farmer of Cereatae (mod. *Casamare*, "home of Marius") near Arpinum. He served first in Spain under the great Scipio Africanus, and rose from the ranks to be an officer. In 119 as tribune he proposed a law intended to limit the influence of the nobles at elections. This brought him into conflict with the aristocratic party, who prevented him from obtaining the aedileship. When about forty years of age he married a lady of patrician rank, Julia, the aunt of Julius Caesar. This gave him a new social status, and being at the same time a popular favourite and a brave, energetic soldier, he was in 115 elected praetor, in which capacity he effected the subjugation of the troublesome province of Further Spain. In the war with Jugurtha (109–106) he came to the front as lieutenant of the consul Quintus Caecilius Metellus Numidicus. When he had already achieved some important successes over Jugurtha (*q.v.*), in 107 he was elected consul for the first time (an almost unheard-of honour for a "new man"), his popularity with the army and people being sufficient to bear down all opposition. In the following year, in conjunction with Sulla, he brought the war to a triumphant issue, and passed two years in his province of Numidia, which he thoroughly subdued and annexed. The surrender of the person of Jugurtha to Sulla gave rise to the view that he, not Marius, had really ended the war, and so laid the foundation of the subsequent enmity between the two leaders.

By this time Marius was generally recognized as the ablest general of the day, and was appointed to the chief command against the Cimbri and Teutones. Two Roman armies had been destroyed near the Lake of Geneva, and it seemed as if a repetition of the disaster of the Allia and the capture of Rome itself might not be impossible. Marius, out of unpromising materials and a demoralized soldiery, organized a well-disciplined army, with which he inflicted on the invaders two decisive defeats, the first in 102 at Aquae Sextiae (*Aix*), 18 m. north of Marseilles, and the second in the following year on the Raudian plain near Vercellae (*Vercelli*), about midway between Turin and Milan. For some centuries afterwards Rome remained unmolested by northern barbarians. In 101 Marius was elected consul a fifth time (previously in 107, 104, 103, 102), hailed as the "saviour of his country," and honoured with a triumph of unprecedented splendour.

The glorious part of his career was now over. Though a very able soldier, he was without the intellectual culture which the Gracchi, his political ancestors, possessed. As a politician he on the whole failed, though he retained the confidence of the popular party almost to the last. But he unfortunately associated himself with the demagogues Saturninus (*q.v.*) and Glaucia, in order to secure the consulship for the sixth time (100). The manner in which he turned against his former associates (although he probably had no choice in the matter) alienated the sympathies of the plebs; and Marius, feeling that his only chance of rehabilitation lay in war, left Rome for Asia, where he endeavoured to provoke Mithradates to hostilities. On his return he served as legate in the Social War (90), and defeated the Marsi on two occasions. In 88 war broke out with Mithradates, and Sulla was appointed by the senate to the chief command, which was eagerly desired by Marius. This led to a rupture. With the assistance of the tribune Sulpicius Rufus, Marius succeeded in getting the command transferred to himself. Sulla marched upon Rome and defeated Marius, who fled to the marshes of Minturnae in Latium. He was discovered and taken prisoner; and the local magistrates, in accordance with Sulla's proclamation, resolved to put him to death. The Gallic trooper sent to strike off the old man's head quailed, it is said, before the fire of his eyes, and fled exclaiming, "I cannot kill Gaius Marius." The inhabitants out of compassion then allowed Marius to depart, and put him on board a ship which conveyed him to Carthage. When forbidden to land, he told the messenger to inform the governor that he had seen Marius sitting as a fugitive among the ruins of Carthage. Having been joined by his son, he took refuge in the island of Cercina. Meantime, Sulla having left Italy for the Mithradatic war, Cinna's sudden and violent revolution put the senate at the mercy of the popular leaders, and Marius greedily caught at the opportunity of a bloody vengeance, which became in fact a reign of terror in which senators and nobles were slaughtered wholesale. He had himself elected consul for the seventh time, in fulfilment of a prophecy given to him in early manhood. Less than three weeks afterwards he died of fever, on the 13th of January 86.

Marius was not only a great general, but also a great military reformer. From his time a citizen militia was replaced by a professional soldiery, which had hitherto been little liked by the Roman people. He further made the cohort the military unit instead of the maniple, and his cavalry and light-armed troops were drawn from foreign countries, so that it may be said that Marius was the originator of the mercenary army. The Roman soldier was henceforth a man who had no trade but war. A great general could hardly fail to become the foremost man in the state. Marius, however, unlike Caesar, did not attempt to overturn the oligarchy by means of the army; he used rather such expedients as the constitution seemed to allow, though they had to be backed up by riot and violence. He failed as a political reformer because the merchants and the moneyed classes, whom the Gracchi had tried to conciliate, feared that they would themselves be swept away by a revolution of which the mob and its leaders would be the ultimate controllers. Marius had a decided tinge of fanaticism and superstition. In canvassing for the consulship he was guided by the counsels of an Etruscan soothsayer, and was accompanied in his campaigns by a Syrian prophetess. The fashionable accomplishments of the day, and the new Greek culture, were wholly alien to his taste.

For the life of Marius the original sources are numerous passages in Cicero's works, Sallust's *Jugurtha*, the epitomes of the lost books of Livy, Plutarch's *Lives* of Sulla and Marius, Velleius Paterculus, Florus and Appian's *Bellum civile*. See F. D. Gerlach, *Marius und Sulla* (Basel, 1856); I. Gilles, *Campagne de Marius dans la Gaule* (1870); W. Votsch, *Marius als Reformator des römischen Heerwesens* (with notes and references to ancient authorities, 1886); A. H. J. Greenidge, *History of Rome*, vol. i. (1904); also ROME: *History*, II. "The Republic."

MARIVAUX, PIERRE CARLET DE CHAMBLAIN DE (1688–1763), French novelist and dramatist, was born at Paris on the 4th of February 1688. His father was a financier of Norman extraction whose real name was Carlet, but who assumed the surname of Chamblain, and then superadded that of Marivaux. M. Carlet de Marivaux was a man of good reputation, and he received the appointment of director of the mint at Riom in Auvergne, where and at Limoges the young Pierre was brought up. It is said that he developed literary tastes early, and wrote his first play, the *Père prudent et équitable*, when he was only eighteen; it was not, however, published till 1712, when he was twenty-four. His chief attention in those early days was paid to novel writing, not the drama. In the three years from 1713 to 1715 he produced three novels—*Effets surprenants de la sympathie*; *La Voiture embourbée*, and a book which had three titles—*Pharsamon*, *Les Folies romanesques*, and *Le Don Quichotte moderne*. All these books were in a curious strain, not in the least resembling the pieces which long afterwards were to make his reputation, but following partly the Spanish romances and partly the heroic novels of the preceding century, with a certain intermixture of the marvellous. Then Marivaux's literary ardour took a new phase. He fell under the influence of Antoine Hondar[d] de La Motte, and thought to serve the cause of that ingenious paradoxer by travestying Homer, an ignoble task, which he followed up (perhaps, for it is not certain) by performing the same office in regard to Fénelon. His friendship for La Motte, however, introduced him to the *Mercure*, the chief newspaper of France, where in 1717 he produced various articles of the "Spectator" kind, which were distinguished by much keenness of observation and not a little literary skill. It was at this time that the peculiar style called Marivaudage first made its appearance in him. The year 1720 and those immediately following were very important ones for Marivaux; not only did he produce a comedy, now lost except in small part, entitled *L'Amour et la vérité*, and another and far better one entitled *Arlequin poli par l'amour*, but he wrote a tragedy, *Annibal* (printed 1737), which was and deserved to be unsuccessful. Meanwhile his wordly affairs underwent a sudden revolution. His father had left him a comfortable subsistence, but he was persuaded by friends to risk it in the Mississippi scheme, and after vastly increasing it for a time lost all that he had. His prosperity had enabled him to marry (perhaps in 1721) a certain Mlle Martin, of whom much good is said, and to whom he was deeply attached, but who died very shortly. His pen now became almost his sole resource. He had a connexion with both the fashionable theatres, for his *Annibal* had been played at the Comédie Française and his *Arlequin poli* at the Comédie Italienne, where at the time a company who were extremely popular, despite their imperfect command of French, were established. He endeavoured too to turn his newspaper practice in the *Mercure* to more account by starting a weekly *Spectateur Français* (1722–1723), to which he was the sole contributor. But his habits were the reverse of methodical; the paper appeared at the most irregular intervals; and, though it contained some excellent work, its irregularity killed it. For nearly twenty years the theatre, and especially the Italian theatre, was Marivaux's chief support, for his pieces, though they were not ill received by the actors at the Français, were rarely successful there. The best of a very large number of plays (Marivaux's theatre numbers between thirty and forty items) were the *Surprise de l'amour* (1722), the *Triomphe de Plutus* (1728), the *Jeu de l'amour et du hasard* (1730), *Les Fausses confidences* (1737), all produced at the Italian theatre, and *Le Legs* (1736), produced at the French. Meanwhile he had at intervals returned to both his other lines of composition. A periodical publication called *L'Indigent philosophe* appeared in 1727, and another called *Le Cabinet du philosophe* in 1734, but the same causes which had proved fatal to the *Spectateur* prevented these later efforts from succeeding. In 1731 Marivaux published the first two parts of his best and greatest work, *Marianne*, a novel of a new and remarkable kind. The eleven parts appeared in batches at intervals during a period of exactly the same number of years, and after all it was left unfinished. In 1735 another novel, *Le Paysan parvenu*, was begun, but this also was left unfinished. He was elected a member of the Academy in 1742. He survived for more than twenty years, and was not idle, again contributing occasionally to the *Mercure*, writing plays, "reflections" (which were seldom of much worth), and so forth. He died on the 12th February 1763, aged seventy-five years.

The personal character of Marivaux was curious and somewhat contradictory, though not without analogies, one of the closest of which is to be found in Goldsmith. He was, however, unlike Goldsmith, at least as brilliant in conversation as with the pen. He was extremely good-natured, but fond of saying very severe things, unhesitating in his acceptance of favours (he drew a regular annuity from Helvetius), but exceedingly touchy if he thought himself in any way slighted. He was, though a great cultivator of *sensibilité*, on the whole decent and moral in his writings, and was unsparing in his criticism of the rising *Philosophes*. This last circumstance, and perhaps jealousy as well, made him a dangerous enemy in Voltaire, who lost but few opportunities of speaking disparagingly of him. He had good friends, not merely in the rich, generous and amiable Helvetius, but in Mme de Tencin, in Fontenelle and even in Mme de Pompadour, who gave him, it is said, a considerable pension, of the source of which he was ignorant. His extreme sensitiveness is shown by many stories. He had one daughter, who took the veil, the duke of Orleans, the regent's successor, furnishing her with her dowry.

The so-called Marivaudage is the main point of importance about Marivaux's literary work, though the best of the comedies have great merits, and *Marianne* is an extremely important step in the legitimate development of the French novel—legitimate, that is, in opposition to the brilliant but episodic productions of Le Sage. Its connexion, and that of *Le Paysan parvenu*, with the work not only of Richardson but of Fielding is also an interesting though a difficult subject. The subject matter of Marivaux's peculiar style has been generally and with tolerable exactness described as the metaphysic of love-making. His characters, in a happy phrase of Claude Prosper Jolyot Crébillon's, not only tell each other and the reader everything they have thought, but everything that they would like to persuade themselves that they have thought. The style chosen for this is justly regarded as derived mainly from Fontenelle, and through him from the Précieuses, though there are traces of it even in La Bruyère. It abuses metaphor somewhat, and delights to turn off a metaphor itself in some unexpected and bizarre fashion. Now it is a familiar phrase which is used where dignified language would be expected; now the reverse. In the criticism of Crébillon's already quoted occurs another happy description of Marivaux's style as being "an introduction to each other of words which have never made acquaintance, and which think that they will not get on together," a phrase as happy in its imitation as in its satire of the style itself. This kind of writing, of course, recurs at several periods of literature, and did so remarkably at the end of the 19th century in more countries than one. Yet this fantastic embroidery of language has a certain charm, and suits perhaps better than any other style the somewhat unreal gallantry and *sensibilité* which it describes and exhibits. The author possessed, moreover, both thought and observation, besides considerable command of pathos.

The best and most complete edition of Marivaux is that of 1781 in 12 vols. reprinted with additions 1825–1830. The plays had been published during the author's lifetime in 1740 and 1748. There are modern editions by Paul de Saint Heylli Victor (1863), by G. d'Heylli (1876) and by E. Fournier (1878), while issues of selections and separate plays and novels are numerous. Of works concerning him J. Fleury's *Marivaux et le Marivaudage* (Paris, 1881), G. Larroumet's *Marivaux, sa vie et ses œuvres* (1882; new ed., 1894), the standard work on the subject, and G. Deschamps's *Marivaux* (1897), in the *Grands écrivains français*, are the most important. Separate articles on him will be found in the collected essays of the chief modern French critics from Sainte-Beuve onwards. (G. Sa.)

MARJORAM, (O. Fr. *majorane*, Med. Lat. *majorana*; not connected with *major*, greater, nor with *amaracus*), in botany, the common name for some aromatic herbs or undershrubs, belonging to the genus *Origanum* (natural order Labiatae). Wild marjoram is *O. vulgare*, a perennial common in England in dry copses and on hedge-banks, with many stout stems 1 to 3 ft. high, bearing short-stalked somewhat ovate leaves and clusters of purple flowers. Sweet or knotted marjoram, *O. Marjorana*, and pot marjoram, *O. Onites*, are cultivated for the use of their aromatic leaves, either green or dry, for culinary purposes; the tops are cut as the plants begin to flower and are dried slowly in the shade.

MARK, ST, the traditional author of the second Gospel. His name occurs in several books of the New Testament, and doubtless refers in all cases to the same person, though this has been questioned. In the Acts of the Apostles (xii. 12) we read of "John, whose surname was Mark," and gather that Peter was a familiar visitor at the house of his mother Mary, which was a centre of Christian life in Jerusalem. That he was, as his Roman surname would suggest, a Hellenist, follows from the fact that he was also cousin ("nephew" is a later sense of ἀνεψιός, see J. B. Lightfoot on Col. iv. 10) of Barnabas, who belonged to Cyprus. When Barnabas and Paul returned from their relief visit to Judaea (*c.* A.D. 46), Mark accompanied them (xii. 25). Possibly he had shown in connexion with their relief work that practical capacity which seems to have been his distinctive excellence (cf. 2 Tim. iv. 11). When, not long after, they started on a joint mission beyond Syria, Mark went as their assistant, undertaking the minor personal duties connected with travel, as well as with their work proper (xiii. 5). As soon, however, as their plans developed, after leaving Cyprus and on arrival at Perga in Pamphylia (see PAUL), Mark withdrew, probably on some matter of principle, and returned to Jerusalem (xiii. 13). When, then, Paul proposed, after the Jerusalem council of Acts xv., to revisit with Barnabas the scenes of their joint labours, he naturally demurred to taking Mark with them again, feeling that he could not be relied on should fresh openings demand a new policy. But Barnabas stood by his younger kinsman and "took Mark and sailed away to Cyprus" (xv. 38 seq.). Barnabas does not reappear, unless we trust the tradition which makes him an evangelist in Alexandria (Clem. *Hom.* i. 9 seq., cf. the attribution to him of the Alexandrine *Epistle of Barnabas*).

When Mark appears once more, it is in Paul's company at Rome, as a fellow-worker joining in salutations to Christians at Colossae (Col. iv. 10; Philem. 24). We gather, too, that his restoration to Paul's confidence took place some time earlier, as the Colossians had already been bidden by oral message or letter to welcome him if he should visit them. This points to a reconciliation during Paul's last sojourn in Jerusalem or Caesarea. Not long after Col. iv. 10 Mark seems to have been sent by Paul to some place in the province of Asia, lying on the route between Ephesus and Rome. For in 2 Tim. iv. 11 Paul bids Timothy, "Pick up Mark and bring him with thee, for he is useful to me for ministering."

Once more Mark's name occurs in the New Testament, this time with yet another leader, Peter, the friend of his earliest Christian years in Jerusalem, to whom he attached himself after the deaths of Barnabas and Paul. Peter's words, "Mark, my son," show how close was the spiritual tie between the older and the younger man (1 Pet. v. 13); and as he is writing from Rome ("Babylon," since Paul's death and the change of policy it implied), this forms a link between the New Testament and early tradition, which speaks of Mark as an Evangelist writing his Gospel under the influence of Peter's preaching (in Rome). This is the essence of the tradition preserved from "the elders of former days" by Clement of Alexandria (in Eus. ii. 15, vi. 14), a tradition probably based on Papias's record (cf. Eus. iii. 39) of the explanation given by "the Elder" (John) as to the contrast in form between Mark's memoirs of Peter's discourses and the Gospel of Matthew (see GOSPELS; PAPIAS), but defining the place where these memoirs were written as Rome. That he acted to some degree as Peter's interpreter or dragoman (ἑρμηνεύς), owing to the apostle's imperfect mastery of Greek, is held by some but denied by others (*e.g.* by Zahn). His rôle throughout his career was *servus servorum dei*; and the fact that he was this successively to Barnabas, Paul and Peter, helps to show the essential harmony of their message.

The identification of the author of the second Gospel with Mark, which we owe to tradition, enables us to fill in our picture of him a little further. Thus it is possible that Mark was himself the youth (νεανίσκος) to whom his Gospel refers as present at Jesus's arrest (xiv. 51 seq.; cf. his detailed knowledge as to the place of the last supper, 13 seq.). It is probably as evangelist, and not in his own person, that he became known as "he of the stunted extremities" (κολοβοδάκτυλος, "curt-fingered"), a title first found in Hippolytus (*Haer.* vii. 30), in a context which makes its metaphorical reference to his Gospel pretty evident.[1] It was too as evangelist that he became personally a subject of later interest, and of speculative legends due to this, *e.g.* he was one of the Seventy (first found in Adamantius, *Dial. de recta fide*, 4th century), he was the founder of the Alexandrine Church (recorded as a tradition by Eusebius, ii. 16) and its first bishop (id. ii. 2), and was author of the local type of liturgy (cf. the *Acts of Mark*, ch. vii., not earlier than the end of the 4th century).

As to his last days and death nothing is really known. It is possible—even probable, if we accept the theory that he had already[2] been there with Barnabas—that Alexandria was his final sphere of work, as the earliest tradition on the point implies (the Latin *Prologue*, and Eusebius as above, probably after Julius Africanus in the early 3rd century), and as was widely assumed in the 4th century. That he died and was buried there is first stated by Jerome (*De vir. ill.* 8), to which his *Acts* adds the glory of martyrdom (cf. Ps.-Hippolytus, *De LXX Apostolis*).

LITERATURE.—H. B. Swete, *The Gospel acc. to St Mark* (1898), Introduction, § I., where the authorities are fully cited; also the art. in Hastings's *Dict. Bible*. The Patristic and other legends are discussed at length by R. A. Lipsius, *Die apokr. Apostelgesch u.s.w.* (1884), ii. 2, and T. Schermann, *Propheten- und Apostellegenden* (1907), 285 seq. (with sepcial reference to Ps.-Hippolytus and Ps.-Dorotheus). (J. V. B.)

Medieval Legends.

The majority of medieval writers on the subject state that Mark was a Levite; but this is probably no more than an inference from his supposed relationship to Barnabas. The Alexandrian tradition seems to have been that he was of Cyrenaean origin; and Severus, a writer of the 10th century, adds to this the statement that his father's name was Aristobulus, who, with his wife Mary, was driven from the Pentapolis to Jerusalem by an invasion of barbarians

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[1] The divergent lines of the later attempts at a literal interpretation—*e.g.* he amputated his thumb in order to escape the Levitical priesthood (Latin *Prologue*), or it was a natural defect (*Cod. Tolet.*)—suggest that all they had to start from was the epithet itself.

[2] Nicephorus Callistus, *Hist. Eccl.* ii. 43, assumes this in his picturesque account of Mark's preaching in a quarter of the city which seems to have contained the tomb of the early bishops of Alexandria (cf. his *Acts*).

(Severus Aschimon in Renaudot, *Hist. patriarch. alex.*, p. 2). In the apocryphal Acts of Barnabas, which profess to be written by him, he speaks of himself as having been formerly a servant of Cyrillus, the high priest of Zeus, and as having been baptized at Iconium. The presbyter John, whom Papias quotes, says distinctly that "he neither heard the Lord nor accompanied Him" (Eusebius, *loc. cit.*); and this positive statement is fatal to the tradition, which does not appear until about two hundred and fifty years afterwards, that he was one of the seventy disciples (Epiphanius, pseudo-Origen *De recta in Deum fide*, and the author of the *Paschal Chronicle*). Various other results of the tendency to fill up blank names in the gospel history must be set aside on the same ground; it was, for example, believed that Mark was one of the disciples who "went back" because of the "hard saying" (pseudo-Hippolyt., *De LXX Apostolis* in Cod. Barocc. Migne, *Patrol. graec.* x. 955); there was an Alexandrian tradition that he was one of the servants at the miracle of Cana of Galilee, that he was the "man bearing a pitcher of water" in whose house the last supper was prepared, and that he was also the owner of the house in which the disciples met on the evening of the resurrection (Renaudot, *loc. cit.*); and even in modern times there has been the conjecture that he was the "certain young man" who "fled naked" from Gethsemane, Mark xiv. 51, 52 (Olshausen).

A tradition which was widely diffused, and which is not in itself improbable, was that he afterwards preached the gospel and presided over the church at Alexandria (the earliest extant testimony is that of Eusebius, *H. E.* ii. 16, 1; ii. 24; for the fully-developed legend of later times see Symeon Metaphrastes, *Vita S. Marci*, and Eutychius *Origines ecclesiae Alexandrinae*). There was another, though perhaps not incompatible, tradition that he preached the gospel and presided over the church at Aquileia in North Italy. The earliest testimony in favour of this tradition is the vague statement of Gregory of Nazianzus that Mark preached in Italy, but its existence in the 7th century is shown by the fact that in A.D. 629 Heraclius sent the patriarchal chair from Alexandria to Grado, to which city the patriarchate of Aquileia had been then transferred (*Chron. patriarch. Gradens.*, in Ughelli, *Italia sacra*, tom. v. p. 1086; for other references to the general tradition see De Rubeis, *Monum. eccles. aquileien.*, c. 1; *Acta sanctorum*, ad April, xxv.). It was through this tradition that Mark became connected with Venice, whither the patriarchate was further transferred from Grado; an early Venetian legend, which is represented in the Cappella Zen in the basilica of St Mark, antedates this connexion by picturing the evangelist as having been stranded on the Rialto, while it was still an uninhabited island, and as having had the future greatness of the city revealed to him (Danduli, *Chron.* iv. 1, ap. Muratori, *Rer. ital. script.* xii. 14).

The earliest traditions appear to imply that he died a natural death (Eusebius, Jerome, and even Isidore of Seville); but the Martyrologies claim him as a martyr, though they do not agree as to the manner of his martyrdom. According to the pseudo-Hippolytus he was burned; but Symeon Metaphrastes and the *Paschal Chronicle* represent him to have been dragged over rough stones until he died. But, however that may be, his tomb appears to have been venerated at Alexandria, and there was a firm belief at Venice in the middle ages that his remains had been translated thither in the 9th century (the fact of the translation is denied even by Tillemont; the weakness of the evidence in support of the tradition is apparent even in Molini's vigorous defence of it, lib. ii. c. 2; the minute account which the same writer gives, lib., ii. c. 11, of the discovery of the supposed actual bones of the evangelist in A.D. 1811, is interesting). There was another though less widely accepted tradition, that the remains soon after their translation to Venice were retranslated to the abbey of Reichenau on Lake Constance; a circumstantial account of this retranslation is given in the treatise *Ex miraculis S. Marci*, in Pertz, *Mon. hist. german. script.*, tom. iv. p. 449. It may be added that the Venetians prided themselves on possessing, not only the body of St Mark, but also the autograph of his Gospel; this autograph, however, proved on examination to be only part of a 6th-century book of the Gospels, the remainder of which was published by Bianchini as the *Evangeliarium forojuliense*; the Venetian part of this MS. was found some years ago to have been wholly destroyed by damp.

It has been at various times supposed that Mark wrote other works besides the Gospel. Several books of the New Testament have been attributed to him: viz. the Epistle to the Hebrews (Spanheim, *Op. miscell.* ii. 240), the Epistle of Jude (cf. Holtzmann, *Die synoptischen Evangelien*, p. 373), the Apocalypse (Hitzig, *Ueber Johannes Marcus*, Zürich, 1843). The apocryphal *Acta Barnabae* purport to have been written by him. There is a liturgy which bears his name, and which exists in two forms; the one form was found in a MS. of the 12th century in Calabria, and is, according to Renaudot, the foundation of the three liturgies of St Basil, St Gregory Nazianzen and St Cyril; the other is that which is used by the Maronite and Jacobite Syrians. Both forms have been published by Renaudot, *Liturg. oriental. collect*, i. 127, and ii. 176, and in Neale's *History of the Holy Eastern Church*; but neither has any substantial claim to belong to the ante-Nicene period of Christian literature.

The symbol by which Mark is designated in Christian art is usually that of a lion. Each of the "four living creatures" of Ezekiel and the Apocalypse has been attributed to each of the four evangelists in turn; Augustine and Bede think that Mark is designated by the "man"; Theophylact and others think that he is designated by the eagle; Anastasius Sinaita makes his symbol the ox; but medieval art acquiesced in the opinion of Jerome that he was indicated by the lion. Most of the martyrologies and calendars assign April 25 as the day on which he should be commemorated; but the *Martyr. Hieron.* gives the 23rd of September, and some Greek martyrologies give the 11th of January. This unusual variation probably arises from early differences of opinion as to whether there was one Mark or more than one.

See Canon Molini of Venice, *De vita et lipsanis S. Marci Evangelistae*, edited, after the author's death, by S. Pieralisi, the librarian of the Barberini library (1864); R. A. Lipsius, *Die apokryphen Apostelgesch. und Apostellegenden* (1883 foll). vol. ii. part 2, pp. 321-353.

MARK, a word of which the principal meanings are in their probable order of development,—boundary, an object set up to indicate a boundary or position; hence a sign or token, impression or trace. The word in O. Eng. is *mearc*, and appears in all Teutonic languages, cf. Du. *merk*, Ger. *Mark*, boundary, *marke*, sign, impression; Romanic languages have borrowed the word, cf. Fr. *marque*, Ital. *marca*. Cognate forms outside Teutonic have been found in Lat. *margo*, "margin," and Pers. *marz*, boundary. Others would refer to the Lith. *margas*, striped, parti-coloured, and Sanskrit *marga*, trace, especially of hunted game. In the sense of boundary, or a tract of country on or near a boundary or frontier, "mark" in English usage proper is obsolete, and "march" (*q.v.*) has established itself. It still remains, however, to represent the German *mark*, a tract of land held in common by a village community (see Mark System), and also historically the name of certain principalities, such as the mark of Brandenburg. The Italian *marca* is also sometimes rendered by "mark," as in the mark of Ancona.

Mark is also the name of a modern silver coin of the German empire. This is apparently a distinct word and not of Teutonic origin; it is found in all Teutonic and Romanic languages, Latinized as *marca* or *marcus*. The mark was originally a measure of weight only for gold and silver and was common throughout western Europe and was equivalent to 8 oz. The variations, however, throughout the middle ages were considerable (see Du Cange, *Gloss. med. et infim. Lat.*, *s.v.* *Marca* for a full list). In England the "mark" was never a coin, but a money of account only, and apparently came into use in the 10th century through the Danes. It first was taken as equal to 100 pennies, but after the Norman Conquest was equal to 160 pennies (20 pennies to the oz.) = ⅔ of the pound sterling, or 13s. 4d., and therefore in Scotland 13⅓d. English; the mark (merk) Scots was a silver coin of this value, issued first in 1570 and afterwards in 1663. The modern German *mark* was adopted in 1873 as the standard of value and the money of account. It is of the value of 6·146 grains of gold, 900 fine, and is equal to English standard gold of the value of 11·747 pence. The modern silver coin, nearly equal in value to the English shilling, was first issued in 1875. (See Numismatics, § iv.)

MARK, GOSPEL OF ST, the second of the four canonical Gospels of the Christian Church. Till quite recent times this Gospel, though nominally equal to the others in authority, has unquestionably not aroused the same interest or feelings of attachment as they have, partly from its not bearing the name of an apostle for its author, as the first and fourth do, partly, also, owing to the fact that the first and third, while they include most of what is found in it, contain much additional matter, which is of the highest value. Of late, however, it has acquired new importance through the critical inquiries which have led to the conclusion that the two other synoptic Gospels are based upon it, or upon a document which is upon the whole most truly represented in it (see Gospel), so that it possesses the advantage of being an earlier source of information, or at least of bringing us more fully into contact with such a source. The significance of all that we can learn as to the history of the composition of Mark's Gospel is clearly enhanced by this consideration.

(1) *Early Account of a Writing by Mark.*—According to a fragment of Papias (ap. Eus. *Hist. Eccl.* III. 39) taken from

a work probably written *c.* A.D. 140, Mark, who was the follower and interpreter of Peter, recorded after the latter's decease the words of Christ and the narratives of His deeds which he had heard the Apostle deliver, but he could not arrange the matter "in order," because he had not himself been a personal follower of Jesus. This account Papias had derived, he tells us, from an informant who had heard it repeatedly given by "the elder," a Christian of the first generation.

There can be little doubt that the work to which Papias himself supposed this story to apply was the Gospel of Mark virtually as we know it. The tradition in regard to this work must have been continuous between his time and that of Irenaeus, who (*c.* A.D. 180) gives a similar account of its composition. It may be noted also that the same view of the origin of the Gospel of Mark appears to have been held by a contemporary of Papias, Justin Martyr. In his *Dialogue with Trypho* (*c.* 106) he cites a fact about the name of Peter from "his Memoirs," and adds also another similar fact about the name given to the sons of Zebedee, just as they are stated in Mark iii. 16, 17, and nowhere else so far as we know. He may well have been ready to call the work "Peter's," though he believed that Mark actually composed it, on the ground that the latter recorded what the Apostle said (cf. ibid. *c.* 103).

But is our Gospel of Mark also to be identified with the writing by Mark spoken of by "the elder" whose account had been reported to Papias? Some confusion is here more conceivable; while, if it is supposed that such a writing was worked up in our second Gospel, this may seem sufficient to explain the connexion of Mark's name with the latter.

In support of this view it is urged, though it is so much less often now than it used to be, that the description "not in order" does not fit our Gospel of Mark, the order in which is from an historical point of view as good as, if not better than, in the other Gospels. But from whomsoever the expression proceeds —whether from Papias, or his informant, or "the elder"— we may feel sure that considerations such as appeal to us from our training in historical criticism are not those which suggested it, but rather the want of agreement between this Gospel and some standard which on altogether different grounds was applied to it. This argument, then, for supposing that the original writing by Mark differed widely in form and contents from the Gospel which now bears his name appears to be without force. The question whether the two differed to any, and if so to what, extent can be decided only from an examination of the Gospel itself.

(2) *The Question of the Integrity of the Gospel of Mark.*—There are in a good many parts of this Gospel indications that the narrative has been derived from Simon Peter, or some one else who was a personal follower of Jesus in the days of His earthly ministry. It has been widely felt that the account of the call of the first four disciples and of the events which immediately followed (i. 15–39) at the opening of the Galilean ministry, bears strong marks of proceeding from Simon Peter. Other passages might be pointed out in which it is suitable to suppose that this disciple in particular was the informant. But we will content ourselves with noticing signs that the reminiscences of some eyewitness are recorded. (*a*) Traits appear which are wholly without importance, and upon which no stress is laid in the context, but which it was natural for a narrator who was actually present, and only for such a one to introduce, because he remembered them as associated with the principal events. The following are instances and others might be cited: the mention of "other boats," iv. 36; the half-foolish remark made by Peter when in a dazed condition at the Transfiguration, ix. 5, 6; the young man who, when Jesus was arrested, followed, "having a linen cloth cast about him," xiv. 51, 52; the fact that Simon of Cyrene was "coming from the country," xv. 21. (*b*) There is great truth of local colouring. The references to places and the descriptions of natural features (the lake-shore, i. 16; ii. 13; iii. 7; the hills near at hand, iii. 13; v. 5, 13; vi. 46; the desert places among the hills or by the shore, i. 35, 45; vi. 31, 32) appear to be accurate; the routes indicated in the journeys that are taken are probable (vii. 24, 31; viii. 27; x. 17, 32, 46; xi. 1). Again, the term "village-towns" (i. 38) is a remarkably appropriate one (cf. Josephus, B. I. III. iii. 2). There would, indeed, be an exception to the general correctness of the topography if we were compelled to suppose that "country of the Gerasenes" (which is the best reading according to existing MS. evidence at Mark v. 1) must mean the territory of the city of Gerasa. But it is easy to imagine that some confusion may have arisen in the transliteration of the name into Greek, and that the place really indicated is Khersa, near the middle of the eastern shore of the lake. The pair of references (vi. 45, 53) which might also be adduced as an exception, will be noticed below. Further, the conditions of life and thought in Palestine at the time in question are faithfully represented, Aramaic words spoken on some important occasions are preserved (iii. 17; v. 41; xv. 34). And, to mention a point of a different kind, the parts played by different sections among the Jewish people are such as might be expected. The point of view of speakers and actors is throughout that belonging to the time of the ministry of Jesus, not to that when the Christian Church had come into existence. (*c*) The good order in this Gospel, *i.e.* the natural development of the narrative, will be indicated below. It has without good reason, as we have seen, been supposed to show that it cannot be the record by Mark referred to by Papias. And in reality it would be difficult to account for this feature except on the supposition that one who had lived through the events had been accustomed, when required to give a comprehensive sketch of the history of the ministry and sufferings of Jesus, to relate the facts in the main as they happened; and that a hearer of his has to a considerable extent reproduced them in the same order.

The last consideration seems to show that the general form and structure of the Gospel, and not merely certain portions of it, are original. In point of style, also, there is a large amount of uniformity. The chief exceptions are that, whereas some incidents are related in a very concise manner (*e.g.* i. 23–28, and 40–45), there is in other cases considerable amplitude of description (see esp. v. 1–20, 35–43 and ix. 14–27). But Mark's own writing might exhibit this variety, according to what he had been told or could remember. Moreover, a tendency to amplitude of language may be noticed here and there in some of the more concise narratives. Further, it would be unreasonable to suppose that Mark, even if he relied chiefly on what he had heard Peter teach, would refrain from using any other sources of information which he possessed. Some have supposed that the same Logian document in Greek which was used by the first and third evangelists was also used by Mark. This is highly improbable, but he may have derived particular sayings from the Aramaic source itself of that document by independent translation; and may also have learned both sayings and narratives in other ways. It would seem also that the Discourse on the Last Things in ch. xiii., differing as it does both in its greater length and in its systematic structure from other discourses recorded by him, must have come to his hands in a written form. In it some genuine sayings of Christ appear to have been worked up along with matter taken from Jewish Apocalypses and in accordance with an Apocalyptic model.

There does not, then, seem to be good reason for thinking that the work which proceeded from the hands of Mark differed widely in character and contents from the Gospel which now bears his name. But there are indications that some passages have been interpolated in it: *e.g.* in Mark iv. 10 there is some want of fitness in the inquiry of the disciples as to the meaning of "the parables" after only one has been given, and again a want of agreement between that inquiry and the words of Jesus at *v.* 13, "Know ye not *this* parable, and how shall ye know all the parables?" We notice further that the two parables in *vv.* 26–32 are somewhat loosely appended. It looks as if they were insertions in the passage as it originally stood, and that the references to parables in the plural, together with the statement at vv. 33, 34, had been introduced in order to adapt the context to these additions. This view is confirmed by the fact that in Luke viii. 4 seq. only one parable, that of the sower, is given or referred to. This evangelist has probably here followed the original form of Mark. Similarly the collection of sayings after Mark ix. 40 (vv. 41–50) has probably been interpolated. They are thrown together in a way unusual with Mark, who is accustomed to place each important saying in a setting of its own. Here again we note that they do not appear at the corresponding point in Luke, though some of them are given by him in other contexts. The account of the crossing of the lake (vi. 45–53) after the feeding of the five thousand furnishes an instance of a different kind. The difficulty as to the position of Bethsaida, or (if εἰς τὸ πέραν, "unto the other side," at v. 45 is taken to refer only to the crossing of a bay at the north-eastern corner of the lake) the discrepancy between "crossing" in this sense and in that of v. 53 would be explained if the narrative (which is not in Luke) may be held to be an interpolation by one not familiar with the localities. Once more, the account of the feeding of the four thousand (viii. 1–9) resembles that of the feeding of the five thousand (vi. 35–44) closely in all respects except that of the numbers given, about which differences might easily arise in tradition, and it looks therefore as if it might be a "doublet," *i.e.* another form of the same narrative derived through a different channel. And it is not so likely that Mark should have mistaken it for a distinct incident as that an editor of his Gospel should have done so. Some other instances, of greater or less probability, might be mentioned.

In addition to such larger insertions, the text of the original document seems to have undergone a certain amount of revision. Some of the cases in which the first and third evangelist agree against Mark in a word or clause may be best accounted for by their both having reproduced the common source (an example may be seen under 4 below).

As we have found it necessary to distinguish between the original composition by Mark, to whom in the main the work appears to be due, and some enlargement and alteration which it subsequently underwent whereby it reached its present form, these stages must be borne in mind in considering dates that may be assigned in connexion with this Gospel. According to Papias, Mark wrote after the death of Peter, *i.e.* after A.D. 64, if we suppose, as it is usual to do, that Peter was martyred in the massacre by Nero after the burning of Rome. It would be natural for Mark to set himself to make his record soon after the Apostle's death; and in confirmation of the view that he did so it may be pointed out that in the form of the prophecy in ch. xiii. of the calamities that were to come upon Jerusalem, no details occur of a kind to suggest that it had actually taken place. Further, Mark's work may very probably have been used by Luke in its original form. On the other hand, it was known to our first evangelist very nearly in the form in which we have it. The chief revision of Mark would seem, then, to have taken place between the times of the composition of the first and third Gospels, which cannot be far removed from one another (see MATTHEW, GOSPEL OF ST). The last twelve verses were added later still, probably early in the 2nd century, probably to take the place of the ending which had been lost, or which was regarded as defective. (On the evidence that the last 12 verses are not by the same hand as the rest of the Gospels see Westcott and Hort's *New Testament in Greek*, append., p. 29 seq. and Swete's *St Mark in loc.* and p. xcvi. seq. of his introduction.)

(3) *The Gospel History as represented in Mark.*—After a (i) prefatory passage, i. 1–13, the Gospel deals with (ii) *Christ's ministry in Galilee and other parts of northern Palestine*, i. 14–ix. 50. This portion of the history may suitably be divided into three periods: (*a*) *Early period.* From the opening of the work of Jesus to the first plot to destroy Him (i. 14–iii. 6). (*b*) *Middle period.* From the gathering of crowds from all parts and appointment of the Twelve to the sending forth of the Twelve to extend Christ's work and the alarm of Herod (iii. 7–vi. 29). (*c*) *Closing period.* From Christ's withdrawal with His disciples after their return from their mission to His final departure from Galilee (vi. 30–ix. 50). Throughout we can trace a development as to (*a*) the stir created and the attitude of men towards Jesus: i. 32–34, 37 (excitement at Capernaum); 38, 45 (fame spreads through a wide district); iii. 7, 8 (people from distant parts appear in the crowds); iv. 2 seq. (the word of the Kingdom is received in very various ways); viii. 28 (great diversity of opinions as to the claims of Jesus); (*b*) the opposition to Him, ii. 1–iii. 6–iii. 22 (scribes come from Jerusalem and a more heinous charge is preferred); (*c*) the formation of a band of disciples and the position accorded to them: i. 16–20 (four are called to follow Him); ii. 14 (yet another); iii. 14 (He "makes twelve" including those before called); vi. 7 seq (He sends them out to preach and work cures); (*d*) the methods which he adopts: i. 21, 39–iii. 1 (preaches in the synagogues, later more commonly by the lake-shore or on the mountain sides; or He teaches in a house where He happens to be); at iv. 1 seq. he adopts a new mode of address because a sifting-process was required; from vi. 45 onwards He mainly devotes Himself to the training of the Twelve, while seeking retirement from the multitude; (*e*) in the districts which he visits: i. 38 (tour in the neighbourhood of Capernaum); v. 1 (crosses to eastern shore of the lake); vi. 6b (a tour which includes Nazareth); vi. 45 (Bethsaida); vii. 31 (journey to Tyre and Sidon and back through Decapolis); viii. 22, 27 (is at Bethsaida and visits neighbourhood of Caesarea Philippi); (*f*) His self-revelation; viii. 27 seq. (first unambiguous declaration of His Messiahship).

(iii) *The Journey from Galilee to Jerusalem, the Last Days, Passion and Resurrection*, x. 1 to end. He goes first to "the borders of Judaea and beyond Jordan" (Peraea), and exercises His ministry there, x. 1–16. In connexion with the journey from this region to Jerusalem three striking incidents are recorded, x. 17–52. The account of the time in Jerusalem includes a series of conflicts with opponents xi. 27–xii. 40, and the discourse on the Last Things, xiii. The only notes of time in the Gospel occur in connexion with the conspiracy to kill Jesus (xiv. 1) and the Last Supper (verse 12).

(4) *The Leading Ideas of St Mark.*—Ch. i. 1, which stands as a title, was probably, even according to the short form of it which is supported by MS. evidence, due to a reviser of the original. Both Matthew and Luke show signs of having had a somewhat different beginning before them. Nevertheless, that title fitly describes the work. It is emphatically "the Gospel," because it sets forth the person and work of the Christ. The evangelist is conscious of this aim. It appears not only at great moments of the history such as the Baptism (i. 11), the confession of Peter (viii. 29), the Transfiguration (ix. 7); nor again merely in the prominence given to the miracles of Jesus and in particular to the casting out of devils, but also in many of the sayings recorded in it, as in the great series contained in the narratives in ch. ii. 5, 10, 17, 19; and again in the reply of Jesus to those who charged Him with being in collusion with Satan (iii. 27). The character of the genuine disciples of the Christ and the demands that are made of them form, as it were, the complement to the representation of what He Himself is, and are set forth in other striking sayings, related along with the memorable occasions on which they were spoken: (iii. 34, 35; viii. 34–36; ix. 23, 29, 35–37; x. 14, 15, 42–45).

See Swete, *Commentary on St Mark* (2nd ed., 1902); A. Menzies, *The Earliest Gospel* (1901); D. W. Wrede, *Das Messiasgeheimniss in den Evangelien, zugleich ein Beitrag zum Verständniss des Markusevangeliums* (1901); E. J. Weiss, *Das älteste Evangelium* (1903). Also bibliography to the article GOSPEL. (V. H. S.)

MARKBY, SIR WILLIAM (1829–), English jurist, the fourth son of the Rev. William Henry Markby, rector of Duxford St Peter's, was born at Duxford, Cambridge, in 1829. He was educated at Bury St Edmunds and Merton College, Oxford, where he took his degree in 1850. In 1856 he was called to the bar, and in 1865 he became recorder of Buckingham. In 1866 he went to India as judge of the High Court of Calcutta. This post he held for twelve years, and on his retirement was appointed Reader in Indian Law at Oxford. In 1892 he was a member of the Commission to inquire into the administration of justice at Trinidad and Tobago. Besides *Lectures on Indian Law*, he wrote *Elements of Law considered with reference to the General Principles of Jurisprudence.* The latter, being intended in the first place for Indian students, calls attention to many difficulties in the definition and application of legal conceptions which are usually passed over in textbooks, and it ranks as one of the few books on the philosophy of law which are both useful to beginners and profitable to teachers and thinkers. In 1897 appeared *The Indian Evidence Act, with Notes.* Sir William Markby also contributed to the law magazines, articles on *Law and Fact*, *German Jurists and Roman Law*, *Legal Fictions*, &c., several of which are embodied in the later editions of the *Elements*. He was made D.C.L. of Oxford in 1879, and K.C.I.E. in 1889.

MARKET (Lat. *mercatus*, trade or place of trade). This term is used in two well-defined senses. (1) It means a definite place where (*a*) traders who are retail sellers of a specific class of commodity or commodities are in the habit of awaiting buyers every day in shops or stalls; or whither (*b*) they are in the habit of proceeding on specified days at more or less frequent regular intervals. Covent Garden market for fruit and flowers, and Leadenhall market for meat and poultry, are good examples in London of the kind of institution included in class (*a*). They are a very ancient economic phenomenon, dating from the earliest period of the development of organized communities of human beings, and in general characteristics have changed little since they began to exist. Markets of the type of class (*b*) are also of very ancient origin (see FAIRS), but inasmuch as they are constituted essentially by the presence of persons, many of whom assemble from various places outside the place of meeting, they were capable of a little more development than those belonging to class (*a*), owing to increased facilities for locomotion. The nature of an ancient market of class (*a*), whither a citizen, say of Athens, or his chief slave, proceeded daily to make household purchases, differs little from the group of shops visited by the wives of the less wealthy citizens of modern states. In many places abroad, and not a few in England, actual markets still exist. It may be said that the huge collections of shops, such as the various co-operative stores, are only a revival of the old "market-place," with its shops or booths gathered round a central area, adapted to the needs of modern big cities. (2) The term "market" has come to be used in another and more general sense in modern times. According to Jevons, a market is "any body of persons who are in intimate business relations, and carry on extensive transactions in any commodity." He adds that "these markets may or may not be localized," and he instances the money market as a case in which the term "market" denotes no special locality. As a rule, however, most of the business of a market is transacted at some particular place, such as the London Stock Exchange, the Baltic, the Bourse of Paris, the Chicago "Wheat-pit." Even in the case of the London money market, merchants still meet twice a week at the Royal Exchange to deal in foreign bills, although a considerable part of the dealings in these securities is arranged daily at offices and counting-houses by personal visits or by telegraphic or telephonic communication. The markets in any important article are all closely interconnected. The submarine cable has long ago made Chicago as important an influence on the London corn market as Liverpool, or rather both London and Liverpool affect and are simultaneously affected by Chicago and other foreign markets. In like manner the Liverpool cotton market is influenced by the markets in New Orleans and other American cities separated from it widely in space. In a minor degree the dealers in all places where a cotton market exists affect the bigger markets to some extent. What is true of the cotton market is also true to some extent of all markets, though few markets are so highly organized or show such large transactions as that for cotton. Among other markets of the first class may be mentioned those for pig-iron, wheat, copper, coffee, and sugar. There are many articles the markets for which are of considerable dimensions at times, but are of an intermittent character, such as the London Wool Sales, which take place now in five "series" during the year. Formerly the number of "series" was four. (For "market overt" see SALE OF GOODS and STOLEN GOODS.)

Characteristics of Markets.—The conditions required in order that the operations of a trading body may display the fully-developed features of a modern market, whether for commodities or securities, are:—

(1) A large number of parties dealing.

(2) A large amount of the commodities or securities to be dealt with.

(3) An organization by which all persons interested in the commodity or security can rapidly communicate with one another.

(4) Existence and frequent publication of statistical and other information as to the present and probable future supply of the commodity or security.

Movements of Prices.

The movements which take place in prices in any market, whether fully organized or not, depend largely on changes of opinion among buyers and sellers. The changes of opinion may be caused by erroneous as well as by correct information. They may also be the result of wrong inferences drawn from correct information. In markets for commodities of the first importance, such as wheat, cotton, iron, and other articles which are dealt in daily, the state of opinion may vary much during a few hours. The broad characteristics of markets of this class are similar. There is a tendency in all of them to show phenomena of annual periodicity, due partly to the seasons, the activity of certain months being in normal years greater in the case of any given market than that of other months. This tendency was always liable to be interfered with by the special forces at work in particular years; and the great increase in the facilities of communication between dealers by telegraph, and of transportation of commodities between widely distant points, which was one of the marked features of the development of the economic organism in all actively commercial countries during the last thirty years of the 19th century, has still further interfered with it. Nevertheless, a tendency to annual periodicity is still perceptible, especially in markets for produce of the soil, the supply of which largely depends on the meteorological conditions of the areas where they are grown on a scale sufficient to furnish an appreciable proportion of the total produce.

Cycles.

Periodicity of another kind known as "cyclic," and due to a different set of causes, is believed to exist by many persons competent to form a judgment; but although the evidence for this view is very strong, the theory expounding it is not yet in a sufficiently advanced state to admit of its being regarded as established.

Phenomena of Markets.—Bagehot said of the money market that it is "often very dull and sometimes extremely excited." This classical description of the market for "money" applies to a large extent to all markets.

Tendency to Equilibrium.

Every market is at every moment tending to an equilibrium between the quantity of commodities offered and that of commodities desired; supposing equilibrium to have been attained in a given market, and that for some appreciable period it is not disturbed, the price for the commodity dealt in, in the market, will remain practically unchanged during that period. Not that there will be no transactions going on, but that the amounts offered daily will be approximately equal to the amounts demanded daily.

Disturbance of Equilibrium.

We have briefly described the statical condition of a market; we must now briefly examine its dynamics. Disturbance may take place through a change in—

(1) Supply, or opinion as to future probable supply.

(2) Demand, or opinion as to future probable demand.

(3) In both simultaneously, but such a change that demand is increased or decreased more than the supply, or vice versa.

A moderate disturbance caused by one of the above changes, or a combination of them, will produce an immediate effect on the price of the commodity, which again will tend to react on both the supply and the demand by altering the opinions of sellers and buyers. If no further change tending to disturb the market takes place, the market will gradually settle down again to a state of equilibrium. But if the disturbance has been considerable, a relatively long time may elapse before the market becomes quiet; and very likely the level of price at which the new equilibrium is established will be very different from that ruling before the disturbance set in. Further scientific investigation of the dynamics of a market is in any case very difficult, and is impossible without a complete analysis of the statical condition, such as is found at length in the textbooks of mathematical economics; but it is possible to describe briefly certain dynamical phenomena of markets which are of a comparatively simple character, and are also of practical interest.

Future Delivery.

Every great market is organized with a view not merely to the purchase and sale of a commodity at once, or "on the spot," but also with a view to the future requirements of buyers and sellers. This organization arises naturally from the necessities of business, since modern industry and commerce are carried on continuously, and provision has to be made for the requirements, say, of a spinning-mill, by arranging for the delivery of successive quantities of cotton, wool or silk over a period of months "ahead." In the case of cotton, "forward deliveries" can be purchased six or seven months in advance, and the person who undertakes to deliver the cotton at the times stated is said in the language of the market to "sell forward." If the quantity of cotton produced each year were always the same, no very remarkable results would follow from this mode of doing business, except the economy resulting to the spinner from not being compelled to lock up part of his capital in raw material before he could use it. But as the cotton and other crops vary considerably from year to year, some curious consequences follow from the practice of "selling forward." The seller, of course, makes his bargain in the belief that he will be able to "cover" the sale he has made at a profit—that is, he hopes to be able to buy the cotton he has to deliver at a lower price than he undertook to deliver it at. If so, all is well for both parties, for the buyer has had the advantage of having insured a supply of cotton. But supposing something has happened to raise the price considerably, such as a great "shortage" of the crop, the seller may lose. If a great many other persons have taken the same mistaken view of the probabilities of the market, a condition of things may arise in which they may be "cornered." (See COTTON.)

"Corners."

A "corner" in an exchangeable article is an abnormal condition of the market for it, in which, owing to a serious miscalculation of probable supply, many traders who have made contracts to deliver at a certain date are unable to fulfil them. In most cases the fact that the market is "oversold" becomes known some time before the date for the completion of the contracts, and other traders take advantage of the position to raise the price against those who are "short" of the article. A corner is therefore usually a result of the failure of a speculation for the fall. Theoretically a trader who has undertaken to deliver 100 tons of an article, but cannot, after every endeavour, obtain more than 90 tons, could be made to pay his whole capital in order to be relieved from the bargain. In practice he gets off more easily than this. Frequently when many traders have sold largely "forward" other traders deliberately try to use that position as a basis for creating a "corner." Generally, however, they only succeed in causing great inconvenience to all parties, themselves included, for as a rule they are only able to make the "corner" effective by buying up so much of the article that when they have compelled their opponents to pay largely to be relieved of contracts to deliver, they are left with so big a stock of the article that they cannot sell it except at a loss, which is sometimes big enough to absorb the gain previously secured. In the case of very small markets "corners" may be complete, but in big markets they are never complete, something always happening to prevent the full realization of the operators' plans. The idea of a "corner" is, however, so fascinating to the commercial mind, especially in the United States, that probably no year passes without an attempt at some operation of the kind, though the conditions may in most cases prevent any serious result.

"Corners" have what is called a "moral" aspect. It is curious to note that the indignation of the "market" at the disturbance to prices which results from operations of this kind is generally directed against the speculators for the fall, while that of the public, including trade consumers, is directed against the operator for the rise. The operator for the fall, or "bear," is denounced for "selling what he has not got," a very inaccurate description of his action, while the "bull" or operator for the rise is spoken of by a much wider circle as a heartless person who endeavours to make a profit out of the necessities of others. From a strict ethical standpoint there is really nothing to choose between the two.

The Money Market.—There is one market which presents features of so peculiar a character that it is necessary to describe it more particularly than other phenomena of the kind, and that is the money market. The term money is here used to denote "money-market money" or "bankers' money," a form of wealth which has existed from early times, but not in great abundance until within the last two or three hundred years. Immense wealth has existed in certain countries at various epochs, owing to the fertility of the soil, success in trade, or the plunder of other communities, and all states which have been great have at the time of their greatness possessed wealth; but the wealth which the countries, or a few fortunate individuals belonging to them, owned consisted largely of what is still called real property—that is, land and buildings—and of the produce of the soil or of mines. The balance consisted partly of merchandise of various kinds and shipping, and to a large extent of the precious metals in the form of coin or bullion, or of precious stones and jewelry. Where no settled government was established no one could become or remain very wealthy who was not in a position to defend himself by the strong hand or allied with those who were; and as a rule the only people who could so defend themselves were possessors of large areas of rich land, who were able to retain the services of those who dwelt on it either through their personal military qualities or in virtue of habit and custom. The inhabitants of wealthy cities were able to protect themselves to some extent, but they nearly always found it necessary to ally themselves with the neighbouring land-owners, whom they aided with money in return for military support.

A money market in the modern sense of the word could only exist in a rudimentary form under these conditions. There was a sort of money market, for there was a changing rate of interest and a whole code of law relating to it (Macleod, *Banking*, 3rd ed., p. 174) in republican Rome; but although large lending and borrowing transactions were part of the daily life of the Roman business world, as well as of those of the Greek cities and of Carthage and its dependencies, none of these communities presented the phenomena of a highly organised market. Money-lending was also a regular practice in Egypt, Chaldea and other ancient seats of civilization, as recent discoveries show. It was only in comparatively recent times, however, when Europe had formed itself into more or less organized states, with conditions fairly favourable to the steady growth of trade and industry, that organized money markets came into existence in places such as Venice, Genoa, Augsburg, Basel, the Hanse towns, and various cities in the Low Countries, Spain and Portugal, as well as in London. The financial strength of these rudimentary money markets was not very great, and as it depended a good deal on the possession by individuals of actual cash, the existence of these markets was precarious. "Hoarded ducats" were too often an attraction to needy princes, whose unwelcome attentions a rich merchant, even when an influential burgher of a powerful city, was less able to resist than the violence of a housebreaker, against whom strong vaults and well-secured chests situated in defensible mansions were a good protection. The necessitous potentate could often urge his desire for a "loan" by very persuasive methods. Occasionally, if his predecessors had acquired the confidence of the banking class sufficiently to induce them to place their cash reserves in one of his strong places "for safety" an unscrupulous ruler could help himself, as Charles II. helped himself to the stores of the London goldsmiths which were left in the Mint. The power of the banking class continued to grow, however, and a real market for money had come into existence in many cities of Europe by the middle of the 17th century. (See Banks and Banking.)

The Early Money Market.

In the 18th century the "money market" consisted of the Bank of England and various banks and merchants, and distinction between the two being still not complete. Towards the end of that century arose an important class of dealers in credit, the bill brokers, and with their appearance the modern money market of London may be said to have assumed its present form, for though the process of development has not ceased, the changes have been of the nature of growth and not of the acquisition of new organs.

The formation of joint-stock banks and discount companies, however, and the reconstitution of the Bank of England by the Act of 1844, exercised an important influence on the way in which the money market of London has developed. It must be explained that in the every-day talk of the City "the market" has a special meaning, by which only the banks and discount houses, or even only the latter in some cases, are denoted, as in the phrases constantly seen in the daily reports published in the newspapers towards the end of a quarter, "the market has to-day borrowed largely from the Bank of England," or, "the market was obliged to renew part of the loans which fell due to the Bank to-day." But this use of the term in a special sense, thoroughly understood by those to whom it is habitual, and resulting in no ambiguity in practice, is not in accord with the requirements of economic analysis.

The Modern Money Market of London.

The working organs of the money market of London at the beginning of the 20th century were:—

A. (1) The Bank of England.
(2) Banks, joint-stock and private, including several great foreign banks.
(3) Discount houses and bill-brokers.
B. (4) Certain members of the Stock Exchange.
(5) Certain great merchants and finance houses.

The institutions included in group A are the most constantly active organs of the money market; those included in group B are intermittently active, but in the case of section (4), though their activity is greater at some times than others, they are never wholly outside the market. Even in the case of (5) a certain amount of qualification is needed, which is indicated by the fact that most of the great merchant houses are "registered" as bankers, though they do not perform the functions usually associated with that term in the United Kingdom. Several of the great houses were originally and still are nominally merchants, but are largely concerned with finance business—that is, with the making of loans to foreign governments and the issue of capital on behalf of companies. These powerful capitalists often have large amounts of money temporarily in their hands, and lend it in the money market or on the Stock Exchange; one or two of them are large buyers of bills from time to time, and generally the members of this group may be said to be in sufficiently close touch with the active organs of the money market to form part of it.

The Working of the Money Market.

The actual working of the money market has been described by Walter Bagehot in his *Lombard Street*, a work which has attained the rank of a classic. Most of what he said in 1873 is true now, but in certain minor respects developments have taken place, the most important being the greater extent to which money is "used up" every day, or rather every night. In Bagehot's time the discount houses only quoted "allowance" rates for "loans at call and short notice," based on the rate "allowed" by the banks for loans at seven days' notice; but since then the bill-brokers have been obliged—(1) occasionally to fix their terms independently of the banks, and (2) to "allow" a rate for "money for the night." This latter practice became usual about 1888 or 1889. The change it introduced was not a vital one, but has some importance from the point of view of the historian. A good deal of the "money" thus dealt with is derived from the group of traders included in class (5). It is (*a*) money which is temporarily in the hands of houses or institutions which have just received subscriptions to loans or other capital offered to the public; (*b*) balances left temporarily with finance houses or banks on behalf of foreign governments or other parties who have payments to make in London. In the former case the "money" is almost invariably only available for a short time, probably only for a few days; in the latter case also it probably will be only available for a few days, but *may* be available for months. Money derived from either of these sources is usually to be had cheap, but is not, in the slang of the City, "good," because it is uncertain how long loans at call obtained from either of them will remain undisturbed. Nevertheless, there has been at times so much "money" of this fugitive character, and derived from such varied sources since about 1888, that its cheapness has been an attraction to the less wealthy bill-brokers, who have occasionally been able to go on using it profitably for many continuous weeks, or even months, in their business. The risk run by employing it is, of course, the certainty that it will be "called" from the borrower sooner or later, and probably at a time when it is very inconvenient to repay it. The more wealthy houses take money of this kind when it suits them, but never rely on it as a basis for business.

The Great Banks.

Since Bagehot wrote the growth of the big joint-stock banks has been enormous, not so much through the increased business done by banks generally, though the expansion in banking has been considerable, as by the absorption of a great number of small banks by three or four large institutions (see Banks and Banking). The growth of these large institutions tends to facilitate combination for purposes of common concern among banks generally—*e.g.* to support the Bank of England in maintaining its reserve, which is the sole reserve of all the banks, at a proper level, and thus render the money market more stable. Two or three of the banks have for a long time, owing to their large holding of bills, had much more influence than the Bank of England over the foreign exchanges, on which the foreign bullion movements chiefly depend; and since 1890 persons of weight in the joint-stock banking body have implicitly, though not explicitly, admitted a certain degree of responsibility in the matter on behalf of their institutions. It is, however, characteristic of British business arrangements that the question of the responsibility for the reserve of the Bank of England, the ultimate reserve of the whole country, is still in as nebulous a condition, so far as explicit acceptance of responsibility by any institution is concerned, as it was in 1870. There has been no improvement in theory, though in practice there has been real improvement, since Bagehot's time. The tendency is, indeed, decidedly in the direction of closer combination between the Bank and the banks. On more than one occasion the Bank has, not merely by borrowing "in the market," but by more or less private negotiations with the big banks, obtained temporary control of large sums belonging to the banks in order to take cash off the market. This proceeding, and its concomitants, did not meet with universal approval; but the results were satisfactory on the whole, and on the later occasions when the measure was carried out there was little or no friction.

Effect of Big Foreign Loans.

The enormous war loans raised by Japan in 1904, 1905, 1906 exemplified aptly the more modern methods of dealing with the disturbance to the money market which such operations produce. The loans were issued by three banks, one of which was a Japanese institution and represented the Japanese government in the operations connected with the various loans. Of the other two, one was a leading London bank and the other the principal British bank doing business in China. These large loans were issued with the minimum of disturbance to the London money market. The very large amounts of cash which were suddenly withdrawn from other banks, and deposited with the institutions issuing the loan as "application money," were lent out again in the short loan market as soon as possible, usually on the afternoon of the day of issue. The work involved was very heavy, as a great number of cheques had to be cleared in a brief space of time, but by skilful organization this was done. Similar promptitude was displayed when the successive instalments on the loans became due and were paid, most of the cash being available for borrowers a few hours after it was paid in by the holders of the scrip which represented the loans until the definitive bonds were ready. The task of dealing with cash forming instalments of the loans was not, however, the only problem before the banks which issued them. As the scrip of each loan gradually became "fully paid" the proceeds of the loan in the hands of the banks became a very large sum. The Japanese government held the whole of it at its disposal, and might have seriously embarrassed the London money market if it had not dealt with its huge balances considerately. The Japanese government had promised not to withdraw any portion of the loans raised in London in gold, but it was under no restrictions as to how it should employ the money lying to its account. It might have kept it locked up until it had a bill for ships or clothing to pay. As might be expected, the government from the outset transferred a portion of what was deposited with the banks to the Bank of England, finding it advantageous on various grounds to do so. The remainder was lent for short periods by the banks, but for some time no means were available for lending for any considerable length of time, though the Japanese government had no immediate use for the whole of it. It was suggested to the government by its advisers that it would be a convenience to the money market, and no inconvenience to Japanese policy, if any balances which were not likely to be wanted for some months were invested in British treasury bills, and the government, after fully acquainting itself with the nature of the operation, agreed to it. The plan was found to work well; it released for definite periods money that would otherwise have been of little use to the money market, and it was of pecuniary benefit to the Japanese exchequer to the extent of the interest earned by the portion of the balances so employed. Incidentally it suited the British treasury; the Japanese demand, which became a constant feature in connexion with treasury bill issues, lowered the discount rates at which "sixes" were placed. The Japanese not only applied for treasury bills and bought them in the market, but they also took up some of the exchequer bonds issued in connexion with the South African war towards the end of their currency, thus relieving the money market of a further part of the weight of British government paper which it would otherwise have had to take on itself. A further important development of Japanese management of its London balances took place in 1906, when a portion of these balances was placed under the control of agents of the Bank of England, to be lent, or not lent, in the market as suited the Bank's policy, which was at that time directed to raising the value of money in order to protect and increase its reserve. The plan worked very well on the whole. It was merely an adaptation of a practice initiated some years before, whereby the Bank sometimes obtained temporary control of moneys belonging to the India Council. The same idea, that of "intercepting" market funds, which were beating down the discount rate, depressing the foreign exchanges and depleting the Bank's reserve, has been employed in regard to the clearing banks themselves, the banks having on more than one occasion agreed to lend the Bank of England a certain portion of their balances.

The Discount Houses.

The discount houses, though an important body of institutions, are not of so much importance as they were before 1866, when they suffered a serious blow through the failure of "Overend's," from which as a body they have never fully recovered. The five large concerns which still exist are, however, very powerful and exercise considerable influence on the market. They hold considerable quantities of bills at all times; occasionally their holdings are very large, but they turn out the contents of their bill cases readily if they think fit. Their business is different in practice from that of the smaller "bill-brokers," who usually are what their name suggests, namely, persons who do not hold many bills, but find them for banks who need them, charging a small commission. The small bill-brokers borrow from the Bank of England much more freely than the big discount houses. The latter only "go to the bank" in ordinary times perhaps once or twice a year. During the South African War, which disturbed the money market very much, they obtained accommodation from the Bank more frequently than usual. The small brokers almost always have to borrow from the Bank at the end of every quarter, when money is scarce owing to the regular quarterly requirements of business, and also, to some extent, because certain of the banks make it a practice to call in loans at the end of each month in order to show a satisfactory cash reserve in their monthly balance-sheet. This practice is not approved by the best authorities, for although it does no great harm in quiet times, the banks who follow it might find it difficult, or even impossible, to call in their loans in times of severe stringency.

AUTHORITIES.—Walter Bagehot, *Lombard Street* (1873); Arthur Ellis, *Rationale of Market Fluctuations*; Robert Giffen, *Stock Exchange Securities* (1879); W. Stanley Jevons, *Theory of Political Economy* (2nd ed., 1879), pp. 91 seq., and *Investigations in Currency and Finance*; Henry Sidgwick, *Principles of Political Economy*, book ii. ch. ii.; Augustin Cournot, *Theory of Wealth* (1838), translated by Nathaniel T. Bacon; George Clare, *A Money Market Primer and Key to the Exchanges*; John Stuart Mill, *Principles of Political Economy*, book iii. ch. i.–vi.; John Shield Nicholson, *Bankers' Money*; Hartley Withers, *The Meaning of Money* (1909). (W. Ho.)

MARKET BOSWORTH, a market town in the Bosworth parliamentary division of Leicestershire, England; 105 m. N.N.W. from London on a branch from Nuneaton of the London & North Western and Midland railways, near the Ashby-de-la-Zouch canal. Pop. (1901), 659. The church of St Peter is Perpendicular, with a lofty tower and spire. At the grammar school, founded in 1528, Dr Samuel Johnson was a master about 1732, but found the work unbearable. The trade of Market Bosworth is principally agricultural, and there are brickworks. Two miles south is the scene of the battle of Bosworth, in 1485, where Richard III. fell before Henry earl of Richmond, who thereupon assumed the crown as Henry VII.

MARKET DRAYTON, a market town in the Newport division of Shropshire, England, on the river Tern and the Shropshire Union canal, 178 m. N.W. from London. Pop. (civil parish of Drayton-in-Hales, 1901), 5167. The Wellington-Crewe line of the Great Western railway is here joined by a branch into Staffordshire of the North Staffordshire railway. The church of St Mary has Norman remains but is modernised by restoration. The town is a centre of agricultural trade, and there are large iron foundries. It is in the parish of Drayton-in-Hales, a name sometimes applied to it; and it is also known as Drayton Magna. It is an ancient town, of which the manor was held successively by the abbots of St Ebrulph in Normandy and Combermere in Cheshire. On Blore Heath, 3 m. east in Staffordshire, Audley Cross marks a great battle in the Wars of the Roses (1459), in which the Yorkists were successful and Lord Audley fell.

MARKET HARBOROUGH, a market town in the Harborough parliamentary division of Leicestershire, England; on the river Welland and the Grand Union Canal. Pop. of urban district (1901), 7735. It is 81 m. N.N.W. from London by the Midland railway, and is served by branches of the London & North Western and Great Northern railways. The church of St Dionysius is Decorated and Perpendicular, with a fine tower and spire. The grammar school was founded in 1614; it occupies modern buildings, but the original house remains, a picturesque half-timbered building, raised upon pillars of wood. Both British and Roman remains have been found in the vicinity. There are malt-houses and boot, shoe and stay factories. The town is also an important fox-hunting centre.

MARKHAM, SIR CLEMENTS ROBERT (1830–), English traveller, geographer and author, son of the Rev. David F. Markham, canon of Windsor, and of Catherine, daughter of Sir W. Milner, Bart., of Nunappleton, Yorkshire, was born on the 20th of July 1830 at Stillingfleet, near York, and educated at Westminster School. He entered the navy in 1844, became midshipman in 1846, and passed for a lieutenant in 1851. In 1850–1851 he served on the Franklin search expedition in the Arctic regions, under Captain Austin. He retired from the navy in 1852, and in

1852–1854 travelled in Peru and the forests of the eastern Andes. He visited South America again in 1860–1861, in order to arrange for the introduction of the cinchona plant into India, a service of the highest value to humanity. In 1865–1866 he visited Ceylon and India, to inspect and report upon the Tinnevelly pearl-fishery and the cinchona plantations. On the Abyssinian expedition of 1867–68 he served as geographer, and was present at the storming of Magdala. In 1874 he accompanied the Arctic expedition under Sir George Nares as far as Greenland. In later years Sir Clements Markham travelled extensively in western Asia and the United States. In 1855 he became a clerk in the Board of Control. From 1867–1877 he was in charge of the geographical department of the Indian Office. He was secretary to the Hakluyt Society from 1858–1887, and became its president in 1890. From 1863–1888 he acted as secretary to the Royal Geographical Society, and on his retirement received the society's gold medal for his distinguished services to geography. He was elected president of the same society in 1893, and retained office for the unprecedented period of twelve years, taking an active share in the work of the society and in increasing its usefulness in various directions. It was almost entirely due to his exertions that funds were obtained for the National Antarctic Expedition under Captain Robert Scott, which left England in the summer of 1901. Sir Clements Markham was elected F.R.S. in 1873; was created C.B. in 1871, and K.C.B. in 1896; became an honorary member of the principal geographical societies; and was president of the International Geographical Congress which met in London in 1895.

Sir Clements Markham conducted the *Geographical Magazine* from 1872–1878, when it became merged in the *Proceedings of the Royal Geographical Society*. Among his other publications may be mentioned the following: *Franklin's Footsteps* (1852); *Cuzco and Lima* (1856); *Travels in Peru and India* (1862); *A Quichua Grammar and Dictionary* (1863); *Spanish Irrigation* (1867); *A History of the Abyssinian Expedition* (1869); *A Life of the Great Lord Fairfax* (1870); *Ollanta, a Quichua Drama* (1871); *Memoir on the Indian Surveys* (1871; 2nd ed., 1878); *General Sketch of the History of Persia* (1873); *The Threshold of the Unknown Region* (1874, 4 editions); *A Memoir of the Countess of Chinchon*, (1875); *Missions to Thibet*, (1877; 2nd ed., 1879); *Memoir of the Indian Surveys*; *Peruvian Bark* (1880); *Peru* (1880); *The War between Chili and Peru* (1879–81; 3rd ed., 1883); *The Sea Fathers* (1885); *The Fighting Veres* (1888); *Paladins of King Edwin* (1896); *Life of John Davis the Navigator* (1889); a *Life of Richard III.* (1906), in which he maintained that the king was not guilty of the murder of the two princes in the Tower; also lives of *Admiral Fairfax*, *Admiral John Markham*, *Columbus* and *Major Rennel*; *a History of Peru*; editions with introductions of twenty works for the Hakluyt Society, of which fourteen were also translations; about seventy papers in the Royal Geographical Society's *Journal*; the *Reports on the Moral and Material Progress of India* for 1871–1872 and 1872–1873; *Memoir of Sir John Harington* for the Roxburghe Club (1880); the Peruvian chapters for J. Winsor's *History of America*, and the chapters on discovery and surveying for Clowes's *History of the Navy*.

MARKHAM, GERVASE (or JERVIS) (1568?–1637), English poet and miscellaneous writer, third son of Sir Robert Markham of Cotham, Nottinghamshire, was born probably in 1568. He was a soldier of fortune in the Low Countries, and later was a captain under the earl of Essex's command in Ireland. He was acquainted with Latin and several modern languages, and had an exhaustive practical acquaintance with the arts of forestry and agriculture. He was a noted horse-breeder, and is said to have imported the first Arab. Very little is known of the events of his life. The story of the murderous quarrel between Gervase Markham and Sir John Holles related in the *Biographia Britannica* (*s.v.* Holles) has been generally connected with him, but in the *Dictionary of National Biography*, Sir Clements R. Markham, a descendant from the same family, refers it to another contemporary of the same name, whose monument is still to be seen in Laneham church. Gervase Markham was buried at St Giles's, Cripplegate, London, on the 3rd of February 1637. He was a voluminous writer on many subjects, but he repeated himself considerably in his works, sometimes reprinting the same books under other titles. His booksellers procured a declaration from him in 1617 that he would produce no more on certain topics.

Markham's writings include: *The Teares of the Beloved* (1600) and *Marie Magdalene's Teares* (1601) long and rather commonplace poems on the Passion and Resurrection of Christ, both reprinted by Dr A. B. Grosart in the *Miscellanies of the Fuller Worthies Library* (1871); *The most Honorable Tragedy of Sir Richard Grinvile* (1595), reprinted (1871) by Professor E. Arber, a prolix and euphuistic poem in eight-lined stanzas which was no doubt in Tennyson's mind when he wrote his stirring ballad; *The Poem of Poems, or Syon's Muse* (1595), dedicated to Elizabeth, daughter of Sir Philip Sidney; *Devoreux, Vertues Teares* (1597). *Herod and Antipater, a Tragedy* (1622) was written in conjunction with William Sampson, and with Henry Machin he wrote a comedy called *The Dumbe Knight* (1608). *A Discourse of Horsemanshippe* (1593) was followed by other popular treatises on horsemanship and farriery. *Honour in his Perfection* (1624) is in praise of the earls of Oxford, Southampton and Essex, and the *Souldier's Accidence* (1625) turns his military experiences to account. He edited Juliana Berners's *Boke of Saint Albans* under the title of *The Gentleman's Academie* (1595), and produced numerous books on husbandry, many of which are catalogued in Lowndes's *Bibliographer's Manual* (Bohn's ed., 1857–1864).

MARKHAM, MRS, the pseudonym of Elizabeth Penrose (1780–1837), English writer, daughter of Edmund Cartwright the inventor of the power-loom. She was born at her father's rectory at Goadby Marwood, Leicestershire, on the 3rd of August 1780. In 1804 she married the Rev. John Penrose, a country clergyman in Lincolnshire and a voluminous theological writer. During her girlhood Mrs Penrose had frequently stayed with relatives at Markham, a village in Nottinghamshire, and from this place she took the *nom de plume* of "Mrs Markham," under which she gained celebrity as a writer of history and other books for the young. The best known of her books was *A History of England from the First Invasion by the Romans to the End of the Reign of George III.* (1823), which went through numerous editions. In 1828 she published a *History of France*. Both these works enjoyed a wide popularity in America as well as in England. The distinctive characteristic of "Mrs Markham's" histories was the elimination of all the "horrors" of history, and of the complications of modern party politics, as being unsuitable for the youthful mind; and the addition to each chapter of "Conversations" between a fictitious group consisting of teacher and pupils bearing upon the subject matter. Her less well-known works were *Amusements of Westernheath, or Moral Stories for Children* (2 vols., 1824); *A Visit to the Zoological Gardens* (1829); two volumes of stories entitled *The New Children's Friend* (1832); *Historical Conversations for Young People* (1836); *Sermons for Children* (1837). Mrs Markham died at Lincoln on the 24th of January 1837.

See Samuel Smiles, *A Publisher and his Friends* (2 vols., London, 1891); G. C. Boase and W. P. Courtney, *Bibliotheca Cornubiensis* (3 vols., London, 1874–1882).

MARKHAM, WILLIAM (1719–1807), archbishop of York, was educated at Westminster and at Christ Church, Oxford. He was one of the best scholars of his day, and attained to the headship of his old school and college in 1753 and 1767 respectively. He held from time to time a number of livings, and in 1771 was made bishop of Chester and tutor to George prince of Wales. In 1777 he became archbishop of York, and also lord high almoner and privy councillor. He was for some time a close friend of Edmund Burke, but his strong championship of Warren Hastings caused a breach. He was accused by Lord Chatham of preaching pernicious doctrines, and was a victim of the Gordon riots in 1780. He died in 1807.

MARKHOR ("snake-eater"), the Pushtu name of a large Himalayan wild goat (*Capra falconeri*), characterized by its spirally twisted horns, and long shaggy winter coat. From the Pir-Panjal range of Kashmir the markhor extends westwards into Baltistan, Astor, Hunza, Afghanistan and the trans-Indus ranges of the Punjab. The twist of the horns varies to a great extent locally, the spiral being most open and corkscrew-like in the typical Astor animal, and closest and most screw-like in the race (*C. falconeri jerdoni*) inhabiting the Suleiman and adjacent ranges.

MARKIRCH (French, *Ste-Marie-aux-Mines*), a town of Germany, in Upper Alsace, prettily situated in the valley of the Leber, an affluent of the Rhine, near the French frontier. Pop. (1900), 12,372. The once productive silver, copper and lead mines of the neighbourhood were practically unworked during the whole of the 19th century, but have recently been reopened. The main industries of the place are, however, weaving and dyeing, and it is estimated that there are about 40,000 workpeople in the industrial district of which Markirch is the centre. The small river Leber, which intersects the town, was at one time the boundary between the German and French languages, and traces of this separation still exist. The German-speaking inhabitants on the right bank were Protestants, and subject to the counts of Rappoltstein, while the French inhabitants were Roman Catholics, and under the rule of the dukes of Lorraine.

See Mühlenbeck, *Documents historiques concernant Ste-Marie aux Mines* (Markirch, 1876–1877); Hauser, *Das Bergbaugebiet von Markirch* (Strass., 1900).

MARKLAND, JEREMIAH (1693–1776), English classical scholar, was born at Childwall in Lancashire on the 29th (or 18th) of October 1693. He was educated at Christ's Hospital and Peterhouse, Cambridge. He died at Milton, near Dorking, on the 7th of July 1776.

His most important works are *Epistola critica* (1723), the *Sylvae* of Statius (1728), notes to the editions of Lysias by Taylor, of Maximus of Tyre by Davies, of Euripides' *Hippolytus* by Musgrave, editions of Euripides' *Supplices*, *Iphigenia in Tauride* and *in Aulide* (ed. T. Gaisford, 1811); and *Remarks on the Epistles of Cicero to Brutus* (1745).

See J. Nichols's *Literary Anecdotes* (1812), iv. 272; also biography by F. A. Wolf, *Literarische Analekten*, ii. 370 (1818).

MARKO KRALYEVICH, Servian hero, was a son of the Servian king or prince, Vukashin (d. 1371). Chagrined at not himself becoming king after his father's death, he headed a revolt against the new ruler of the Servians. Later he passed into the service of the sultan of Turkey, and was killed in battle about 1394. Marko, however, is more celebrated in legend than in history. He is regarded as the personification of the Servian race, and stories of strength and wonder have gathered round his name. He is supposed to have lived for 300 years, to have ridden a horse 150 years old, and to have used his enormous physical strength against oppressors, especially against the Turks. He is a great figure in Servian poetry, and his deeds are also told in the epic poems of the Rumanians and the Bulgarians. One tradition relates how he retired from the world owing to the advent of firearms, which, he held, made strength and valour of no account in battle. Goethe regards Marko as the counterpart of Hercules and of the Persian Rustem.

The Servian poems about him were published in 1878; a German translation by Gröber (*Marko, der Königssohn*) appeared at Vienna in 1883.

MARK SYSTEM, the name given to a social organization which rests on the common tenure and common cultivation of the land by small groups of freemen. Both politically and economically the mark was an independent community, and its earliest members were doubtless blood relatives. In its origin the word is the same as mark or march (*q.v.*), a boundary. First used in this sense, it was then applied to the land cleared by the settlers in the forest areas of Germany, and later it was used for the system which prevailed—to what extent or for how long is uncertain—in that country. It is generally assumed that the lands of the mark were divided into three portions, forest, meadow and arable, and as in the manorial system which was later in vogue elsewhere, a system of rotation of crops in two, three or even six fields was adopted, each member of the community having rights of pasture in the forest and the meadow, and a certain share of the arable. The mark was a self-governing community. Its affairs were ordered by the markmen who met together at stated times in the markmoot. Soon, however, their freedom was encroached upon, and in the course of a very short time it disappeared altogether.

The extent and nature of the mark system has been, and still is, a subject of controversy among historians. One school holds that it was almost universal in Germany; that it was, in fact, the typical Teutonic method of holding and cultivating the land. From Germany, it is argued, it was introduced by the Angle and Saxon invaders into England, where it was extensively adopted, being the foundation upon which the prevailing land system in early England was built. An opposing school denies entirely the existence of the mark system, and a French writer, Fustel de Coulanges, refers to it contemptuously as "a figment of the Teutonic imagination." This view is based largely upon the supposition that common ownership of the land was practically unknown among the early Germans, and was by no means general among the early English. The truth will doubtless be found to lie somewhere between the two extremes. The complete mark system was certainly not prevalent in Anglo-Saxon England, nor did it exist very widely, or for any very long period in Germany, but the system which did prevail in these two countries contained elements which are also found in the mark system.

The chief authority on the mark system is G. L. von Maurer, who has written *Einleitung zur Geschichte der Mark- Hof- Dorf- und Stadtverfassung und der öffentlichen Gewalt* (Munich, 1854; new ed., Vienna, 1896), and *Geschichte der Markenverfassung in Deutschland* (Erlangen, 1856). See also N. D. Fustel de Coulanges, *Recherches sur quelques problèmes de l'histoire* (1885); and a translation from the same writer's works called *The Origin of Property in Land*, by M. Ashley. This contains an introductory chapter by Professor W. J. Ashley. Other authorities are K. Lamprecht, *Deutsches Wirtschaftsleben im Mittelalter* (Leipzig, 1886); R. Schröder, *Lehrbuch der deutschen Rechtsgeschichte* (Leipzig, 1902); and W. Stubbs, *Constitutional History of England*, vol. i. (1891).

MARL (from O. Fr. *marle*, Late Lat. *margila*, dim. of *marga*; cf. Du. and Ger. *Mergel*), a calcareous clay, or a mixture of carbonate of lime with argillaceous matter. It is impossible to give a strict definition of a marl, for the term is applied to a great variety of rocks and soils with a considerable range of composition. On the one hand, the marls graduate into clays by diminution in the amount of lime that they contain, and on the other hand they pass into argillaceous limestones (see LIMESTONE). From 25–75% of carbonate of lime may be regarded as characteristic of the marls. But in popular usage many substances are called marls which would not be included under the definition given here. The practice formerly much in vogue of top-dressing land with marls, and the use of many different kinds of earth and clay for that purpose, has led to a very general misapplication of the term; for all sorts of rotted rock, some being of igneous origin while others are rain-wash, loams, and various superficial deposits, have been called "marls" in different parts of Britain, if only it was believed that an application of them to the surface of the fields would result in increased fertility.

The typical marls are soft, earthy, and of a white, grey or brownish colour. Many of them disintegrate in water; and they are readily attacked by dilute hydrochloric acid, which dissolves the carbonate of lime rapidly, giving off bubbles of carbon dioxide. The lime of some marls is present in the form of shells, whole or broken; in others it is a fine impalpable powder mixed with the clay. In many marls there is organic matter (plant fragments or humus). Sand is usually not abundant but is rarely absent. Gypsum occurs in some marls, occasionally in large simple crystals with the form of lozenge-shaped plates or in twinned groups resembling an arrow-head; fine examples of these are obtained in the marls of Montmartre near Paris, where celestine (strontium sulphate) occurs also in nodular or concretionary masses. Large crystals of calcite or of dolomite, lumps of iron pyrites or radiate nodules of marcasite, and small crystals of quartz are found in certain marl deposits; and in Westphalia the marls of the Senonian (part of the Cretaceous system) at Hamm yield masses of strontianite up to two feet in length. A very large variety of accessory minerals may be proved to exist in marls by microscopic examination.

The rocks known as shell marls are found in many parts of Britain and other northern countries, and are much valued by farmers as a source of carbonate of lime, though rarely burned to produce quicklime. They are generally obtained by digging pits in marshy spots or meadows, and often occur below considerable thicknesses of peat. Large numbers of shells of fresh-water mollusca are scattered through a matrix of clay; usually retaining their shapes though they are in a friable and semi-decomposed state. The species represented are very few, and from their unbroken state it is obvious that they have not been transported but lived in the place where their remains are found. As mollusca of this kind thrive best in open stretches of clear water, the sites of the marl deposits must have been shallow lakes and open pools.

Among the older strata it is not uncommon to find beds which have the same composition and in many cases the same origin as shell marl. While some of them are fresh-water deposits, others are of marine origin. The "crag beds" of the Pliocene formation in Norfolk, Suffolk and Essex are essentially sand and gravel, which are often rich in shells; with them occur clays such as the Chillesford clay; and many of these beds have actually been used as marls for dressing the surface of agricultural land. Better examples occur among the Oligocene beds of the Hampshire basin and the Isle of Wight, where the Steadon, Bembridge and Hempstead marls are clays, more or less sandy, containing fresh-water shells. In the Cretaceous rocks of the south of England soft argillaceous limestones of marine origin, which may be described as marls, occur on several horizons. At its base the white chalk is often mixed with clay, and the "chalk marl" is a rock of this kind; it is known in Cambridgeshire, at Folkestone, in the Isle of Wight, &c. The chloritic marl, which underlies the chalk and is well developed in the Isle of Wight, is a greenish argillaceous limestone, the colour being due to the presence of glauconite, not of chlorite; it is often very fossiliferous. The Gault, an argillaceous type of the Upper Greensand, is a stiff greyish calcareous clay, beneath the white chalk, well known for the excellent preservation of its fossils. It outcrops along the base of the escarpment of the North and South Downs; the original name given to it by William Smith was "the blue marl." In the Jurassic rocks of England there are marls or shelly fresh-water clays in the Purbeck series and also in the estuarine beds of the Great Oolite, but the name "marlstone" has long been reserved for the argillaceous limestone of the Middle Lias. It ranges from the Dorset coast, through Edge Hill in Warwickshire and Lincolnshire, and thence to the sea in the north of Yorkshire, presenting many variations in this long extent of country and often accompanied by, or converted into, beds of clay ironstone. The marlstone is typically a firm, greyish limestone weathering to a rusty brown colour, and is always more or less argillaceous.

In the Triassic rocks of Britain there is a very important series of red, green and mottled clays, over a thousand feet thick in some places, which have been called the New Red marls. They belong to the Keuper or uppermost division of the system, and in Cheshire contain valuable deposits of rock salt, the principal sources of that mineral in Great Britain. In the strict sense these rocks are not marls, being ferruginous clays rather than calcareous clays. Most of them appear to have been laid down in saline lakes in desert regions. As a rule they contain very few fossils, and often they have little or no carbonate of lime, but beds and veins of fibrous gypsum occur in them in considerable profusion. These rocks cover a wide area in the midland counties extending to the south coast near Exmouth, and reappear in the north in the Vale of Eden and a few places in southern Scotland. The clays are used for brick-making, and yield a stiff soil, mostly devoted to pasture and dairy farming. In the Rhaetic beds which immediately overlie the Triassic rocks there are three seams of calcareous clay, often only a few feet thick, which have been called the "grey marls" and the "tea-green marls."

To rocks older than these the name marl has not often been given, probably because, though argillaceous limestones are often common in the Carboniferous and Silurian rocks, they are usually firm and compact, while marls usually comprise rocks which are more or less soft and friable. In other countries, and especially in Germany, many different kinds of marl and of marl-slate are described. Two of these are of especial importance—the dark copper-bearing marl slate of the Permian rocks near Mansfeld in Germany, which has been long and extensively worked as sources of copper, and the white or creamy Solenhofen limestone, much quarried in Bavaria, and used as a lithographic stone. (J. S. F.)

MARLBOROUGH, EARLS AND DUKES OF. The earldom of Marlborough was held by the family of Ley from 1626 to 1679. James Ley, the 1st earl (*c.* 1550–1629), was lord chief justice of the King's Bench in Ireland and then in England; he was an English member of parliament and was lord high treasurer from 1624 to 1628. In 1624 he was created Baron Ley and in 1626 earl of Marlborough. The 3rd earl was his grandson James (1618–1665), a naval officer who was killed in action with the Dutch. James was succeeded by his uncle William, a younger son of the 1st earl, on whose death in 1679 the earldom became extinct.

In 1689 John Churchill was created earl and in 1702 duke of Marlborough (see below). After the death of his only son Charles in 1703 an act of parliament was passed in 1706 settling the duke's titles upon his daughters and their issue. Consequently when he died in June 1722 his eldest daughter Henrietta (1681–1733), wife of Francis Godolphin, 2nd earl of Godolphin, became duchess of Marlborough. She died without sons and was succeeded by her nephew Charles Spencer, 5th earl of Sunderland (1706–1758), a son of the great duke's second daughter Anne (d. 1716). Although at this time Charles handed over the Sunderland estates to his younger brother John, the ancestor of the earls Spencer, he did not obtain Blenheim until Sarah, the dowager duchess, died in 1744. His eldest son George Spencer, the 4th duke (1739–1817), left three sons. The eldest, George Spencer, the 5th duke (1766–1840), was summoned to the House of Lords as Baron Spencer of Wormleighton in 1806, and in 1817, after succeeding to the dukedom, he took the name of Spencer-Churchill. The 4th duke's second son was Lord Henry John Spencer (1770–1795), envoy to Sweden and to Prussia; and his third son was Lord Francis Almeric Spencer (1779–1845), who was created a peer as Baron Churchill of Whichwood in 1815. His grandson Victor Albert Francis Charles Spencer (b. 1864) succeeded his father as 3rd Baron Churchill in 1886, and was raised to the rank of a viscount in 1902.

The 7th duke of Marlborough, John Winston Spencer-Churchill (1822–1883), a prominent Conservative politician, was lord-lieutenant of Ireland 1876–1880, and when marquess of Blandford (the courtesy title borne by the duke's eldest son in his father's lifetime) was responsible for the act of 1856 called the "Blandford Act," enabling populous parishes to be divided for purposes of Church work. In 1892 his grandson Charles Richard John Spencer-Churchill (b. 1871) became 9th duke of Marlborough.

MARLBOROUGH, JOHN CHURCHILL, 1st Duke of (1650–1722), English soldier, was born in the small manor house of Ash, in Musbury, Devonshire, near Axminster, in May or June 1650. Arabella Churchill, his eldest sister, and the mother of the duke of Berwick, was born in the same house on the 28th of February 1648. They were the children of Winston Churchill of Glanville Wotton in Dorset and Elizabeth the fourth daughter of Sir John Drake, who died in 1636; his widow, after the close of the civil war, received her son-in-law into her own house. From 1663 to 1665 John Churchill went to St Paul's school, and there is a tradition that during this period he showed the bent of his taste by reading and re-reading Vegetius *De re militari.* When fifteen years old he became page of honour to the duke of York, and about the same time his sister Arabella became maid of honour to the duchess, two events which contributed greatly to the advancement of the Churchills. On the 14th of September 1667 he received through the influence of his master a commission in the Guards, and left England for service at Tangier but returned home in the winter of 1670–1671. For a short interval Churchill remained in attendance at the court, and it was during this period that the natural carefulness of his disposition was shown by his investing in an annuity a present of £5,000 given him by the duchess of Cleveland.

In June 1672, when England to her shame sent six thousand troops to aid Louis XIV. in his attempt to subdue the Dutch, Churchill was made a captain in the company of which the duke of York was colonel, and soon attracted the attention of Turenne, by whose profound military genius the whole army was directed. At the siege of Nimeguen Churchill acquitted himself with such success that the French commander predicted his ultimate rise to distinction. When Maestricht was besieged in June 1673 he saved the life of the duke of Monmouth, and received the thanks of Louis XIV. for his services. In 1678 he was married to Sarah Jennings (b. June 5, 1660), the favourite attendant on the Princess Anne, younger daughter of the duke of York. Her father, Richard Jennings of Sandridge, near St Albans, had twenty-two brothers and sisters; one of the latter married a London tradesman named Francis Hill, and their daughter Abigail Hill afterwards succeeded her cousin the duchess of Marlborough as favourite to Queen Anne.

On the accession of James II. the Churchills received a great increase in fortune. Colonel Churchill had been created a Scotch peer as Lord Churchill of Eyemouth on the 21st of December 1682; and as a reward for his services in going on a special mission from the new monarch to Louis XIV. he was advanced on the 14th of May 1685 to the English peerage under the title of Baron Churchill of Sandridge in Hertfordshire. When the duke of Monmouth attempted his ill-fated enterprise in the western counties, the second position in command of the king's army was bestowed on Lord Churchill, and on the 3rd of July 1685 he was raised to the rank of major-general. Through his vigilance and energy at the battle of Sedgemoor (July 6) victory declared itself on the king's side. After the death of Monmouth he withdrew as far as possible from the administration of public business, but both he and his wife remained the favourite attendants of the princess Anne. Whilst on his embassy to the French court he had declared with emphasis that if the king of England should change the religion of the state he should at once leave his service, and it was not long before the design of James became apparent to the world. Churchill was one of the first to send overtures of obedience to the prince of Orange, to whom he had gone on a commission in 1678. Although he continued in a high position under James and drew the emoluments of his places, he promised William of Orange to use every exertion to bring over the troops to his side. James had been warned against putting any trust in the loyalty of the man on whom he had showered so many favours, but the warnings were in vain, and on the landing of the Dutch prince at Brixham Churchill was promoted to be lieutenant-general (Nov. 7, 1688) and was sent against him with five thousand men. When the royal army had advanced to the downs of Wiltshire and a battle seemed imminent, James was dismayed at finding that in the dead of night his general had stolen away like a thief into the opposite camp.

Churchill was sworn as a privy councillor on the 14th of February 1688/9 and on the 9th of April became earl of Marlborough. William felt, however, that he could not place implicit reliance in his friend's integrity; and, with a clear sense of the manner in which Marlborough's talents might be employed without any detriment to the stability of his throne, he sent him in June 1689 with the army into the Netherlands, and in the autumn of 1690 into Ireland, where owing to his generalship Cork and Kinsale fell into his hands after short sieges. For some time there was no open avowal of any distrust in Marlborough's loyalty, but in May 1692 he was thrown into the Tower on an accusation of treason. Though the evidence which could be brought against him was slight, and he was soon set at liberty, there is no doubt that Marlborough was in close relations with the exiled king at St Germains, and that he even went so far as to disclose, in May 1694, to his late master the intention of the English to attack the town of Brest. The talents of the statesmen of this reign were chiefly displayed in their attempts to convince both the exiled and the reigning king of England of their attachment to his fortunes. The sin of Marlborough lay in the fact that he had been favoured above his fellows by each in turn, and that he betrayed both alike apparently without scruple or without shame. Once again during the Fenwick plot of 1696 he was charged with treason, but William, knowing that if he pushed Marlborough and his friends to extremities there were no other statesmen on whom he could rely, contented himself with ignoring the accusation of Sir John Fenwick, and with executing that conspirator himself. In 1698 the forgiven traitor was made governor to the young duke of Gloucester, the only one of Anne's numerous children who gave promise of attaining to manhood. During the last years of William's reign Marlborough once more was placed in positions of responsibility. His daughters were married into the most prominent families of the land; Henrietta, the eldest, became the wife of Francis, the eldest son of Lord Godolphin; the second, the loveliest woman at the court, with her father's tact and temper and her mother's beauty, married Charles, Lord Spencer, the only surviving son of the earl of Sunderland. Higher honours came on the accession of Queen Anne in March 1702. He was at once appointed a Knight of the Garter, captain-general of the English troops both at home and abroad, and master-general of the ordnance. The new queen did not forget the lifelong service of his wife; three positions at the court by which she was enabled to continue by the side of the sovereign were united in her person. The queen showed her devotion to her friend by another signal mark of favour. The rangership of Windsor Park was granted her for life, with the especial object of enabling Lady Marlborough to live in the Great Lodge. These were the opening days of many years of fame and power. A week or two after the death of William it was agreed by the three great powers, England, Holland and Austria, which formed the grand alliance, that war should be declared against France on the same day, and on the 4th of May 1702 the War of the Spanish Succession was declared by the three countries. Marlborough was made commander-in-chief of the united armies of England and Holland, but throughout the war his plans were impeded by the jealousy of the commanders who were nominally his inferiors, and by the opposite aims of the various countries that were striving to break the power of France. He himself wished to penetrate into the French lines; the anxiety of the Dutch was for the maintenance of their frontier and for an augmentation of their territory; the desire of the Austrian emperor was to secure that his son the Archduke Charles should rule over Spain. To secure concerted action by these different powers taxed all the diplomacy of Marlborough, but he succeeded for the most part in his desires. In the first year of the campaign it was shown that the armies of the French were not invincible. Several fortresses which Louis XIV. had seized upon surrendered to the allies. Kaiserswerth on the Rhine surrendered on the 15th of June, and Venlo on the Meuse on the 23rd of September. The prosperous commercial town of Liège with its commanding citadel capitulated on the 29th of October. The successes of Marlborough caused much rejoicing in his own country, and for these brilliant exploits he was raised (Dec. 14, 1702) to be duke of Marlborough, and received a grant of £5000 per annum for the queen's life. In the spring of the following year a crushing blow fell upon the duke and duchess. Their eldest and only surviving son, the marquess of Blandford, was seized whilst at King's College, Cambridge (under the care of Francis Hare, afterwards bishop of Chichester), with the small-pox, and died on the 20th of February 1703, in his seventeenth year. His talents had already justified the prediction that he would rise to the highest position in the state.

The result of the campaign of 1703 inspired the French king with fresh hopes of ultimate victory. The dashing plans of Marlborough were frustrated by the opposition of his Dutch colleagues. When he wished to invade the French territory they urged him to besiege Bonn, and he was compelled to accede to their wishes. It surrendered on the 15th of May, whereupon he returned to his original plan of attacking Antwerp; but, in consequence of the incapacity of the Dutch leaders, the generals (Villeroi and Boufflers) of the French army surprised the Dutch division on the 30th of June and inflicted on it a loss of many thousands of men. Marlborough was forced to abandon his enterprise, and all the compensation which he received was the capture of the insignificant forts of Huy and Limburg. After a year of comparative failure for the allies, Louis XIV. was emboldened to enter upon an offensive movement against Austria; and Marlborough, smarting under the misadventures of 1703, was eager to meet him. A magnificent army was sent by the French king, under the command of Marshal Tallard, to join the forces of the elector of Bavaria and to march by the Danube so as to seize Vienna itself. Marlborough divined the intention of the expedition, and while making a feint of marching into Alsace led his troops into Bavaria. The two armies (that under Marlborough and Prince Eugène numbering more than fifty thousand men, whilst Tallard's forces were nearly four thousand stronger) met in battle near the village of Blenheim on the left bank of the Danube. The French commander made the mistake of supposing that the enemy's attack would be directed against his position in the village, and he concentrated an excessive number of his troops at that point. The early part of the fight was in favour of the French. Three times were the troops led by Prince Eugène, which were attacking the Bavarians, the enemy's left wing, driven back in confusion; Marlborough's cavalry failed on their first attack in breaking the line of the enemy's centre. But in the end the victory of the allies was conclusive. Nearly thirty thousand of the French and Bavarians were killed and wounded, and eleven thousand of the French who had been driven down to the Danube were forced to surrender. Bavaria fell into the hands of the allies. Never was a victory more eagerly welcomed than this, and never was a conquering leader more rewarded than Marlborough. Poets and prose writers were employed to do him honour, and the lines of Addison comparing the English commander to the angel who passed over "pale Britannia" in the storm of 1703 have been famous for over two centuries. The manor of Woodstock, which was transferred by act of parliament from the crown to the duke, was a reward more after his own heart. The gift even in that form was noble, but the queen heightened it by instructing Sir John Vanbrugh to build a palace in the park at the royal expense, and £240,000 of public money was spent on the buildings. He was also created a prince of the empire and the principality of Mindelheim was formed in his honour.

The following year was not marked by any stirring incident. Marlborough was hampered by tedious formalities at the Hague and by jealousies at the German courts. The armies of the French were again brought up to their full standard, but the generals of Louis were instructed to entrench themselves behind earthworks and to act on the defensive. In the darkness of a July night these lines were broken through near Tirlemont, and the French were forced to take shelter under the walls of Louvain. Marlborough in vain urged an attack upon them in their new position, and when 1705 had passed away the forces of the French king had suffered no diminution. This immunity from disaster tempted Villeroi in the next spring into meeting the allied forces in an open fight, but his assurance proved his ruin. Through the superior tactics of Marlborough the battle of Ramillies (May 23, 1706) ended in the total rout of the French, and caused the transference of nearly the whole of Brabant and Flanders to the allies. Five days afterwards the victor entered Brussels in state, and the inhabitants acknowledged the rule of the archduke. Antwerp and Ostend surrendered themselves with slight loss. Menin held out until three thousand of the soldiers of the allies were laid low around its walls, but Dendermonde, which Louis had forty years previously besieged in vain, quickly gave itself up to the resistless Marlborough. Again a year of activity and triumph was succeeded by a period of languor and depression. During the whole of 1707 fortune inclined to the other side, with the result that in July 1708 Ghent and Bruges returned to the allegiance of the French, and Marlborough, fearing that their example might be followed by the other cities, advanced with his whole army towards Oudenarde. Had the counsels of Vendôme, one of the ablest of the French generals, prevailed, the fight might have had a different issue, but his suggestions were disregarded by the duke of Burgundy, the grandson of Louis, and the battle, which raged on the high ground above Oudenarde, ended in their defeat (July 11, 1708). After this victory Marlborough, ever anxious for decisive measures, wished to advance on Paris, but he was overruled. The allied army invested the town of Lille, on the fortifications of which Vauban had expended an immensity of thought; and after a struggle of nearly four months, and the loss to the combatants of thirty thousand men, the citadel was surrendered by Marshal Boufflers on the 9th of December. By the end of the year Brabant was again subject to the rule of the allies. The suffering in France at this time weighed so heavily upon the people that its proud king humbled himself to sue for peace. Each of the allies in turn did he supplicate, and Torcy his minister endeavoured by promises of large sums of money to obtain the support of Marlborough to his proposals. These attempts were in vain, and when the winter passed away a French army of one hundred and ten thousand, under the command of Villars, took the field. On the 3rd of September 1709 Tournay capitulated, and the two leaders, Marlborough and Eugène, led their forces to Mons, in spite of the attempt of Villars to prevent them. For the last time during the protracted war the two armies met in fair fight at Malplaquet, on the south of Mons (Sept. 11, 1709), where the French leader had strengthened his position by extensive earthworks. The fight was long and doubtful, and although the French ultimately retreated under the direction of Boufflers, for Villars had been wounded on the knee, it was in good order, and their losses were less than those of their opponents. The campaign lasted for a year or two after this indecisive contest, but it was not signalized by any such "glorious victory" as Blenheim. All that the English could plume themselves on was the acquisition of a few such fortresses as Douai and Bethune, and all that the French had to fear was the gradual tightening of the enemy's chain until it reached the walls of Paris. The energies of the French were concentrated in the construction of fresh lines of defence, until their commander boasted that his position was impregnable. In this way the war dragged on until the conclusion of the Peace of Utrecht in June 1712.

These victorious campaigns had not prevented the position of Marlborough from being undermined by party intrigues at home. In the early part of Queen Anne's reign his political friends were to be found among the Tories, and the ministry under Sidney Godolphin was chiefly composed of members of that party. After a year or two, however, the more ardent Tories withdrew, and two younger adherents of the same cause, Harley and St John, were introduced in May 1704 into the ministry. The duchess, partly through the influence of her son-in-law, the earl of Sunderland, who came into office against the queen's wish on the 3rd of December 1706, and partly through the opposition of the Tories to the French war, had gone over to the Whig cause, and she pressed her views on the sovereign with more vehemence than discretion. She had obtained for her indigent cousin, Abigail Hill, a small position at court, and the poor relation very soon began to injure the benefactor who had befriended her. With Hill's assistance Harley and St John widened the breach with the queen which was commenced by the imperious manner of the duchess. The love of the two friends changed into hate, and no opportunity for humiliating the family of Marlborough was allowed to pass neglected. Sunderland and Godolphin were the first to fall (July–Aug. 1710); a few months later the duchess was dismissed from her offices; and, although Marlborough himself was permitted to continue in his position a short time longer, his fall was only delayed until the last day of 1711. Life in England had become so unpleasant that he went to the Continent in November 1712 and remained abroad until the death of Anne (Aug. 1, 1714).

Then he once more returned to England and resumed his old military posts, but he took little part in public affairs. Even if he had wished to regain his commanding position in the country, ill health would have prevented him from obtaining his desires. Johnson indeed says, in the *Vanity of Human Wishes*, that "the streams of dotage" flowed from his eyes; but this is a poetical exaggeration. It is certain that at the time of his death he was able to understand the remarks of others and to express his own wishes. At four o'clock on the morning of the 16th of June 1722 he died at Cranbourn Lodge, near Windsor. His remains were at first deposited in Westminster Abbey, in the vault at the east end of King Henry VII.'s chapel, but they now rest in a mausoleum in the chapel at Blenheim.

His widow, to whom must be assigned a considerable share both in his rise and in his fall, survived till the 18th of October 1744. Those years were spent in bitter animosity with many within and without her own family. Left by her husband with the command of boundless wealth, she used it for the vindication of his memory and for the justification of her own resentment. Two of the leading opponents of the Whig ministry, Chesterfield and Pitt, were especially honoured by her attentions. To Pitt she left ten thousand pounds, to the other statesman twice that sum and a reversionary interest in her landed property at Wimbledon. Whilst a widow she received numerous offers of marriage from titled suitors. She refused them all: from her marriage to her death her heart had no other inmate than the man as whose wife she had become almost a rival to royalty.

The rapid rise of Marlborough to the highest position in the State was due to his singular tact and his diplomatic skill in the management of men. In an age remarkable for grace of manner and for adroitness of compliment, his courteous demeanour and the art with which he refused or granted a favour extorted the admiration of every one with whom he came in contact. Through his consideration for the welfare of his soldiers he held together for years an army drawn from every nation in Christendom. His talents may not have been profound (he possessed "an excellent plain understanding and sound judgment" is the opinion of Lord Chesterfield), but they were such as Englishmen love. Alike in planning and in executing, he took infinite pains in all points of detail. Nothing escaped his observation, and in the hottest moment of the fight the coolness of his intellect shone conspicuous. His enemies indeed affected to attribute his uniform success in the field to fortune, and they magnified his love of money by drawing up balance sheets which included every penny which he had received, but omitted the pounds which he had spent in the cause he had sincerely at heart. All that can be alleged in excuse of his attempts to serve two masters, the king whom he had deserted and the king who had received him into favour, is that not one of his associates was without sin in this respect.

The books on Marlborough are very numerous. Under his name in the catalogue of the British Museum there are 165 entries, and 44 under that of his wife. The chief works are Lediard's, Archdeacon William Coxe's (1818–1819), Sir Archibald Alison's (1855), and Viscount Wolseley's (1894) *Lives*, but Wolseley stops with the accession of Queen Anne; a French memoir in three volumes, 1808; Marlborough's *Letters and Despatches*, edited by Sir George Murray (5 vols., 1845); and the interesting summaries of Mrs Creighton (1879) and George Saintsbury (1885). The descriptions in John Hill Burton's *Reign of Queen Anne* of the battle scenes of Marlborough are from personal observation. A good account of his birthplace and country will be found in G. P. R. Pulman's *Book of the Axe District* (4th ed., 1875); and for the home of the duchess the reader can refer to the *History of Hertfordshire*, by J. E. Cussans. A memoir of her, by one of her descendants, Mrs Arthur Colville, appeared in 1904. The pamphlets written on her conduct at court relate to matters of little interest at the present time. (W. P. C.)

MARLBOROUGH, a market town and municipal borough in the Devizes parliamentary division of Wiltshire, England, 75¾ m. W. of London, on the Great Western and the Midland and South Western Junction railways. Pop. (1901), 3887. It is an old-fashioned place on the skirts of Savernake Forest, lying in a valley of the chalk uplands known as Marlborough Downs, and traversed by the river Kennet. It consists mainly of one broad street, in which a majority of the houses are Jacobean; those on the north side, which have projecting upper storeys, forming the colonnade commended in the Diary of Samuel Pepys for 1668. St Peter's church, a Perpendicular building, is said to have been the scene of the ordination of Cardinal Wolsey in 1498. The church of Preshute, largely rebuilt, but preserving its Norman pillars, has a curious piscina, and a black basalt font of great size dating from 1100–1150, in which according to a very old tradition King John was baptized. Other noteworthy buildings are the town-hall, 16th century grammar school and Marlborough College. This important public school was opened in 1843, originally for the sons of clergymen, by whom alone certain scholarships are tenable. The number of boys is about 600. Marlborough possesses little trade other than agricultural; but there are breweries, tanneries and roperies. The town is governed by a mayor, 4 aldermen and 12 councillors. Area, 598 acres.

The antiquity of Marlborough is shown by the Castle Mound, a British earthwork, which local legend makes the grave of Merlin; and the name of Marlborough has been regarded as a corrupt form of Merlin's Berg or Rock.

Near the site of the modern Marlborough (*Merleberge, Marleberge*) was originally a Roman *castrum* called Cunetio, and later there was a Norman fortress in which William I. established a mint. In Domesday it was royal demesne and during the following centuries figures in numerous grants generally as the dowry of queens. The castle, built under Henry I., by Roger, bishop of Salisbury, was held for Matilda against Stephen, and became a favourite residence of Henry II., Savernake being a royal deer-park. In 1267 Henry III. held his last parliament here, at which the Statute of Marlborough was passed. The castle ceased to be an important stronghold after the Wars of the Roses, but was garrisoned for Charles I. by its owners, the Seymour family. Marlborough itself, however, is mentioned by Clarendon as "the most notoriously disaffected [town] in Wiltshire," and was captured by the royal forces in 1642, and partly burnt. At the Restoration Charles II. was received and magnificently entertained by Lord Seymour, whose mansion forms the oldest part of Marlborough College. The town was constituted a suffragan see by Henry II. Sacheverell, the politician and divine, was born here in 1674, and educated at the grammar school. In 1653 the town was nearly destroyed by fire, and it again suffered in 1679 and 1690; after which an act was passed forbidding the use of thatch. Marlborough, from its position on the Great Bath Road, was a famous coaching centre.

The first charter was granted by John in 1204, and conferred a gild merchant, together with freedom from all pleas except pleas of the Crown and from all secular exactions by sea and land. This was confirmed by subsequent sovereigns from Henry III. to Henry VIII. Later charters were obtained from Henry IV. in 1407 and from Elizabeth in 1576. The former granted some additional exemptions whilst the latter incorporated the town under the title of mayor and burgesses of Marlborough. The corporation was finally reconstructed in 1835 under the title of a mayor, 4 aldermen and 12 councillors. Marlborough returned two members to parliament until 1867 when the number was reduced to one, and in 1885 the representation was merged in that of the county. A yearly fair was granted by John in 1204, for eight days from August 14, and two more by Henry III. for three days from November 11 and June 29 respectively. In 1204 John also granted a weekly market on Wednesday and Saturday. In Tudor times the corn trade prospered here.

See "Victoria County History": *Wilts*; James Waglen, *History of Marlboro* (London, 1854).

MARLBOROUGH, a city of Middlesex county, Massachusetts, U.S.A., about 28 m. W. of Boston. Pop. (1900), 13,609 (3311 were foreign-born); (1910), 14,579; it is served by the Boston & Maine and the New York New Haven & Hartford railways, and by inter-urban electric lines. The city, with a total area of 21·08 sq. m., lies in a fertile hilly country, and contains several ponds, including the beautiful Williams Pond, which covers ¼ sq. m. A public library was established here in 1792; it was housed in a new building in 1904. Other public buildings are the city hall, the Federal building and a state armoury. There is a boarding school for girls, St Ann's Academy (1887), under the direction of the Sisters of St Ann. The city's importance is industrial; in 1905 its factory product was valued at $7,468,849 (an increase of 66% since 1900), of which 88·6% was the value of boots and shoes. Whether the city is named from Marlborough in Wiltshire, or, as seems more probable, because of early spellings "Marlberg" and "Marlbridge," from the presence of marl in the neighbourhood, is uncertain. Settlers from Sudbury in 1665 took possession of a hill called by the Indians Whipsuffenicke and gradually hemmed in the Christian Indian village of Ockoocangansett (or Ognoikonguamescitt), on an adjoining hill still bearing this name. The town was incorporated in 1660. It was destroyed by Indians in March 1676, during King Philip's war, and was abandoned for a year. Westborough was separated from it in 1717, Southborough in 1727, and a part of Berlin in 1784; parts of it were annexed to Northborough in 1807, to Bolton in 1829 and to Hudson in 1866; and it annexed parts of Framingham in 1791, and of Southborough in 1843. In 1890 it was incorporated as a city.

See S. A. Drake, *History of Middlesex County*, ii. 137 sqq., "Marlborough" by Rev. R. S. Griffin and E. L. Bigelow (Boston, 1880).

MARLITT, E., the pseudonym of EUGENIE JOHN (1825–1887), German novelist, who was born at Arnstadt in Thuringia, the daughter of a merchant, on the 5th of December 1825. By her musical talent she attracted the notice of the reigning princess of Schwarzburg-Sondershausen, who provided for her training as a singer at the Vienna Conservatoire. After three years' study she made a successful stage début, but was compelled in consequence of deafness to abandon this career She then became reader and travelling companion to her patroness, and her life at the court and on her many travels furnished her with material for her novels. In 1863 she resigned her post, and then lived with her brother at Arnstadt until her death on the 22nd of June 1887

Her first novel, *Die zwölf Apostel*, was published in the *Gartenlaube* in 1865 and this was followed in 1866 by *Goldelse* (23rd ed., 1890), with which she established her literary reputation. Among others of her novels may be mentioned *Blaubart* (1866); *Das Geheimnis der alten Mamsell* (1867; 13th ed., 1888); *Reichsgräfin Gisela* (1869; 9th ed., 1900), *Das Heideprinzesschen* (1871; 8th ed., 1888) and *Im Hause des Kommerzienrats* (1877; 5th ed., 1891). All these works are directed against social prejudices, but, although attractively written, are deficient in higher literary qualities and appeal mostly to juvenile readers.

E. Marlitt's *Gesammelte Romane und Novellen* were published in 10 volumes (1888–1890; 2nd ed., 1891–1894), to which is appended a biographical memoir.

MARLOW (GREAT MARLOW), a market town in the Wycombe parliamentary division of Buckinghamshire, England, 31½ m. W of London on a branch of the Great Western railway Pop. of urban district (1901), 4526. It is beautifully situated on the north (left) bank of the Thames, which is here confined closely between low wooded hills. A weir and lock, near which rise the high tower and spire of the modern church of All Saints, separate two fine reaches of the river, and the town is a favourite resort for boating and fishing. The village of Little Marlow, where the foundations of a Benedictine nunnery of the time of Henry III. have been revealed by excavation, lies near the river two miles below. The town is, as a whole, modern in appearance, but a few old houses remain, such as the grammar school, founded as a bluecoat school in 1624, adjoining which is a house occupied by the poet Shelley in 1817. The town has manufactures of chairs, lace and embroidery, paper mills and breweries.

Great Marlow (*Merlaue*, *Merlawe*, *Marlowe*, *Marlow*) appears as a manor in Domesday Book, but its "borough and liberties" are not mentioned before 1261. It was then held by the earls of Gloucester, and its importance was probably due to the bridge across the Thames, first built, according to tradition, by the Templars at Bisham. No charter of incorporation was ever granted to the town, but there are faint traces of its constitution in the 14th century. In 1342 the mayor and burgesses presented to a chantry and continued to be the patrons till 1394. Later writs addressed to the town only mention two bailiffs as officers of the borough, nor were the pontage rights and dues held by it until the 15th century. Two burgesses sat in parliament from 1300 to 1309, but the representation of the borough lapsed until 1621, when the right to return members was re-established. After the Reform Bill of 1832 the boundaries of the parliamentary borough were enlarged, but in 1867 its representation was reduced to one member, and in 1885 was merged in that of the county. No grant of a market in the borough has been found, but a market was held by the Despensers who had succeeded the De Clares as lords of the manor in the 14th century. In the 16th century the market seems to have been given up, but it was revived and held in the 18th century, only to disappear again before 1862. Fairs were mentioned in 1306 on the death of Gilbert de Clare, when they were held on St Luke's Day and on the Wednesday in Whit-week by the earl of Gloucester, and Hugh le Despenser was granted a fair in his manor of Marlow in 1324. In 1792 there were two fairs, one of which, for horses and cattle, is still held on the 29th of October. Lace and satin-stitch work used to be made to a considerable extent.

MARLOWE, CHRISTOPHER (1564–1593), English dramatist, the father of English tragedy, and instaurator of dramatic blank verse, the eldest son of a shoemaker at Canterbury, was born in that city on the 6th of February 1564. He was christened at St George's Church, Canterbury, on the 26th of February, 1563/4, some two months before Shakespeare's baptism at Stratford-on-Avon. His father, John Marlowe, is said to have been the grandson of John Morley or Marlowe, a substantial tanner of Canterbury The father, who survived by a dozen years or so his illustrious son, married on the 22nd of May 1561 Catherine, daughter of Christopher Arthur, at one time rector of St Peter's, Canterbury, who had been ejected by Queen Mary as a married minister. The dramatist received the rudiments of his education at the King's School, Canterbury, which he entered at Michaelmas 1578, and where he had as his fellow-pupils Richard Boyle, afterwards known as the great earl of Cork, and Will Lyly, the brother of the dramatist. Stephen Gosson entered the same school a little before, and William Harvey, the famous physician, a little after Marlowe. He went to Cambridge as one of Archbishop Parker's scholars from the King's School, and matriculated at Benet (Corpus Christi) College, on the 17th of March 1571, taking his B.A. degree in 1584, and that of M.A. three or four years later.

Francis Kett, the mystic, burnt in 1589 for heresy, was a fellow and tutor of his college, and may have had some share in developing Marlowe's opinions in religious matters. Marlowe's classical acquirements were of a kind which was then extremely common, being based for the most part upon a minute acquaintance with Roman mythology, as revealed in Ovid's *Metamorphoses* His spirited translation of Ovid's *Amores* (printed 1596), which was at any rate commenced at Cambridge, does not seem to point to any very intimate acquaintance with the grammar and syntax of the Latin tongue. Before 1587 he seems to have quitted Cambridge for London, where he attached himself to the Lord Admiral's Company of Players, under the leadership of the famed actor Edward Alleyn, and almost at once began writing for the stage. Of Marlowe's career in London, apart from his four great theatrical successes, we know hardly anything; but he evidently knew Thomas Kyd, who shared his unorthodox opinions. Nash criticized his verse, Greene affected to shudder at his atheism; Gabriel Harvey maligned his memory. On the other hand Marlowe was intimate with the Walsinghams of Scadbury, Chiselhurst, kinsmen of Sir Francis Walsingham: he was also the personal friend of Sir Walter Raleigh, and perhaps of the poetical earl of Oxford, with both of whom, and with such men as Walter Warner and Robert Hughes the mathematicians, Thomas Harriott the notable astronomer, and Matthew Royden, the dramatist is said to have met in free converse. Either this free converse or the licentious character of some of the young dramatist's tirades seems to have sown a suspicion among the strait-laced that his morals left everything to be desired. It is probable enough that this attitude of reprobation drove a man of so exalted a disposition as Marlowe into a more insurgent attitude than he would have otherwise adopted. He seems at any rate to have been associated with what was denounced as Sir Walter Raleigh's school of atheism, and to have dallied with opinions which were then regarded as putting a man outside the pale of civilized humanity. As the result of some depositions made by Thomas Kyd under the influence of torture, the Privy Council were upon the eve of investigating some serious charges against Marlowe when his career was abruptly and somewhat scandalously terminated. The order had already been issued for his arrest, when he was slain in a quarrel by a man variously named (Archer and Ingram) at Deptford, at the end of May 1593, and he was buried on the 1st of June in the churchyard of St Nicholas at Deptford. The following September Gabriel Harvey referred to him as "dead of the plague." The disgraceful particulars attached to the tragedy of Marlowe in the popular mind would not seem to have appeared until four years later (1597) when Thomas Beard, the Puritan author of *The Theatre of God's Judgements*, used the death of this playmaker and atheist as one of his warning examples of the vengeance of God. Upon the embellishments of this story, such as that of Francis Meres the critic, in 1598, that Marlowe came to be "stabbed to death by a bawdy servingman, a rival of his in his lewde love," or that of William Vaughan in the *Golden Grove* of 1600, in which the unfortunate poet's dagger is thrust into his own eye in prevention of his felonious assault upon an innocent man, his guest, it is impossible now to pronounce. We really do not know the circumstances of Marlowe's death. The probability is he was killed in a brawl, and his atheism must be interpreted not according to the *ex parte* accusation of one Richard Baines, a professional informer (among the Privy Council records), but as a species of rationalistic antinomianism, dialectic in character, and closely related to the deflection from conventional orthodoxy for which Kett was burnt at Norwich in 1589. A few months before the end of his life there is reason to believe that he transferred his services from the Lord Admiral's to Lord Strange's Company, and may have thus been brought into communication with Shakespeare, who in such plays as *Richard II.* and *Richard III.* owed not a little to the influence of his romantic predecessor.

Marlowe's career as a dramatist lies between the years 1587 and 1593, and the four great plays to which reference has been made were *Tamburlaine the Great*, an heroic epic in dramatic form divided into two parts of five acts each (1587, printed in 1590), *Dr Faustus* (1588, entered at Stationers' Hall 1601), *The Famous Tragedy of the Rich Jew of Malta* (dating perhaps from 1589, acted in 1592, printed in 1633); and *Edward the Second* (printed 1594). The very first words of *Tamburlaine* sound the trumpet note of attack in the older order of things dramatic:—

> "From jigging veins of riming mother wits
> And such conceits as clownage keeps in pay
> We'll lead you to the stately tent of war,
> Where you shall hear the Scythian Tamburlaine
> Threatening the world with high astounding terms
> And scourging kingdoms with his conquering sword."

It leapt with a bound to a place beside Kyd's *Spanish Tragedy*, and few plays have been more imitated by rivals (Greene's *Alphonsus of Aragon*, Peele's *Battle of Alcazar*, *Selimus*, *Scanderbeg*) or more keenly satirized by the jealousy and prejudice of out-distanced competitors. (T. SE.)

The majestic and exquisite excellence of various lines and passages in Marlowe's first play must be admitted to relieve, if it cannot be allowed to redeem, the stormy monotony of Titanic truculence which blusters like a simoom through the noisy course of its ten fierce acts. With many and heavy faults, there is something of genuine greatness in *Tamburlaine the Great*; and for two grave reasons it must always be remembered with distinction and mentioned with honour. It is the first poem ever written in English blank verse, as distinguished from mere rhymeless decasyllabics; and it contains one of the noblest passages, perhaps indeed the noblest, in the literature of the world, ever written by one of the greatest masters of poetry in loving praise of the glorious delights and sublime submission to the everlasting limits of his art. In its highest and most distinctive qualities, in unfaltering and infallible command of the right note of music and the proper tone of colour for the finest touches of poetic execution, no poet of the most elaborate modern school, working at ease upon every consummate resource of luxurious learning and leisurely refinement, has ever excelled the best and most representative work of a man who had literally no models before him and probably or evidently was often if not always compelled to write against time for his living.

The just and generous judgment passed by Goethe on the *Faustus* of his English predecessor in tragic treatment of the same subject is somewhat more than sufficient to counterbalance the slighting or the sneering references to that magnificent poem which might have been expected from the ignorance of Byron or the incompetence of Hallam. And the particular note of merit observed, the special point of the praise conferred, by the great German poet should be no less sufficient to dispose of the vulgar misconception yet lingering among sciolists and pretenders to criticism, which regards a writer than whom no man was ever born with a finer or a stronger instinct for perfection of excellence in execution as a mere noble savage of letters, a rough self-taught sketcher or scribbler of crude and rude genius, whose unhewn blocks of verse had in them some veins of rare enough metal to be quarried and polished by Shakespeare. What most impressed the author of *Faust* in the work of Marlowe was a quality the want of which in the author of *Manfred* is proof enough to consign his best work to the second or third class at most "How greatly it is all planned!" the first requisite of all great work, and one of which the highest genius possible to a greatly gifted barbarian could by no possibility understand the nature or conceive the existence. That Goethe "had thought of translating it" is perhaps hardly less precious a tribute to its greatness than the fact that it has been actually and admirably translated by the matchless translator of Shakespeare—the son of Victor Hugo, whose labour of love may thus be said to have made another point in common, and forged as it were another link of union, between Shakespeare and the young master of Shakespeare's youth. Of all great poems in dramatic form it is perhaps the most remarkable for absolute singleness of aim and simplicity of construction; yet is it wholly free from all possible imputation of monotony or aridity *Tamburlaine* is monotonous in the general roll and flow of its stately and sonorous verse through a noisy wilderness of perpetual bluster and slaughter, but the unity of tone and purpose in *Doctor Faustus* is not unrelieved by change of manner and variety of incident. The comic scenes, written evidently with as little of labour as of relish. are for the most part scarcely more than transcripts, thrown into the form of dialogue, from a popular prose *History of Dr Faustus*. and therefore should be set down as little to the discredit as to the credit of the poet. Few masterpieces of any age in any language can stand beside this tragic poem—it has hardly the structure of a play—for the qualities of terror and splendour, for intensity of purpose and sublimity of note. In the vision of Helen, for example, the intense perception of loveliness gives actual sublimity to the sweetness and radiance of mere beauty in the passionate and spontaneous selection of words the most choice and perfect; and in like manner the sublimity of simplicity in Marlowe's conception and expression of the agonies endured by Faustus under the immediate imminence of his doom gives the highest note of beauty, the quality of absolute fitness and propriety, to the sheer straightforwardness of speech in which his agonizing horror finds vent ever more and more terrible from the first to the last equally beautiful and fearful verse of that tremendous monologue which has no parallel in all the range of tragedy.

It is now a commonplace of criticism to observe and regret the decline of power and interest after the opening acts of *The Jew of Malta*. This decline is undeniable, though even the latter part of the play (the text of which is very corrupt) is not wanting in rough energy; but the first two acts would be sufficient foundation for the durable fame of a dramatic poet. In the blank verse of Milton alone—who perhaps was hardly less indebted than Shakespeare was before him to Marlowe as the first English master of word-music in its grander forms—has the glory or the melody of passages in the opening soliloquy of Barabbas been possibly surpassed. The figure of the hero before it degenerates into caricature is as finely touched as the poetic execution is excellent; and the rude and rapid sketches of the minor characters show at least some vigour and vivacity of touch.

In *Edward the Second* the interest rises and the execution improves as visibly and as greatly with the course of the advancing story as they decline in *The Jew of Malta*. The scene of the king's deposition at Kenilworth is almost as much finer in tragic effect and poetic quality as it is shorter and less elaborate than the corresponding scene in Shakespeare's *King Richard II.* The terror of the death-scene undoubtedly rises into horror; but this horror is with skilful simplicity of treatment preserved from passing into disgust. In pure poetry, in sublime and splendid imagination, this tragedy is excelled by *Doctor Faustus*; in dramatic power and positive impression of natural effect it is certainly the masterpiece of Marlowe. It was almost inevitable, in the hands of any poet but Shakespeare, that none of the characters represented should be capable of securing or even exciting any finer sympathy or more serious interest than attends on the mere evolution of successive events or the mere display of emotions (except always in the great scene of the deposition) rather animal than spiritual in their expression of rage or tenderness or suffering. The exact balance of mutual effect, the final note of scenic harmony, between ideal conception and realistic execution is not yet struck with perfect accuracy of touch and security of hand; but on this point also Marlowe has here come nearer by many degrees to Shakespeare than any of his other predecessors have ever come near to Marlowe.

Of *The Massacre at Paris* (acted in 1593, printed 1600?) it is impossible to judge fairly from the garbled fragment of its genuine text which is all that has come down to us. To Mr Collier, among numberless other obligations, we owe the discovery of a noble passage excised in the piratical edition which gives us the only version extant of this unlucky play, and which, it must be allowed, contains nothing of quite equal value. This is obviously an occasional and polemical work, and being as it is overcharged with the anti-Catholic passion of the time has a typical quality which gives it some empirical significance and interest. That antipapal ardour is indeed the only note of unity in a rough and ragged chronicle which shambles and stumbles onward from the death of Queen Jeanne of Navarre to the murder of the last Valois. It is possible to conjecture, what it would be fruitless to affirm, that it gave a hint in the next century to Nathaniel Lee for his far superior and really admirable tragedy on the same subject, issued ninety-seven years after the death of Marlowe.

In the tragedy of *Dido Queen of Carthage* (completed by Thomas Nash, produced and printed 1594), a servile fidelity to the text of Virgil's narrative has naturally resulted in the failure which might have been expected from an attempt at once to transcribe what is essentially inimitable and to reproduce it under the hopelessly alien conditions of dramatic adaptation. The one really noble passage in a generally feeble and incomposite piece of work is, however, uninspired by the unattainable model to which the dramatists have been only too obsequious in their subservience. It is as nearly certain as anything can be which depends chiefly upon cumulative and collateral evidence that the better part of what is best in the serious scenes of *King Henry VI.* is mainly the work of Marlowe. That he is at any rate the principal author of the second and third plays passing under that name among the works of Shakespeare, but first and imperfectly printed as *The Contention between the two Famous Houses of York and Lancaster*, can hardly be now a matter of debate among competent judges. The crucial difficulty of criticism in this matter is to determine, if indeed we should not rather say to conjecture, the authorship of the humorous scenes in prose, showing as they generally do a power of comparatively high and pure comic realism to which nothing in the acknowledged works of any pre-Shakespearian dramatist is even remotely comparable. Yet, especially in the original text of these scenes as they stand unpurified by the ultimate revision of Shakespeare or his editors, there are tones and touches which recall rather the clownish horseplay and homely ribaldry of his predecessors than anything in the lighter interludes of his very earliest plays. We find the same sort of thing which we find in their writings, only better done than they usually do it, rather than such work as Shakespeare's a little worse done than usual. And even in the final text of the tragic or metrical scenes the highest note struck is always, with one magnificent and unquestionable exception, rather in the key of Marlowe at his best than of Shakespeare while yet in great measure his disciple.

A Taming of a Shrew, the play on which Shakespeare's comedy was founded, has been attributed, without good reason, to Marlowe. The passages in the play borrowed from Marlowe's works provide an argument against, rather than for his authorship; while the humorous character of the play is not in keeping with his other work. He may have had a share in *The Troublesome Raigne of King John* (1591), and Fleay conjectured that the plays *Edward III.* and *Richard III* usually included in editions of Shakespeare are at least based on plays by Marlowe. *Lust's Dominion*, printed in 1657, was incorrectly ascribed to him, and a play no longer extant, *The True History of George Scanderbage*, was assumed by Fleay on the authority of an obscure passage of Gabriel Harvey to be his work. *The Maiden's Holiday*, assigned to Day and Marlowe, was destroyed by Warburton's cook. Day was considerably Marlowe's junior, and collaboration between the two is not probable.

Had every copy of Marlowe's boyish version or perversion of Ovid's *Elegies* (P. Ovidii Nasonis *Amorum* compressed into three books) deservedly perished in the flames to which it was judicially condemned by the sentence of a brace of prelates, it is possible that an occasional bookworm, it is certain that no poetical student, would have deplored its destruction, if its demerits could in that case have been imagined. His translation of the first book of Lucan alternately rises above the original and falls short of it,—often inferior to the Latin in point and weight of expressive rhetoric, now and then brightened by a clearer note of poetry and lifted into a higher mood of verse. Its terseness, vigour and purity of style would in any case have been praiseworthy, but are nothing less than admirable, if not wonderful, when we consider how close the translator has on the whole (in spite of occasional slips into inaccuracy) kept himself to the most rigid limit of literal representation, phrase by phrase and often line by line. The really startling force and felicity of occasional verses are worthier of remark than the inevitable stiffness and heaviness of others, when the technical difficulty of such a task is duly taken into account.

One of the most faultless lyrics and one of the loveliest fragments in the whole range of descriptive and fanciful poetry would have secured a place for Marlowe among the memorable men of his epoch, even if his plays had perished with himself. His *Passionate Shepherd* remains ever since unrivalled in its way—a way of pure fancy and radiant melody without break or lapse. The untitled fragment, on the other hand, has been very closely rivalled, perhaps very happily imitated, but only by the greatest lyric poet of England—by Shelley alone. Marlowe's poem of *Hero and Leander* (entered at Stationers' Hall in September 1593; completed and brought out by George Chapman, who divided Marlowe's work into two sestiads and added four of his own, 1598), closing with the sunrise which closes the night of the lovers' union, stands alone in its age, and far ahead of the work of any possible competitor between the death of Spenser and the dawn of Milton. In clear mastery of narrative and presentation, in melodious ease and simplicity of strength, it is not less pre-eminent than in the adorable beauty and impeccable perfection of separate lines or passages. It is doubtful whether the heroic couplet has ever been more finely handled.

The place and the value of Christopher Marlowe as a leader among English poets it would be almost impossible for historical criticism to over-estimate. To none of them all, perhaps, have so many of the greatest among them been so deeply and so directly indebted. Nor was ever any great writer's influence upon his fellows more utterly and unmixedly an influence for good. He first, and he alone, guided Shakespeare into the right way of work; his music, in which there is no echo of any man's before him, found its own echo in the more prolonged but hardly more exalted harmony of Milton's. He is the greatest discoverer, the most daring and inspired pioneer, in all our poetic literature. Before him there was neither genuine blank verse nor a genuine tragedy in our language. After his arrival the way was prepared, the paths were made straight, for Shakespeare. (A. C. S.)

Marlowe's fame, so finely appreciated by Shakespeare and Drayton, was in obscuration from the fall of the theatres until the generation of Lamb and Hazlitt. A collected edition was brought out by Pickering in 1826. This was greatly improved upon by A. Dyce (1858, 1865, 1876). A one-volume edition was prepared by Colonel Francis Cunningham in 1871. The standard edition of Mr A. H. Bullen in 3 vols. appeared in 1884–1885 and is now under revision. The "Best Plays" were edited for the Mermaid series by Havelock Ellis with an Introduction by J. A. Symonds (1887–1889). The best modern text is that edited by C. F. Tucker Brooke (Oxf. Univ. Press, 1910). A sketch in outline of Marlowe's Life was essayed by J. G. Lewis (Canterbury, 1891). A not very conclusive monograph on *Christopher Marlowe and his Associates* by J. H. Ingram, followed in 1904. For further information the reader should consult the histories of the stage by Collier, Ward, Fleay, Schelling, and the studies of Shakespeare's Predecessors by Symonds, Mezières, Boas, Manley, Churton Collins, Feuillerat and J. M. Robertson. See also Verity's *Essay on Marlowe's Influence* (1886); *Mod. Lang. Rev.* iv 167 (M. at Cambridge); Swinburne, *Study of Shakespeare* (1880); Elze, *Notes*, and Hazlitt *Dramatic Lit. of the Age of Elizabeth*; *Fortnightly Review*, xiii., lxxi., and Sept.–Oct., 1905; Jusserand, *Hist. of English Lit.*; the *Cambridge Hist. of English Lit.*; Seccombe and Allen, *Age of Shakespeare* (vol. ii. 3rd ed., 1909), and the separate editions of *Dr Faustus*, *Edward II.*, &c. The main sources of Marlowe were as follows: for *Tamburlaine*, Pedro Mexia's *Life of Timur* in his *Silva* (Madrid, 1543), anglicized by Fortescue in his *Foreste* (1571) and Petrus Perondinus *Vita Magni Tamerlanis* (1551); for *Faustus*: a contemporary English version of the Faust-buch or *Historia von D. Johann Fausten* (Frankfort, 1587), and for *Edward II.*, the *Chronicles* of Fabyan (1516), Holinshed (1577) and Stow (1580). (T. Se.)

MARLOWE, JULIA [Sarah Frances Frost] (1870–   ), American actress, was born near Keswick, England, on the 17th of August 1870, and went with her family to America in 1875. Her first formal appearance on the stage was in New York in 1887, although she had before that travelled with a juvenile opera company in *H.M.S. Pinafore*, and afterwards was given such parts as Maria in *Twelfth Night* in Miss Josephine Riley's travelling company. Her first great success was as Parthenia in *Ingomar*, and her subsequent presentations of Rosalind, Viola, and Julia in *The Hunchback* confirmed her position as a "star." In 1894 she married Robert Taber, an actor, with whom she played until their divorce in 1900. Subsequently she had great success as Barbara Frietchie in Clyde Fitch's play of that name, and other dramas; and from 1904 to 1907 she acted with E. H. Sothern in a notable series of Shakespeare plays, as well as in modern drama.

MARLY-LE-ROI, a village of northern France in the department of Seine-et-Oise, 5 m. N. by W. of Versailles by road. Pop. (1906), 1409. Notwithstanding some fine country houses, Marly is dull and unattractive, and owes all its celebrity to the sumptuous château built towards the end of the 17th century by Louis XIV., and now destroyed. It was originally designed as a simple hermitage to which the king could occasionally retire with a few of his more intimate friends from the pomp of Versailles, but gradually it grew until it became one of the most ruinous extravagances of the Grand Monarque. The central pavilion (inhabited by the king himself) and its twelve subsidiary pavilions were intended to suggest the sun surrounded by the signs of the zodiac. Seldom visited by Louis XV., and wholly abandoned by Louis XVI., it was demolished after the Revolution, its art treasures having previously been dispersed, and the remains now consist of a large basin, the Abreuvoir, a few mouldering ivy-grown walls, some traces of parterres with magnificent trees, the park, and the forest of 8½ sq. m., one of the most pleasant promenades of the neighbourhood of Paris, containing the shooting preserves of the President of the Republic.

Close to the Seine, half-way between Marly-le-Roi and St Germain, is the village of Port-Marly, and one mile farther up is the hamlet of Marly-la-Machine. Here, in 1684, an immense hydraulic engine, driven by the current of the river, was erected, it raised the water to a high tower, where the aqueduct of Marly began (700 yds. in length, 75 in height, with 36 arches, still well-preserved), carrying the waters of the Seine to Versailles.

MARMALADE (adopted from Fr. *marmelade*, from *marmelo*, a quince, derived through the Lat. *melimelum*, from Gr. μέλι, honey, and μῆλον, an apple, an apple grafted on a quince), a preserve originally made of quinces, but now commonly of Seville oranges. The "marmalade-tree" (*Lucuma mammosa*) bears a fruit whose thick pulp resembles marmalade and is called natural marmalade. "Marmalade box" is the name of the fruit of the *Genipa Americana*, which opens in the same manner as a walnut, the nut being replaced by a soft pulp.

MARMANDE, a town of south-western France, capital of an arrondissement in the department of Lot-et-Garonne, 35 m. N.W. of Agen, on the Southern railway from Bordeaux to Cette. Pop. (1906), town 6373, commune, 9748. Marmande is situated at the confluence of the Trec with the Garonne on the right bank of the latter river, which is here crossed by a suspension bridge. Public institutions include the sub-prefecture, the tribunals of first instance and commerce, the communal college and schools of commerce and industry and of agriculture. Apart from the administrative offices, the only building of importance is the church of Nôtre-Dame, which dates from the 13th, 14th and 15th centuries. The graceful windows of the nave, the altar-piece of the 18th century, and in particular, the Renaissance cloister adjoining the south side, are its most interesting features. Among the industries are iron-founding, steam sawing, the manufacture of woollens, carriage-making, cooperage and brandy-distilling. There is a large trade in wine, plums, cattle, grain and other agricultural produce.

Marmande was a *bastide* founded about 1195 on the site of a more ancient town by Richard Cœur de Lion, who granted it a liberal measure of self-government. Its position on the banks of the Garonne made it an important place of toll. It soon passed into the hands of the counts of Toulouse, and was three times besieged and taken during the Albigensian crusade, its capture by Amaury de Montfort in 1219 being followed by a massacre of the inhabitants. It was united to the French crown under Louis IX. A short occupation by the English in 1447, an unsuccessful siege by Henry IV. in 1577 and its resistance of a month to a division of Wellington's army in 1814, are the chief events in its subsequent history.

MARMIER, XAVIER (1809–1892), French author, was born at Pontarlier, in Doubs, on the 24th of June 1809. He had a passion for travelling, and this he combined throughout his life with the production of literature. After journeying in Switzerland, Belgium and Holland, he was attached in 1835 to the Arctic expedition of the "Recherche"; and after a couple of years at Rennes as professor of foreign literature, he visited (1842) Russia, (1845) Syria, (1846) Algeria, (1848–1849) North and South America, and numerous volumes from his pen were the result. In 1870 he was elected to the Academy, and he was for many years prominently identified with the Sainte-Geneviève library. He did much to encourage the study of Scandinavian literature in France, publishing translations of Holberg, Oehlenschläger and others. He died in Paris on the 11th of October 1892.

MARMONT, AUGUSTE FRÉDÉRIC LOUIS VIESSE DE, Duke of Ragusa (1774–1852), marshal of France, was born at Châtillon-sur-Seine, on the 20th of July 1774. He was the son of an ex-officer in the army who belonged to the *petite noblesse* and adopted the principles of the Revolution. His love of soldiering soon showing itself, his father took him to Dijon to learn mathematics prior to entering the artillery, and there he made the acquaintance of Bonaparte, which he renewed after obtaining his commission when he served in Toulon. The acquaintance ripened into intimacy; Marmont became General Bonaparte's aide-de-camp, remained with him during his disgrace and accompanied him to Italy and Egypt, winning distinction and promotion to general of brigade. In 1799 he returned to Europe with his chief; he was present at the *coup d'état* of the 18th Brumaire, and organized the artillery for the expedition to Italy, which he commanded with great effect at Marengo. For this he was at once made general of division. In 1801 he became inspector-general of artillery, and in 1804 grand officer of the Legion of Honour, but was greatly disappointed at being omitted from the list of officers who were made marshals. In 1805 he received the command of a corps, with which he did good service at Ulm. He was then directed to take possession of Dalmatia with his army, and occupied Ragusa. For the next five years he was military and civil governor of Dalmatia, and traces of his beneficent régime still survive both in great public works and in the memories of the people. In 1808 he was made duke of Ragusa, and in 1809, being summoned by Napoleon to take part in the Austrian War, he marched to Vienna and bore a share in the closing operations of the campaign. Napoleon now made him a marshal and governor-general of all the Illyrian provinces of the empire. In July 1810 Marmont was hastily summoned to succeed Masséna in the command of the French army in the north of Spain. The skill with which he manœuvred his army during the year he commanded it has been always acknowledged. His relief of Ciudad Rodrigo in the autumn of 1811 in spite of the presence of the English army was a great feat, and in the manœuvring which preceded the battle of Salamanca he had the best of it. But Wellington more than retrieved his position in the battle (see Salamanca), and inflicted a severe defeat on the French, Marmont himself being gravely wounded in the right arm and side. He retired to France to recover, and was still hardly cured when in April 1813 Napoleon, who soon forgot his fleeting resentment for the defeat, gave him the command of a corps. With it he served at the battles of Lützen, Bautzen and Dresden, and throughout the great defensive campaign of 1814 until the last battle before Paris, from which he drew back his forces to the commanding position of Essonne. Here he had 20,000 men in hand, and was the pivot of all thoughts. Napoleon said of this camp of Essonne, "C'est là que viendront s'addresser toutes les intrigues, toutes les trahisons; aussi y ai-je placé Marmont, mon enfant élevé sous ma tente." Marmont then took upon himself a political rôle which has, no doubt justly, been stigmatized as ungrateful and treasonable. A secret convention was concluded, and Marmont's corps was surrounded by the enemy. Napoleon, who still hoped to retain the crown for his infant son, was prostrated, and said with a sadness deeper than violent words, "Marmont me porte le dernier coup."

This act was never forgiven by Marmont's countrymen. On the restoration of the Bourbons he was indeed made a peer of France and a major-general of the royal guard, and in 1820 a knight of the Saint Esprit and a grand officer of the order of St Louis; but he was never trusted. He was the major-general of the guard on duty in July 1830, and was ordered to put down with a strong hand any opposition to the ordinances (see France). Himself opposed to the court policy, he yet tried to do his duty, and only gave up the attempt to suppress the revolution when it became clear that his troops were outmatched. This brought more obloquy upon him, and the duc d'Angoulême even ordered him under arrest, saying, "Will you betray us, as you betrayed him?" Marmont did not betray them; he accompanied the king into exile and forfeited his marshalate thereby. His desire to return to France was never gratified and he wandered in central and eastern Europe, settling finally in Vienna, where he was well received by the Austrian government, and strange to say made tutor to the duke of Reichstadt, the young man who had once for a few weeks been styled Napoleon II. He died at Venice on the 22nd of March 1852.

Much of his time in his last years was spent upon his *Mémoires*, which are of great value for the military history of his time, though they must be read as a personal defence of himself in various junctures rather than as an unbiased account of his times. They show Marmont, as he really was, an embittered man, who never thought his services sufficiently requited, and above all, a man too much in love with himself and his own glory to be a true friend or a faithful servant. His strategy indeed tended to become pure virtuosity, and his tactics, though neat, appear frigid and antiquated when contrasted with those of the instinctive leaders, the fighting generals whom the theorists affect to despise. But his military genius is undeniable, and he was as far superior to the mere theorist as Lannes and Davout were to the pure *divisionnaire* or "fighting" general.

His works are *Voyage en Hongrie*, &c. (4 vols., 1837); *Voyage en Sicile* (1838); *Esprit des institutions militaires* (1845); *César*; *Xenophon*; and *Mémoires* (8 vols., published after his death in 1856). See the long and careful notice by Sainte-Beuve, *Causeries du Lundi*, vol. vi.

MARMONTEL, JEAN FRANÇOIS (1723–1799), French writer, was born of poor parents at Bort, in Cantal, on the 11th of July 1723. After studying with the Jesuits at Mauriac, he taught in their colleges at Clermont and Toulouse; and in 1745, acting on the advice of Voltaire, he set out for Paris to try for literary honours. From 1748 to 1753 he wrote a succession of tragedies which,[1] though only moderately successful on the stage, secured the admission of the author to literary and fashionable circles. He wrote for the *Encyclopédie* a series of articles evincing considerable critical power and insight, which in their collected form, under the title *Éléments de Littérature*, still rank among the French classics. He also wrote several comic operas, the two best of which probably are *Sylvain* (1770) and *Zémire et Azore* (1771). In the Gluck-Piccini controversy he was an eager partisan of Piccini with whom he collaborated in *Didon* (1783) and *Pénélope* (1785). In 1758 he gained the patronage of Madame de Pompadour, who obtained for him a place as a civil servant, and the management of the official journal *Le Mercure*, in which he had already begun the famous series of *Contes moraux*. The merit of these tales lies partly in the delicate finish of the style, but mainly in the graphic and charming pictures of French society under Louis XV. The author was elected to the French Academy in 1763. In 1767 he published a romance, *Bélisaire*, now remarkable only on account of a chapter on religious toleration which incurred the censure of the Sorbonne and the archbishop of Paris. Marmontel retorted in *Les Incas* (1778) by tracing the cruelties in Spanish America to the religious fanaticism of the invaders.

He was appointed historiographer of France (1771), secretary to the Academy (1783), and professor of history in the Lycée (1786). In his character of historiographer Marmontel wrote a history of the regency (1788) which is of little value. Reduced to poverty by the Revolution, Marmontel in 1792 retired during the Terror to Évreux, and soon after to a cottage at Abloville in the department of Eure. To that retreat we owe his *Mémoires d'un père* (4 vols., 1804) giving a picturesque review of his whole life, a literary history of two important reigns, a great gallery of portraits extending from the venerable Massillon, whom more than half a century previously he had seen at Clermont, to Mirabeau. The book was nominally written for the instruction of his children. It contains an exquisitely drawn picture of his own childhood in the Limousin; its value for the literary historian is very great. Marmontel lived for some time under the roof of Mme Geoffrin, and was present at her famous dinners given to artists; he was, indeed, an *habitué* of most of the houses where the encyclopaedists met. He had thus at his command the best material for his portraits, and made good use of his opportunities. After a short stay in Paris when elected in 1797 to the Conseil des Anciens, he died on the 31st of December 1799 at Abloville.

See Sainte-Beuve, *Causeries du lundi*, iv.; Morellet, *Éloge* (1805).

MARMORA (anc. *Proconnesus*), an island in the sea of the same name. Originally settled by Greeks from Miletus in the 8th century B.C., Proconnesus was annexed by its powerful neighbour Cyzicus in 362. The island has at all times been noted for its quarries of white marble which supplied the material for several famous buildings of antiquity (*e.g.* the palace of Mausolus at Halicarnassus).

See C. Texier, *Asie mineure* (Paris, 1839–1849); M. I. Gedeon, *Προικόννησος* (Constantinople, 1895); an exhaustive monograph by F. W. Hasluck in *Journ. Hell. Stud.*, xxix., 1909.

MARMORA, SEA OF (anc. *Propontis*; Turk. *Mermer Denisi*), the small inland sea which (in part) separates the Turkish dominions in Europe from those in Asia, and is connected through the Bosporus with the Black Sea (*q.v.*) and through the Dardanelles with the Aegean. It is 170 m. long (E. to W.) and nearly 50 m. in extreme width, and has an area of 4500 sq. m. Its greatest depth is about 700 fathoms, the deepest parts (over 500 fathoms) occurring in three depressions in the northern portion—one close under the European shore to the south of Rodosto, another near the centre of the sea, and a third at the mouth of the Gulf of Ismid. There are several considerable islands, of which the largest, Marmora, lies in the west, off the peninsula of Kapu Dagh, along with Afsia, Aloni and smaller islands. In the east, off the Asiatic shore between the Bosporus and the Gulf of Ismid, are the Princes' Islands.

MARMOSET, a name derived from Fr. *marmouset* (meaning "of a gross figure"), and used to designate the small tropical American monkeys classed by naturalists in the family *Hapalidae* (or *Chrysothricidae*). Marmosets are not larger than squirrels, and present great variation in colour; all have long tails, and many have the ears tufted. They differ from the other American monkeys in having one pair less of molar teeth in each jaw. The common marmoset, *Hapale* (or *Chrysothrix*) *jacchus*, is locally known as the *oustiti*, while the name piriché is applied to another species (see PRIMATES).

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[1] *Denys le Tyran* (1748); *Aristomène* (1749); *Cléopâtre* (1750); *Héraclides* (1752); *Egyptus* (1753).

MARMOT, the vernacular name of a large, thickly built, burrowing Alpine rodent mammal, allied to the squirrels, and typifying the genus *Arctomys*, of which there are numerous species ranging from the Alps through Asia north of (but including the inner ranges of) the Himalaya, and recurring in North America. All these may be included under the name marmot. In addition to their stout build and long thickly haired tails, marmots are characterized by the absence of cheek-pouches, and the rudimentary first front-toe, which is furnished with a flat nail, as well as by certain features of the skull and cheek-teeth. Europe possesses two species, the Alpine or true marmot (*A. marmotta*), and the more eastern bobac (*A. bobac*); and there are numerous kinds in Central Asia, one of which, the red marmot (*A. caudata*), is a much larger animal, with a longer tail. Marmots inhabit open country, either among mountains, or, more to the north, in the plains; and associate in large colonies, forming burrows, each tenanted by a single family. During the day-time the hillock at the entrance to the burrow is frequently occupied by one or more members of the family, which at the approach of strangers sit up on their hind-legs in order to get a better view. If alarmed they utter a shrill loud whistle, and rush down the burrow, but reappear after a few minutes to see if the danger is past. In the winter when the ground is deep in snow, marmots retire to the depths of their burrows, where as many as ten or fifteen may occupy the same chamber. No store of food is accumulated, and the winter sleep is probably unbroken. From two to four is the usual number of young in a litter. In America marmots are known as "wood-chucks" (*q.v.*), the commonest species being *A. monax*. The so-called prairie-dogs, which are smaller and more slender North American rodents with small cheek-pouches, form a separate genus, *Cynomys*; while the term pouched-marmots denotes the various species of souslik (*q.v.*), *Spermophilus* (or *Citillus*), which are common to both hemispheres, and distinguished by the presence of large cheek-pouches (see RODENTIA). (R.L.*)

The Alpine Marmot (*Arctomys marmotta*).

MARNE, a river of northern France, rising on the Plateau of Langres, 3 m. S. by E. of Langres, and uniting with the Seine at Charenton, an eastern suburb of Paris. Leaving Langres on the left the river flows northward, passing Chaumont, as far as a point a little above St Dizier. Here it turns west and enters the department of Marne, where it waters the Perthois and the wide plain of Champagne-Pouilleuse. Soon after its entrance into this department it receives the Blaise; and turning north-west passes Vitry-le-François where it receives the Saulx, Châlons, below which it resumes a westerly course, and Epernay, where it enters picturesque and undulating country. Its subsequent course lies through the departments of Aisne, where it flows through Chateau-Thierry; Seine-et-Marne, where it drives the picturesque mills of Meaux; Seine-et-Oise and Seine. Its chief tributaries in those departments are the Petit-Morin, the Ourcq and the Grand-Morin. The length of the Marne is 328 m., the area of its basin 4894 sq. m. It is joined a mile from its source of the Marne-Saône canal which is continued at Rouvroy by the Haute-Marne canal as far as Vitry-le-François. From that town, which is the starting-point of the canal between the Marne and the Rhine, it is accompanied by the lateral canal of the Marne to Dizy where its own channel is canalized. At Condé, above Epernay, the river is joined by the canal connecting it with the Aisne. From Lizy, above Meaux, it is accompanied on the right bank, though at some distance, by the Ourcq canal.

MARNE, a department of north-eastern France, made up from Champagne-Pouilleuse, Rémois, Haute-Champagne, Perthois, Tardenois, Bocage and Brie-Pouilleuse, districts formerly belonging to Champagne, and bounded W. by Seine-et-Marne and Aisne, N. by Aisne and Ardennes, E. by Meuse, and S. by Haute-Marne and Aube. Pop. (1906), 434,157. Area 3167 sq. m.

About one-half consists of Champagne-Pouilleuse, a monotonous and barren plain covering a bed of chalk 1300 ft. in thickness. On the west and on the east it is commanded by two ranges of hills. The highest point in the department (920 ft.) is in the hill district of Reims, which rises to the south-west of the town of the same name, between the Vesle and the Marne. The lowest level (164 ft.) where the Aisne leaves the department, is not far distant. To the south of the Marne the hills of Reims are continued by the heights of Brie (700 to 800 ft.). All these belong geologically to the basin of Paris. They slope gently towards the west, but command the plain of Champagne-Pouilleuse by a steep descent on the east. On the farther side of the plain are the heights of Argonne (860 ft.) formed of beds of the Lower Chalk, and covered by forests; they unite the calcareous formations of Langres to the schists of Ardennes, and a continuation of them stretches southward into Perthois and the marshy Bocage. The department belongs entirely to the Seine basin, but includes only 13 miles of that river, in the south-west; it there receives the Aube, which flows for 10 miles within the department. The principal river is the Marne, which runs through the department for 105 miles in a great sweep concave to the south-west. The Aisne enters the department at a point 12 miles from its source, and traverses it for 37 miles. Two of its affluents on the left, the Suippes and the Vesle, on which stands Reims, have a longer course from south-east to north-west across the department.

Marne has the temperate climate of the region of the Seine; the annual mean temperature is 50° F., the rainfall about 24 in. Oats, wheat, rye and barley among the cereals, lucerne, sainfoin and clover, and potatoes, mangold-wurzels and sugar-beet are the principal agricultural crops. The raising of sheep of a mixed merino breed and of other stock together with bee-farming are profitable. The vineyards, concentrated chiefly round Reims and Épernay, are of high value; the manufacture of the sparkling Champagne wines being a highly important industry, of which Épernay, Reims and Châlons are the chief centres. Several communes supply the more valuable vegetables, such as asparagus, onions, &c. The principal orchard fruits are the apple, plum and cherry. Pine woods are largely planted in Champagne-Pouilleuse. The department produces peat, millstones and chalk.

The woollen industry has brought together in the neighbourhood of Reims establishments for spinning, carding, dyeing and weaving. The materials wrought are flannels, merinoes, tartans, shawls, rugs and fancy articles; the manufacture of woollen and cotton hosiery must also be mentioned. The manufacture of wine-cases, corks, casks and other goods for the wine trade is actively carried on. Marne contains blast-furnaces, iron and copper foundries, and manufactories of agricultural implements. Besides these there are tan-yards, currying and leather-dressing establishments and glassworks, which, with sugar, chemical, whiting and oil works, potteries, flour-mills and breweries, complete the list of the most important industries. Biscuits and gingerbread are a speciality of Reims. The chief imports are wool and coal; the exports are wine, grain, live-stock, stone, whiting, pit-props and woollen stuffs. Communication is afforded chiefly by the river Marne with its canal connexions, and by the Eastern railway. There are five arrondissements—those of Châlons (the capital), Épernay, Reims, Ste Ménehould and Vitry-le-François—with 33 cantons and 662 communes. The department belongs partly to the archbishopric of Reims and partly to the see of Châlons. Châlons is the headquarters of the VI. army corps. Its educational centre and court of appeal are at Paris. The principal towns—Châlons-sur-Marne, Reims, Épernay and Vitry-le-François—are separately treated. The towns next in population are Ay (4994) and Sézanne (4504). Other places of interest are Ste Ménehould (3348), formerly an important fortress and capital of the Argonne; Montmort with a Renaissance château once the property of Sully; Trois-Fontaines with a ruined church of the 12th century and the remains of a Cistercian abbey founded in 1115; and Orbais with an abbey church dating from about 1200.

MARNIAN EPOCH, the name given by G. de Mortillet to the period usually called in France the Gallic, which extends from about five centuries before the Christian era to the conquest of Gaul by Caesar. M. de Mortillet objects to the term "Gallic," as the civilization characteristic of the epoch was not peculiar to the ancient Gauls, but was common to nearly all Europe at the same date. The name is derived from the fact that the French department of Marne has afforded the richest "finds."

MAROCHETTI, CARLO, BARON (1805–1867), Italian sculptor, was born at Turin. Most of his early life was spent in France, his first systematic instruction being given him by Bosio and Gros in Paris. Here his statue of "A Young Girl playing with a Dog" won a medal in 1829. But between 1822 and 1830 he studied chiefly in Rome. From 1832 to 1848 he lived in France. His "Fallen Angel" was exhibited in 1831. In 1848 Marochetti removed to London, and there he lived for the greater part of his time till his death in 1867. Among his chief works were statues of Queen Victoria, Lord Clyde (the obelisk in Waterloo Place), Richard Cœur-de-Lion (Westminster), Emmanuel Philibert (1833, Turin), the tomb of Bellini (Père-la-Chaise), and the altar in the Madeleine. His style was vigorous and effective, but rather popular than artistic. Marochetti, who was created a baron by the king of Sardinia, was also a chevalier of the Legion of Honour.

MARONITES (Arab. *Mawarina*), a Christian people of the Ottoman Empire in communion with the Papal Church, but forming a distinct denomination. The original seat and present home of the nucleus of the Maronites is Mt Lebanon; but they are also to be found in considerable force in Anti-Lebanon and Hermon, and more sporadically in and near Antioch, in Galilee, and on the Syrian coast. Colonies exist in Cyprus (with a large convent near Cape Kormakiti), in Alexandria, and in the United States of America. These began to be formed during the troubles of 1860. The Lebanon community numbers about 300,000, and the total of the whole denomination cannot be much under half a million.

The origin of Maronism has been much obscured by the efforts of learned Maronites like Yusuf as-Simani (Assemanus), Vatican librarian under Clement XII., Faustus Nairon, Gabriel Sionita and Abraham Ecchellensis to clear its history from all taint of heresy. We are told of an early Antiochene, Mar Marun or Maro, who died about A.D. 400 in the odour of sanctity in a convent at Ribla on the Orontes, whence orthodoxy spread over mid-Syria. But nothing sure is known of him, and not much more about a more historical personage, Yuhanna Marun (John Sirimensis of Suedia), said to have been patriarch of Antioch, to have converted Lebanon from Monothelism, and to have died in A.D. 707. It is, however, certain that the Lebanon Christians as a whole were not orthodox in the time of Justinian II., against whose supporters, the Melkites, they ranged themselves after having co-operated awhile with the emperor against the Moslems. They were then called Mardaites or rebels, and were mainly Monothelite in the 12th century, and remained largely so even a century later. The last two facts are attested by William of Tyre and Barhebraeus. It seems most probable that the Lebanon offered refuge to Antiochene Monothelites flying from the ban of the Constantinopolitan Council of A.D. 680; that these converted part of the old mountain folk, who already held some kind of Incarnationist creed; and that their first patriarch and his successors, for about 500 years at any rate, were Monothelite, and perhaps also Monophysite. It is worth noting that even as late as the close of the 16th century the Maronite patriarch found it necessary to protest by anathema against imputations of heresy. In 1182 it is said that Amaury, patriarch of Antioch, induced some Maronite bishops, who had fallen under crusading influences, to rally to Rome; and a definite acceptance of the Maronite Church into the Roman communion took place at the Council of Florence in 1445. But it is evident that the local particularism of the Lebanon was adverse to this union, and that even Gregory XIII., who sent the *pallium* to the patriarch Michael, and Clement VII. who in 1596 dispatched a mission to a synod convoked at Kannobin, the old patriarchal residence, did not prevail on the lower clergy or the mass of the Maronites. A century and a half later Clement XII. was more successful. He sent to Syria, Assemanus, a Maronite educated at the Roman college of Gregory XIII.; and at last, at a council held at the monastery of Lowaizi on the 30th of September 1736, the Maronite Church accepted from Rome a constitution which is still in force, and agreed to abandon some of its more incongruous usages such as mixed convents of monks and nuns. It retained, however, its Syriac liturgy and a non-celibate priesthood. The former still persists unchanged, while the Bible is read and exhortations are given in Arabic; and priests may still be ordained after marriage. But marriage is not permitted subsequent to ordination, nor does it any longer usually precede it. The tendency to a celibate clergy increases, together with other romanizing usages, promoted by the papal legate in Beirut, the Catholic missioners, and the higher native clergy who are usually educated in Rome or at St Sulpice. The legate exercises growing influence on patriarchal and other elections, and on Church government and discipline. The patriarch receives confirmation from Rome, and the political representation of the Maronites at Constantinople is in the hands of the vicar apostolic. Rome has incorporated most of the Maronite saints in her calendar, while refusing (despite their apologists) to canonize either of the reputed eponymous founders of Maronism.

While retaining many local usages, the Maronite Church does not differ now in anything essential from the Papal, either in dogma or practice. It has, like the Greek Church, two kinds of clergy—parochial and monastic. The former are supported by their parishes; the latter by the revenues of the monasteries, which own about one-sixth of the Lebanon lands. There are some 1400 monks in about 120 monastic establishments (many of these being mere farms in charge of one or two monks). All are of the order of St Anthony, but divided into three congregations, the Ishaya, the Halebiyeh (Aleppine) and the Beladiyeh or Libnaniyeh (local). The distinction of the last named dates only from the early 18th century. The lower clergy are educated at the theological college of Ain Warka. There are five archbishoprics and five bishoprics under the patriarch, who alone can consecrate. The sees are Aleppo, Baalbek, Tripoli, Ehden, Damascus, Beirut, Tyre, Cyprus and Jebeil (held by the patriarch himself *ex officio*). There are also four prelates *in partibus*.

The Maronites are most numerous and unmixed in the north of Lebanon (districts of Bsherreh and Kesrawan). Formerly they were wholly organized on a clan system under feudal chiefs, of whom those of the house of Khazin were the most powerful; and these fought among themselves rather than with the Druses or other denominations down to the 18th century, when the Arab family of Shehab for its own purposes began to stir up strife between Maronites and Druses (see DRUSES). Feudalism died hard, but since 1860 has been practically extinct; and so far as the Maronites own a chief of their own people it is the "Patriarch of Antioch and the whole East," who resides at Bkerkeh near Beirut in winter, and at a hill station (Bdiman or Raifun) in summer. The latter, however, has no recognized jurisdiction except over his clergy. The Maronites have four members on the provincial council, two of whom are the sole representatives of the two *mudirats* of Kesrawan; and they have derived benefit from the fact that so far the governor of the privileged province has always been a Catholic (see LEBANON). The French protection of them, which dates from Louis XIV., is no longer operative but to French official representatives is still accorded a courteous precedence. The Maronite population has greatly increased at the expense of the Druses, and is now obliged to emigrate in considerable numbers. Increase of wealth and the influence of returned emigrants tend to soften Maronite character, and the last remnants of the barbarous state of the community—even the obstinate blood-feud—are disappearing.

See C. F. Schnurrer, *De ecclesia Maronitica* (1810); F. J. Bliss in *Pal. Expl. Fund Quarterly Statement* (1892); and authorities for DRUSES and LEBANON. (D. G. H.)

MAROONS. A *nègre marron* is defined by Littré as a fugitive slave who betakes himself to the woods; a similar definition of *cimarron* (apparently from *cima*, a mountain top) is given in the *Dictionary* of the Spanish Academy. The old English form of the word is *symaron* (see Hawkins's *Voyage*, § 68). The term "Maroons" is applied almost as a proper name to the descendants of those negroes in Jamaica who at the first English occupation in the 17th century fled to the mountains. (See JAMAICA.)

MAROS-VÁSÁRHELY, a town of Hungary in Transylvania, capital of the county of Maros-Torda, 79 m. E. of Kolozsvár by rail. Pop. (1900), 19,522. It is situated on the left bank of the Maros, and is a well-built town, once the capital of the territory of the Szeklers. On a hill dominating the town stands the old fortress, which contains a beautiful church in Gothic style built about 1446, where in 1571 the diet was held which proclaimed the equality of the Unitarian Church with the Roman Catholic, the Lutheran, and Calvinistic Churches. The Teleki palace contains the Teleki collections, which include a library of 70,000 volumes and several valuable manuscripts (*e.g.* the Teleki Codex), a collection of old Hungarian poems, and a manuscript of Tacitus, besides a collection of antiquities and another of minerals. Maros-Vásárhely has also an interesting Szekler industrial museum. The trade is chiefly in timber, grain, wine, tobacco, fruit and other products of the neighbourhood. There are manufactures of sugar, spirits and beer.

MAROT, CLÉMENT (1496–1544), French poet, was born at Cahors, the capital of the province of Quercy, some time during the winter of the year 1496–1497. His father, Jean Marot (*c.* 1463–1523), whose more correct name appears to have been des Mares, Marais or Marets, was a Norman of the neighbourhood of Caen. Jean was himself a poet of considerable merit, and held the post of *escripvain* (apparently uniting the duties of poet laureate and historiographer) to Anne of Brittany. He had however resided in Cahors for a considerable time, and was twice married there, his second wife being the mother of Clément. The boy was "brought into France"—it is his own expression, and is not unnoteworthy as showing the strict sense in which that term was still used at the beginning of the 16th century—in 1506, and he appears to have been educated at the university of Paris, and to have then begun the study of law. But, whereas most other poets have had to cultivate poetry against their father's will, Jean Marot took great pains to instruct his son in the fashionable forms of verse-making, which indeed required not a little instruction. It was the palmy time of the *rhétoriqueurs*, poets who combined stilted and pedantic language with an obstinate adherence to the allegorical manner of the 15th century and to the most complicated and artificial forms of the *ballade* and the *rondeau*. Clément himself practised with diligence this poetry (which he was to do more than any other man to overthrow), and he has left panegyrics of its coryphaeus Guillaume Crétin, the supposed original of the Raminagrobis of Rabelais, while he translated Virgil's first eclogue in 1512. Nor did he long continue even a nominal devotion to law. He became page to Nicolas de Neuville, seigneur de Villeroy, and this opened to him the way to court life. Besides this, his father's interest must have been not inconsiderable, and the house of Valois, which was about to hold the throne of France for the greater part of a century, was devoted to letters.

As early as 1514, before the accession of Francis I., Clément presented to him his *Judgment of Minos*, and shortly afterwards he was either styled or styled himself *facteur* (poet) *de la reine* to Queen Claude. In 1519 he was attached to the suite of Marguerite d'Angoulême, the king's sister, who was for many years to be the mainstay not only of him but of almost all French men of letters. He was also a great favourite of Francis himself, attended the Field of the Cloth of Gold in 1520, and duly celebrated it in verse. Next year he was at the camp in Flanders, and writes of the horrors of war. It is certain that Marot, like most of Marguerite's literary court, and perhaps more than most of them, was greatly attracted by her gracious ways, her unfailing kindness, and her admirable intellectual accomplishments, but there is not the slightest ground for thinking that his attachment was other than platonic. It is, however, evident that at this time either sentiment or matured critical judgment effected a great change in his style, a change which was wholly for the better. At the same time he celebrates a certain Diane, whom it has been sought to identify with Diane de Poitiers. There is nothing to support this idea and much against it, for it was an almost invariable habit of the poets of the 16th century, when the mistresses whom they celebrated were flesh and blood at all (which was not always the case), to celebrate them under pseudonyms. In the same year, 1524, Marot accompanied Francis on his disastrous Italian campaign. He was wounded and taken at Pavia, but soon released, and he was back again at Paris by the beginning of 1525. His luck had, however, turned. Marguerite for intellectual reasons, and her brother for political, had hitherto favoured the double movement of *Aufklärung*, partly humanist, partly Reforming, which distinguished the beginning of the century. Formidable opposition to both forms of innovation, however, now began to be manifested, and Marot, who was at no time particularly prudent, was arrested on a charge of heresy and lodged in the Châtelet, February 1526. But this was only a foretaste of the coming trouble, and a friendly prelate, acting for Marguerite, extricated him from his durance before Easter. The imprisonment gave him occasion to write a vigorous poem on it entitled *Enfer*, which was afterwards imitated by his luckless friend Étienne Dolet. His father died about this time, and Marot seems to have been appointed to the place which Jean had latterly enjoyed, that of valet de chambre to the king. He was certainly a member of the royal household in 1528 with a stipend of 250 livres, besides which he had inherited property in Quercy. In 1530, probably, he married. Next year he was again in trouble, not it is said for heresy, but for attempting to rescue a prisoner, and was again delivered; this time the king and queen of Navarre seem to have bailed him themselves.

In 1532 he published (it had perhaps appeared three years earlier), under the title of *Adolescence Clémentine*, a title the characteristic grace of which excuses its slight savour of affectation, the first printed collection of his works, which was very popular and was frequently reprinted with additions. Dolet's edition of 1538 is believed to be the most authoritative. Unfortunately, however, the poet's enemies were by no means discouraged by their previous ill-success, and the political situation was very unfavourable to the Reforming party. In 1535 Marot was implicated in the affair of "The Placards,"[1] and this time he was advised or thought it best to fly. He passed through Béarn, and then made his way to Renée, duchess of Ferrara, a supporter of the French reformers as steadfast as her aunt Marguerite, and even more efficacious, because her dominions were out of France. At Ferrara he wrote a good deal, his work there including his celebrated *Blasons* (a descriptive poem, improved upon medieval models[2]), which set all the verse-writers of France imitating them. But the duchess Renée was not able to persuade her husband, Ercole d'Este, to share her views, and Marot had to quit the city.

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[1] These "placards" were the work of the extreme Protestants. Pasted up in the principal streets of Paris on the night of the 17th of October 1534, they vilified the Mass and its celebrants, and thus led to a renewal of the religious persecution.

[2] The *blason* was defined by Thomas Sibilet as a perpetual praise or continuous vituperation of its subject. The *blasons* of Marot's followers were printed in 1543 with the title of *Blasons anatomiques du corps féminin*.

He then went to Venice, but before very long the pope Paul III. remonstrated with Francis I. on the severity with which the Protestants were treated, and they were allowed to return to Paris on condition of recanting their errors. Marot returned with the rest, and abjured his heresy at Lyons. In 1539 Francis gave him a house and grounds in the suburbs.

It was at this time that his famous translations of the Psalms appeared. The merit of these has been sometimes denied, it is, however, considerable, and the powerful influence which the book exercised on contemporaries is not denied by anyone. The great persons of the court chose different pieces, each as his or her favourite. They were sung in court and city, and they are said, with exaggeration doubtless, but still with a basis of truth, to have done more than anything else to advance the cause of the Reformation in France. Indeed, the vernacular prose translations of the Scriptures were in that country of little merit or power, and the form of poetry was still preferred to prose, even for the most incongruous subjects. At the same time Marot engaged in a curious literary quarrel characteristic of the time, with a bad poet named Sagon, who represented the reactionary Sorbonne. Half the verse-writers of France ranged themselves among the Marotiques or the Sagontiques, and a great deal of versified abuse was exchanged. The victory, as far as wit was concerned, naturally rested with Marot, but his biographers are probably not fanciful in supposing that a certain amount of odium was created against him by the squabble, and that, as in Dolet's case, his subsequent misfortunes were not altogether unconnected with a too little governed tongue and pen.

The publication of the Psalms gave the Sorbonne a handle, and the book was condemned by that body. In 1543 it was evident that he could not rely on the protection of Francis. Marot accordingly fled to Geneva; but the stars were now decidedly against him. He had, like most of his friends, been at least as much of a freethinker as of a Protestant, and this was fatal to his reputation in the austere city of Calvin. He had again to fly, and made his way into Piedmont, and he died at Turin in the autumn of 1544.

In character Marot seems to have been a typical Frenchman of the old stamp, cheerful, good-humoured and amiable enough, but probably not very much disposed to elaborately moral life and conversation or to serious reflection. He has sometimes been charged with a want of independence of character; but it is fair to remember that in the middle ages men of letters naturally attached themselves as dependants to the great. Such scanty knowledge as we have of his relations with his equals is favourable to him. He certainly at one time quarrelled with Dolet, or at least wrote a violent epigram against him, for which there is no known cause. But, as Dolet quarrelled with almost every friend he ever had, and in two or three cases played them the shabbiest of tricks, the presumption is not against Marot in this matter. With other poets like Mellin de Saint Gelais and Brodeau, with prose writers like Rabelais and Bonaventure Desperiers, he was always on excellent terms. And whatever may have been his personal weaknesses, his importance in the history of French literature is very great, and was long rather under than over-valued. Coming immediately before a great literary reform—that of the Pléiade—Marot suffered the drawbacks of his position; he was both eclipsed and decried by the partakers in that reform. In the reaction against the Pléiade he recovered honour; but its restoration to virtual favour, a perfectly just restoration, again unjustly depressed him. Yet Marot is in no sense one of those writers of transition who are rightly obscured by those who come after them. He himself was a reformer, and a reformer on perfectly independent lines, and he carried his own reform as far as it would go. His early work was couched in the *rhétoriqueur* style, the distinguishing characteristics of which are elaborate metre and rhyme, allegoric matter and pedantic language. In his second stage he entirely emancipated himself from this, and became one of the easiest, least affected and most vernacular poets of France. In these points indeed he has, with the exception of La Fontaine, no rival, and the lighter verse-writers ever since have taken one or the other or both as model. In his third period he lost a little of this flowing grace and ease, but acquired something in stateliness, while he certainly lost nothing in wit. Marot is the first poet who strikes readers of French as being distinctively modern. He is not so great a poet as Villon nor as some of his successors of the Pléiade, but he is much less antiquated than the first (whose works, as well as the *Roman de la rose*, it may be well to mention that he edited) and not so elaborately artificial as the second. Indeed if there be a fault to find with Marot, it is undoubtedly that in his gallant and successful effort to break up, supple, and liquefy the stiff forms and stiffer language of the 15th century, he made his poetry almost too vernacular and pedestrian. He *has* passion, and picturesqueness, but rarely; in his hands, and while the *style Marotique* was supreme, French poetry ran some risk of finding itself unequal to anything but graceful *vers de société*. But it is only fair to remember that for a century and more its best achievements, with rare exceptions, had been *vers de société* which were not graceful.

The most important early editions of Marot's *Œuvres* are those published at Lyons in 1538 and 1544. In the second of these the arrangement of his poems which has been accepted in later issues was first adopted. In 1596 an enlarged edition was edited by François Mizière. Others of later date are those of N. Lenglet du Fresnoy (the Hague, 1731) and P. Jannet (1868–1872; new ed., 1873–1876), on the whole the best, but there is a very good selection with a still better introduction by Charles d'Héricault, the joint editor of the Jannet edition in the larger *Collection Garnier* (no date). An elaborate edition by G. Guiffrey remained incomplete, only vols. ii. and iii. (1875–1881) having been issued. For information about Marot himself see *Notices biographiques des trois Marot*, edited from the MS. of Guillaume Colletet by G. Guiffrey (1871); H. Morley, *Clément Marot*, a study of Marot as a reformer; O. Douen, *Clément Marot et le psautier huguenot*; the section concerning him in G. Saintsbury's *The Early Renaissance* (1901); and A. Tilley, *Literature of the French Renaissance*, vol. i., ch. iv. (1904). (G. Sa.)

MAROT, DANIEL (seventeenth century), French architect, furniture designer and engraver, and pupil of Jean le Pautre (*q.v.*), was the son of Jean Marot (1620–1679), who was also an architect and engraver. He was a Huguenot, and was compelled by the Revocation of the Edict of Nantes in 1685 to settle in Holland. His earlier work is characteristic of the second period of Louis XIV., but eventually it became tinged with Dutch influence, and in the end the English style which is loosely called "Queen Anne" owed much to his manner. In Holland he was taken almost immediately into the service of the Stadtholder, who, when he shortly afterwards became William III. of England, appointed him one of his architects and master of the works. Comparatively little is known of his architectural achievements, and his name cannot be attached to any English building, although we know from his own engraving that he designed the great hall of audience for the States-General at the Hague. He also decorated many Dutch country-houses. In England his activities appear to have been concentrated upon the adornment of Hampton Court Palace. Among his plans for gardens is one inscribed: "Parterre d'Amton-court inventé par D. Marot." Much of the furniture—especially the mirrors, guéridons and beds—at Hampton Court bears unmistakable traces of his authorship; the tall and monumental beds, with their plumes of ostrich feathers, their elaborate valances and *chantournes* in crimson velvet or other rich stuffs agree very closely with his published designs. As befits an artist of the time of Louis XIV. splendour and elaboration are the outstanding characteristics of Marot's style, and he appears even to have been responsible for some of the curious and rather barbaric silver furniture which was introduced into England from France in the latter part of the 17th century. At Windsor Castle there is a silver table, attributed to him, supported by caryatid legs and gadrooned feet, with a foot-rail supporting the pine-apple which is so familiar a motive in work of this type. The slab is engraved with the arms of William III. and with the British national emblems with crowns and cherubs. Unquestionably it is an exceedingly fine example of its type. During his life in France Marot made many designs for André Charles Boulle (*q.v.*), more especially for long case and bracket clocks. The bracket clocks were intended to be mounted in chased and gilded bronze, and with their garlands and masquerons and elegant dials are far superior artistically to those of the "grandfather" variety. It is impossible to examine the designs for Marot's long clocks without suspecting that Chippendale derived from them some at least of the inspiration which made him a master of that kind of furniture. Marot's range was extraordinarily wide. He designed practically every detail in the internal ornamentation of the house—carved chimney-pieces, ceilings, panels for walls, girandoles and wall brackets, and even tea urns and cream jugs—he was indeed a prolific designer of gold and silver plate. Many of his interiors are very rich and harmonious although commonly over-elaborated. The craze for collecting china which was at its height in his time is illustrated in his lavish designs for receptacles for porcelain—in one of his plates there are more than 300 pieces of china on the chimney-piece alone. Marot was still living in 1718, and the date of his death is unknown.

We owe much of our knowledge of his work to the volume of his designs published at Amsterdam in 1712: *Œuvres du Sieur D. Marot, architecte de Guillaume III. Roi de la Grande Bretagne*, and to *Receuil des planches des sieurs Marot, père et fils*. In addition to decorative work these books contain prints of scenes in Dutch history, and engravings of the statues and vases, produced by Marot, at the Palace of Loo.

MARPLE, an urban district in the Hyde parliamentary division of Cheshire, England, 12 m. S.E. of Manchester, served by the Great Central, Midland & Sheffield and Midland railways, and the Cheshire lines. Pop. (1901), 5595. It lies on and above the valley of the Goyt, and its situation has brought the town into favour as a residential centre for those whose business lies in Manchester, Stockport, and the great manufacturing district to the west. Marple Hall, a beautiful Elizabethan mansion, is connected with the youth, and sometimes stated to be the birthplace, of John Bradshaw the regicide (1602–1659).

MARPRELATE CONTROVERSY, a war of pamphlets waged in 1588 and 1589 between a puritan writer who employed the pseudonym "Martin Marprelate" and defenders of the Established Church. Martin's tracts are characterized by violent and personal invective against the Anglican dignitaries, by the assumption that the writer had numerous and powerful adherents and was able to enforce his demands for reform, and by a plain and homely style combined with pungent wit. While he maintained the puritan doctrines as a whole, the special point of his attack was the Episcopacy. The pamphlets were printed at a secret press established by John Penry, a Welsh puritan, with the help of the printer Robert Waldegrave, about midsummer 1588, for the issue of puritan literature forbidden by the authorities. The first tract by "Martin Marprelate," known as the *Epistle*, appeared at Molesey in November 1588. It is in answer to *A Defence of the Government established in the Church of Englande*, by Dr. John Bridges, dean of Salisbury, itself a reply to earlier puritan works, and besides attacking the episcopal office in general assails certain prelates with much personal abuse. The *Epistle* attracted considerable notice, and a reply was written by Thomas Cooper, bishop of Winchester, under the title *An Admonition to the People of England*, but this was too long and too dull to appeal to the same class of readers as the Marprelate pamphlets, and produced little effect. Penry's press, now removed to Fawsley, near Northampton, produced a second tract by Martin, the *Epitome*, which contains more serious argument than the *Epistle* but is otherwise similar, and shortly afterwards, at Coventry, Martin's reply to the *Admonition*, entitled *Hay any Worke for Cooper* (March 1589). It now appeared to some of the ecclesiastical authorities that the only way to silence Martin was to have him attacked in his own railing style, and accordingly certain writers of ready wit, among them John Lyly, Thomas Nashe and Robert Greene, were secretly commissioned to answer the pamphlets. Among the productions of this group were *Pappe with an Hatchet* (Sept. 1589), probably by Lyly, and *An Almond for a Parrat* (1590), which, with certain tracts under the pseudonym of Pasquil, has been attributed to Nashe (*q.v.*). Some anti-Martinist plays or shows (now lost) performed in 1589 were perhaps also their work. Meanwhile, in July 1589, Penry's press, now at Wolston, near Coventry, produced two tracts purporting to be by "sons" of Martin, but probably by Martin himself, namely, *Theses Martinianae* by Martin Junior, and *The Just Censure of Martin Junior* by Martin Senior. Shortly after this, *More Work for Cooper*, a sequel to *Hay any Worke*, was begun at Manchester, but while it was in progress the press was seized. Penry however was not found, and in September issued from Wolston or Haseley *The Protestation of Martin Marprelate*, the last work of the series, though several of the anti-Martinist pamphlets appeared after this date. He then fled to Scotland, but was later apprehended in London, charged with inciting rebellion, and hanged (May 1593). The authorship of the tracts has been attributed to several persons: to Penry himself, who however emphatically denied it and whose acknowledged works have little resemblance in style to those of Martin, to Job Throckmorton, and to Henry Barrow.

See, for list and full titles of the tracts, related documents, and discussion of the authorship, E. Arber's *Introductory Sketch to the Martin Marprelate Controversy* (1880), which, however, gives no connected account of the matter. A good summary, with quotations from the pamphlets, will be found in H. M. Dexter's *Congregationalism* (New York, 1880), pp. 129–202. See also articles on John Penry and Job Throckmorton in *Dict. of Nat. Biography*; and for the history of the press, *Bibliographica*, ii. 172–180. Maskell's *Martin Marprelate Controversy* (1845) is of little service. The more important tracts have been reprinted by Petheram in his series of *Puritan Discipline Tracts* (1842–1860), in Arber's *English Scholar's Library* (1879–1880), in R. W. Bond's edition of Lyly and in the editions of Nashe. (R. B. McK.)

MARQUAND, HENRY GURDON (1819–1902), American philanthropist and collector, was born in New York City on the 11th of April 1819. In 1839, upon the retirement from the jewelry business of his brother Frederick (1799–1882), who was a liberal benefactor of Yale College and of the Union Theological Seminary, he became his brother's agent. He was one of the purchasers in 1868 of the Iron Mountain railroad, afterwards its president, and a director of the Missouri-Pacific system. He was the first honorary member of the American Institute of Architects, and president (1889–1902) of the Metropolitan Museum of Art, to which he made valuable presents and loans from his collection of paintings. He died in New York City, on the 26th of February 1902. His varied and valuable art collection and rare books were sold in 1903. He was a benefactor of Princeton University and other institutions. His son, ALLAN MARQUAND (b. 1853), graduated at Princeton in 1874, and in 1883 became professor of archaeology and art.

MARQUARDT, JOACHIM (1812–1882), German historian and writer on Roman antiquities, was born at Danzig on the 19th of April 1812. He studied at Berlin and Leipzig, held various educational appointments from 1833 onwards at Berlin, Danzig and Posen, and became in 1859 head of the gymnasium in Gotha, where he died on the 30th of November 1882. The dedication of his treatise *Historiae equitum romanorum libri quatuor* (1841) to Lachmann led to his being recommended to the publisher of W. A. Becker's *Handbuch der römischen Alterthümer* to continue the work on the death of the author in 1846. It took twenty years to complete, and met with such success that a new edition was soon called for. Finding himself unequal to the task single-handed, Marquardt left the preparation of the first three volumes (*Römisches Staatsrecht*) to Theodor Mommsen, while he himself contributed vols. iv.–vi. (*Römische Staatsverwaltung*, 1873–1878; 2nd ed., 1881–1885, vol. v. by H. Dessau and A. von Domaszewski, vol. vi. by G. Wissowa) and vol. vii. (*Das Privatleben der Römer*, 1879–1882; 2nd ed., by A. Mau, 1886). Its clearness of style, systematic arrangement and abundant references to authorities ancient and modern, will always render it valuable to the student.

See E. Förstemann in *Allgemeine deutsche Biographie*, Bd. XX; R. Ehwald, *Gedächtnisrede* (progr. Gotha, 1883).

MARQUESAS or MENDAÑA ISLANDS (Fr. *Les Marquises*), an archipelago of the Pacific Ocean lying between 7° 50′ and 10° 35′ S. and 138° 50′ and 140° 50′ W., and belonging to France. It extends over 250 m. from S.E. to N.W., and has a total area of 490 sq. m. The southern or Mendaña group consists of the islands Fatuhiva or Magdalena, Motane or San Pedro, Tahuata or Santa Christina and Hivaoa or Dominica, the last with a coast-line of more than 60 m. With these is often included the rocky islet of Fatuhuku or Hood, lying in mid-channel to the north of Hivaoa. The north-western or Washington group is formed of seven islands, the four largest being Huapu or Adams, Huahuna or Washington, Nukuhiva (70 m. in circumference) and Eiao.[1] Along the centre of each island is a ridge of mountains, attaining an altitude of 4042 ft. in Huapu, whence rugged spurs forming deep valleys stretch towards the sea. The volcanic origin of the whole archipelago is proved by the principal rocks being of basalt, trachyte and lava. Vegetation is luxuriant in the valleys, which are well watered with streams and, from their seaward termination in small bays, are themselves known as "bays." The flora includes about four hundred known species, many of them identical with those belonging to the Society Islands. The vegetable products comprise bananas, bread-fruit, yams, plantains, wild cotton, bamboos, sugar-cane, coco-nut and dwarf palms, and several kinds of timber trees. The land fauna however is very poor; there are few mammals with the exception of dogs, rats and pigs; and amphibia and insects are also generally scarce. Of twenty species of birds more than half belong to the sea, where animal life is as abundant as about other sub-tropical Polynesian groups. The climate, although hot and damp, is not unhealthy. During the greater part of the year moderate easterly trade-winds prevail, and at the larger islands there are often both land and sea breezes. The rainy season accompanied by variable winds sets in at the end of November, and lasts for about six months. During this period the thermometer varies from 84° to 91° F.; in the dry season its average range is from 77° to 86°. The archipelago, which has some small trade in copra, cotton and cotton seeds, is administered by a French resident, and has a total population of about 4300, nearly all natives.

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[1] Most of the islands have each three or four alternative names.

The natives, a pure Polynesian race, are usually described as physically the finest of all South Sea Islanders. Their traditions point to Samoa as the colonizing centre from which they sprang. Their complexion is a healthy bronze. Until the introduction of civilization they were remarkable for their elaborate tattooing. Their cannibalism seems to have been dictated by taste, for it was never associated with their religion, the sacrifices to their gods being always swine. Of these and fowls they rear a great quantity. Their native drink is *kava*. Their houses are unlike those usual in Polynesia in being built on platforms raised from the ground. In disposition the islanders are friendly and hospitable, brave and somewhat bloodthirsty; and, although naturally indolent and morose, they have proved industrious and keen traders. As among their kinsfolk the Tahitians, debauchery was systematized and infanticide an organized institution. A population which at the time of the annexation by France (1842) was 20,000 has been reduced to little over 4000. Latterly the natives have for the most part outwardly adopted Christianity.

The Marquesas Islands were discovered on the 21st of July 1595 by Alvaro Mendaña, who, however, only knew of the south-eastern group, to which he gave the name by which they are generally known (although they also bear his own), in honour of Don Garcia Hurtado de Mendoza, marquis of Cañete, viceroy of Peru, and patron of the voyage. Captain Cook pursuing the same track rediscovered this group, with the addition of Fatuhuku, in 1774. The north-western islands were first sighted by the American Captain Ingraham in 1791, and given the name of Washington by him; the French Captain Marchand followed in the same year, and Lieut. Hergest in 1792. The Russian explorer, Adam Ivan Krusenstern, made an extensive investigation of the archipelago in 1804. In 1813 the American Commodore David Porter failed to establish a colony here; and in May 1842, after French Roman Catholic missionaries had prepared the way, Rear-admiral Dupetit-Thouars took formal possession of the archipelago for France. A complete settlement was not effected without bloodshed and about 1860–1870 the colony was practically abandoned.

See Vincendon-Dumoulin *Îles Marquises* (Paris, 1843); E. Jardin, *Essai sur l'histoire naturelle de l'archipel de Mendaña* (Paris, 1860); Clavel, *Les Marquisiens* (Paris, 1885); Dordillon, *Grammaire et dictionnaire de la langue des Îles Marquises* (Paris, 1904).

MARQUESS, or Marquis (Fr. *marquis*, Ital. *marchese*; from med. Lat. *marchio, marchisus, i.e. comes marchiae*, "count of the March"), a title and rank of nobility. In the British peerage it is the second in order and therefore next to duke. In this sense the word was a reintroduction from abroad; but lords of the Welsh and Scottish "marches" are occasionally termed *marchiones* from an early date. The first marquess in England was Robert de Vere, the 9th earl of Oxford, who was created marquess of Dublin by Richard II. on the 1st of December 1385 and assigned precedence between dukes and earls. On the 13th of October following the patent of this marquessate was recalled, Robert de Vere then having been raised to a dukedom. John de Beaufort, earl of Somerset, the second legitimate son of John of Gaunt, was raised to the second marquessate as marquess of Dorset on the 29th of September 1397, but degraded again to earl in 1399. The Commons petitioned for the restoration of his marquessate in 1402, but he himself objected because "le noun de Marquys feust estraunge noun en cest Roialme." From that period this title appears to have been dormant till the reign of Henry VI., when it was revived (1442), and thenceforward it maintained its place in the British peerage. Anne Boleyn was created marchioness of Pembroke in 1532. A marquess is "most honourable," and is styled "my lord marquess." His wife, who is also "most honourable," is a marchioness, and is styled "my lady marchioness." The coronet is a circlet of gold on which rest four leaves and as many large pearls, all of them of equal height and connected. The cap and lining, if worn, are the same as in the other coronets (see Crown and Coronet). The mantle of parliament is scarlet, and has three and a half doublings of ermine.

In France, so early as the 9th century, counts who held several counties and had succeeded in making themselves quasi-independent began to describe themselves as *marchiones*, this use of the word being due to the fact that originally none but the margraves, or counts of the marches, had been allowed to hold more than one county. The *marchio* or marquess thus came to be no more than a count of exceptional power and dignity, the original significance of the title being lost. In course of time the title was recognized as ranking between those of duke and count; but with the decay of feudalism it lost much of its dignity, and by the 17th century the savour of pretentiousness attached to it had made it a favourite subject of satire for Molière and other dramatists of the classical comedy. Abolished at the Revolution, the title of marquess was not restored by Napoleon, but it was again revived by Louis XVIII., who created many of Napoleon's counts marquesses. This again tended to cheapen the title, a process hastened under the republic by its frequent assumption on very slender grounds in the absence of any authority to prevent its abuse. In Italy too the title of *marchese*, once borne only by the powerful margraves of Verona, has shared the fate of most other titles of nobility in becoming common and of no great social significance. (See also Margrave.) (J. H. R.)

MARQUETRY (Fr. *marqueterie*, from *marqueter*, to inlay, literally to mark, *marquer*), an inlay of ornamental woods, ivory, bone, brass and other metals, tortoise-shell, mother-of-pearl, &c., in which shaped pieces of different materials or tints are combined to form a design. It is a later development of the ornamental inlays of wood known by the name of Intarsia, and though in the main the latter was a true inlay of one or more colours upon a darker or lighter ground, while marquetry is composed of pieces of quite thin wood or other material of equal thickness laid down upon a matrix with glue, there are examples of Intarsia in which this mode of manufacture was evidently followed. For instance, the backs of the stalls in the cathedral of Ferrara show the perspective lines of some of the subjects traced upon the ground where the marquetry has fallen off, but none of the sinkings in the surface which would be there if the panels had been executed as true inlays. In the endeavour to gain greater relief, shading and tinting the wood were resorted to, the shading being generally produced by scorching, either with a hot iron or hot sand, and the tinting by chemical washes and even by the use of actual colour, but the result is usually hardly commensurate with the labour expended. A combination of tortoise-shell and metal, the one forming the ground and the other the pattern upon it, which may be classed as marquetry also appears in the 17th century. The subjects of the *intarsiatori* are generally arabesques or panels with elaborate perspectives, either of buildings or cupboards with different articles upon the shelves seen through half-open doors, which themselves are frequently of lattice-work delineated with extraordinary perfection, though figure subjects occur also. The later *marqueteurs* used a freer form of design for the most part, and scrolls and bunches of flowers appear in profusion, while if architectural forms occur they are generally in the shape of ruins amid landscape. The greater portion of the examples in England are importations, either from Holland (in which country very fine work was produced during the latter half of the 16th and 17th centuries) or from France. The reputation of the Dutch *marqueteurs* was so great that Colbert engaged two, named Pierre Gole and Vordt, for the Gobelins at the beginning of the 17th century. Jean Macé of Blois, the first Frenchman known to have practised the art, who was at work in Paris from 1644 (when he was lodged in the Louvre), or earlier, till 1672, as a sculptor and painter, learnt it in the Netherlands. His title was "menuisier et faiseur de cabinets et tableaux en marqueterie de bois"; but as early as 1576 a certain Hans Kraus had been called "marqueteur du roi." Jean Macé's daughter married Pierre Boulle, and the greatest of the family, André Charles Boulle (*q.v.*), succeeded to his lodging in the Louvre on his death in 1672. The members of this family are perhaps the best known of the French *marqueteurs*. Their greatest triumphs were gained in the marquetry of metal and tortoise-shell combined with beautifully chiselled ormulu mountings; but many foreign workmen found employment in France from the time of Colbert, and some of them rose to the highest eminence. The names of Roentgen, under whom the later German marquetry perhaps reached its highest point, Riesener and Oeben, testify to their nationality. A good deal of marquetry was executed in England in the later Stuart period, mainly upon long-case clocks, cabinets and chests of drawers, and it is often of real excellence. Marquetry in a shallower form was also extensively used in the latter part of the 18th century. The most beautiful examples of the art in Italy are mainly panels of choir stalls or sacristy cupboards, though marriage coffers were also often sumptuously decorated in this manner. With the increase in luxury and display in the 17th and 18th centuries in France and Germany cabinets and escritoires became objects upon which extraordinary talent and expenditure were lavished. In South Germany musical instruments, weapons and bride chests were often lavishly decorated with marquetry. The cabinets are of elaborate architectural design with inlays of ebony and ivory or with veneers of black and white, the design counterchanging so that one cutting produced several repeats of the same pattern in one colour or the other. In modern practice as many as four or even six thicknesses are put together and so cut. When all the parts have been cut and fitted together face downwards paper is glued over them to keep them in place and the ground and the veneer are carefully levelled and toothed so as to obtain a freshly worked surface. The ground is then well wetted with glue at a high temperature and the surfaces squeezed tightly together between frames called "cauls" till the glue is hard. There are several modes of ensuring the accurate fitting of the various parts, which is a matter of the first importance.

MARQUETTE, JACQUES (1637–1675), French Jesuit missionary and explorer, re-discoverer (with Louis Joliet) of the Mississippi. He was born at Laon, went to Canada in 1666, and was sent in 1668 to the upper lakes of the St Lawrence. Here he worked at Sault Ste Marie, St Esprit (near the western extremity of Lake Superior) and St Ignace (near Michilimackinac or Mackinaw, on the strait between Huron and Michigan). In 1673 he was chosen with Joliet for the exploration of the Mississippi, of which the French had begun to gain knowledge from Indians of the central prairies. The route taken lay up the north-west side of Lake Michigan, up Green Bay and Fox river, across Lake Winnebago, over the portage to the Wisconsin river, and down the latter into the Mississippi, which was descended to within 700 m. of the sea, at the confluence of the Arkansas river. Entering the Mississippi on the 17th of May, Joliet and his companion turned back on the 17th of July, and returned to Green Bay and Michigan (by way of the Illinois river) at the end of September 1673. On the journey Marquette fell ill of dysentery; and a fresh excursion which he undertook to plant a mission among the Indians of the Illinois river in the winter of 1674–1675 proved fatal. He died on his way home to St Ignace on the banks of a small stream (the lesser and older Marquette River) which enters the east side of Lake Michigan in Marquette Bay (May 18, 1675). His name is now borne by a larger watercourse which flows some distance from the scene of his death.

See Marquette's *Journal*, first published in Melchissédech Thévenot's *Recueil de Voyages* (Paris, 1681), and fully given in Martin's *Relations inédites*, and in Shea's *Discovery and Exploration of the Mississippi Valley* (New York, 1852); cf. also Pierre Margry's *Découvertes . . . des Français dans l'ouest et dans le sud de l'Amérique septentrionale (1614–1754)*; *Mémoires et documents originaux* (Paris, 1875), containing Joliet's *Détails* and *Relations*; Francis Parkman, *La Salle and the Discovery of the Great West* (Boston 1869–1878), esp. pp. x., 20, 32–33, 49–72.

MARQUETTE, a city, a port of entry and the county seat of Marquette county, Michigan U.S.A., on the south shore of Lake Superior. Pop. (1900), 10,058 (3460 foreign-born); (1910), 11,503. It is served by the Duluth, South Shore & Atlantic, the Marquette & South-Eastern, the Chicago, Milwaukee & St Paul, the Chicago & North-Western, and the Lake Superior & Ishpeming railways. The city, which is situated on a bluff 100 ft. above the lake, in a region characterized by rounded hills and picturesque irregularities, has a delightful climate, and is a popular summer resort. Presque Isle park (400 acres), a headland north of the city, is one of its principal attractions. Marquette is the seat of the Northern State Normal School (established 1899) and of the state house of correction and branch prison (established 1885). A county-court-house, the Peter White library, and the Federal building are the most prominent public buildings. Marquette is the seat of Roman Catholic and Protestant Episcopal bishoprics. The city is best known as a shipping centre of one of the richest iron-ore districts in the world, and its large and well-equipped ore docks are among its most prominent features. Marquette is the port of entry of the customs district of Superior. In 1896 its imports were valued at $358,505 and its exports at $4,708,302; in 1908, imports $1,845,724 and exports $7,040,473. Foundries, railway machine-shops, lumber and planing-mills, brewery and bottling works, and quarries of brownish-red sandstone contribute largely to the city's economic importance. The charcoal iron blast-furnaces of the city manufacture pig-iron, and, as by-products, wood alcohol and acetic acid, recovered from the smoke of the charcoal pits. The value of the city's factory products increased from $1,585,083 in 1900 to $2,364,081 in 1905, or 49·1 %. The first settlement was made about 1845, and in 1849 it was named Worcester; but "Marquette" was soon substituted in honour of Jacques Marquette. It was incorporated as a village in 1859, and chartered as a city in 1871.

MARR, CARL (1858–), American artist, was born at Milwaukee, Wisconsin, on the 14th of February 1858, the son of an engraver. He was a pupil of Henry Vianden in Milwaukee, of Schauss in Weimar, of Gussow in Berlin, and subsequently of Otto Seitz, Gabriel and Max Lindenschmitt in Munich. His first work, "Ahasuerus, the Wandering Jew," received a medal in Munich. One of his pictures, "Episode of 1813," is in the Royal Hanover Gallery, and his "Germany in 1806" received a gold medal in Munich and is in the Royal Academy of Koenigsberg. A large canvas "The Flagellants," now in the Milwaukee public library, received a gold medal at the Munich Exposition in 1889. Another canvas, "Summer Afternoon," in the Phoebe Hearst collection, received a gold medal in Berlin, in 1892. Marr became a professor in the Munich Academy in 1893, and in 1895 a member of the Berlin Academy of Arts.

MARRADI, GIOVANNI (1852–), Italian poet, was born at Leghorn, and educated at Pisa and Florence. At the latter place he started with others a short-lived review, the *Nuovi Goliardi*, which made some literary sensation. He became a teacher at various colleges, and eventually an educational inspector in Massa Carrara. He was much influenced by Carducci, and became known not only as a critic but as a charming descriptive poet, his principal volumes of verse being *Canzone moderne* (1870), *Fantasie marnie* (1881), *Canzoni e fantasie* (1853), *Ricordi lirici* (1884), *Poesie* (1887), *Nuovi canti* (1891) and *Ballate moderne* (1895).

MARRĀKESH (erroneously MOROCCO or MAROCCO CITY), one of the quasi-capitals of the sultanate of Morocco, Fez and Mequinez being the other two. It lies in a spacious plain—Blad el Hamra, "The Red"—about 15 m. from the northern underfalls of the Atlas, and 96 m. E.S.E. of Saffi, at a height variously estimated at 1639 ft. (Hooker and Ball) and 1410 ft. (Beaumier). Ranking during the early centuries of its existence as one of the greatest cities of Islām, Marrākesh has long been in a state of grievous decay, but it is rendered attractive by the exceptional beauty of its situation, the luxuriant groves and gardens by which it is encompassed and interspersed, and the magnificent outlook which it enjoys towards the mountains. The wall, 25 or 30 ft. high, and relieved at intervals of 360 ft, by square towers, is so dilapidated that foot-passengers, and in places even horsemen, can find their way through the breaches. Open spaces of great extent are numerous within the walls, but for the most part they are defaced by mounds of rubbish and putrid refuse. With the exception of the tower of the Kutubia Mosque and a certain archway which was brought in pieces from Spain, there is not, it is asserted, a single stone building in the city; and even bricks (although the local manufacture is of excellent quality) are sparingly employed. *Tabiya* or rammed concrete of red earth and stone is the almost universal building material, and the houses are consequently seldom more than two storeys in height. The palace of the sultan covers an extensive area, and beyond it lie the imperial parks of Agudal, the inner one reserved for the sultan's exclusive use. The tower of the Kutubia is a memorial of the constructive genius of the early Moors; both it and the similar Hasan tower at Rabat are after the type of the contemporary Giralda at Seville, and if tradition may be trusted, all three were designed by the same architect, Jabir. The mosque to which the tower belongs is a large brick building erected by 'Abd el Mumin; the interior is adorned with marble pillars, and the whole of the crypt is occupied by a vast cistern excavated by Yakūb el Mansur. Other mosques of some note are those of Ibn Yusef, El Mansur and El Mo'izz; the chapel of Sidi Bel Abbas, in the extreme north of the city, possesses property of great value, and serves as an almshouse and asylum. There is a special Jews' quarter walled off from the rest. The general population is of a very mixed and turbulent kind; crimes of violence are common, and there are many professional thieves. The murder of a Frenchman, Dr Mauchamp, in March 1907, by the rabble of Marrākesh was the immediate cause of the occupation of Udja by France (see MOROCCO: *History*). Almost the only manufacture extensively prosecuted is that of Morocco leather, mainly red and yellow, about 1,500 men being employed as tanners and shoemakers. Scottish missionaries and a few European traders have become established here. The city was founded in 1062 by Yusef bin Tashfin. Before it was a hundred years old it is said to have had 700,000 inhabitants, but the population in 1906 probably did not exceed 50,000 to 60,000.

See Leo Africanus, and Paul Lambert's detailed description in *Notice sur la ville de Maroc* (Paris, 1868). Lambert's plan of Marrākesh is reproduced with some additions by Dr A. Leared, and another may be found in Gatell.

MARRI, a Baluch tribe on the Dera Ghazi Khan border of Baluchistan. In the census of 1901 they numbered 19,161 and their fighting strength is about 3000. Their relations with the British commenced in 1840 with attacks made on the communications of Sir John Keane's army, after it had passed through the Bolan. An attempt was made to punish the tribe, which ended in disastrous failure. Major Clibborn was repulsed in an attempt to storm the Naffusak Pass, losing 179 killed and 92 wounded out of 650. Many of his force died of heat and thirst. The fort of Kahan, which he was trying to relieve at the time, was forced to capitulate with the honours of war. The Marris, however, joined the British against the Bugtis in 1845. After the annexation of Sind in 1843 the Marris gave much trouble, but were pacified by the policy of General John Jacob and Sir Robert Sandeman. In 1880 during the second Afghan War they made frequent raids on the British line of communications, ending with the plunder of a treasure convoy. A force of 3070 British troops under Brigadier-General Macgregor marched through the country, and the tribe submitted and paid 1¼ lakh (£12,500) out of a fine of 2 lakhs (£20,000); they also gave hostages for their future good behaviour. Since then they have given little trouble.

The Marri-Bugti country is classed as a tribal area in Baluchistan, politically controlled from Sibi, but enjoying a large measure of autonomy under its own chieftains. Total area, 7129 sq. m.; total pop. (1901), 38,919, almost equally divided between the two tribes of Marris and Bugtis.

MARRIAGE. Marriage (Fr. *mariage*, from *marier*, to marry; Lat. *maritare*, from *mas*, *maris*, a male), or "matrimony" (Lat. *matrimonium*, from *mater*, a mother), may be defined either (*a*) as the act, ceremony, or process by which the legal relationship of husband and wife is constituted; or (*b*) as a physical, legal and moral union between man and woman in complete community of life for the establishment of a family.[1] It is possible to discriminate between three stages, taking marriage in the latter sense as an institution—the animal or physical stage, the proprietary or legal stage, and the personal or moral stage. In the first or physical stage the relation of the sexes was unregulated, and in many cases of brief duration. In the second or legal stage greater permanence was secured in marriage by assigning the husband a property right in his wife or wives. In the last stage the proprietary relation falls more and more into the background, and the relation of husband and wife approximates that of two individuals entirely equal before the law. Although in the history of marriage these three stages have been roughly successive, the order of their entering the conscious experience of the individual is usually the reverse of their order in the development of the race; and in the solemnization of a marriage based upon affection and choice the growth of the relation begins with the moral, advances to the legal and culminates in the physical union, each one of these deriving its meaning and its worth from the preceding. In most legal systems marriage, in the sense of a ceremony, takes the form of a contract—the mutual assent of the parties being the prominent and indispensable feature. Whether it is really a contract or not, and if so to what class of contracts it belongs, are questions which have been much discussed, but into which it is not necessary to enter. While the consent of parties is universally deemed one of the conditions of a legal marriage, all the incidents of the relationship constituted by the act are absolutely fixed by law. The jurist has to deal with marriage in so far as it creates the legal status of husband and wife. It should be added that, while marriage is generally spoken of by lawyers as a contract, its complete isolation from all other contracts is invariably recognized. Its peculiar position may be seen at once by comparing it with other contracts giving rise to continuous relationships with more or less indefinite obligations, like those of landlord and tenant, master and servant, &c. In these the parties may in general make their rights and duties what they please, the law only intervening when they are silent. In marriage every resulting right and duty is fixed by the law.

Besides true marriage, inferior forms of union have from time to time been recognized, and may be briefly noticed here. These have all but disappeared from modern society, depending as they do on matrimonial restrictions now obsolete.

The institution of slavery is a fruitful source of this kind of debased matrimony. In Roman law no slave could contract marriage whether with another slave or a free person. The union of male and female slaves (*contubernium*) was recognized for various purposes; a free woman entering into a union with a slave incurred under the S.C. Claudianum the forfeiture of her own liberty; but the bondwoman might be the concubine of a freeman. In the United States, where slavery was said to be regulated by the principle of the civil law, the marriage of slaves was so far recognized that on emancipation complete matrimony took effect and the children became legitimate without any new ceremony.

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[1] It is doubtless true, as anthropologists have pointed out, that in the history of the race "marriage is rooted in the family rather than the family in marriage" (WESTERMARCK: *History of Human Marriage*, p. 22); but in that conscious experience of the individual with which law and ethics are especially concerned, this relationship is reversed, and the family originates in marriage (see FAMILY, and allied headings).

In Roman law no legal marriage could be contracted unless there was *connubium* between the parties. Originally there was no connubium between plebs and patricians, and the privilege was conceded after a long struggle by the Lex Canuleia. In later times Latini and Peregrini were excluded from connubium except where the right had been expressly conferred. The great matrimonial law of the early empire (Lex Julia et Papia Poppaea) introduced restrictions depending on the condition of the parties which later legislation extended and perpetuated. Senators under that law were forbidden to marry freedwomen or women of inferior rank, and the husband of a freedwoman becoming a senator was set free from his marriage. In the canon law[1] new restrictions were developed. Persons who bound themselves not to marry were deemed incapable of marrying. The order of the clergy were forbidden to marry. And disparity of faith was recognized by the early church as a bar to matrimony, *e.g.* between Christians and pagans and between orthodox and heretics (see *Dictionary of Christian Antiquities*, art. "Marriage").

CONCUBINAGE, which such restrictions tended to develop, is noticed under a separate heading (*q.v.*). It might be described as marriage which has no consequences, or only slight and peculiar consequences, in legal *status*. In the left-handed or "morganatic" marriages of the German royal families we have the nearest approach ever made by concubinage to true marriage, the children being legitimate, but neither they nor the wife acquiring any right to the rank or fortune of the husband. The marriage of persons of different religions frequently requires the intervention of the law as to the faith of the children, more particularly in Europe as between Roman Catholics and Protestants. English law gives the father, except under special circumstances, the right to dictate the faith of his children (see INFANT). The practice on this point varies in Europe—the question being ignored in French law, Germany following in some parts the same rule as England, in others giving effect to ante-nuptial stipulations. In Ireland mixed marriages (*i.e.* between Roman Catholic and Protestant) were by 19 Geo. II. c. 13 null and void if celebrated by a Roman Catholic priest. This act was repealed by 33 & 34 Vict. c. 110, which permits mixed marriages to be validly celebrated by an Episcopalian or Roman Catholic clergyman, subject to conditions set forth in § 38.

Roman law.—The three primitive modes of marriage were *confarreatio*, *coemptio in manum*, and *usus*, all of which had the effect of placing the woman in the "power" (*manus*) of her husband, and on the same footing as the children. The first was a religious ceremony before ten witnesses, in which an ox was sacrificed and a wheaten cake broken and divided between the spouses by the priest. *Coemptio* was a conveyance of the woman by *mancipatio*, and might be described as a fictitious sale *per aes et libram*, like that employed in emancipation and testamentary disposition and other processes. *Usus* was the acquisition of the wife by prescription, through her cohabiting with the husband for one year, without having been absent from his house three continuous nights. But a true marriage might be concluded without adopting any of these modes, and they all fell into desuetude and with them the subjection of the wife to the *manus*. Marriage without *manus* was contracted by the interchange of consent, without writing or formality of any kind. By some jurists it is regarded as incomplete until consummated by delivery of the woman, and is accordingly referred to the class of *real* contracts. The restrictions as to age, relationship by consanguinity and affinity, previous marriage, &c., were in the main those which have continued to prevail in modern Europe with one important exception. The consent of the *paterfamilias* to the marriage of the children under his power was essential.

Canon law.—The canon law of marriage is based partly on the Roman law, the validity of which the Church from the first recognized, partly on the Jewish law as modified by the new principles introduced by Christ and his apostles, developed by the fathers of the Church and medieval schoolmen, and regulated and defined by popes and councils. The most important of these principles was that of the indissolubility of marriage, proclaimed by Christ without qualification according to Mark x. 11, 12, and with the qualifying clause "saving for the cause of fornication" according to Matt. v. 32. This lofty view of marriage, according to which man and wife are made "one flesh" by the act of God ("What therefore God hath joined together, let no man put asunder," Mark x. 9) was, however, modified by the idea of the consummating act of marriage as in itself something unholy, a result of the Fall. Christ himself, indeed, did not teach this; but for St Paul marriage is clearly a concession to the weakness of the flesh (1 Cor. vii.). "The time is short," and in view of the imminent coming of the Lord the procreation of children a matter of no importance (v. 29), but "it is better to marry than to burn" (v. 9). He is, however, obviously not clear on the point, and at the end of his argument strikes a note of doubt (v. 40); elsewhere he defends marriage, against those who would have forbidden it altogether, as a gift of God (1 Tit. iv. 3–5) and even, in seeming contradiction to 1 Cor. vii. 29, commands the bearing of children (1 Tit. v. 14). Finally it is to St Paul that the idea of marriage as a sacrament is to be traced, in the mystic comparison of the relations of husband and wife to those of Christ and his Church (Eph. v. 23–32). These are the main foundations in Scripture on which the Christian law of marriage is built up, and they are obviously principles which admit of a large amount of variety of interpretation and of practice. They were developed in the early Church under the influence of the rapidly growing passion for the celibate life, partly an outcome of the same dualistic principle which produced the asceticism of the Jewish Essenes and of the Gnostics, partly perhaps a natural reaction from the appalling moral corruption of the decaying empire. Marriage, it is true, from being no more than a terminable civil contract, became a thing holy, a mystic union of souls and bodies never to be divided; valid, indeed, but not spiritually complete, without the public blessing of the Church (Tertullian, *Ad uxorem*, lib. ii. cap. 9); and from Augustine's time onward it was reckoned as a sacrament. But at the same time there was a tendency to restrict its rights and its range. So far as marriage was a physical union, this had for its object solely the perpetuation of the race and the avoidance of fornication; the most that was conceded was that the intention of having offspring not only made the conjugal act blameless, but even gave to the desire that inspired it an element of good (Augustine, *de nupt. et conc.* 3). But the ideal married life was that attributed to Mary and Joseph. Thus Augustine cited this as an example that a true marriage may exist where there is a mutual vow of chastity (*op. cit.* 12), and held that the sooner this relation was established the better (*de bono conjug.* 22). Marriage being then an inferior state, to be discouraged rather than the reverse, the tendency was rapidly to narrow the field within which it might be contracted. Remarriage (bigamy) was only allowed after many struggles, and then only to the laity; St Paul had laid down that a "bishop" must be "the husband of one wife," and to this day the priests of the Orthodox Eastern Church may not remarry. Clerical celibacy, at first a counsel of perfection, was soon to become the rule of the Church, though it was long before it was universally enforced in the West; in the East it still applies only to monks, nuns and bishops (see CELIBACY). The marriage of the laity was hampered by the creation of a number of impediments. The few and definite prohibitions of the Roman and of the Jewish law (Lev. xviii. 6–18; xx.) in the matter of marriage between kindred, were indefinitely extended; until in 506 the council of Agde laid it down that any consanguinity or affinity whatever constituted an impediment.[2] Moreover, man and wife being "one flesh," the Church exaggerated relationship by affinity into equal importance with that of consanguinity as an impediment to matrimony; and, finally, to all this added the impediments created by "spirtual affinity," *i.e.* the relations established between baptizer and baptized, confirmer and confirmed, and between godparents, their godchildren and their godchildren's relatives.

The result of this system was hopeless confusion and uncertainty, and it was early found necessary to modify it. This was done by Pope Gregory I., who limited the impediment to the 7th degree of relationship inclusive (civil computation)[1] which was afterwards made the law of the empire by Charlemagne. Later still Innocent III. found it necessary again to issue a decree (4th Lateran Council) permitting marriages between a husband and the relations of his wife, and vice versa, beyond the 4th degree inclusive (canonical computation).[2] This remains the canonical rule of the Roman Catholic Church. As regards impediments due to spiritual affinity, these were limited by the Council of Trent to the relation of the baptizer and baptized; the baptizer and the parents of the baptized; the baptizer and the godfather and godmother; the godparents and the baptized and its parents: *i.e.* a godfather may not marry the mother of the child he has held at the font, nor the godmother the father of such child.

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[1] The restrictions are enumerated in the following lines:—

Error, Conditio, Votum, Cognatio, Crimen,
Cultus, Disparitas, Vis, Ordo, Ligamen, Honestas,
Aetas, Affinis, si Clandestinus et Impos,
Raptave sit mulier nec parti reddita tutae.

[2] Canon lxi. Aut qui ex propria consanguinitate aliquam, aut quam consanguineus habuit . . . duceret uxorem . . . incestos esse non dubitamus (Mansi *Conc.* viii. p. 336). According to the canon law "affinity" is the relation between two persons of whom one has had commerce, licit or illicit, with a relation of the other.

In the fully developed canon law impediments to marriage are of two kinds, public and private (*impedimenta publica* and *privata*), *i.e.* according as the objection arises out of the very nature of marriage itself or from consideration for the rights of particular persons; near relationship, for instance, is a public impediment, impotence (*impotentia*) and force (*vis et metus*) are private impediments. Impediments are further divided into separating (*impedimenta dirimentia*) or merely suspensive (*impedimenta tantum impedientia*); to the first class belongs, *e.g.* a previous marriage not dissolved by death, which involves the nullification of the marriage even where through ignorance the crime of bigamy is not involved; to the second belongs the case of one or both of the contracting parties being under the age of puberty.[3] Impediments, moreover, are absolute or relative, according as they are of universal application or only affect certain persons; near relationship, for instance, is an absolute impediment, difference of religion between the parties a relative impediment. In addition to consanguinity and affinity, impuberty and existing marriage, the canon law lays down as public and absolute impediments to marriage the taking of holy orders and the vows of chastity made on entering any of the religious orders approved by the Holy See. In these impediments the canon law further distinguishes between those which are based on the law of nature (*jus naturae*) and those which are based on the law of the Church (*jus ecclesiae*). From impediments based on the law of nature, or of God, there is no power even in the pope to dispense; *e.g.* marriage of father and daughter, brother and sister, or remarriage of husband or wife during the lifetime of the wife or husband of another marriage, which is held to be a violation of the very nature of marriage as an indissoluble union.[4] From impediments arising out of the law of the Church dispensations are granted, more or less readily, either by the pope or by the bishop of the diocese in virtue of powers delegated by the pope (see DISPENSATION). Thus dispensations may be granted for marriage between persons related by consanguinity in any beyond the 2nd degree and not in the direct line of ascent or descent; *e.g.* between uncle and niece (confined by the council of Trent to the case of royal marriages for reasons of state) and between cousins-german, or in the case of marriage with a heretic. In this latter case a dispensation is now (*i.e.* since the papal decrees *ne temere* of the 2nd of August 1907, which came into force at Easter 1908) only granted on condition that the parties are married by a Catholic bishop, or a priest accredited by him, that no religious ceremony shall take place except in a Catholic church, and that all the children shall be brought up in the Roman Catholic faith.[5]

In the absence of any impediment a marriage is according to the canon law completed between baptized persons by the facts of consent and consummation; the principle is still maintained that the parties to the marriage, not the priest, are the "ministers of the sacrament" (*ministri sacramenti*).[6] From the first, however, the Church, while recognizing the validity of private contracts, enjoined the addition of a public religious ceremony, so that they might be "sanctified by the word of God and prayer" (1 Tim. iv. 5).[7] Tertullian (*de pudicitia*, cap. iv.) says that clandestine marriages, not professed in the Church, were reckoned among Christians as all but fornication, and he speaks of the custom of seeking permission to marry from the bishop, priests and deacons (*de monogamia*, cap. xi.). This latter precaution became increasingly necessary as impediments were multiplied, and Charlemagne, in a capitulary of 802, forbade the celebration of a marriage until "the bishops, priests and elders of the people" had made diligent inquiry into the question of the consanguinity of the parties. This was the origin of the publication of banns which, long customary in France, was made obligatory on the whole Church by Pope Innocent III. In the Eastern Church the primitive practice survives in the ceremonial blessing by the priest of the betrothal, as distinguished from the marriage ceremony. The ecclesiastical recognition of clandestine marriages, however, survived until the crying evil was remedied by a decree of the council of Trent (Sess. xiv. *de matrim.*),[1] which laid it down that for a valid marriage it was at least necessary that consent should be declared before a priest and in the presence of three witnesses. According to the actual law of the Roman Catholic Church, then, a civil marriage is only valid when the Tridentine decree has not been published; where this has been published, or has been in practice without publication, such a marriage can only become valid if followed by a religious ceremony in the prescribed form. Where such form has not followed the ecclesiastical courts must treat the marriage as voidable through the *impedimentum clandestinitatis*.

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[1] The civil law counts, in the direct line, as many degrees as there are generations between the parties; *e.g.* the son is in regard to his father in the 1st degree, the grandson in the 2nd, and vice versa. In the collateral line it computes degrees by generations, *i.e.* from one of the relations to the common ancestor, without including him or her, and from him or her back to the other relation; *e.g.* two brothers are in the 2nd degree of relationship to one another, uncle and nephew in the 3rd, cousins-german in the 4th.

The canon law, which in this case derives from the old Germanic law, has the same computation as regards the direct line. In the case of collateral relations, however, it differs, having two rules: (1) In the case of *equal line*—*i.e.* when the collaterals are equally removed from the common progenitor, it reckons the same number of degrees between the collaterals as between one of them and the progenitor; *e.g.* brothers are related in the 1st degree, while cousins-german are related in the 2nd degree because they are two generations from the common grandfather. (2) In the case of *unequal line*—*i.e.* when the collaterals are unequally removed from the common ancestor, the degree of their relationship is that of the most remote from the common progenitor; *e.g.* uncle and niece are related in the 2nd degree—*i.e.* that of the niece to the grandfather.

The civil computation was furiously attacked by canonists as tending to laxity (see Peter Damianus, "De parentelae gradibus," in Migne, *Patrol. Lat.* cxlv. 191, &c.).

[2] Innocent III. also decided that the husband's relations were not related to those of the wife, and vice versa, thus establishing the rule that "affinity does not breed affinity" (*affinitas non parit affinitatem*).

[3] This is fixed by the canon law at 14 for a male, 12 for a female. If, however, owing to the precocious physical development of a girl, the marriage has been consummated before she has reached this age, it cannot be nullified.

[4] It is maintained that no pope has ever given a dispensation for such a marriage. Such a case seems, however, to be narrated by Ordericus Vitalis (*Hist. eccles.* viii. 23; ed. A. le Prevost, Paris, 1838–1855, t. iii. p. 408; ed. A. Duchesne, 1619, 704 B). Robert Mowbray, earl of Northumberland, had only been married to Maud de Laigle three months when he was condemned to perpetual imprisonment for rebellion against King William Rufus. After describing her forlorn state Orderic continues: "Nec ipsa eo vivente, secundum legem Dei, alteri nubere legitime valebat. Tandum, permissu Paschalis Papae (II.), cui res, a curiosis enucleata, patuit, post multos dies Nigellus de Albineo ipsam uxorem accepit." This may mean no more, of course, than that the *curiosi* "untied the knot" by discovering an impediment—the usual expedient in such cases. In any case the fact that Nigel de Albini, in his turn, soon afterwards obtained a "divorce" from her on the ground that her first husband was his relative by consanguinity, hardly points to a strict view of the sanctity of the marriage tie.

[5] The customary rule for more than three centuries after the Council of Trent was that male children followed the religion of the father, female children that of the mother. On the general subject of the attitude of the Church towards mixed marriages see O. D. Watkins, *Holy Matrimony*, pp. 468 et seq. For the Roman Catholic view see "An Instruction on Mixed Marriages" in Bishop Ullathorne's *Eccl. Discourses* (London, 1876).

[6] Among the "errors" denounced by Pope Pius IX. in the Syllabus of 1864 is lxvi.: Matrimonii sacramentum non est, nisi quid contractui accessorium ab eoque separabile, ipsumque sacramentum in una tantum nuptiali benedictione situm est." This condemns the attempts of certain canonists (*e.g.* Melchior Cano) to distinguish between the *contractus naturalis* and *sacramentalis*. This view, which was first advanced by the jurist and theologian Johann Gropper (1502–1559) at the council of Cologne (1536), and gained support especially in France, makes the "matter" of the sacrament the consent of the parties, the "form" the prayers and benedictions, the "minister" the priests (see *e.g.* "Du sacrament de mariage" in vol. v. of the *Dissertationes selectae* of Petrus de Marca, d. 1662, archbishop of Paris, Bamberg, 1789, p. 148).

[7] See the list of quotations from the early fathers given by Watkins, *Holy Matrimony*, p. 93.

Divorce, *i.e.* the annulment of marriage for any cause but an impediment which makes the marriage *ipso facto* void, is unknown to the Roman Catholic Church. Separation *a vinculo matrimonii* is only possible under the canon law by a judicial decree of nullity (*annullatio matrimonii*), which implies, not the severing of the ties of a real marriage, but the solemn declaration that such marriage has never existed. There may, however, be a "separation from bed and board" (*a thoro et mensa*), even perpetual, which does not however give either party the right to remarry during the lifetime of the other. But, marriage not being regarded as a sacrament until consummated, it may be dissolved, if non-consummation be proved, by one or both parties taking the religious vows, or by papal dispensation. The Church claims exclusive control over marriage, and the council of Trent anathematized the opinion held by Luther and other Reformers, that it was properly a subject for the civil courts (*si quis dixerit causas matrimoniales non spectare ad judices ecclesiasticos anathema sit*, Sess. xxiv. cap. 2). This attitude became of extreme political importance when even in Catholic countries the codes established civil marriage as the only legally binding form.

England.—Marriage may be the subject of an ordinary contract on which an action may be brought by either party. It is not necessary that the promise should be in writing, or that any particular time should be named. Promises to marry are not within the meaning of "agreement made in consideration of marriage" in the statute of frauds, which requires such agreements to be in writing. Contracts in restraint of marriage, *i.e.* whose object is to prevent a person from marrying anybody whatever, are void, as are also contracts undertaking for reward to procure a marriage between two persons. These latter are termed marriage brocage contracts.

Any man and woman are capable of marrying, subject to certain disabilities, some of which are said to be canonical as having been formerly under the cognisance of the ecclesiastical courts, others civil. The effect of a canonical disability as such was to make the marriage not void but voidable. The marriage must be set aside by regular process, and sentence pronounced during the lifetime of the parties. Natural inability at the time of the marriage to procreate children is a canonical disability. So was relationship within the prohibited degrees, which has been made an absolute avoidance of marriage by the Marriage Act 1835. Civil disabilities are (1) the fact that either party is already married and has a spouse still living;[2] (2) the fact that either person is a party of unsound mind; (3) want of full age, which for this purpose is fixed at the age of puberty as defined in the Roman law, viz. fourteen for males and twelve for females;[3] (4) relationship within the prohibited degrees.

The statute which lawyers regard as establishing the rule on this last point is the 32 Hen. VIII. c. 38 (repealed in part by 2 & 3 Edw. VI. c. 23, in whole by 1 & 2 P. and M. c. 8, but revived by 1 Eliz. c. 1, and so left as under the Act of Edward), which enacts that "no prohibition, God's law except, shall trouble or impeach any marriage without the Levitical degrees." The forbidden marriages, as more particularly specified in previous statutes, are those between persons in the ascending and descending line *in infinitum*, and those between collaterals to the third degree inclusive, according to the computation of the civil law. The prohibitions extend not only to *consanguinei* (related by blood) but to *affines* (related by marriage), now altered so far as a deceased wife's sister is concerned (see below). The act of 1835 enacted that "all marriages which shall hereafter be celebrated between persons within the prohibited degrees of consanguinity or affinity shall be absolutely null and void to all intents and purposes whatsoever." They had previously been only voidable. The act at the same time legalized marriages within the prohibited degrees of affinity (but not consanguinity) actually celebrated before the 31st of August 1835.

Marriage with a Deceased Wife's Sister.

For many years an active and ceaseless agitation was carried on on behalf of the legalization in England of marriage with a deceased wife's sister. In all the self-governing colonies, with the exception of Newfoundland, the restriction had ceased to exist. The first act legalizing marriage with a deceased wife's sister was adopted by South Australia. The royal assent, however, was not given till the parliament of that state had five times passed the bill. In quick succession similar statutes followed in Victoria, Tasmania, New South Wales, Queensland, New Zealand, West Australia, Barbados, Canada, Mauritius, Natal and Cape Colony. As regards the Channel Islands, marriages of the kind in question were made legal in 1899, and in 1907 in the Isle of Man.

In England the bill to render marriage with a deceased wife's sister valid was first adopted by the House of Commons in 1850, and rejected by the House of Lords in 1851. It was subsequently brought before the legislature in 1855, 1856, 1858, 1859, 1861, 1862, 1866, 1869, 1870, 1871, 1872, 1873, 1875, 1877 and 1878 (Colonial bills), 1879 (6th May, when in the House of Lords the prince of Wales and the duke of Edinburgh voted in favour of it), 1880, 1882, 1883, 1884, 1886, 1888, 1889, 1890, 1891, 1896, and 1898 and 1900 (Colonial bills). In most cases it passed the House of Commons but was rejected in the House of Lords. The bill of 1896, however, which was judiciously drafted to avoid the compulsory celebration by clergymen of marriages against which they had conscientious scruples, was carried in the Lords. Both the prince of Wales and the duke of York were among the "contents." The prime minister and eighteen bishops, including the two archbishops, voted against the bill, the earl of Rosebery and Lord Kimberley for it. At the third reading the bill was carried by 142 to 104 votes. Its promoters, however, did not succeed in getting an opportunity of bringing it before the House of Commons.

From 1896 to 1901 no further direct steps were taken, but in 1898 and again in 1900 (May 28) the subject was brought forward in the House of Lords by Lord Strathcona in the form of a bill under which marriages with a deceased wife's sister contracted in any British colony should be deemed valid for all purposes within the United Kingdom. In 1898, and again in 1900, the bill was carried on the third reading without a dissentient vote. The House of Commons took no action on either occasion. An imperial bill reached a second reading in the House of Commons in 1901 and again in 1902, but it was blocked by the High Church opponents of the measure when attempts were made to get it to the committee stage (Feb. 5 and June 6). The reform was, however, finally adopted in 1906 under the title of the Colonial Marriages (Deceased Wife's Sister) Act. The effect of the act was to make such marriages legal in all respects, including the right of succession to real property and to honours and dignities within the United Kingdom. The natural sequence of the passing of the act of 1906 was the reintroduction in 1907 of the bill relating to England. Introduced by a private member, it was adopted by the government, passed the House of Commons, and finally the House of Lords (on the second reading by 111 votes to 79), and became law as the Deceased Wife's Sister Marriage Act, 1907. The act contains a proviso justifying clergymen in refusing to solemnize marriages with a deceased wife's sister, and it preserves the peculiar status of the wife's sister under the Matrimonial Causes Act 1857, under which adultery with her by the husband is incestuous adultery.

The celebration of marriages is now regulated wholly by statutory legislation. The most important acts in force are the Marriage Acts 1823, 1836, 1886 and 1898.[4] The former regulates marriages within the Church of England, but was intended to be of universal application, Jews and Quakers only being excepted by section 31. It requires either the previous publication of banns, or a licence from the proper ecclesiastical authority. As to banns, the rule of the rubric, so far as not altered by the statute, is required to be observed. They must be published on three successive Sundays at morning service after the second lesson, in the church of the parish in which the parties dwell; the bishop may, however, authorize the publication of banns in a public chapel. Seven days' notice must be given to the clergyman of the names of the parties, their place of abode, and the time during which they have lived there. If either party is under age, the dissent of the parents or guardians expressed at the time of publication of banns renders such publication null and void. Licence in lieu of banns may only be granted by the archbishop, bishop or other authority, for the solemnization of a marriage within the church of the parish in which one of the parties shall have resided for fifteen days before. Before a licence can be granted an oath must be taken as to the fact of residence and that the necessary consent has been obtained in the case of persons under age. The father, or lawful guardian, is the proper person to consent to the marriage of a minor, and the place of any such person incapacitated mentally is taken by the lord chancellor. The absence of such consent does not, however, avoid a marriage once solemnized. But if persons wilfully intermarry (unless by special licence) in a place not being a church or public chapel, or without due publication of banns or proper licence, or before a person not in holy orders, the marriage is null and void to all purposes. Marriage must be celebrated within three months after banns or licence, and between the hours of eight in the morning and three in the afternoon.

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[1] The later teaching of the Eastern Church is laid down in the Orthodox Confession of Peter Mogilas, patriarch of Kiev (1640). There are three essentials for a Christian marriage: (1) suitable matter (ὕλη ἁρμόδιος), *i.e.* a man and woman whose union no impediment bars, (2) a duly ordained bishop or priest, (3) the invocation of the Holy Ghost, and the solemnity of the formularies (τὸ εἶδος τῶν λογίων).

[2] A divorce *nisi* does not enable the parties to marry until it is made absolute.

[3] A marriage in which either of the parties is below the age of consent is, however, said to be not absolutely void; if the parties agree to continue together at the age of consent no new marriage is necessary, but either of them may disagree and avoid the marriage.

[4] A complete list of the acts regulating the solemnization of marriage or confirming marriages, which through some defect might be void, will be found in Phillimore's *Ecclesiastical Law* (2nd ed. 1895).

For the relief of the great body of Dissenters the act of 1836 was passed. It permits marriage to be solemnized in two additional ways—viz. (1) by certificate of the superintendent registrar of a district without licence, and (2) by such certificate with licence. In the first case, notice must be given to the registrar of the district or districts within which the parties have resided for seven days previous, which notice is inscribed in a marriage-notice book, open to public inspection at all reasonable times, and thereafter suspended for twenty-one days in some conspicuous place in the registrar's office. Any person whose consent is necessary to an ecclesiastical licence may forbid the issue of a certificate, but in default of such prohibition the certificate will issue at the end of the twenty-one days. The marriage may then take place on any day within three months of the entry of notice, and in one of the following ways: (1) in a certified place of religious worship, registered for the solemnization of marriage; in that case a registrar of the district with two witnesses must be present, and the ceremony must include a mutual declaration of assent by the parties and a disavowal of any impediment; (2) at the superintendent registrar's office, with the same declaration, but with no religious service; (3) in a church according to the usual form, the consent of the minister thereof having been previously obtained; (4) according to the usages of Jews and Quakers. The place of marriage in all cases must have been specified in the notice and certificate.

In the second case, when it is desired to proceed by licence, notice must be given to the registrar of the district in which one of the persons resides, together with a declaration that he or she has resided for fifteen days therein, that there is no impediment, and that the necessary consents if any have been obtained. The notice is not exhibited in the registrar's office, and the certificate may be obtained at the expiration of one whole day after entry, together with the licence. No registrar's licence can be granted for a marriage in church or according to the forms of the Church of England—the ecclesiastical authorities retaining their jurisdiction in that respect. It is also provided that in the case of persons wilfully intermarrying in a place other than that mentioned in the notice and certificate, or without notice or certificate, &c., the marriage shall be null and void.

The various rules as to consent of parents, &c., to the marriages of minors are regulations of procedure only. The absence of the necessary consent is not a disability invalidating a marriage actually solemnized.

The Act 26 Geo. II. c. 33, commonly known as Lord Hardwicke's Act, which forbids the solemnization of marriage without banns or licence, also enacts that "in no case whatsoever shall any suit or proceeding be had in any ecclesiastical court in order to compel a celebration *in facie ecclesiae*, by reason of any contract of matrimony whatsoever whether *per verba de presenti* or *per verba de futuro*." Blackstone observes that previous to this act "any contract made *per verba de presenti*, or in words of the present tense, and in case of cohabitation *per verba de futuro* also, was deemed valid marriage to many purposes; and the parties might be compelled in the spiritual courts to celebrate it *in facie ecclesiae*."

Royal marriages in England have been subject to special laws. The Royal Marriage Act of 1772 (12 Geo. III. c. 11), passed in consequence of the marriages of the dukes of Cumberland and Gloucester, enacted that "no descendant of his late majesty George II. (other than the issue of princesses married or who may marry into foreign families) shall be capable of contracting matrimony without the previous consent of his majesty, his heirs and successors, signified under the Great Seal. But in case any descendant of George II., being above twenty-five years old, shall persist to contract a marriage disapproved of by his majesty, such descendant, after giving twelve months' notice to the privy council, may contract such marriage, and the same may be duly solemnized without the consent of his majesty, &c., and shall be good except both Houses of Parliament shall declare their disapprobation thereto."

In 1886 an act was passed in the British parliament to remove doubts which had been entertained as to the validity of certain marriages solemnized in England when one of the parties was resident in Scotland. The Summary Jurisdiction (Married Women) Act of 1895 enabled a wife whose husband is convicted of an assault on her, or who has been deserted by him, or been obliged owing to his cruelty to live apart from him, to apply to the justices, who are empowered by the act to make an order for separation and for payment by the husband to his wife of such weekly sum, not exceeding two pounds, as they may consider reasonable. The Marriage Act 1898 authorized the celebration of marriages in places of worship duly registered for the solemnization of marriages under the Marriage Act of 1836 without the presence of the registrar, on condition of their being solemnized in the presence of a person duly authorized by the governing body of the place of worship in question. It also made further provision for the due recording of all marriages in the general registers. The Marriages Validity Act of 1899 removed doubts as to the validity of marriages in England on Irish banns and in Ireland on English banns. Lastly, the Marriage with Foreigners Act 1906 enabled a British subject desirous of marrying a foreigner in a foreign country to comply with the foreign law by obtaining from a registrar a certificate that no legal impediment to the marriage has been shown. Similar certificates, by arrangement between His Majesty and foreign countries, are issued in the case of a foreigner desirous of marrying a British subject in the United Kingdom.

The Foreign Marriage Act 1892 has consolidated the English law relating to marriages celebrated abroad, and brings it into harmony with the current tendencies of marriage law reform generally. Under it a marriage between British subjects abroad is as valid as a marriage duly solemnized in England (as heretofore), if celebrated in accordance with the local law or in the presence of diplomatic or consular agents who are appointed to act as "marriage officers." The old fiction of assimilation of a British embassy to British soil can no longer be relied upon to uphold a marriage at a British embassy solemnized by an ordained clergyman. An order in council of the 28th of October 1892, moreover, provides that in the case of any marriage under the act, if it appears to the marriage officer that the woman about to be married is a British subject, and that the man is an alien, he must be satisfied that the marriage will be recognized by the law of the foreign country to which the alien belongs.

A marriage may be solemnized on board one of His Majesty's ships at a foreign station, provided a warrant of a secretary of state has authorized the commanding officer to be a marriage officer. At sea, marriages on British public or private ships seem still valid at common law, if performed by an episcopally ordained minister. The Merchant Shipping Act 1894 (sect. 240) provides that the master of a ship for which an official log is required shall enter in it every marriage taking place on board, with the names and ages of the parties.

Again, under the Foreign Marriage Act all marriages solemnized within the British lines by a chaplain or officer or other person officiating under the orders of the commanding officer of a British army serving abroad, are as valid in law as if they had been solemnized within the United Kingdom subject to due observance of all forms required by law. The Naval Marriages Act 1908 authorizes, for the purpose of marriages in the United Kingdom, the publication of banns and the issue of certificates on board His Majesty's ships in certain cases, or when one of the parties to a marriage intended to be solemnized in the United Kingdom is an officer, seaman or marine, borne on the books of one of His Majesty's ships at sea.

The principle of the English law of marriage, that a marriage contracted abroad is valid if it has been solemnized according to the *lex loci*, may be now taken to apply just as much to a marriage in a heathen as in a Christian country. Whether the marriage has or has not been celebrated according to Christian laws has no bearing upon the question, providing it is a monogamous marriage—a marriage which prevents the man who enters into it from marrying any other woman while his wife continues alive.

Scotland.—The chief point of distinction, as compared with English law, is the recognition of irregular marriages. (1) "A public or regular marriage," says Fraser, "is one celebrated, after due proclamation of banns, by a minister of religion; and it may be celebrated either in a church or in a private house, and on any day of the week at any hour of the day." The ministers of the National Church at first alone could perform the ceremony; but the privilege was extended to Episcopalians by 10 Anne c. 7 (1711), and to other ministers by 4 and 5 Will. IV. c. 28 (1834). (2) A marriage may also "be constituted by declarations made by the man and the woman that they *presently* do take each other for husband and wife." These declarations "may be emitted on any day at any time and without the presence of witnesses," and either by writing or orally or by signs, and in any form which is clearly expressive of intention. Such a marriage is as effectual to all intents and purposes as a public marriage. The children of it would be legitimate; and the parties to it would have all the rights in the property of each other, given by the law of Scotland to husband and wife. (3) A promise followed by *copula* does not constitute marriage, unless followed either by solemnization *in facie ecclesiae* or declarator. Lord Moncreiff's opinion in the case of *Brown* v. *Burns* is admitted to be good law, viz. that declarator is essential to the constitution of a marriage of this kind, so that, if no such declarator be brought in the lifetime of both parties, the marriage can never be established afterwards. The *copula* is presumed to have reference to the promise, but evidence may be adduced to show that such was not the case.

By the Marriage (Scotland) Act 1856 it is enacted that no *irregular* marriage shall be valid in Scotland, unless one of the parties has lived in Scotland for the twenty-one days next preceding the marriage, or has his or her usual residence there at the time.

"Habit and repute" has sometimes been spoken of as constituting marriage in the law of Scotland, but it is more correctly described as evidence from which marriage may be inferred. The repute must be the general, constant, and unvarying belief of friends and neighbours, not merely the controverted opinion of a section of them. The cohabitation must be in Scotland, but in one case proof of cohabitation in another country was allowed, as tending to throw light on the nature of the cohabitation in Scotland.

The consent of parents is not necessary to the validity of the marriage, even of minors, but marriage under the age of puberty with or without such consent is void.

United States.—The absence of ecclesiastical courts has suggested difficulties as to the extent to which the law of England on this subject continued to prevail after the revolution. Bishop holds it to be the universal fact running through all the cases that everywhere in the country the English decisions on marriage and divorce are referred to with the same apparent deference which is shown on other subjects to the decisions of the English common law and equity tribunals. The same author observes that "all our marriage and divorce laws, and of course all our statutes on the subject, in so far as they pertain to localities embraced within the limits of particular states, are state laws and state statutes, the national power with us not having legislative or judicial cognisance of the matter within those localities." Some of the states have extended the ages below which marriage cannot take place. The common law of the states is assumed to be that "a contract *per verba de presenti*, or *per verba de futuro cum copula*, constitutes a complete marriage." Conditions, however, may be imposed by the various state legislatures, and as to these the rule has established itself in American jurisprudence that "a marriage good at common law is good notwithstanding the existence of any statute on the subject, unless the statute contains express words of nullity." Thus in Pennsylvania, where a statute provided that all marriages "should be solemnized before twelve witnesses," marriages not so celebrated were nevertheless held to be good. In New Hampshire justices and ministers of the gospel are authorized to solemnize marriage, and all other persons are forbidden to do so under penalties; yet a marriage by consent, as at common law, without justice or minister, has been held valid. On the other hand, under a very similar statute in Massachusetts, it was held that "parties could not solemnize their own marriage," and that a marriage by mutual agreement, not in accordance with the statute, was void. Bishop regards this as an isolated exception to the general course of the decisions. So when state legislation requires any particular form to be used the want thereof only invalidates the act if the statute expressly so enacts. Many of the state codes inflict penalties on ministers or justices for celebrating the marriage of minors without the consent of the parents or guardians. The original law as to prohibited degrees has been considerably modified in the states. The prohibition of marriage with a deceased wife's sister has been abolished in the United States. But New Hampshire, Ohio, Indiana, Kansas, Arkansas, Nevada, Washington, the Dakotas and Montana have for long forbidden marriages between first cousins by blood, and Louisiana, Oregon, Pennsylvania, Michigan, Nebraska, Utah and Wisconsin have since adopted the same principle. Virginia prohibits the marriage of a woman with the husband of her brother's or sister's daughter.

Attention is also being paid to the question of marriage from a physical point of view. New Jersey prohibits the marriage of any person who has been confined in any public asylum as an epileptic, insane or feeble-minded patient, without a medical certificate from two physicians of complete recovery, and that there is no probability of the transmission of such defects. This prohibits the granting of a marriage licence where either party is an habitual drunkard, epileptic, imbecile or insane, or where the applicant at the time of making application is under the influence of any intoxicant or narcotic drug. In Michigan, Minnesota, Kansas and Oregon, marriage is prohibited to epileptics, &c., except when the woman is over forty-five. In Michigan, also, marriage is forbidden to anyone who has suffered from a venereal disease and has not been cured. The equality of property rights between husband and wife is fully established in America. Indeed, in many states the movement has gone so far as to give the wife in matters of property and in reference to divorce greater privileges than the husband. Thus a husband is often liable for a wife's debts where a wife would not be, *mutatis mutandis*, for a husband's; and a wife may usually obtain a decree of divorce for any ground on which one may be awarded to the husband, and, in addition, for neglect to provide sustenance or support. Emphasis on the personal or moral relation of the parties in marriage tends to throw into the background the legal aspects and requirements; and it tends also to minimize, so far as the state is concerned, the religious and sacramental aspect of marriage. Marriage tends to become a relation established by parties between themselves, and one in which the consent of the parties becomes the only constitutive element. In the theory of American law no ceremony is essential to create the marriage relation. But this position has never been endorsed by any considerable proportion of the community, and in fact probably $\frac{9}{10}$ths and perhaps $\frac{99}{100}$ths of the marriages in the United States are contracted through some ceremony.

France.—Articles 144–226 of the Code Napoléon, as amended by an act of 1907, prescribe the qualifications and conditions of marriage. The man must be eighteen and the woman fifteen years of age. A son and daughter under twenty-one cannot marry without consent of the father and mother, or of the father only if they disagree, or of the survivor if one be dead. If both are dead grandfather and grandmother take their place. Between the ages of twenty-one and thirty the parties must still obtain the consent of their parents, but if this be refused it can be regulated by means of a "respectful and formal act" before a notary. If the consent is not given within thirty days the marriage may take place without it. If neither parents nor grandparents be alive, parties under twenty-one require the consent of the family council. These rules apply to natural children when affiliated; those not affiliated require the consent of a specially appointed guardian. Marriage is prohibited between all ascendants and descendants in the direct line, and between persons related by marriage in the same line, between brother and sister, between uncle and niece, and brother-in-law and sister-in-law.

Before the solemnization of marriage banns are required to be published for a period of ten days, which must include two Sundays, containing the names, occupations, and domiciles of the parties and their parents. There must be an interval of three days before the marriage can take place, and if a year is allowed to elapse fresh banns must be put up. On the day appointed by the parties, and in the parish to which one of them belongs, the marriage is celebrated by the civil officer or registrar reading over to them the various necessary documents, with the chapter of the code relating to husband and wife, receiving from each a declaration that they take each other for husband and wife, and drawing up the act of marriage. All this has to be done in the presence of four witnesses.

Marriages contracted abroad between French subjects or between French subjects and foreigners are valid in France if celebrated according to the forms of the foreign law, provided the French conditions as to consent of parents have been observed. (See also Marriage with Foreigners Act, *supra.*)

Germany.—The code of 1900 lays down rules applicable to the celebration of all marriages within the German Empire. Civil marriage alone is recognized by the code. It is effected by the declaration of the parties before a registrar in the presence of each other of their intention to be married. Two witnesses of full age must be present. The registrar asks each of the parties whether he or she will marry the other, and on their answer in the affirmative declares them duly married and enters the marriage in the register. The marriage must be preceded by a public notice. Marriages are void between descendants and ascendants; relatives by marriage in the ascending or descending line; brother and sister of the whole or half blood.

Other Countries.—In the great majority of the other European countries civil marriage is obligatory. In Roman Catholic countries the parties usually supplement the obligatory civil marriage by a religious ceremony, more especially since the papal decree *Ne temere* of the 2nd of August 1907 (which came into force at Easter 1908), which requires marriages between Roman Catholics, or between Roman Catholics and those not professing that faith, to be celebrated before a bishop or priest duly authorized for the celebration thereof.

Authorities.—Eversley, *The Law of Domestic Relations* (3rd ed., London, 1906); Lush, *The Law of Husband and Wife* (London, 1909); Crawley, *The Law of Husband and Wife* (London, 1892); Geary, *Marriage and Family Relations* (London, 1892); Griffiths, *Married Women's Property Acts* (London, 1891); Vaizley, *Law of Settlements of Property made on Marriage* (London, 1887); Bishop, (America) *Marriage, Divorce and Separation* (Chicago, 1892); David Murray, (Scotland) *The Law relating to the Property of Married Persons* (Glasgow, 1892); E. A. Westermarck, *History of Human Marriage* (3rd ed., 1901), with other works cited in the article Family. M. Neustadt, *Kritische Studien zum Familienrecht des bürgerlichen Gesetzbuchs* (Berlin, 1907); O. D. Watkins, *Holy Matrimony* (London, 1895), a comprehensive study of the history and theory of Christian marriage, from the High Anglican point of view, with special reference to missions dealing with heathen converts; J. Wickham Legg, "Notes on the Marriage Service in the Book of Common Prayer of 1549," in *Ecclesiological Essays* (London, 1905), a valuable comparative study of Christian marriage rites, with numerous references; the articles "Ehe, Christliche," by Gottschick, and "Eherecht" (many references), by Sehling, in Herzog-Hauck, *Realencyklopädie* (3rd ed., Leipzig, 1898, vol. v.); Abbé André, *Cours de droit canon* (3rd ed., Wagner, Paris, 1901), art. "Mariage," "Affinité," &c.

See also Age; Divorce; Family; Husband and Wife; Legitimacy and Legitimation; Morganatic Marriage.

MARRUCINI, an ancient tribe which occupied a small strip of territory round about Teate (mod. Chieti), on the east coast of Italy. It is first mentioned in history as a member of a confederacy with which the Romans came into conflict in the second Samnite War, 325 B.C., and it entered the Roman Alliance as a separate unit at the end of that war (see further Paeligni). We know something of the language of the Marrucini from an inscription known as the "Bronze of Rapino," which belongs to about the middle of the 3rd century B.C. It is written in Latin alphabet, but in a dialect which belongs to the North Oscan group (see Paeligni). The name of the city or tribe which it gives us is *touta marouca*, and it mentions also a citadel with the epithet *tarincris*. Several of its linguistic features, both in vocabulary and in syntax, are of considerable interest to the student of Latin or Italic grammar (*e.g.* the use of the subjunctive, without any conjunction, to express purpose, a clause prescribing a sacrifice to Ceres being followed immediately by *pacr si ut propitia sit*). The earliest Latin inscriptions are of Ciceronian date.

The form of the name is of considerable interest, as it shows the suffix -NO- superimposed upon the suffix -CO-, a change which probably indicates some conquest of an earlier tribe by the invading Safini (or Sabini, *q.v.*).

For further details as to Marrucine inscriptions and place-names see R. S. Conway, *The Italic Dialects*, p. 253 seq. (R. S. C.)

MARRUVIUM, the chief town of the Marsi, on the E. bank of the Lacus Fucinus, 4 m. S. of Cerfennia, on the Via Valeria. Though no doubt of great antiquity, nothing is known of its history before the imperial period; and none of the remains visible there (city walls, various buildings within them, an amphitheatre, &c.), from which it seems to have been a place of some importance, can be attributed to an earlier date. On the site is the insignificant village of St Benedetto.

MARRYAT, FREDERICK (1792–1848), English sailor and novelist, was born at Westminster on the 10th of July 1792. He was the grandson of Thomas Marryat (physician, author of *The Philosophy of Masons*, and writer of verse), and son of Joseph Marryat, agent for the island of Grenada, who wrote pamphlets in defence of the Slave Trade. His mother was a Bostonian of German extraction. Young Marryat distinguished himself as a boy by frequently running away to go to sea; and at last, at the age of fourteen, he was allowed to enter the navy. His first service was under Lord Cochrane (afterwards tenth earl of Dundonald) in the famous "Impérieuse," and no midshipman ever had a livelier apprenticeship to the sea. During his two and a half years of service under Cochrane, the young midshipman witnessed more than fifty engagements, and had much experience of service on the coast of Spain in the early stage of the Peninsular War, in the attack on the French squadron in the Roads (April 1809) and in the Walcheren expedition. Before the general peace of 1815 he had served in North America and the West Indies and gained a wide knowledge of conditions of life on board ship under various commanders. In 1815 he was promoted to the rank of commander. After holding various commands he commissioned the "Larne," 20, for the East Indies and was senior naval officer at Rangoon during the Burmese War from May to September 1824. In the early part of the next year he commanded an expedition up the Bassein River, in which Bassein was occupied and the Burmese stores seized. His services were acknowledged by a nomination as C.B. in 1826. He frequently received honourable mention for his behaviour in action, and in 1818 he received the medal of the Humane Society for "at least a dozen" gallant rescues. Marryat's honours were not confined to gallant exploits. He adapted Sir Home Popham's code of signals to a code for the Mercantile Marine, for which he was made F.R.S. in 1819, and received the Legion of Honour from Louis Philippe in 1833. A pamphlet written to propose a substitute for the system of impressment in 1822 is said to have offended King William IV.

Marryat brought ripe experience and unimpaired vivacity to his work when he began to write novels. *Frank Mildmay, or the Naval Officer*, was published in 1829, and *The King's Own* followed in 1830. The novels of the sea captain at once won public favour. The freshness of the new field which was opened up to the imagination—so full of vivid lights and shadows, light-hearted fun, grinding hardship, stirring adventure, heroic action, warm friendships, bitter hatreds—was in exhilarating contrast to the world of the historical romancer and the fashionable novelist, to which the mind of the general reader was at that date given over. He had an admirable gift of lucid, direct narrative, and an unfailing fund of incident, and of humour, sometimes bordering on farce. Of all his portraits of adventurous sailors, "Gentleman Chucks" in *Peter Simple* and "Equality Jack" in *Mr Midshipman Easy* are the most famous, but he created many other types which take rank among the characteristic figures in English fiction. Marryat's first attempt was somewhat severely criticized from an artistic point of view, and he was accused of gratifying private grudges by introducing real personages too thinly disguised; and as he attributed some of his own adventures to Frank Mildmay he was rather shocked to learn that readers identified him with that disagreeable character. *The King's Own* was a vast improvement, in point of construction, upon *Frank Mildmay*; and he went on, through a quick succession of tales, *Newton Forster* (1832), *Peter Simple* (1834), *Jacob Faithful* (1834), *The Pacha of Many Tales* (1835), *Japhet in Search of a Father* (1836), *Mr Midshipman Easy* (1836), *The Pirate and the Three Cutters* (1836), till he reached his high-water mark of constructive skill in *Snarley-yow, or the Dog Fiend* (1837). The best of his books after this date are those written expressly for boys, the favourites being *Masterman Ready* (1841), *The Settlers in Canada* (1844), and *The Children of the New Forest* (1847). Among his other works are *The Phantom Ship* (1839); *A Diary in America* (1839); *Olla Podrida* (1840), a collection of miscellaneous papers; *Poor Jack* (1840); *Joseph Rushbrook* (1841); *Percival Keene* (1842); *Monsieur Violet* (1842); *The Privateer's*

Man (1844); *The Mission, or Scenes in Africa* (1845); *The Little Savage* (1848–1849), published posthumously; and *Valerie*, not completed (1849). His novels form an important link between Smollett and Fielding and Charles Dickens.

Captain Marryat had retired from the naval service in 1830, becoming equerry to the duke of Sussex. He edited the *Metropolitan Magazine* from 1832 to 1835, and some of his best stories appeared in that paper. He spent a great part of his time in Brussels, where he was very popular. He visited Canada during Papineau's revolt and the United States in 1837, and gave a disparaging account of American institutions in a *Diary* published on his return to England. While at New York he wrote a play, *The Ocean Waif, or Channel Outlaw*, which was acted, and is forgotten. His versatility is further shown by the fact that he drew rough caricatures and other sketches with some spirit. Some capital snatches of verse are scattered throughout his novels, the best being "Poll put her arms akimbo" in *Snarleyyow*, and the "Hunter and the Maid" in *Poor Jack*. In 1843 he settled at Langham Manor, Norfolk. He indulged in costly experiments in farming, so that in spite of the large income earned by his books he was not a rich man. He died at Langham on the 9th of August 1848, his death being hastened by news of the loss of his son by shipwreck.

His daughter, Florence Marryat, herself a novelist, published his *Life and Letters* in 1872. See also David Hannay, *Life of Marryat* (1889). (D. H.)

MARS, MLLE [ANNE FRANÇOISE HYPPOLYTE BOUTET] (1779–1847), French actress, was born in Paris on the 9th of February 1779, the natural daughter of the actor-author named Monvel [Jacques Marie Boutet, 1745-1812], and Mlle Mars Salvetat, an actress whose southern accent had made her Paris *début* a failure. Mlle Mars began her stage career in children's parts, and by 1799, after the rehabilitation of the Comédie Française, she and her sister (Mars *aînée*) joined that company, of which she remained an active member for thirty-three years. Her beauty and talents soon placed her at the top of her profession. She was incomparable in *ingénue* parts, and equally charming as the coquette. Molière, Marivaux, Sedaine, and Beaumarchais had no more accomplished interpreter, and in her career of half a century, besides many comedy rôles of the older *répertoire*, she created fully a hundred parts in plays which owed success largely to her. For her farewell performance she selected Elmire in *Tartuffe*, and Silvia in *Jeu de l'amour et du hasard*, two of her most popular rôles; and for her benefit, a few days after, Célimène in *Le Misanthrope* and Araminthe in *Les Femmes savantes*. She retired in 1841, and died in Paris on the 20th of March 1847.

MARS (Mavors, Marmar, Marspiter or Maspiter), after Jupiter the most important deity of the Roman state, and one who, unlike most Roman deities, was never so much affected by foreign influences as to lose his essentially Roman and Italian character. Traces of his worship are found in all parts of central and southern Italy, in Umbria, Picenum, Samnium, and in one or two Etruscan cities, as well as in Latium; and in several communities, as we learn from Ovid (*Fasti*, 3. 93 seq.), he gave his name to a month, as at Rome to the first month of the old Roman year. We know little of the character of his cult except at Rome, and even at Rome it has been variously interpreted. He has been explained as a sun-god, a god of wind and storm, a god of the year and a god of vegetation; and he has been compared with Apollo by Roscher (*Apollo, and Mars*, 1873, and in the article "Mars" in his *Lexicon of Mythology*). But in historical times his chief function at Rome was to protect the state in war, and it is as a god of war that he is known to all readers of Roman literature. So entirely did this characteristic get the better of all others, that his name came to be used as a synonym for *bellum*; and in the latest and most careful of all accounts of the Roman religion he is pronounced to have been from first to last a god of war only (see Wissowa, *Religion und Kultus der Römer*, p. 129 seq.).

Until the time of Augustus Mars had but two temples at Rome, and both are connected with warlike operations. One of these was originally only an altar; it was in the Campus Martius, the exercising-ground of the army. The other was outside the Porta Capena, the gate through which the army marched on its way to campaigns to the south: here too each year the Equites met in order to start in procession through the city (*Dion. Hal.* 6. 13). Each of these sites was outside the *pomerium*, and this has been explained to mean that the war-god "must be kept at a distance" (Carter, *Religion of Numa*, p. 19). But in the heart of the city there was a *sacrarium* of Mars in the *regia*, originally the king's house, in which the sacred spears of Mars were kept, and the fact that on the outbreak of war the consul had to shake these spears, saying as he did it, *Mars vigila* ("Mars, wake up!"), shows that the god was believed to reside here in some spiritual sense. If the spears moved of themselves, the omen was bad and called for expiation. The *ancilia*, or sacred shields, also formed part of this symbolic armoury of the Roman state: they were carried in procession by the Salii (*q.v.*) or dancing warrior-priests of Mars on several occasions during the month of March up to the 23rd (*tubilustrium*), when the military trumpets (*tubae*) were lustrated: and again in October to the 19th (*armilustrium*), when both the *ancilia* and the arms of the exercitus were purified and put away for the winter. During the four months of the Italian winter the worship of Mars seems at a standstill: we have no trace of it in the calendar or in Roman literature. His activity is all in the warm season, *i.e.* in the season of warfare. It is only at the end of February that we find indications of the coming force of the Mars-cult in the month which bears his name: Quirinus, who was probably the Mars of the community settled on the Quirinal Hill, and had his twelve Salii corresponding to those of the Palatine Mars, held his festival on the 17th of February, and on the 27th was the first festival called Equirria, the second being on the 14th of March. The name indicates horse-racing; horses were bred and used at Rome chiefly for military purposes, and it is possible to see here, as in the Equirria of the 14th of March, which we know was a festival of Mars (W. W. Fowler, *Roman Festivals*, p. 44), an exercise of the war-horses, accompanied with sacrifice to Mars, preparatory to the opening of the season of arms.

There is thus abundant evidence, based on the ancient calendars and the features of the cult, that Mars was all along a deity especially connected with warfare; and it is hardly necessary to add proof of a less convincing kind, *e.g.* that the wolf, his special animal, is a warlike beast, or that Nerio, a female deity who may anciently have been coupled with him, seems to be etymologically "the strong one," or that he is in legend the father of Romulus the warlike king and founder of the Roman army, as compared with Numa, who instituted the Roman law and religion. Enough has been said to show why Mars should have become exclusively a god of war, even if the Roman state in its advance in the conquest of other peoples had not given a continual impulse to this aspect of the cult. In founding his famous temple of Mars Ultor (the avenger of Caesar) in the Forum Augusti, Augustus gave a new turn to this worship, and for a time it seems to have been a rival of that of the Capitoline Jupiter (see Carter, *Religion of Numa*, p. 174 seq.), and late in the period of the empire Mars became the most prominent of the *di militares* worshipped by the Roman legions.

There are however certain features in the Mars cult which make it probable that this god was not entirely warlike in character. He seems, in early times, at least, to have been also associated with agriculture; and this is in harmony with the facts: (1) that the season of arms is also the season of the growth, ripening and harvesting of the crops; (2) that the early Roman community was an agricultural as well as a military one, as is indicated in its religious calendar (Fowler, *Roman Festivals*, p. 334). Thus Mars was invoked in the ancient hymn of the Arval Brothers, whose religious duties had as their object to keep off enemies of all kinds from crops and herds (Henzen, *Acta Fratr. Arv.* p. 26, 1874; Wordsworth, *Fragments and Specimens of Early Latin*, p. 385 seq.); and his association here with the Lares (*q.v.*) proves that he is not regarded as a war-god who could avert the raid of an enemy. Still more striking is the invocation of Mars (with the cult-title Silvanus) in the yearly lustration of his land by the Roman farmer (Cato, *De re rustica*, 141), where it is not a human enemy, but disease, and all unwholesome influences, which the god is besought to avert from the farm and land, plantations and flocks. Three times the procession went round the land, reciting prayers and driving the victims to be sacrificed, viz. ox, sheep and pig (*suovetaurilia*), representing the farmer's most valuable stock. We can hardly doubt that in the state ceremony of the Ambarvalia, *i.e.* the *lustratio* of the ager romanus in its earliest form, the same god was invoked and the same ritual used (Fowler, *op. cit.* p. 124 seq.). Again in the curious ritual of the sacrifice to Mars of the October horse (Oct. 15: Fowler *op. cit.* 241), though the animal was undoubtedly a war-horse, the head was cut off and decked with cakes, as we are told (Paul. Diac. 220) *ob frugum eventum*. Even Quirinus, the form of Mars worshipped in the Quirinal community, is not without an association with agricultural perils, for it was his *flamen* who sacrificed the victims at the Robigalia on the 25th of April, when the spirit of the mildew (robigus) was invoked to spare the corn (Ovid, *Fasti*, 4. 901 seq.).

War and agriculture are thus the two factors of human life and experience which are unquestionably prominent in the cult of Mars, and explain his importance in a community like that of Rome: and there is no need, in a short account of this religious conception, to determine whether he was by origin a solar deity, a storm-god, or a vegetation-spirit. His name gives us no help, its etymology is uncertain (Roscher in *Mythological Lexicon*, *s.v.* "Mars," p. 2436). But we are safe in conjecturing that Mars first came into prominence among the Latins and kindred peoples in the course of their long struggle for settlements among the mountains and forests of Italy. The clearing of primeval woodland, the perils of agriculture from the raids of enemies and of wild beasts, and from the ravages of disease, are all indicated in the later Mars cult. The wolf and the woodpecker, denizens of the forest, always remained his sacred animals, and were believed in Italian legend to have led the Piceni and Hirpini to their places of settlement. Mars is specially associated with the early foundation legends of Italy, as was the case at Rome: and it was to him that the *ver sacrum* was dedicated, *i.e.* the entire produce of a spring, including the children born then, who were eventually driven forth from their homes to form new settlements elsewhere (Roscher in *Lex. Myth.* 2411). The fierce character of the god, gained no doubt in this period of struggle and danger, never entirely left him. Even in the hymn of the Fratres Arvales he is the "fierce Mars" (*fere Mars*), and in the prayer of Cato's farmer, though he has become "Father Mars," he is Silvanus (*q.v.*), the dweller in the woodland which surrounded the agricultural clearing.

See Roscher in *Myth. Lex. s.v.* 2385 seq.; Wissowa, *Religion und Kultus der Römer*, p. 129 seq.; Preller, *Römische Mythologie*, ed. Jordan, i. 332 seq.; Fowler, *Roman Festivals*, p. 33 seq. (W. W. F.*)

MARS, in astronomy, the fourth planet in the order of distance from the sun, and the next outside the earth. To the naked eye it appears as a bright star of a decidedly reddish or lurid tint, which contrasts strongly with the whiteness of Venus and Jupiter. At opposition it is brighter than a first magnitude star, sometimes outshining even Sirius. It is by virtue of its position the most favourably situated of all the planets for observation from the earth. The eccentricity of its orbit, 0·0933, is greater than that of any other major planet except Mercury. The result is that at an opposition near perihelion Mars is markedly nearer to the earth than at an opposition near aphelion, the one distance being about 35 million miles; the other 63 million. These numbers express only the minimum distances at or near opposition, and not the distance at other times. The time of revolution of Mars is 686·98 days. The mean interval between oppositions is 2 years 49½ days, but, owing to the eccentricity of the orbit, the actual excess over two years ranges from 36 days to more than 2½ months. Its period of rotation is 24 h. 37 m. 22·66 s. (H. G. Bakhuyzen).

Motions.—The accompanying diagram will convey a notion of the varied aspects presented by the planet, of the cycles of change through which they go, and of the order in which the oppositions follow each other. The outer circle represents the orbit of Mars, the inner one that of the earth. AE is the line of the equinoxes from which longitudes are counted. The perihelion of Mars is in longitude 335° at the point π. The ascending node ☊ is in longitude 47°. The line of nodes makes an angle of 74° with the major axis, so that Mars is south of the ecliptic near perihelion, but north of it near aphelion. Around the inner circle, representing the earth's orbit, are marked the months during which the earth passes through the different parts of the orbit. It will be seen that the distance of Mars at the time of any opposition depends upon the month in which opposition occurs. The least possible distance would occur in an opposition about the end of August, a little before Mars reached the perihelion, because the eccentricity of the earth's orbit throws our planet a little farther from the sun and nearer the orbit of Mars in July than it does in August. The opposition of 1909 occurred on the 24th of September, at a point marked by the year near the equinox, and the month and years of the oppositions following, up to 1941, are also shown in the same way. Tracing them around, it will be seen that the points of opposition travel around the orbit in about 16 years, so that oppositions near perihelion, when Mars is therefore nearest the earth, occur at intervals of 15 or 17 years.

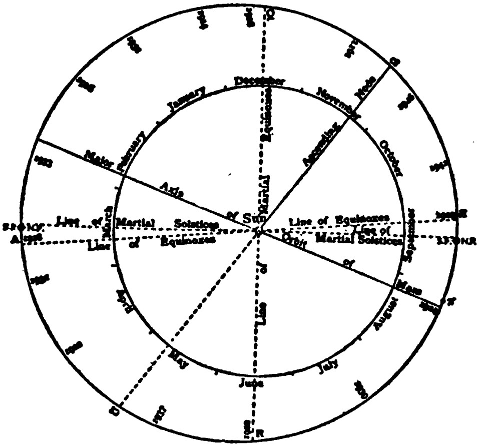

FIG. 1.—Orbits of Mars and the Earth, showing aspects of the planet relative to the earth and sun.

The axis of rotation of the planet is inclined between 23° and 24° to the orbit, and the equator of the planet has the same inclination to the plane of the orbit. The north pole is directed toward a point in longitude 355°, in consequence of which the projection of the planet's axis upon the plane of the ecliptic is nearly parallel to the line of our equinoxes. This projection is shown by the dotted line SP–NP, which corresponds closely to the line of the Martian solstices. It will be seen that at a September opposition the north pole of the planet is turned away from the sun, so that only the southern hemisphere is presented to us, and only the south pole can be seen from the earth. The Martian vernal equinox is near Q and the northern solstice near A. Here at the point S.P. the northern hemisphere is turned toward the sun. It will be seen that the aspect of the planet at opposition, especially the hemisphere which is visible, varies with the month of opposition, the general rule being that the northern hemisphere of the planet is entirely seen only near aphelion oppositions, and therefore when farthest from us, while the southern hemisphere is best seen near perihelion oppositions. The distances of the planet from the sun at aphelion and at perihelion are nearly in the ratio 6 : 5. The intensity of the sun's radiation on the planet is as the inverse square of this ratio. It is therefore more than 40% greater near perihelion than near aphelion. It follows from all this that the southern hemisphere is subjected to a more intense solar heat than the northern, and must therefore have a warmer summer season. But the length of the seasons is the inverse of this, the summer of the northern hemisphere being longer and the heat of the southern hemisphere shorter in proportion.

Surface Features.—The surface features of the planet will be better understood by first considering what is known of its atmosphere and of the temperature which probably prevails on its surface. One method of detecting an atmosphere is through its absorption of the different rays in the spectrum of the sunlight reflected from the planet. Several observers have thought that they saw fairly distinct evidence of such absorption when the planet was examined with the spectroscope. But the observations were not conclusive; and with the view of setting the question at rest if possible, W. W. Campbell at the Lick Observatory instituted a very careful series of spectroscopic observations.[1] To reduce the chances of error to a minimum the spectrum of Mars was compared with that of the moon when the two bodies were near each other. Not the slightest difference could be seen between any of the lines in the two spectra. It being certain that the spectrum of the moon is not affected by absorption, it followed that any absorption produced by the atmosphere of Mars is below the limit of perception. It was considered by Campbell that if the atmosphere of Mars were ¼ that of the earth in density, the absorption would have been visible. Consequently the atmosphere of Mars would be of a density less than ¼ that of the earth.[2]

Closely related to the question of an atmosphere is that of possible clouds above the surface of the planet, the existence of which, if real, would necessarily imply an atmosphere of a density approaching the limit set by Campbell's observations. The most favourable opportunity for seeing clouds would be when they are formed above a region of the planet upon which the sun is about to rise, or from which it has just been setting. The cloud will then be illuminated by the sun's rays while the surface below it is in darkness, and will appear to an observer on the earth as a spot of light outside the terminator, or visible edge of the illuminated part of the disk. It is noticeable that phenomena more or less of this character, though by no means common, have been noted by observers on several occasions. Among these have been the Mt Hamilton and Lowell observers, and W. H. Pickering at Arequipa. Campbell has shown that many of them may be accounted for by supposing the presence of mountains not more than two miles in height, which may well exist on the planet. While this hypothesis will serve to explain several of these appearances, this can scarcely be said of a detached spot observed on the evening of the 26th of May 1903, at the Lowell Observatory.[3] Dr Slipher, who first saw it, was so struck by the appearance of the projection from the terminator upon the dark side of the disk that he called the other observers to witness it. Micrometric measures showed that it was some 300 miles in length, and that its highest point stood some 17 miles above the surface of the planet. That a cloud should be formed at such a height in so rare an atmosphere seems difficult to account for except on the principle that the rate of diminution of the density of an atmosphere with its height is proportional to the intensity of gravity, which is smaller on Mars than on the earth. The colour was not white, but tawny, of the tint exhibited by a cloud of dust. Percival Lowell therefore suggests that this and other appearances of the same kind seen from time to time are probably dust clouds, travelling over the desert, as they sometimes do on the earth, and settling slowly again to the ground.

Temperature.—Up to a recent time all that could be said of the probable temperature of Mars was that, being more distant from the sun than the earth, and having a rarer atmosphere, it had a general mean temperature probably below that of the earth. Greater precision can now be given to this theoretical conclusion by recent determination of the law of radiation of heat by bodies at different temperatures. Regarding it as fairly well established that at ordinary temperatures the radiation varies directly as the fourth power of the absolute temperature, it is possible when the "solar constant" is known to compute the temperature of a non-coloured body at the distance of Mars which presents every part of its surface in rapid succession to the sun's rays in the absence of atmosphere only. This has been elaborately done for the major planets by J. H. Poynting,[4] who computes that the mean temperature of Mars is far below the freezing point of water. On the other hand an investigation made by Lowell in 1907,[5] taking into account the effect of the rare atmosphere on the heat lost by reflection, and of several other factors in the problem hitherto overlooked, led him to the conclusion that the mean temperature is about 48° Fahr.[6] But the temperature may rise much above the mean on those regions of the surface exposed to a nearly vertical noon-day sun. The diurnal changes of temperature, being diminished by an atmosphere, must be greater on Mars than on the earth, so that the vicissitudes of temperature are there very great, but cannot be exactly determined, because they must depend upon the conductivity and thermal capacity of the matter composing the surface of the planet. What we can say with confidence is that, during the Martian winter of between eight and twelve of our months, the regions around either pole must fall to a temperature nearer the absolute zero than any known on this planet. In fact the climatic conditions in all but the equatorial regions are probably of the same nature as those which prevail on the tops of our highest mountains, except that the cold is more intense.[7]

Having these preliminary considerations in mind, we may now study the features presented to our view by the surface of the planet. These have a permanence and invariability which markedly differentiate them from the ever varying surfaces of Jupiter and Saturn, and show that what we see is a solid surface, like that of our earth. They were observed and delineated by the leading astronomers of the 16th century, especially Huygens, Cassini and Hooke. These observers could only distinguish the different regions upon the planet as bright or dark. Reasoning as they did in the case of the moon, it was naturally supposed that the brighter regions were land and the darker ones seas. The observers of our time find that the darker regions have a slightly blue-green aspect, which might suggest the idea of water, but are variegated in a way to show that they must be composed of a solid crust, like the brighter regions. The latter have a decidedly warm red or ochre tint, which gives the characteristic colour to the planet as seen by the naked eye. The regions in equatorial and middle latitudes, which are those best seen from our planet, show a surface of which the general aspect is not dissimilar to that which would be presented by the deserts of our earth when seen from the moon. With each improvement in the telescope the numerous drawings of the planet show more definiteness and certainty in details. About 1830 a fairly good map was made by W. Beer and J. H. Mädler, a work which has been repeated by a number of observers since that time. The volume of literature on the subject, illustrated by drawings and maps, has become so great that it is impossible here to present even an abstract of it; and it would not be practicable, even were it instructive, to enter upon any detailed description of Martian topography. A few great and well-marked features were depicted by the earliest observers, who saw them so plainly that they may be recognized by their drawings at the present time. There is also a general agreement among nearly all observers with good instruments as to the general features of the planet, but even in the latest drawings there is a marked divergence as to the minuter details. This is especially true of the boundaries of the more ill-defined regions, and of the faint and difficult markings of various kinds which are very numerous on every part of the planet. There is not even a close agreement between the drawings by the same observer at different oppositions; but this may be largely due to seasonal and other changes.

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[1] *Astronomy and Astrophysics*, iii. 752, and *Astron. Soc. of the Pacific, Publications*, vi. 273 and ix. 109.

[2] According to Percival Lowell these results were, however, inconclusive because the strong atmospheric lines lie redwards beyond the part of the spectrum then possible to observe. Subsequently, by experimenting with sensitizing dyes, Dr Slipher of the Lowell Observatory succeeded in 1908 in photographing the spectrum far into the red. Comparison spectrograms of Mars and the Moon, taken by him at equal altitudes on such plates, eight in all, show the "a" band, the great band of water-vapour was distinctly stronger in the spectrum of Mars, thus affording what appeared decisive evidence of water vapour in the atmosphere of the planet.

[3] Lowell, *Mars and its Canals*, p. 101.

[4] *Phil. Trans.*, vol. 202 A, p. 525.

[5] *Proc. Amer. Acad. Arts and Sciences*, vol. xliii. No. 25.

[6] Professor F. W. Very concurs with Lowell (*Phil. Mag.*, 1908).

[7] According to Lowell, the climatic conditions are proportionally warm in summer.

The most striking feature, and one which shows the greatest resemblance to a familiar terrestrial process, is that when either polar region comes into view after being turned nearly a year away from the sun, it is found to be covered with a white cap. This gradually contracts in extent as the sun shines upon it during the remaining half of the Martian year, sometimes nearly disappearing. That this change is due to the precipitation of watery vapour in the form of ice, snow or frost during the winter, and its melting or evaporation when exposed to the sun's rays, is so obvious a conclusion that it has never been seriously questioned. It has indeed been suggested that the deposit may be frozen carbonic acid. While we cannot pronounce this out of the question, the probabilities seem in favour of the deposit being due to the precipitation of aqueous vapour in a frozen form. At a temperature of −50° C, which is far above what we can suppose to prevail in the polar regions during the winter, the tension of aqueous vapour is 0·034 mm. On the other hand Faraday found the tension of carbonic acid to be still an entire atmosphere at as low a temperature as −80° C. Numerically exact statements are impossible owing to our want of knowledge of the actual temperature, which must depend partly upon air currents between the equator and the poles of Mars. It can, however, be said, in a general way, that a proportion of aqueous vapour in the rare atmosphere of Mars, far smaller than that which prevails on the earth, would suffice to explain the observed formation and disappearances of the polar caps. Since every improvement in the telescope and in the conditions of observation must enable modern observers to see all that their predecessors did and yet more, we shall confine our statements to the latest results. These may be derived from the work of Professor Lowell of Boston, who in 1894 founded an observatory at Flagstaff, Arizona, 7250 ft. above sea-level, and supplied it with a 24″ telescope, of which the main purpose was the study of Mars. This work has been continued with such care and assiduity that its results must take precedence of all others in everything that relates to our present subject.[1]

Among the more probable conclusions to be drawn from Lowell's observations, the following are of most interest. The darker areas are all seamed by lines and dots darker than themselves, which are permanent in position, so that there can be no bodies of water on the planet. On the other hand, their colour, blue-green, is that of vegetation. This fades out as vegetation would at certain seasons to faint blue-green, but in some places to a tawny brown. Each hemisphere undergoes these changes in its turn, the changes being opposite in opposite hemispheres. The changes in the dark areas follow some time after the melting of the polar caps. The aspect of these areas suggests old sea bottoms, and when on the terminator appear as depressions, though this may be only apparent and due to the dark colour. The smoothness and soft outline of the terminator shows that there are no mountains on Mars comparable with ours, but that the surface is surprisingly flat. White spots are occasionally visible in the tropical and temperate regions, which are perhaps due to the condensation of frost or snow, or to saline exudation such as seasonally occurs in India (Lowell). Moreover in winter the temperate zones are more or less covered by a whitish veil, which may be either hoar frost or cloud. A spring haze seems to surround the north polar cap during its most extensive melting; otherwise the Martian sky is quite clear, like that of a dry desert land. When either polar cap is melting it is bordered by a bluish area, which Lowell attributes to the water produced by the melting. But the obliquity at which the sun's rays strike the surface as the cap is melting away is so great that it would seem to preclude the possibility of a temperature high enough to melt the snow into water. Under the low barometric pressure prevailing on the planet, snow would evaporate under the influence of the sun's rays without changing into water. It is also contended that what looks like such a bluish border may be formed around a bright area by the secondary aberration of a refracting telescope.[2]

The modern studies of Mars which have aroused so much public interest began with the work of Schiaparelli in 1877. Accepting the term "ocean," used by the older observers, to designate the widely extended darker regions on the planet, and holding that they were really bodies of water, he found that they were connected by comparatively narrow streaks. (Schiaparelli considered them really water until after the Lowell observations.) In accordance with the adopted system of nomenclature, he termed these streaks *canale*, a word of which the proper rendering into English would be *channels*. But the word was actually translated into both English and French as *canal*, thus connoting artificiality in the supposed waterways, which were attributed to the inhabitants of the planet. The fact that they were many miles in breadth, and that it was therefore absurd to call them canals, did not prevent this term from being so extensively used that it is now scarcely possible to do away with it. A second series of observations was made by Schiaparelli at the opposition of 1879, when the planet was farther away, but was better situated as to altitude above the horizon. He now found a number of additional channels, which were much finer than those he had previously drawn. The great interest attaching to their seemingly artificial character gave an impetus to telescopic study of the planet which has continued to the present time. New canals were added, especially at the Lowell Observatory, until the entire number listed in 1908 amounted to more than 585. The general character of this complex system of lines is described by Lowell as a network covering the whole face of the planet, light and dark regions alike, and connecting at either end with the respective polar caps there. At their junctions are small dark pinheads of spots. The lines vary in size between themselves, but each maintains its own width throughout. But the more difficult of these objects are only seen occasionally and are variable in definiteness. Of two canals equally well situated for seeing, only one may be visible at one time and only the other at other times. If this variability of aspect among different canals is true as they are seen from the Lowell Observatory, we find it true to a much greater extent when we compare descriptions by different observers. At Flagstaff, the most favourably situated of all the points of observation, they are seen as fine sharp lines, sometimes as well marked as if drawn with a pencil. But other observers see them with varying degrees of breadth and diffuseness.

One remarkable feature of these objects is their occasional

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[1] The great space penetration of the Lowell Observatory is shown in the case of stars. More stars have been mapped there in a given space than at the Lick, and Mr Ritchey of the Yerkes Observatory found stars easily visible there which were only just perceptible at Yerkes.

[2] As against this, Lowell's answer is that the effect is not optical; for the belt surrounds the *melting*, not the *making* cap.

"gemination," some of the canals appearing as if doubled. This was first noticed by Schiaparelli, and has been confirmed, so far as observations can confirm it, by other observers. Different explanations of this phenomenon have been suggested, but the descriptions of it are not sufficiently definite to render any explanation worthy of entire confidence possible. Indeed the more cautious astronomers, who have not specially devoted themselves to the particular phenomena, reserve a doubt as to how far the apparent phenomena of the finer canals are real, and what the markings which give rise to their appearance might prove to be if a better and nearer view of the planet than is now possible could be obtained. Of the reality of the better marked ones there can be no doubt, as they have been seen repeatedly by many observers, including those at the Lick Observatory, and have actually been photographed at the Lowell Observatory. The doubt is therefore confined to the vast network of lines so fine that they never certainly have been seen elsewhere than at Flagstaff. The difficulty of pronouncing upon their reality arises from the fact that we have to do mainly with objects not plainly visible (or, as Lowell contends, not plainly visible elsewhere). The question therefore becomes one of psychological optics rather than of astronomy. When the question is considered from this point of view it is found that combinations of light and shaded areas very different from continuous lines, will, under certain conditions, be interpreted by the eye as such lines; and when such is the case, long practice by an observer, however carefully conducted, may confirm him in this interpretation. To give a single example of the principles involved; it is found by experiment that if, through a long line so fine as to approach the limit of visibility, segments not too near each other, or so short that they would not be visible by themselves, be taken out, their absence from the line will not be noticed, and the latter will still seem continuous.[1] In other words we do not change the aspect of the line by taking away from it a part which by itself would be invisible. This act of the eye, in interpreting a discontinuous series of very faint patches as a continuous line, is not, properly speaking, an optical illusion, but rather a habit. The arguments for the reality of all the phenomena associated with the canals, while cogent, have not sufficed to bring about a general consensus of opinion among critics beyond the limit already mentioned.

Accepting the view that the dark lines on Mars are objectively real and continuous, and are features as definite in reality as they appear in the telescope, Professor Lowell has put forth an explanation of sufficient interest to be mentioned here. His first proposition is that lines frequently thousands of miles long, each following closely a great circle, must be the product of design rather than of natural causes. His explanation is that they indicate the existence of irrigating canals which carry the water produced annually by the melting of the polar snows to every part of the planet. The actual canals are too minute to be visible to us. What we really see as dark lines are broad strips of vegetation, produced by artificial cultivation extending along each border of the irrigating streams. On the other hand, in the view of his critics, the quantity of ice or snow which the sun's rays could melt around the poles of Mars, the rate of flow and evaporation as the water is carried toward the equator, and several other of the conditions involved, require investigation before the theory can be established.[2]

The accompanying illustrations of Mars and its canals are those of Lowell, and represent the planet as seen by the Flagstaff observers.

Satellites and Pole of Mars.—At the opposition of Mars which occurred in August 1877 the planet was unusually near the earth. Asaph Hall, then in charge of the 26" telescope at the Naval Observatory in Washington, took advantage of this favourable circumstance to make a careful search for a visible satellite of the planet. On the night of the 11th of August he found a faint object near the planet. Cloudy weather intervened, and the object was not again seen until the 16th, when it was found to be moving with the planet, leaving no doubt as to its being a satellite. On the night following an inner satellite much nearer the planet was observed. This discovery, apart from its intrinsic

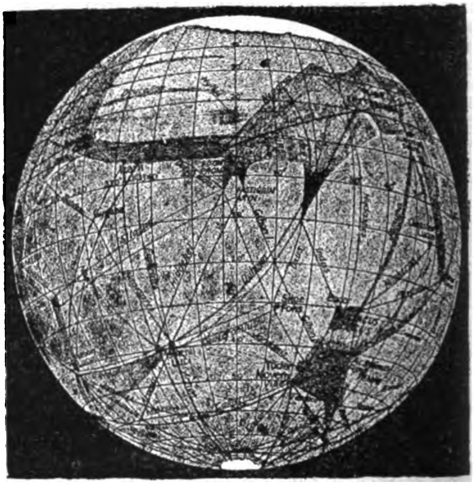

FIG. 2.

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[1] For limits of this theory and Lowell's view of its inapplicability to Mars, see *Astrophys. Jour.*, Sept. 1907.

[2] Prof. Lowell's theory is supported by so much evidence of different kinds that his own exposition should be read *in extenso* in *Mars and its canals* and *Mars as the abode of life*. In order, however, that his views may be adequately presented here, he has kindly supplied the following summary in his own words:—

"Owing to inadequate atmospheric advantages generally, much misapprehension exists as to the definiteness with which the surface of Mars is seen under good conditions. In steady air the canals are perfectly distinct lines, not unlike the Fraunhofer ones of the Spectrum, pencil lines or gossamer filaments according to size. All the observers at Flagstaff concur in this. The photographs of them taken there also confirm it up to the limit of their ability. Careful experiments by the same observers on artificial lines show that if the canals had breaks amounting to 16 m. across, such breaks would be visible. None are; while the lines themselves are thousands of miles long and perfectly straight (*Astrophys. Journ.*, Sept. 1907). Between expert observers representing the planet at the same epoch the accordance is striking; differences in drawings are differences of time and are due to seasonal and secular changes in the planet itself. These seasonal changes have been carefully followed at Flagstaff, and the law governing them detected. They are found to depend upon the melting of the polar caps. After the melting is under way the canals next the cap proceed to darken, and the darkening thence progresses regularly down the latitudes. Twice this happens every Martian year, first from one cap and then six Martian months later from the other. The action reminds one of the quickening of the Nile valley after the melting of the snows in Abyssinia; only with planet-wide rhythm. Some of the canals are paired. The phenomenon is peculiar to certain canals, for only about one-tenth of the whole number, 56 out of 585, ever show double and these do so regularly. Each double has its special width; this width between the pair being 400 m. in some cases, only 75 in others. Careful plotting has disclosed the fact that the doubles cluster round the planet's equator, rarely pass 40° Lat., and never occur at the poles, though the planet's axial tilt reveals all its latitudes to us in turn. They are thus features of those latitudes where the surface is greatest compared with the area of the polar cap, which is suggestive. Space precludes mention of many other equally striking peculiarities of the canals' positioning and development. At the junctions of the canals are small, dark round spots, which also wax and wane with the seasons. These facts and a host of others of like significance have led Lowell to the conclusion that the whole canal system is of artificial origin, first because of each appearance and secondly because of the laws governing its development. Every opposition has added to the assurance that the canals are artificial; both by disclosing their peculiarities better and better and by removing generic doubts as to the planet's habitability. The warmer temperature disclosed from Lowell's investigation on the subject, and the spectrographic detection by Slipher of water-vapour in the Martian air, are among the latest of these confirmations."—[ED.]

interest, is also noteworthy as the first of a series of discoveries of satellites of the outer planets. The satellites of Mars are difficult to observe, on account not merely of their faintness, but of their proximity to the planet, the light of which is so bright as to nearly blot out that of the satellite. Intrinsically the inner satellite is brighter than the outer one, but for the reason just mentioned it is more difficult to observe. The names given them by Hall were Deimos for the outer satellite and Phobos for the inner one, derived from the mythological horses that drew the chariot of the god Mars. A remarkable feature of the orbit of Phobos is that it is so near the planet as to perform a revolution in less than one-third that of the diurnal rotation of Mars. The result is that to an inhabitant of Mars this satellite would rise in the west and set in the east, making two apparent diurnal revolutions every day. The period of Deimos is only six days greater than that of a Martian day; consequently its apparent motion around the planet would be so slow that more than two days elapse between rising and setting, and again between setting and rising.

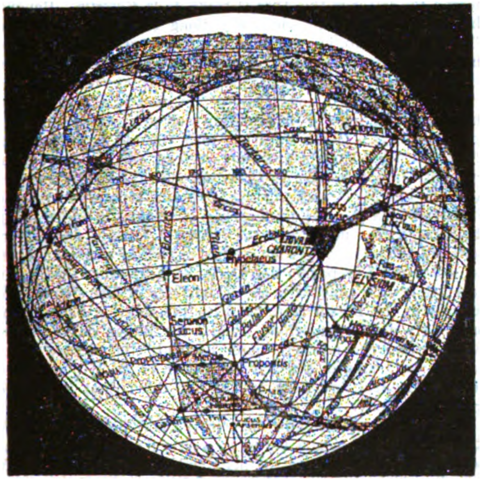

FIG. 3.

Owing to the minuteness of these bodies it is impossible to make any measures of their diameters. These can be inferred only from their brightness. Assuming them to be of the same colour as Mars, Lowell estimates them to be about ten miles for Deimos and somewhat more for Phobos. But these estimates are uncertain, not only from the somewhat hypothetical character of the data on which they rest, but from the difficulty of accurately estimating the brightness of such an object in the glare of the planet.

A long and careful series of observations was made upon these bodies by other observers. Later, especially at the very favourable oppositions of 1892 and 1894, observations were made by Hermann Struve at Poulkova, who subjected all the observations up to 1898 to a very careful discussion. He showed that the inclination of the planes of the orbits to the equator of the planet is quite small, thus making it certain that these two planes can never wander far from each other. In the following statement of the numerical elements of the entire system, Struve's results are given for the satellites, while those of Lowell are adopted for the position of the plane of the equator.

The relations of the several planes can be best conceived by considering the points at which lines perpendicular to them, or their poles, meet the celestial sphere. By theory, the pole of the orbital plane of each satellite revolves round the pole of a certain fixed plane, differing less from the plane of the equator of Mars the nearer the satellite is to Mars. Lowell from a combination of his own observations with those of Schiaparelli, Lohse and Cerulli, found for the pole of the axis of rotation of Mars[1]:—

R.A. = 317·5°; Dec. = + 54·5°; Epoch, 1905.

Tilt[2] of Martian Equator to Martian ecliptic, 23°. 59′. Hermann Struve, from the observations of the satellites, found theoretically the following positions of this pole, and of those of the fixed planes of the satellite orbits for 1900:—

	R.A.	Dec.
Pole of Mars: R.A.	=317·25°	Dec. = 52·63°
Pole of fixed plane for Phobos	=317·24°	= 52·64°
Pole of fixed plane for Deimos	=316·20°	= 53·37°

Lowell's position of the pole is that now adopted by the British Nautical Almanac.

The actual positions of the poles of the satellite—orbits revolve around these poles of the two fixed planes in circles. Putting N for the right-ascensions of their nodes on the plane of the terrestrial equator, and J for their angular distance from the north terrestrial pole, N, and J, for the corresponding poles of the fixed planes, and *t* for the time in years after 1900, Struve's results are:—

Deimos.

$$N_1 = 46^\circ . 12' \; 0{\cdot}463' \, t; \; J = 36^\circ . 42' - 0{\cdot}24' \, t$$
$$(N - N_1) \sin J = 97{\cdot}6' \sin (356{\cdot}8^\circ - 6{\cdot}375^\circ \, t)$$
$$J - J_1 = 97{\cdot}6 \cos (356{\cdot}8^\circ - 6{\cdot}375^\circ \, t)$$

Phobos.

$$N_1 = 47^\circ \; 14{\cdot}3' + 0{\cdot}46' \, t; \; J_1 = 37^\circ \; 21{\cdot}9' . - 0{\cdot}24' \, t$$
$$(N - N_1) \sin J = 53{\cdot}1' \sin (257^\circ{\cdot}1' - 158{\cdot}0^\circ \, t)$$
$$J - J_1 = 53{\cdot}1 \cos (257^\circ 1' - 158{\cdot}0 \, t)$$

The other elements are:—

	Deimos.	Phobos.
Mean long. 1894, Oct. 0.0. G.M.T	186·25°	296·13°
Mean daily motion (tropical)	285·16198°	1128·84396°
Mean distance ($\Delta = 1$)	32·373″	12·938″
Long. of pericentre, ($\pi + N$)	$264^\circ + 6{\cdot}375^\circ \, t$	$14^\circ + 158{\cdot}0^\circ \, t$
Eccentricity of orbit	0·0031	0·0217
Epoch for *t*	1900·0	1900·0

BIBLIOGRAPHY.—Flammarion, *La Planète Mars et ses conditions d'habitilité* (Paris, 1892), embodies so copious a *résumé* of all the publications and drawings relating to Mars up to 1891 that there is little occasion for reference in detail to early publications. Among the principal sources may be mentioned the *Monthly Notices* and *Memoirs* of the Royal Astronomical Society, the publications of the Astronomical Society of the Pacific, especially vols. vi., viii. and ix., containing observations and discussions by the Mt Hamilton astronomers, and the journals, *Sidereal Messenger*, *Astronomy* and *Astrophysics* and *Astrophysical Journal*. Schiaparelli's extended memoirs appeared under the general title *Osservazioni astronomiche e fisiche sull' asse di rotazione e sulla topografia del pianeta Marte*, and were published in different volumes of the *Memoirs* of the *Reale Accademia dei Lincei* of Rome. The observations and drawings of Lowell are found *in extenso* in *Annals* of the Lowell Observatory. Lowell's conclusions are summarized in *Mars and its Canals*, by Percival Lowell (1906), and *Mars as the Abode of Life* (1909). In connexion with his work may be mentioned *Mars and its Mystery*, by Edward S. Morse (Boston, 1906), the work of a naturalist who made studies of the planet at the Lowell Observatory in 1905. Brief discussions and notices will also be found in the Lowell Observatory *Bulletins*. The optical principles involved in the interpretations of the canals are discussed in recent volumes of the *Monthly Notices, R.A.S.*, and in the *Astrophysical Journal*. In 1907 the veteran A. R. Wallace disputed Lowell's views vigorously in his *Is Mars Habitable?* and was briefly answered by Lowell in *Nature*, who contended that Wallace's theory was not in accord with celestial mechanics. (S. N.)

MARSALA, a seaport of Sicily, in the province of Trapani, 19 m. by rail S. of Trapani. Pop. (1881), 19,732; (1901), 57,567. The low coast on which it is situated is the westernmost point of the island. The town is the seat of a bishop, and the cathedral contains 16 grey marble columns, which are said to have been intended for Canterbury Cathedral in England, the vessel conveying them having been wrecked here. The town owes its importance mainly to the trade in Marsala wine.

Marsala occupies the site of *Lilybaeum*, the principal stronghold of the Carthaginians in Sicily, founded by Himilco after the abandonment of *Motya*. Neither Pyrrhus nor the Romans were able to reduce it by siege, but it was surrendered to the latter in 241 B.C. at the end of the First Punic War. In the later wars it was a starting point for the Roman expeditions against Carthage;

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[1] *Bulletin Lowell Obsy., Monthly Notices, R.A.S.* (1905), 66, p. 51.

[2] *St Petersburg Memoirs*, series viii., Phys. Mars-classe, vol. viii.

and under Roman rule it enjoyed considerable prosperity (*C.I.L.* x. p. 742). It obtained municipal rights from Augustus and became a colony under Pertinax or Septimus Severus. The Saracens gave it its present name, *Marsa Ali*, port of Ali. The harbour, which lay on the north-east, was destroyed by Charles V. to prevent its occupation by pirates. The modern harbour lies to the south-east. In 1860 Garibaldi landed at Marsala with 1000 men and began his campaign in Sicily. Scanty remains of the ancient *Lilybaeum* (fragments of the city walls, of squared stones, and some foundations of buildings between the walls and the sea) are visible; and the so-called grotto and spring of the Sibyl may be mentioned. To the east of the town is a great fosse which defended it on the land side, and beyond this again are quarries like those of Syracuse on a small scale. The modern town takes the shape of the Roman camp within the earlier city, one of the gates of which still existed in 1887. The main street (the Cassaro) perpetuates the name *castrum*.

MARSDEN, WILLIAM (1754–1836), English orientalist, the son of a Dublin merchant, was born at Verval, Co. Wicklow on the 16th of November 1754. He was educated in Dublin, and having obtained an appointment in the civil service of the East India Company arrived at Benkulen, Sumatra, in 1771. There he soon rose to the office of principal secretary to the government, and acquired a knowledge of the Malay language and country. Returning to England in 1779 with a pension, he wrote his *History of Sumatra*, published in 1783. Marsden was appointed in 1795 second secretary and afterwards first secretary to the admiralty. In 1807 he retired and published in 1812 his *Grammar and Dictionary of the Malay Language*, and in 1818 his translation of the *Travels of Marco Polo*. He was a member of many learned societies, and treasurer and vice-president of the Royal Society. In 1834 he presented his collection of oriental coins to the British Museum, and his library of books and Oriental MSS. to King's College, London. He died on the 6th of October 1836.

Marsden's other works are: *Numismata orientalia* (London, 1823–1825); *Catalogue of Dictionaries, Vocabularies, Grammars and Alphabets* (1796); and several papers on Eastern topics in the *Philosophical Transactions* and the *Archaeologia*.

MARSEILLES, a city of southern France, chief seaport of France and of the Mediterranean, 219 m. S. by E. of Lyons and 534 m. S.S.E. of Paris, by the Paris-Lyon-Méditerranée railway. Pop. (1906), commune 517,498; town 421,116. Marseilles is situated on the Golfe du Lion on the eastern shore of a bay protected to the south by Cape Croisette but open towards the west; to the east the horizon is bounded by an amphitheatre of hills, those in the foreground clothed with vegetation while the more distant eminences are bare and rugged. The city is built on undulating ground and the south-western and most aristocratic quarter covers the slopes of the ridge crowned by a fort and the church of Notre-Dame de la Garde and projecting westward into the bay to form a protection for the harbour. The newest and most pleasant portion lies on the south-eastern slope of the ridge, between the southern end of the Rue Paradis and the Prado avenues, which is better protected than most other quarters from the mistral that blows down the Rhone valley, and where in summer the temperature is always a little lower than in the centre of the town. The old harbour of Marseilles opens on the west to the Golfe du Lion, the famous Rue Cannebière[1] prolonged by the Rue Noailles leading E.N.E. from its inner end. These two streets are the centre of the life of the city. Continued in the Allées de Meilhan and the Boulevard de la Madeleine, they form one of its main arteries. The other, at right angles with the first, connects the Place d'Aix with the spacious and fashionable Promenade du Prado, by way of the Cours Belsunce and the Rue de Rome. Other fine streets—the Rue St Ferréol, the Rue Paradis and the Rue Breteuil are to the south of the Cannebière running parallel with the Rue de Rome. To these must be added the neighbouring avenue of Pierre Puget named after the sculptor whose statue stands in the Borély Park. The Prado, with its avenues of trees and fine houses, runs to within a quarter of a mile of the Huveaune, a stream that borders the city on the south-east, then turns off at right angles and extends to the sea, coming to an end close to the Borély Park and the race-course. From its extremity the Chemin de la Corniche runs northwards along the coast, fringed by villas and bathing establishments, to the Anse des Catalans, a distance of 4½ miles.

The old town of Marseilles is bounded W. by the Joliette basin and the sea, E. by the Cours Belsunce, S. by the northern quay of the old port, and N. by the Boulevard des Dames. It consists of a labyrinth of steep, dark and narrow streets inhabited by a seafaring population. Through its centre runs the broad Rue de la République, extending from the Cannebière to the Place de la Joliette. The entrance to the old harbour is defended by Fort St Jean on the north and Fort St Nicolas on the south. Behind the latter is the Anse (Creek) de la Réserve. Beyond this again, situated in succession along the shore, come the Château du Pharo, given by the empress Eugénie to the town, the Anse du Pharo, the military exercising ground, and the Anse des Catalans. To the old harbour, which covers only 70 acres with a mean depth of 19½ ft. and is now used by sailing vessels, the basin of La Joliette (55 acres) with an entrance harbour was added in 1853. Communicating with the old harbour by a channel which passes behind Fort St Jean, this dock opens on the south into the outer harbour, opposite the palace and the Anse du Pharo. A series of similar basins separated from the roadstead by a jetty 2½ m. long was subsequently added along the shore to the north, viz. the basins of Lazaret and Arenc, bordered by the harbour railway station and the extensive warehouses of the Compagnie des Docks et Entrepôts, the Bassin de la Gare Maritime with the warehouses of the chamber of commerce; the Bassin National with the refitting basin, comprising six dry docks behind it; and the Bassin de la Pinède entered from the northern outer harbour. These new docks have a water area of 414 acres and over 11 m. of quays, and are commodious and deep enough for the largest vessels to manœuvre easily.

In the roads to the south-west of the port lie the islands of Ratonneau and Pomègue, united by a jetty forming a quarantine port. Between them and the mainland is the islet of Château d'If, in which the scene of part of Dumas' *Monte Cristo* is laid.

Marseilles possesses few remains of either the Greek or Roman periods of occupation, and is poor in medieval buildings. The old cathedral of la Major (Sainte-Marie-Majeure), dating chiefly from the 12th century and built on the ruins of a temple of Diana, is in bad preservation. The chapel of St Lazare (late 15th century) in the left aisle is in the earliest Renaissance style, and a bas-relief of white porcelain by Lucca della Robbia is of artistic value. Beside this church and alongside the Joliette basin is a modern building begun in 1852, opened for worship in 1893 and recognized as the finest modern cathedral in France. It is a Byzantine basilica, in the form of a Latin cross, 460 ft. long built in green Florentine stone blended with white stone from the neighbourhood of Arles. The four towers which surmount it—two at the west front, one over the crossing, one at the east end—are roofed with cupolas. Near the cathedral stands the bishop's palace, and the Place de la Major, which they overlook, is embellished with the statue of Bishop Belsunce, who displayed great devotion during the plague of 1720–1721. The celebrated Notre-Dame de la Garde, the steeple of which, surmounted by a gilded statue of the Virgin, 30 ft. in height, rises 150 ft. above the summit of the hill on which it stands, commands a view of the whole port and town, as well as of the surrounding mountains and the neighbouring sea. The present chapel is modern and occupies the site of one built in 1214.

On the south side of the old harbour near the Fort St Nicolas stands the church of St Victor, built in the 13th century and once attached to an abbey founded early in the 4th century. With its lofty crenellated walls and square towers built of large blocks of uncemented stone, it resembles a fortress. St Victor is built above crypts dating mainly from the 11th century but also embodying architecture of the Carolingian period and of the early centuries of the Christian era. Tradition relates that St Lazarus inhabited the catacombs under St Victor; and the black image of the Virgin, still preserved there, is popularly attributed to St Luke. The spire, which is the only relic of the ancient church of Accoules, marks the centre of Old Marseilles. At its foot are a "calvary" and a curious underground chapel in rock work, both modern. Notre-Dame du Mont Carmel, also in the old town, occupies the place of what was the citadel of the Massaliots when they were besieged by Julius Caesar.

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[1] From the Latin *cannabis*, Provençal *cannèbe*, "hemp," in allusion to the rope-walks formerly occupying its site.

Of the civil buildings of the city, the prefecture, one of the finest in France, the Palais de Justice, in front of which is the statue of the advocate Antoine Berryer (1790–1868) and the Exchange, all date from the latter half of the 19th century. The Exchange, built at the expense of the Chamber of Commerce, includes the spacious hall of that institution with its fine mural paintings and gilding. The hôtel-de-ville (17th century) stands on the northern quay of the old harbour. All these buildings are surpassed by the Palais Longchamp (1862–1870), situated in the north-east of the town at the end of the Boulevard Longchamp. The centre of the building is occupied by a monumental *château d'eau* (reservoir). Colonnades branch off from this, uniting it on the left to the picture gallery, with a fine collection of ancient and modern works, and on the right to the natural history museum, remarkable for its conchological department and collection of ammonites. In front are ornamental grounds; behind are extensive zoological gardens, with the astronomical observatory. The museum of antiquities is established in the Château Borély (1766–1778) in a fine park at the end of the Prado. It includes a Phoenician collection (containing the remains that support the hypothesis of the Phoenician origin of Marseilles), an Egyptian collection, numerous Greek, Latin, and Christian inscriptions in stone, &c. A special building within the city contains the school of art with a valuable library and a collection of medals and coins annexed to it. The city also has a colonial museum and a laboratory of marine zoology. The triumphal arch of Aix, originally dedicated to the victors of the Trocadéro, was in 1830 appropriated to the conquests of the empire.

The canal de Marseille, constructed from 1837 to 1848, which has metamorphosed the town and its arid surroundings by bringing to them the waters of the Durance, leaves the river opposite Pertuis. It has a length of 97 miles (including its four main branches) of which 13 are underground, and irrigates some 7500 acres. After crossing the valley of the Arc, between Aix and Rognac, by the magnificent aqueduct of Roquefavour, it purifies its waters, charged with ooze, in the basins of Réaltort. It draws about 2200 gallons of water per second from the Durance, supplies 2450 horse-power to works in the vicinity of Marseilles, and ensures a good water-supply and efficient sanitation to the city.

Marseilles is the headquarters of the XV. army corps and the seat of a bishop and a prefect. It has tribunals of first instance and of commerce, a chamber of commerce, a board of trade arbitration, and a branch of the Bank of France. The educational institutions include a faculty of science, a school of medicine and pharmacy, and a faculty (*faculté libre*) of law, these three forming part of the university of Aix-Marseille; lycées for boys and girls, a conservatoire of music, a school of fine art, a higher school of commerce, a school for ships' boys, a school of navigation and industrial schools for both sexes.

Trade and Industry.—Marseilles is the western emporium for the Levant trade and the French gate of the Far East. It suffers, however, from the competition of Genoa, which is linked with the Rhine basin by the Simplon and St Gotthard railway routes, and from lack of communication with the inland waterways of France. In January 1902 the chamber of deputies voted £3,656,000 for the construction of a canal from Marseilles to the Rhone at Arles. This scheme was designed to overcome the difficulties of egress from the Rhone and to make the city the natural outlet of the rich Rhone basin. Much of the activity of the port is due to the demand for raw material created by the industries of Marseilles itself. The imports include raw silk, sesame, ground-nuts and other oil-producing fruits and seeds largely used in the soap manufacture, cereals and flour, wool, hides and skins, olive and other oils, raw cotton, sheep and other livestock, woven goods, table fruit, wine, potatoes and dry vegetables, lead, cocoon silk, coffee, coal, timber. The total value of imports was £64,189,000 in 1907, an increase of £18,000,000 in the preceding decade. The exports, of which the total value was £52,901,000 (an increase of £21,000,000 in the decade) included cotton fabrics, silk fabrics, cereals and flour, hides and skins, wool fabrics, worked skins, olive and other oils, chemical products, wine, refined sugar, raw cotton, wool, coal, building-material, machinery and pottery.

The port is the centre for numerous lines of steamers, of which the chief are the Messageries Maritimes, which ply to the eastern Mediterranean, the east coast of Africa, Australia, India, Indo-China, Havre and London, and the Compagnie Générale Transatlantique, whose vessels run to Algiers, Tunis, Malta, Corsica, Morocco and the Antilles. In addition many important foreign lines call at the port, among them being the P. and O., the Orient, the North German Lloyd, and the German East Africa lines.

Marseilles has five chief railway stations, two of which serve the new harbours, while one is alongside the old port; the city is on the main line of the Paris-Lyon-Méditerranée railway from the Riviera and Toulon to Paris via Arles, Avignon and Lyons, another less important line connecting it with Aix.

Soap-making, introduced in antiquity from Savona and Genoa, is carried on in upwards of fifty factories. These utilize the products of the oil-distilleries and of the chemical works, the latter being also an important adjunct to the manufacture of candles, another leading industry. A large quantity of iron, copper and other ores is smelted in the blast-furnaces of Saint Louis in the vicinity and in other foundries, and the Mediterranean Engineering Company and other companies have large workshops for the construction or repair of marine steam-engines and every branch of iron ship-building. To these industries must be added flour-milling, the manufacture of semolina and other farinaceous foods and of biscuits, bricks and tiles, rope, casks, capsules for bottles and other tin-goods, tanning, distilling, brewing and sulphur- and sugar-refining. There are state tobacco and match factories.

History.—The Greek colony of Massalia (Lat. *Massilia*) was founded by the mariners of Phocaea in Asia Minor, about 600 B.C. The settlement of the Greeks in waters which the Carthaginians reserved for their own commerce was not effected without a naval conflict; it is not improbable that the Phoenicians were settled at Marseilles before the Greek period, and that the name of the town is the Phoenician for "settlement." Whether the judges (*sophetim*, "suffetes") of the Phoenician sacrificial tablet of Marseilles were the rulers of a city existing before the advent of the Phocaeans, or were consuls for Punic residents in the Greek period, is disputed. In 542 B.C. the fall of the Phocaean cities before the Persians probably sent new settlers to the Ligurian coast and cut off the remote city of Massalia from close connexion with the mother country. Isolated amid alien populations, the Massaliots made their way by prudence in dealing with the inland tribes, by vigilant administration of their oligarchical government, and by frugality united to remarkable commercial and naval enterprise. Their colonies spread east and west along the coast from Monaco to Cape St Martin in Spain, carrying with them the worship of Artemis; the inland trade, in which wine was an important element, can be traced by finds of Massalian coins across Gaul and through the Alps as far as Tirol. In the 4th century B.C. the Massaliot Pytheas visited the coasts of Gaul, Britain and Germany, and Euthymenes is said to have sailed down the west coast of Africa as far as Senegal. The great rival of Massalian trade was Carthage, and in the Punic Wars the city took the side of Rome, and was rewarded by Roman assistance in the subjugation of the native tribes of Liguria. In the war between Caesar and Pompey Massilia took Pompey's side and in A.D. 49 offered a vain resistance to Caesar's lieutenant Trebonius. In memory of its ancient services the city, "without which," as Cicero says, "Rome had never triumphed over the Transalpine nations," was left as a *civitas libera*, but her power was broken and most of her dependencies taken from her. From this time Massilia has little place in Roman history; it became for a time an important school of letters and medicine, but its commercial and intellectual importance declined. The town appears to have been christianized before the end of the 3rd century, and at the beginning of the 4th century was the scene of the martyrdom of St Victor. Its reputation partly revived through the names of Gennadius and Cassian, which give it prominence in the history of Semi-Pelagianism and the foundation of western monachism.

After the ravages of successive invaders, Marseilles was repeopled in the 10th century under the protection of its viscounts. The town gradually bought up their rights, and at the beginning of the 13th century was formed into a republic, governed by a *podestat*, who was appointed for life, and exercised his office in conjunction with 3 notables, and a municipal council, composed of 80 citizens, 3 clerics, and 6 principal tradesmen. During the rest of the middle ages, however, the higher town was governed by the bishop, and had its harbour at the creek of La Joliette which at that period ran inland to the north of the old town. The southern suburb was governed by the abbot of St Victor, and owned the Port des Catalans. Situated between the two, the lower town, the republic, retained the old harbour, and was the most powerful of the three divisions. The period of the crusades brought prosperity to Marseilles, though throughout the middle ages it suffered from the competition of Pisa, Genoa and Venice. In 1245 and 1256 Charles of Anjou, count of Provence, whose predecessors had left the citizens a large measure of independence, established his authority above that of the republic. In 1423 Alphonso V. of Aragon sacked the town. King René, who had made it his winter residence, however, caused trade, arts and manufactures again to flourish. On the embodiment of Provence in the kingdom of France in 1481, Marseilles preserved a separate administration directed by royal officials. Under Francis I. the disaffected constable Charles de Bourbon vainly besieged the town with the imperial forces in 1524. During the wars of religion, Marseilles took part against the Protestants, and long refused to acknowledge Henry IV. The loss of the ancient liberties of the town brought new disturbances under the Fronde, which Louis XIV. came in person to suppress. He entered the town by a breach in the walls and afterwards had Fort St Nicolas constructed. Marseilles repeatedly suffered from the plague, notably from May 1720 to May 1721.

During the Revolution the people rose against the aristocracy, who up to that time had governed the commune. In the Terror they rebelled against the Convention, but were promptly subdued by General Carteaux. The wars of the empire, by dealing a blow to their maritime commerce, excited the hatred of the inhabitants against Napoleon, and they hailed the return of the Bourbons and the defeat of Waterloo. The news of the latter provoked a bloody reaction in the town against those suspected of imperialism. The prosperity of the city received a considerable impulse from the conquest of Algeria and from the opening of the Suez Canal.

See P. Castanier, *Histoire de la Provence dans l'antiquité*, vol. ii. (Paris, 1896); E. Caman, *Marseille au XX^{me} siècle* (Paris, 1905); P. Joanne, *Marseille et ses environs.*

MARSH, ADAM (ADAM DE MARISCO) (d. *c.* 1258), English Franciscan, scholar and theologian, was born about 1200 in the diocese of Bath, and educated at Oxford under the famous Grosseteste. Before 1226 Adam received the benefice of Wearmouth from his uncle, Richard Marsh, bishop of Durham; but between that year and 1230 he entered the Franciscan order. About 1238 he became the lecturer of the Franciscan house at Oxford, and within a few years was regarded by the English province of that order as an intellectual and spiritual leader. Roger Bacon, his pupil, speaks highly of his attainments in theology and mathematics. His fame, however, rests upon the influence which he exercised over the statesmen of his day. Consulted as a friend by Grosseteste, as a spiritual director by Simon de Montfort, the countess of Leicester and the queen, as an expert lawyer and theologian by the primate, Boniface of Savoy, he did much to guide the policy both of the opposition and of the court party in all matters affecting the interests of the Church. He shrank from office, and never became provincial minister of the English Franciscans, though constantly charged with responsible commissions. Henry III. and Archbishop Boniface unsuccessfully endeavoured to secure for him the see of Ely in 1256. In 1257 Adam's health was failing, and he appears to have died in the following year. To judge from his correspondence he took no interest in secular politics. He sympathized with Montfort as with a friend of the Church and an unjustly treated man; but on the eve of the baronial revolution he was on friendly terms with the king. Faithful to the traditions of his order, he made it his ambition to be a mediator. He rebuked both parties in the state for their shortcomings, but he did not break with either.

See his correspondence, with J. S. Brewer's introduction, in *Monumenta franciscana*, vol. i. (Rolls ser., 1858); the biographical notice in A. G. Little's *Grey Friars in Oxford* (Oxford, 1892), where all the references are collected. On Marsh's relations with Grosseteste, see *Roberti Grosseteste epistolae*, ed. H. R. Luard (Rolls ed., 1861), and F. S. Stevenson, *Robert Grosseteste* (London, 1809).

(H. W. C. D.)

MARSH, GEORGE PERKINS (1801–1882), American diplomatist and philologist, was born at Woodstock, Vermont, on the 15th of March 1801. He graduated at Dartmouth College in 1820, was admitted to the bar in 1825, and practised law at Burlington, Vermont, devoting himself also with ardour to philological studies. In 1835 he was a member of the Supreme Executive Council of Vermont, and from 1843 to 1849 a Whig representative in Congress. In 1849 he was appointed United States minister resident in Turkey, and in 1852–1853 discharged a mission to Greece in connexion with the imprisonment by the authorities of that country of an American missionary, Dr Jonas King (1792–1869). He returned to Vermont in 1854, and in 1857 was a member of the state railway commission. In 1861 he became the first United States minister to the kingdom of Italy, and died in that office at Vallombrosa on the 23rd of July 1882. He was buried in a Protestant cemetery in Rome. Marsh was an able linguist, writing and speaking with ease the Scandinavian and half a dozen other European languages, a remarkable philologist for his day, and a scholar of great breadth, knowing much of military science, engraving and physics, as well as of Icelandic, which was his specialty. He wrote many articles for Johnson's *Universal Cyclopaedia*, and contributed many reviews and letters to the *Nation*. His chief published works are: *A Compendious Grammar of the Old Northern or Icelandic Language* (1838), compiled and translated from the grammars of Rask; *The Camel, his Organization, Habits, and Uses, with Reference to his Introduction into the United States* (1856); *Lectures on the English Language* (1860); *The Origin and History of the English Language* (1862; revised ed., 1885); and *Man and Nature* (1865). The last-named work was translated into Italian in 1872, and, largely rewritten, was issued in 1874 under the title *The Earth as Modified by Human Action*; a revised edition was published in 1885. He also published a work on *Mediaeval and Modern Saints and Miracles* (1876). His valuable library was presented in 1883 by Frederick Billings to the university of Vermont. His second wife, CAROLINE (CRANE) MARSH (1816–1901), whom he married in 1839, published *Wolfe of the Knoll and other Poems* (1860), and the *Life and Letters of George Perkins Marsh* (New York, 1888). This last work was left incomplete, the second volume never having been published. She also translated from the German of Johann C. Biernatzki (1795–1840), *The Hallig; or the Sheepfold in the Waters* (1856).

MARSH, HERBERT (1757–1839), English divine, was born at Faversham, Kent, on the 10th of December 1757, and was educated at St John's College, Cambridge, where he was elected fellow in 1782, having been second wrangler and second Smith's prizeman. For some years he studied at Leipzig, and between 1793 and 1801 published in four volumes a translation of J. D. Michaelis's *Introduction to the New Testament*, with notes of his own, in which he may be said to have introduced German methods of research into English biblical scholarship. His *History of the Politics of Great Britain and France* (1799) brought him much notice and a pension from William Pitt. In 1807 he was appointed Lady Margaret professor of divinity at Cambridge, and lectured to large audiences on biblical criticism, substituting English for the traditional Latin. Both here, and afterwards as bishop of Llandaff (1816) and of Peterborough (1819), he stoutly opposed hymn-singing, Calvinism, Roman Catholicism, and the Evangelical movement as represented by Charles Simeon and the Bible Society. Among his writings are *Lectures on the Criticism and Interpretation of the Bible* (1828), *A Comparative View of the Churches of England and Rome* (1814), and *Horae Pelasgicae* (1815). He died at Peterborough on the 1st of May 1839.

MARSH, NARCISSUS (1638–1713), archbishop of Dublin and Armagh, was born at Hannington, Wiltshire, and educated at Oxford. He became a fellow of Exeter College, Oxford, in 1658. In 1662 he was ordained, and presented to the living of Swindon, which he resigned in the following year. After acting as chaplain to Seth Ward, bishop of Exeter and Salisbury, and Lord Chancellor Clarendon, he was elected principal of St Alban Hall, Oxford, in 1673. In 1679 he was appointed provost of Trinity College, Dublin, where he did much to encourage the study of the Irish language. He helped to found the Royal Dublin Society, and contributed to it a paper entitled "Introductory Essay to the Doctrine of Sounds" (printed in *Philosophical Transactions*, No. 156, Oxford, 1684). In 1683 he was consecrated bishop of Ferns and Leighlin, but after the accession of James II. he was compelled by the turbulent soldiery to flee to England (1689), where he became vicar of Gresford, Flint, and canon of St Asaph. Returning to Ireland in 1691 after the battle of the Boyne, he was made archbishop of Cashel, and three years later he became archbishop of Dublin. About this time he founded the Marsh Library in Dublin. He became archbishop of Armagh in 1703. Between 1699 and 1711 he was six times a lord justice of Ireland. He died on the 2nd of November 1713.

MARSH, OTHNIEL CHARLES (1831–1899), American palaeontologist, was born in Lockport, New York, on the 29th of October 1831. He graduated at Yale College in 1860, and studied geology and mineralogy in the Sheffield scientific school, New Haven, and afterwards palaeontology and anatomy in Berlin, Heidelberg and Breslau. Returning to America in 1866 he was appointed professor of vertebrate palaeontology at Yale College, and there began the researches of the fossil vertebrata of the western states, whereby he established his reputation. He was aided by a private fortune from his uncle, George Peabody, whom he induced to establish the Peabody Museum of Natural History (especially devoted to zoology, geology and mineralogy) in the college. In May 1871 he discovered the first pterodactyl remains found in America, and in subsequent years he brought to light from Wyoming and other regions many new genera and families, and some entirely new orders of extinct vertebrata, which he described in monographs or periodical articles. These included remains of the Cretaceous toothed birds *Hesperornis* and *Ichthyornis*, the Cretaceous flying-reptiles (*Pteranodon*), the swimming reptiles or Mosasauria, and the Cretaceous and Jurassic land reptiles (*Dinosauria*) among which were the *Brontosaurus* and *Atlantosaurus*. The remarkable mammals which he termed Brontotheria (now grouped as Titanotheriidae), and the huge Dinocerata, one being the *Uintatherium*, were also brought to light by him. Among his later discoveries were remains of early ancestors of horses in America. On becoming vice-president of the American Association for the Advancement of Science in 1875 he gave an address on the "Introduction and Succession of Vertebrate Life in America," summarizing his conclusions to that date. He repeatedly organized and often accompanied scientific exploring expeditions in the Rocky Mountains, and their results tended in an important degree to support the doctrines of natural selection and evolution. He published many papers on these, and found time—besides that necessarily given to the accumulation and care of the most extensive collection of fossils in the world—to write *Odontornithes: A Monograph on the Extinct Toothed Birds of North America* (1880); *Dinocerata: A Monograph on an Extinct Order of Gigantic Mammals* (1884); and *The Dinosaurs of North America* (1896). His work is full of accurately recorded facts of permanent value. He was long in charge of the division of vertebrate palaeontology in the United States Geological Survey, and received many scientific honours, medals and degrees, American and foreign. He died in New Haven on the 18th of March 1899.

See obituary by Dr Henry Woodward (with portrait) in *Geol. Mag.* (1899), p. 237.

MARSH (O. F. *mersc*, for *merisc*, a place full of "meres" or pools; cf. Ger. *Meer*, sea, Lat. *mare*), an area of low-lying watery land. The significance of a marsh area is not so much in the manner of its formation as in the peculiar chemical and physical results that accompany it, and its relation to the ecology of plant and animal life. Chemically it is productive of such gases as arise from decomposing vegetation and are transitory in their effects, and in the production of hydrated iron oxide, which may be seen floating as an iridescent scum at the edge of rusty, marshy pools. This sinks into the soil and forms a powerful iron cement to many sandstones, binding them into a hard local mass, while the surrounding sandstones are loose and friable. A curious morphological inversion follows in a later geological period, the marsh area forming the hard cap of a hill (see MESA) while the surrounding sandstones are weathered away. Salt marshes are a feature of many low-lying sea-coasts and areas of inland drainage.

MARSHAL (med. Lat. *marescalcus*, from O.H.Ger. *marah*, horse, and *calc*, servant), a title given in various countries to certain military and civil officers, usually of high rank. The origin and development of the meaning of the designation is closely analogous with that of constable (*q.v.*). Just as the title of constable, in all its medieval and modern uses, is traceable to the style and functions of the Byzantine count of the stable, so that of marshal was evolved from the title of the *marescalci*, or masters of the horse, of the early Frankish kings. In this original sense the word survived down to the close of the Holy Roman empire in the titular office of *Erz-Marschalk* (arch-marshal), borne by the electors of Saxony. Elsewhere the meaning of office and title was modified. The importance of cavalry in medieval warfare led to the marshalship being associated with military command; this again led to the duty of keeping order in court and camp, of deciding questions of chivalry, and to the assumption of judicial and executive functions. The marshal, as a military leader, was originally a subordinate officer, the chief command under the king being held by the constable; but in the 12th century, though still nominally second to the constable, the marshal has come to the forefront as commander of the royal forces and a great officer of state. In England after the Conquest the marshalship was hereditary in the family which derived its surname from the office, and the hereditary title of earl-marshal originated in the marriage of William Marshal with the heiress of the earldom of Pembroke (see EARL MARSHAL). Similarly, in Scotland, the office of marischal (from the French *maréchal*), probably introduced under David I., became in the 14th century hereditary in the house of Keith. In 1485 the Scottish marischal became an earl under the designation of earl-marischal, the dignity coming to an end by the attainder of George, 10th earl-marischal, in 1716. In France, on the other hand, though under Philip Augustus the marshal of France (*marescalcus Franciae*) appears as commander-in-chief of the forces, care was taken not to allow the office to become descendible; under Francis I. the number of marshals of France was raised to two, under Henry III. to four, and under Louis XIV. to twenty. Revived by Napoleon, the title fell into abeyance with the downfall of the Second empire.

In England the use of the word marshal in the sense of commander of an army appears very early; so Matthew Paris records that in 1214 King John constituted William, earl of Salisbury, *marescalcus* of his forces. The modern military title of field marshal, imported from Germany by King George II. in 1736, is derived from the high dignity of the *marescalcus* in a roundabout way. The *marescalcus campi*, or *maréchal des champs*, was originally one of a number of officials to whom the name, with certain of the functions, of the marshal was given. The marshal, being responsible for order in court and camp, had to employ subordinates, who developed into officials often but nominally dependent upon him. On military expeditions it was usual for two such marshals to precede the army, select the site of the camp and assign to the lords and knights their places in it. In time of peace they preceded the king on a journey and arranged for his lodging and maintenance. In France *maréchal des logis* is the title of superior non-commissioned officers in the cavalry.

Similarly at the king's court the *marescalcus aulae* or *intrinsecus* was responsible for order, the admission or exclusion of those seeking access, ceremonial arrangements, &c. Such "marshals" were maintained, not only by the king, but by great lords and ecclesiastics. The more dignified of their functions, together with the title, survive in the various German courts, where the court marshal (*Hofmarschall*) is equivalent to the English lord chamberlain. Just as the *marescalcus intrinsecus* acted as the vicar of the marshal for duties "within" the court, so the *marescalcus forinsecus* was deputed to perform those acts of serjeanty due from the marshal to the Crown "without." Similarly there appears in the statute 5 Edw. III. cap. 8, a *marescalcus banci regii* (*maréchal du Banc du Roy*), or marshal of the king's bench, who presided over the Marshalsea Court, and was responsible for the safe custody of prisoners, who were bestowed in the *mareschalcia*, or Marshalsea prison. The office of marshal of the queen's bench survived till 1849 (see LORD STEWARD; and MARSHALSEA). The official known as a judge's marshal, whose office is of considerable antiquity, and whose duties consisted of making abstracts of indictments and pleadings for the use of the judge, still survives, but no longer exercises the above functions. He accompanies a judge of assize on circuit and is appointed by him at the beginning of each circuit. His travelling and other expenses are paid by the judge, and he receives an allowance of two guineas a day, which is paid through the Treasury. He introduces the high sheriff of the county to the judge of assize on his arrival, and swears in the grand jury. For the French *maréchaussée* see FRANCE: § *Law and Institutions.*

In the sense of executive legal officer the title marshal survives in the United States of America in two senses. The United States marshal is the executive officer of the Federal courts, one being appointed for each district, or exceptionally, one for two districts. His duties are to open and close the sessions of the district and circuit courts, serve warrants, and execute throughout the district the orders of the court. There are United States marshals also in Alaska, Hawaii, Porto Rico and the Philippines. They are appointed by the President, with the advice and consent of the Senate, for a term of four years, and, besides their duties in connexion with the courts, are employed in the service of the internal revenue, public lands, post office, &c. The temporary police sworn in to maintain order in times of disturbance, known in England as special constables, are also termed marshals in the United States. In some of the southern and western states of the Union the title marshal has sunk to that of the village policeman, as distinct from the county officers known as sheriffs and those of the justices' courts called constables.

In England the title of marshal, as applied to an executive officer, survives only in the army, where the provost marshal is chief of the military police in large garrisons and in field forces. Office and title were borrowed from the French *prévôt des maréchaux*, the modern equivalent of the medieval *praepositus marescalcorum* or *guerrarum.*

MARSHALL, ALFRED (1842–), English economist, was born in London on the 26th of July 1842. He was educated at the Merchant Taylors' School and St John's College, Cambridge, being second wrangler in 1865, and in the same year becoming fellow of his college. He became principal of University College, Bristol, in 1877, and was lecturer and fellow of Balliol College, Oxford in 1883–1884. He was professor of political economy at Cambridge University from 1885 to 1908, and was a member of the Royal Commission on Labour in 1891. He became a fellow of the British Academy in 1902. He wrote (in conjunction with his wife) *Economics of Industry* (1879), whilst his *Principles of Economics* (1st ed., 1890) is a standard English treatise.

MARSHALL, JOHN (1755–1835), American jurist, chief-justice of the U.S. Supreme Court, was born on the 24th of September 1755 at Germantown (now Midland), in what four years later became Fauquier county, Virginia. He was of English descent, the son of Thomas Marshall (1732–1806) and his wife Mary Isham Keith. Marshall served first as lieutenant and after July 1778 as captain in the Continental Army during the War of Independence. He resigned his commission early in 1781; was admitted to the bar after a brief course of study, first practised in Fauquier county; and after two years began to practise in Richmond. In 1786 we find him counsel in a case of great importance, *Hite* v. *Fairfax*, involving the original title of Lord Fairfax to that large tract of country between the headwaters of the Potomac and Rappahannock, known as the northern neck of Virginia. Marshall represented tenants of Lord Fairfax and won his case. From this time, as is shown by an examination of Call's *Virginia Reports* which cover the period, he maintained the leadership of the bar of Virginia. He was a member of the Virginia Assembly in 1782–1791 and again in 1795–1797; and in 1788, he took a leading part in the Virginia Convention called to act on the proposed constitution for the United States, with Madison ably urging the ratification of that instrument. In 1795 Washington offered him the attorney-generalship, and in 1796, after the retirement of James Monroe, the position of minister to France. Marshall declined both offers because his situation at the bar appeared to him "to be more independent and not less honourable than any other," and his "preference for it was decided." He spent the autumn and winter of 1797–1798 in France as one of the three commissioners appointed by President John Adams to adjust the differences between the young republic and the directory. The commission failed, but the course pursued by Marshall was approved in America, and with the resentment felt because of the way in which the commission had been treated in France, made him, on his return, exceedingly popular. To this popularity, as well as to the earnest advocacy of Patrick Henry, he owed his election as a Federalist to the National House of Representatives in the spring of 1799, though the feeling in Richmond was overwhelmingly in favour of the opposition or Republican party. His most notable service in Congress was his speech on the case of Thomas Nash, alias Jonathan Robbins, in which he showed that there is nothing in the constitution of the United States which prevents the Federal government from carrying out an extradition treaty. He was secretary of state under President Adams from the 6th of June 1800 to the 4th of March 1801. In the meantime he had been appointed chief-justice of the Supreme Court, his commission bearing date the 31st of January. Thus while still secretary he presided as chief-justice.

At the time of Marshall's appointment it was generally considered that the Supreme Court was the one department of the new government which had failed in its purpose. John Jay, the first chief-justice, who had resigned in 1795, had just declined a reappointment to the chief-justiceship on the ground that he had left the bench perfectly convinced that the court would never acquire proper weight and dignity, its organization being fatally defective. The advent of the new chief-justice was marked by a change in the conduct of business in the court. Since its organization, following the prevailing English custom, the judges had pronounced their opinions seriatim. But beginning with the December term 1801, the chief-justice became practically the sole mouthpiece of the court. For eleven years the opinions are almost exclusively his, and there are few recorded dissents. The change was admirably adapted to strengthen the power and dignity of the court. The chief-justice embodied the majesty of the judicial department of the government almost as fully as the president stood for the power of the executive. That this change was acquiesced in by his associates without diminishing their goodwill towards their new chief is testimony to the persuasive force of Marshall's personality; for his associates were not men of mediocre ability. After the advent of Mr Justice Joseph Story the practice was abandoned. Marshall, however, still delivered the opinion in the great majority of cases, and in practically all cases of any importance involving the interpretation of the Constitution. During the course of his judicial life his associates were as a rule men of learning and ability. During most of the time the majority were the appointees of

Democratic presidents, and before their elevation to the bench supposed to be out of sympathy with the federalistic ideas of the chief-justice. Yet in matters pertaining to constitutional construction, they seem to have had hardly any other function than to add the weight of their silent concurrence to the decision of their great chief. Thus the task of expounding the constitution during the most critical period of its history was his, and it was given to him to preside over the Supreme Court when it was called upon to decide four cases of vital importance: *Marbury* v. *Madison*, *M'Culloch* v. *Maryland*, *Cohens* v. *Virginia* and *Gibbons* v. *Ogden*. In each of these cases it is Marshall who writes the opinion of the court; in each the continued existence of the peculiar Federal system established by the Constitution depended on the action of the court, and in each the court adopted a principle which is now generally perceived to be essential to the preservation of the United States as a federal state.

In *Marbury* v. *Madison*, which was decided two years after his elevation to the bench, he decided that it was the duty of the court to disregard any act of Congress, and, therefore, a fortiori any act of a legislature of one of the states, which the court thought contrary to the Federal Constitution.

In *Cohens* v. *Virginia*, in spite of the contention of Jefferson and the then prevalent school of political thought that it was contrary to the Constitution for a person to bring one of the states of the United States, though only as an appellee, into a court of justice, he held that Congress could lawfully pass an act which permitted a person who was convicted in a state court, to appeal to the Supreme Court of the United States, if he alleged that the state act under which he was convicted conflicted with the Federal Constitution or with an act of Congress.

In *M'Culloch* v. *Maryland*, though admitting that the Federal government is one of delegated powers and cannot exercise any power not expressly given in the Constitution, he laid down the rule that Congress in the exercise of a delegated power has a wide latitude in the choice of means, not being confined in its choice of means to those which must be used if the power is to be exercised at all.

Lastly, in *Gibbons* v. *Ogden*, he held that when the power to regulate interstate and foreign commerce was conferred by the Constitution on the Federal government, the word "commerce" included not only the exchange of commodities, but the means by which interstate and foreign intercourse was carried on, and therefore that Congress had the power to license vessels to carry goods and passengers between the states, and an act of one of the states making a regulation which interfered with such regulation of Congress was, *pro tanto*, of no effect. It will be seen that in the first two cases he established the Supreme Court as the final interpreter of the Constitution.

The decision in *M'Culloch* v. *Maryland*, by leaving Congress unhampered in the choice of means to execute its delegated powers, made it possible for the Federal government to accomplish the ends of its existence. "Let the end be legitimate," said Marshall in the course of its opinion, "let it be within the scope of the Constitution, and all means which are appropriate, which are plainly adapted to that end, which are not prohibited, but consist with the letter and spirit of the Constitution, are constitutional."

If the decision in *M'Culloch* v. *Maryland* gave vigour to all Federal power, the decision in *Gibbons* v. *Ogden*, by giving the Federal government control over the means by which interstate and foreign commerce is carried on, preserved the material prosperity of the country. The decision recognizes what the framers of the Constitution recognized, namely that the United States is an economic union, and that business which is national should be under national, not state, control.

Though for the reasons stated, the four cases mentioned are the most important of his decisions, the value of his work as an expounder of the Constitution of the United States is not to be measured by these cases alone. In all he decided forty-four cases involving constitutional questions. Nearly every important part of the Constitution of the United States as it existed before the amendments which were adopted after the Civil War, is treated in one or more of them. The Constitution in its most important aspects is the Constitution as he interpreted it. He did not work out completely the position of the states in the Federal system, but he did grasp and establish the position of the Federal legislature and the Federal judiciary. To appreciate his work, however, it is necessary to see that it was the work not of a statesman but of a judge. Had Marshall been merely a far-seeing statesman, while most of his important cases would have been decided as he decided them, his life-work would have been a failure. It was not only necessary that he should decide great constitutional questions properly, but also that the people of the United States should be convinced of the correctness of his interpretation of the Constitution. His opinions, therefore, had to carry to those who studied them a conviction that the constitution as written had been interpreted according to its evident meaning. They fulfilled this prime requisite. Their chief characteristic is the cumulative force of the argument. The ground for the premiss is carefully prepared, the premiss itself is clearly stated; nearly every possible objection is examined and answered; and then comes the conclusion. There is little or no repetition, but there is a wealth of illustration, a completeness of analysis, that convinces the reader, not only that the subject has been adequately treated, but that it has been exhausted. His style, reflecting his character, suits perfectly the subject matter. Simple in the best sense of the word, his intellectual processes were so clear that he never doubted the correctness of the conclusion to which they led him. Apparently from his own point of view, he merely indicated the question at issue, and the inexorable rules of logic did the rest. Thus his opinions are simple, clear, dignified. Intensely interesting, the interest is in the argument, not in its expression. He had, in a wonderful degree, the power of phrase. He expressed important principles of law in language which tersely yet clearly conveyed his exact meaning. Not only is the Constitution interpreted largely as he taught the people of the United States to interpret it, but when they wish to express important constitutional principles which he enunciated they use his exact words. Again, his opinions show that he adhered closely to the words of the Constitution; indeed no one who has attempted to expound that instrument has confined himself more strictly to an examination of the text. In the proper, though not in the historical, sense he was the strictest of strict constructionalists, and as a result his opinions are practically devoid of theories of government, sovereignty and the rights of man.

A single illustration of his avoidance of all theory and his adherence to the words of the Constitution will suffice. In the case of the *United States* v. *Fisher* the constitutional question involved was the power of Congress to give to the United States a preference over all other creditors in the distribution of the assets of a bankrupt. Such an act can be upheld on the ground that all governments have necessarily the right to give themselves priority. Not so Marshall. To him the act must be supported, if supported at all, not on any theory of the innate nature of the government, national or otherwise, but as a reasonable means of carrying out one of the express powers conferred by the Constitution on the Federal government. Thus, he upholds the act in question because of the power expressly conferred on the Federal government to pay the debts of the union, and as a necessary consequence of this power the right to make remittances by bills or otherwise and to take precautions which will render the transactions safe.

It is important to emphasize the fact that Marshall adhered in his opinions to the Constitution as written, not only because it is a fact which must be recognized if we are to understand the correct value of his work in the field of constitutional law, but also because there exists to-day a popular impression that by implication he stretched to the utmost the powers of the Federal government. This impression is due primarily to the ignorance of many of those who have undertaken to praise him. During his life he was charged by followers of the States Rights School of political thought with upholding Federal power in cases not warranted by the constitution. Later, however, those who admired a strong national government, without taking the trouble to ascertain whether the old criticism by members of the States Rights Party was just, regarded the assumption on which it was founded as Marshall's best claim to his country's gratitude.

As a constitutional lawyer, Marshall stands without a rival. His work on international law and admiralty is of first rank. But though a good, he was not a great, common law or equity lawyer. In these fields he did not make new law nor clarify what was obscure, and his constitutional opinions which to-day are found least satisfactory are those in which the question to be solved necessarily involves the discussion of some common-law conception, especially those cases in which he was required to construe the restriction imposed by the Constitution on any state impairing the obligation of contracts. His decision in the celebrated case of *Dartmouth College* v. *Woodward*, in which he held that a state could not repeal a charter of a private corporation, because a charter is a contract which a subsequent act of the state repealing the charter impairs, though of great economic importance, does not touch any fundamental question of constitutional law. The argument which he advances lacks the clearness and finality for which most of his opinions are celebrated. It is not certain with whom he thought the contract was made: with the corporation created by the charter, with the trustees of the corporation. or with those who had contributed money to its objects.

Of the wonderful persuasive force of Marshall's personality there is abundant evidence. His influence over his associates, already referred to, is but one example though a most impressive one. From the moment he delivered the opinion in *Marbury* v. *Madison* the legal profession knew that he was a great judge. Each year added to his reputation and made for a better appreciation of his intellectual and moral qualities. The bar of the Supreme Court during his chief-justiceship was the most brilliant which the United States has ever known. Leaders, not only of legal, but political thought were among its members; one, Webster, was a man of genius and commanding position. To a very great degree Marshall impressed on the members of this bar and on the profession generally his own ideas of the correct interpretation of the Constitution and his own love for the union. He did this, not merely by his arguments but by the influence which was his by right of his strong, sweet nature. Statesmen and politicians, great and small, were at this time, almost without exception, members of the bar. To influence the political thought of the bar was to a great extent to influence the political thought of the people.

In 1782 he married Mary Willis Ambler, the daughter of the then treasurer of Virginia. They had ten children, six of whom grew to full age. For the greater part of the forty-eight years of their married life Mrs Marshall suffered intensely from a nervous affliction. Her condition called out the love and sympathy of her husband's deep and affectionate nature. Judge Story tells us: "That which, in a just sense, was his highest glory, was the purity, affectionateness, liberality and devotedness of his domestic life." For the first thirty years of his chief-justiceship his life was a singularly happy one. He never had to remain in Washington for more than three months. During the rest of the year, with the exception of a visit to Raleigh, which his duties as circuit judge required him to make, and a visit to his old home in Fauquier county, he lived in Richmond. His house on Shockhoe Hill is still standing.

On Christmas Day 1831 his wife died. He never was quite the same again. On returning from Washington in the spring of 1835 he suffered severe contusions, from an accident to the stage coach in which he was riding. His health, which had not been good, now rapidly declined and in June he returned to Philadelphia for medical attendance. There he died on the 6th of July. His body, which was taken to Richmond, lies in Shockhoe Hill Cemetery under a plain marble slab, on which is a simple inscription written by himself. In addition to his decisions Marshall wrote a famous biography of George Washington (5 vols., 1804–1807; 2nd ed., 2 vols., 1832), which though prepared hastily contains much material of value.

The principal sources of information are: an essay by James B. Thayer (Boston and New York, 1904); *Great American Lawyers* (Philadelphia, 1908), ii. 313–408, an essay by Wm. Draper Lewis; and Allan B. Magruder, *John Marshall* (Boston, 1885), in the "American Statesmen Series." The addresses delivered on Marshall Day, the 4th of February 1901, are collected by John F. Dillon (Chicago, 1903). In the "Appendix" to Dillon's collection will be found the "Discourse" by Joseph Story and the "Eulogy" by Horace Binney, both delivered soon after Marshall's death. For a study of Marshall's decisions, the *Constitutional Decisions of John Marshall*, edited by Joseph P. Collon, Jr. (New York and London, 1905), is of value. (W. D. L.)

MARSHALL, JOHN (1818–1891), British surgeon and physiologist, was born at Ely, on the 11th of September 1818, his father being a lawyer of that city. He entered University College, London, in 1838, and in 1847 he was appointed assistant-surgeon at the hospital, becoming in 1866 surgeon and professor of surgery. He was professor of anatomy at the Royal Academy from 1873 till his death. In 1883 he was president of the College of Surgeons, also Bradshaw lecturer (on "Nerve-stretching for the relief or cure of pain"), Hunterian orator in 1885, and Morton lecturer in 1889. In 1867 he published his well-known textbook *The Outlines of Physiology* in two volumes. He died on the 1st of January 1891. "Marshall's fame," wrote Sir W. MacCormac in his volume on the *Centenary of the College of Surgeons* (1900), "rests on the great ability with which he taught anatomy in relation to art, on the introduction into modern surgery of the galvano-cautery, and on the operation for the excision of varicose veins. He was one of the first to show that cholera might be spread by means of drinking water, and issued a report on the outbreak of cholera in Broad Street, St James's, 1854. He also invented the system of circular wards for hospitals, and to him are largely owing the details of the modern medical student's education."

MARSHALL, STEPHEN (*c.* 1594–1655), English Nonconformist divine, was born at Godmanchester in Huntingdonshire, and was educated at Emmanuel College, Cambridge (M.A. 1622, B.D. 1629). After holding the living of Wethersfield in Essex he became vicar of Finchingfield in the same county, and in 1636 was reported for "want of conformity." He was a preacher of great power, and influenced the elections for the Short Parliament of 1640. Clarendon esteemed his influence on the parliamentary side greater than that of Laud on the royalist. In 1642 he was appointed lecturer at St Margaret's, Westminster, and delivered a series of addresses to the Commons in which he advocated episcopal and liturgical reform. He had a share in writing *Smectymnuus*, was appointed chaplain to the earl of Essex's regiment in 1642, and a member of the Westminster Assembly in 1643. He represented the English Parliament in Scotland in 1643, and attended the parliamentary commissions at the Uxbridge Conference in 1645. He waited on Archbishop Laud before his execution, and was chaplain to Charles I. at Holmby House and at Carisbrooke. A moderate and judicious presbyterian, he prepared with others the "Shorter Catechism" in 1647, and was one of the "Triers," 1654. He died in November 1655 and was buried in Westminster Abbey, but his body was exhumed and maltreated at the Restoration. His sermons, especially that on the death of John Pym in 1643, reveal eloquence and fervour. The only "systematic" work he published was *A Defence of Infant Baptism*, against John Tombes (London, 1646).

MARSHALL, a city and the county-seat of Saline county, Missouri, U.S.A., situated a little W. of the centre of the state, near the Salt Fork of the La Mine River. Pop. (1890), 4297; (1900), 5086 (208 being foreign-born and 98 negroes); (1910) 4869. It is served by the Missouri Pacific and the Chicago & Alton railways. The city is laid out regularly on a high, undulating prairie. It is the seat of Missouri Valley College (opened 1889; coeducational), which was established by the Cumberland Presbyterian church, and includes a preparatory department and a conservatory of music. The court-house (1883), a Roman Catholic convent and a high school (1907) are the principal buildings. The Missouri colony for the feeble-minded and epileptic (1899) is at Marshall. The principal trade is with the surrounding farming country. The municipality owns and operates the waterworks. Marshall was first settled and was made the county seat in 1839; it became a town in 1866 (re-incorporated 1870) and a city in 1878.

MARSHALL, a city and the county-seat of Harrison county, Texas, U.S.A., about 145 m. E. by S. of Dallas. Pop. (1890), 7207; (1900) 7855 (3769 negroes); (1910) 11,452. Marshall is served by the Texas & Pacific and the Marshall & East Texas railways, which have large shops here. Wiley University was founded in 1873 by the Freedman's Aid Society of the Methodist Episcopal Church, and Bishop College, was founded in 1881 by the American Baptist Home Mission Society and incorporated in 1885. Marshall is situated in a region growing cotton and Indian corn, vegetables, small fruits and sugar-cane; in the surrounding country there are valuable forests of pine, oak and gum. In the vicinity of the city there are several lakes (including Caddo Lake) and springs (including Hynson and Rosborough springs). The city has a cotton compress, and among its manufactures are cotton-seed oil, lumber, ice, foundry products and canned goods. The municipality owns and operates the waterworks. Marshall was first settled in 1842, was incorporated in 1843, and received a city charter in 1848; in 1909 it adopted the commission form of government.

MARSHALL ISLANDS, an island group in the western Pacific Ocean (Micronesia) belonging to Germany. The group consists of a number of atolls ranged in two almost parallel lines, which run from N.W. to S.E. between 4° and 15° N. and 161° and 174° E. The north-east line, with fifteen islands, is called Ratak, the other, numbering eighteen, Ralik. These atolls are of coralline formation and of irregular shape. They rise but little above high-water mark. The highest elevation occurs on the island of Likieb, but is only 33 ft. The lagoon is scarcely more than 150 ft. deep and is accessible through numerous breaks in the reef. On the outward side the shore sinks rapidly to a great depth. The surface of the atolls is covered with sand, except in a few places where it has been turned into soil through the admixture of decayed vegetation. The reef in scarcely any instance exceeds 600 ft. in width.

The climate is moist and hot, the mean temperature being 80·50° F. Easterly winds prevail all the year round. There is no difference between the seasons, which, though the islands belong to the northern hemisphere, have the highest temperature in January and the lowest in July. Vegetation, on the whole, is very poor. There are many coco-nut palms, bread-fruit trees (*Artocarpus incisa*), various kinds of bananas, yams and taro, and pandanus, of which the natives eat the seeds. From the bark of another plant they manufacture mats. There are few animals. Cattle do not thrive, and even poultry are scarce. Pigs, cats, dogs and rats have been imported. There are a few pigeons and aquatic birds, butterflies and beetles. Crustacea and fish abound on the reefs.

The natives are Micronesians of a dark brown colour, though lighter shades occur. Their hair is not woolly but straight and long. They practise tattooing, and show Papuan influence by distending the ear-lobes by the insertion of wooden disks. They are expert navigators, and construct curious charts of thin strips of wood tied together with fibres, some giving the position of the islands and some the direction of the prevailing winds. Their canoes carry sails and are made of the trunk of the bread-fruit tree. The people are divided into four classes, of which only two are allowed to own land. The islands lie entirely within the German sphere of interest, and the boundaries were agreed upon between Great Britain and Germany on the 10th of April 1889. Their area is estimated at 160 sq. m., with 15,000 inhabitants, who are apparently increasing, though the contrary was long believed. All but about 250 are natives. The administrator of the islands is the governor of German New Guinea, but a number of officials reside on the islands. There is no military force, the natives being of peaceful disposition. The chief island and seat of government is Jaluit. The most populous island is Majeru, with 1600 inhabitants. The natives are generally pagans, but a Roman Catholic mission has been established, and the American Mission Board maintains coloured teachers on many of the islands. There is communication with Sydney by private steamer, and a steamer sails between Jaluit and Ponape to connect with the French boats for Singapore. The chief products for export are copra, tortoise-shell, mother-of-pearl, sharks' fins and trepang. The natives are clever boat-builders, and find a market for their canoes on neighbouring islands. They have made such progress in their art that they have even built seaworthy little schooners of 30 to 40 tons. The only other articles they make are a few shell ornaments.

The Marshall Islands may have been visited by Alvaro de Saavedra in 1529, Captain Wallis touched at the group in 1767, and in 1788 Captains Marshall and Gilbert explored it. The Germans made a treaty with the chieftains of Jaluit in 1878 and annexed the group in 1885–1886.

See C. Hager, *Die Marshall-Inseln* (Leipzig, 1886); Steinbach and Grösser, *Wörterbuch der Marshall-Sprache* (Hamburg, 1902).

MARSHALLTOWN, a city and the county-seat of Marshall county, Iowa, U.S.A., near the Iowa River and about 60 m. N.E. of Des Moines. Pop. (1890), 8914; (1900), 11,544, of whom 1590 were foreign-born; (1910 census) 13,374. Marshalltown is served by the Chicago & North-Western, the Chicago Great Western, and the Iowa Central railways, the last of which has machine shops here. At Marshalltown are the Iowa soldiers' home, supported in part by the Federal Government, and St. Mary's institute, a Roman Catholic commercial and business school. The city is situated in a rich agricultural region, and is a market for grain, neat cattle, horses and swine. There are miscellaneous manufactures, and in 1905 the factory product was valued at $3,090,312. The municipality owns and operates its waterworks and its electric-lighting plant. Marshalltown, named in honour of Chief Justice John Marshall, was laid out in 1853, and became the county-seat in 1860. It was incorporated as a town in 1863, and was chartered as a city in 1868.

MARSHALSEA, a prison formerly existing in Southwark, London. It was attached to the court of that name held by the steward and marshal of the king's house (see LORD STEWARD and MARSHAL). The date of its first establishment is unknown, but it existed as early as the reign of Edward III. It was consolidated in 1842 with the queen's bench and the Fleet, and was then described as "a prison for debtors and for persons charged with contempt of Her Majesty's courts of the Marshalsea, the court of the queen's palace of Westminster, and the high court of admiralty, and also for admiralty prisoners under sentence of courts martial." It was abolished in 1849. The Marshalsea Prison is described in Charles Dickens' *Little Dorrit*.

MARSHBUCK, a book-name proposed for such of the African bushbucks or harnessed antelopes as have abnormally long hoofs to support them in walking on marshy or swampy ground. (See BUSHBUCK and ANTELOPE.)

MARSHFIELD, a city of Wood county, Wisconsin, about 165 m. N.W. of Milwaukee. Pop. (1890), 3450; (1900), 5240, of whom 1161 were foreign-born; (1905) 6036; (1910) 5783. It is served by the Chicago & North-Western, the Chicago, St Paul, Minneapolis & Omaha, and the Minneapolis, St Paul & Sault Ste Marie railways. It contains the mother-house of the Sisters of the Sorrowful Mother. Lumbering is the most important industry, and there are various manufactures. The city is situated in a clover region, in which dairying is important, and Guernsey and Holstein-Friesland cattle are raised. The municipality owns and operates the waterworks and the electric-lighting plant. The site of Marshfield was part of a tract granted by the Federal government to the Fox River Improvement Company, organized to construct a waterway between the Mississippi river and Green Bay, and among the original owners of the town site were Samuel Marsh of Massachusetts (in whose honour the place was named) and Horatio Seymour, Ezra Cornell, Erastus Corning, and William A. Butler of New York. Marshfield was settled about 1870, and was first chartered as a city in 1883.

MARSH GAS (methane), CH_4, the first member of the series of paraffin hydrocarbons. It occurs as a constituent of the "fire-damp" of coal-mines, in the gases evolved from volcanoes, and in the gases which arise in marshy districts (due to the decomposition of vegetable matter under the surface of water). It is found associated with petroleum and also in human intestinal gases. It is a product of the destructive distillation of complex organic matter (wood, coal, bituminous shale, &c.), forming in this way from 30 to 40% of ordinary illuminating gas. It may be synthetically obtained by passing a mixture of the vapour of carbon bisulphide with sulphuretted hydrogen over red-hot copper (M. Berthelot, *Comptes rendus*, 1856, 43, p. 236), $CS_2 + 2H_2S + 8Cu = 4Cu_2S + CH_4$; by passing a mixture of hydrogen and carbon monoxide over reduced nickel at 200–250° C., or hydrogen and carbon dioxide at 230–300° C. (P. Sabatier and J. B. Senderens, *Comptes rendus*, 1902, 134, pp. 514, 689); by the decomposition of aluminium carbide with water [H. Moissan, *Bull. Soc. Chim.*, 1894, (3) 11, p. 1012]; and by heating phosphonium iodide with carbon bisulphide in a sealed tube to 120–140° C. (H. Jahn, *Ber.*, 1880, 13, p. 127). It is also obtained by the reduction of many methyl compounds with nascent hydrogen; thus methyl iodide dissolved in methyl alcohol readily yields methane when acted on by the zinc-copper couple (J. H. Gladstone and A. Tribe, *Jour. Chem. Soc.*, 1884, 45, p. 156) or by the aluminium-mercury couple. It may be obtained in an indirect manner from methyl iodide by conversion of this compound into zinc methyl, or into magnesium methyl iodide (formed by the action of magnesium on methyl iodide dissolved in anhydrous ether), and decomposing these latter substances with water (E. Frankland, 1856; V. Grignard, 1900),

$$Zn(CH_3)_2 + H_2O = 2CH_4 + ZnO; \; 2CH_3MgI + H_2O = 2CH_4 + MgI_2 + MgO.$$

In the laboratory it is usually prepared by J. B. A. Dumas' method (*Ann.*, 1840, 33, p. 181), which consists in heating anhydrous sodium acetate with soda lime, $CH_3CO_2Na + NaOH = Na_2CO_3 + CH_4$. The product obtained by this method is not pure, containing generally more or less ethylene and hydrogen.

Methane is a colourless gas of specific gravity 0·559 (air = 1). It may be condensed to a colourless liquid at −155° to −160° C. under atmospheric pressure (S. Wroblewsky, *Comptes rendus*, 1884, 99, p. 136). It boils at −162° C. and freezes at −186°C. Its critical temperature is −99·5° C. (J. Dewar). The gas is almost insoluble in water, but is slightly soluble in alcohol. It decomposes into its constituents when passed through a red-hot tube, small quantities of other hydrocarbons (ethane, ethylene, acetylene, benzene, &c.) being formed at the same time. It burns with a pale flame, and when mixed with air or oxygen forms a highly explosive mixture. W. A. Bone (*Jour. Chem. Soc.*, 1902, 81, p. 535; 1903, 83, p. 1074) has shown that in the oxidation of methane by oxygen at 450–500° C. formaldehyde (or possibly methyl alcohol) is formed as an intermediate product, and is ultimately oxidized to carbon dioxide. Methane is an exceedingly stable gas, being unaffected by the action of chromic acid, nitric acid, or a mixture of nitric and sulphuric acids. Chlorine and bromine, however, react with methane, gradually replacing hydrogen and forming chlor- and brom- substitution products.

MARSHMAN, JOSHUA (1768–1837), English Baptist missionary and orientalist, was born on the 20th of April 1768, at Westbury Leigh, in Wiltshire. He followed the occupation of a weaver until 1794, but having meanwhile devoted himself to study he removed to Broadmead, Bristol, to take charge of a small school. In 1799 he was sent by the Baptist Missionary Society to join their mission at Serampur. Here, in addition to his more special duties, he studied Bengali and Sanskrit, and afterwards Chinese. He translated the Bible into various dialects, and, aided by his son, established newspapers and founded Serampur College. He received the degree of D.D. from Brown University, U.S.A., in 1810. He died at Serampur on the 5th of December 1837. His son, John Clark Marshman (1794–1877), was official Bengali translator; he published a *Guide to the Civil Law* which, before the work of Macaulay, was the civil code of India, and wrote a *History of India* (1842).

Marshman translated into Chinese the book of Genesis, the Gospels, and the Epistles of Paul to the Romans and the Corinthians; in 1811 he published *The Works of Confucius, containing the Original Text, with a Translation*, and in 1814 his *Clavis Sinica*. He was also the author of *Elements of Chinese Grammar, with Preliminary Dissertation on the Characters and Colloquial Mediums of the Chinese*, and was associated with W. Carey in the preparation of a Sanskrit grammar and of a Bengali-English dictionary.

See J. C. Marshman, *Life and Times of Carey, Marshman and Ward* (2 vols., 1859).

MARSI, an ancient people of Italy, whose chief centre was Marruvium, on the eastern shore of Lake Fucinus. They are first mentioned as members of a confederacy with the Vestini, Paeligni and Marrucini (Liv. viii. 29, cf. viii. 6, and Polyb. ii. 24, 12). They joined the Samnites in 308 B.C. (Liv. ix. 41), and on their submission became allies of Rome in 304 B.C. (Liv. ix. 45). After a short-lived revolt two years later, for which they were punished by loss of territory (Liv. x. 3), they were readmitted to the Roman alliance and remained faithful down to the social war, their contingent (*e.g.* Liv. xliv. 46) being always regarded as the flower of the Italian forces (*e.g.* Hor. *Od.* ii. 20, 18). In this war, which, owing to the prominence of the Marsian rebels is often known as the Marsic War, they fought bravely against odds under their leader Q. Pompaedius Silo, and, though they were frequently defeated, the result of the war was the enfranchisement of the allies (see ROME: *History*, "The Republic"). The Marsi were a hardy mountain people, famed for their simple habits and indomitable courage. It was said that the Romans had never triumphed over them or without them (Appian). They were also renowned for their magicians, who had strange remedies for various diseases.

The Latin colony of Alba Fucens near the north-west corner of the lake was founded in the adjoining Aequian territory in 303, so that from the beginning of the 3rd century the Marsians were in touch with a Latin-speaking community, to say nothing of the Latin colony of Carsioli (298 B.C.) farther west. The earliest pure Latin inscriptions of the district seem to be *C.I.L.* ix. 3827 and 3848 from the neighbourhood of Supinum; its character generally is of the Gracchan period, though it might be somewhat earlier.

Mommsen (*Unteritalische Dialekten*, p. 345) pointed out that in the social war all the coins of Pompaedius Silo have the Latin legend "Italia," while the other leaders in all but one case used Oscan.

The chief record of the dialect or patois we owe to the goddess Angitia, whose chief temple and grove stood at the south-west corner of Lake Fucinus, near the inlet to the *emissarius* of Claudius (restored by Prince Torlonia), and the modern village of Luco. She (or they, for the name is in the plural in the Latin inscription next cited) was widely worshipped in the central highlands (Sulmo, *C.I.L.* ix. 3074, Furfo Vestinorum, ibid. 3515) as a goddess of healing, especially skilled to cure serpent bites by charms and the herbs of the Marsian woods. Her worshippers naturally practised the same arts—as their descendants do (see A. de Nino's charming collection of *Usi e costumi abruzzesi*), their country being in Rome counted the home of witchcraft; see Hor. *Sat.* 1, 9, 29, *Epod.* 17, 28, &c.

The earliest local inscriptions date from about 300 to 150 B.C. and include the interesting and difficult bronze of Lake Fucinus, which seems to record a votive offering to Angitia, if *A(n)ctia*, as is probable, was the local form of her name. Their language differs very slightly from Roman Latin of that date; for apparently contracted forms like *Fougno* instead of *Fucino* may really only be a matter of spelling. In final syllables the diphthongs *ai*, *ei*, *oi*, all appear as *ē*. On the other hand, the older form of the namē of the tribe (dat. plur. *Martses* = Lat. *Martiis*) shows its derivation and exhibits the assibilation of *-tio-* into *-tso-* proper to many Oscan dialects (see OSCA LINGUA) but strange to classical Latin.

See R. S. Conway, *The Italic Dialects*, pp. 290 seq. (from which some portions of this article are taken by permission of the syndics of the Camb. Univ. Press); on the Fucino-Bronze, ib. p. 294. (R. S. C.)

MARSIGLI [Latinized MARSILIUS], **LUIGI FERDINANDO**, COUNT (1658–1730), Italian soldier and scientific writer, was born at Bologna on the 10th of July 1658. After a course of scientific studies in his native city he travelled through Turkey collecting data on the military organization of that empire, as well as on its natural history. On his return he entered the service of the emperor Leopold (1682) and fought with distinction against the Turks, by whom he was wounded and captured in an action on the river Raab, and sold to a pasha whom he accompanied to the siege of Vienna. His release was purchased in 1684, and he afterwards took part in the war of the Spanish succession. In 1703 he was appointed second in command under Count Arco in the defence of Alt-Breisach. The fortress surrendered to the duke of Burgundy, and both Arco and Marsigli were court martialled; the former was condemned to death and the latter cashiered, although acquitted of blame by public opinion. Having thus been forced to give up soldiering, he devoted the rest of his life to scientific investigations, in the pursuit of which he made many journeys through Europe, spending a considerable time at Marseilles to study the nature of the sea. In 1712 he presented his collections to his native city, where they formed the nucleus of the Bologna Institute of Science and Art. He died at Bologna on the 1st of November 1730. Marsigli was a fellow of the London Royal Society and a member of the Paris Academy of Science.

Bibliography.—A list of his works, over twenty in number, is given in Niceron's *Memoirs*; his *Breve ristretto del saggio fisico intorno alla storia del mare* was published at Venice in 1711, and again at Amsterdam (in French) in 1725; the *Stato militare dell' impero ottomano* was published at Amsterdam and the Hague in Italian and French (1732), the *Osservazioni intorno al Bosforo Tracio* in Rome (1681) and the *Danubius pannonico-mysicus*, a large work in six volumes containing much valuable historic and scientific information on the Danubian countries, at the Hague (1725). See Fontenelle, "Éloge" in the *Mém. de l'acad. des sciences* (Paris, 1730); Quincy, *Mémoires sur la vie de M. le comte Marsigli* (Zurich, 1741), and Fantuzzi's biography of Marsigli (Bologna, 1770).

MARSILIUS OF PADUA [Marsiglio Mainardino] (1270–1342), Italian medieval scholar, was born at Padua, and at first studied medicine in his own country. After practising various professions, among others that of a soldier, he went to Paris about 1311. The reputation which he had gained in the physical sciences soon caused him to be raised to the position of rector of the university (for the first term of the year 1313). While still practising medicine he entered into relations with another master of Paris, the philosopher John of Jandun, who collaborated with him in the composition of the famous *Defensor pacis* (1324), one of the most extraordinary political and religious works which appeared during the 14th century. A violent struggle had just broken out between pope John XXII. and Louis of Bavaria, king of the Romans, and the latter, on being excommunicated and called upon to give up the empire, only replied to the pope's threats with fresh provocations. Marsilius of Padua and John of Jandun, though they had both reason to be grateful for the benefits of John XXII., chose this moment to demonstrate, by plausible arguments, the supremacy of the Empire, its independence of the Holy See, and the emptiness of the prerogatives "usurped" by the sovereign pontiffs—a demonstration naturally calculated to give them a claim on the gratitude of the German sovereign.

The *Defensor pacis*, as its name implies, is a work intended to restore peace, as the most indispensable benefit of human society. The author of the law is the people, *i.e.* the whole body, or at least the most important part (*valentior*) of the citizens; the people should themselves elect, or at least appoint, the head of the government, who, lest he should be tempted to put himself above the scope of the laws, should have at his disposal only a limited armed force. This chief is responsible to the people for his breaches of the law, and in serious cases they can condemn him to death. The real cause of the trouble which prevails among men is the papacy, a "fictitious" power, the development of which is the result of a series of usurpations. Marsilius denies, not only to the pope, but to the bishops and clergy, any coercive jurisdiction or any right to pronounce on their own authority excommunications and interdicts, or in any way to impose the observation of the divine law. He is not opposed to penalties against heretics, but he would have them pronounced only by civil tribunals. Desiring to see the clergy practise a holy poverty, he proposes the suppression of tithes and the seizure by the secular power of the greater part of the property of the church. The clergy, thus deprived of its wealth, privileges and jurisdiction, is further to be deprived of independence, for the civil power is to have the right of appointing to benefices, &c. The supreme authority in the church is to be the council, but a council summoned by the emperor. The pope, no longer possessing any more power than other bishops (though Marsilius recognizes that the supremacy of the Church of Rome goes back to the earliest times of Christianity), is to content himself with a pre-eminence mainly of an honorary kind, without claiming to interpret the Holy Scriptures, define dogmas or distribute benefices; moreover, he is to be elected by the Christian people, or by the delegates of the people, *i.e.* the princes, or by the council, and these are also to have the power to punish, suspend or depose him. Such is this famous work, full of obscurities, redundancies and contradictions, in which the thread of the argument is sometimes lost in a labyrinth of reasonings and citations, both sacred and profane, but which nevertheless expresses, both in religion and politics, such audacious and novel ideas that it has been possible to trace in it, as it were, a rough sketch of the doctrines developed during the periods of the Reformation and of the French Revolution. The theory was purely democratic, but was all ready to be transformed, by means of a series of fictions and implications, into an imperialist doctrine; and in like manner it contained a visionary plan of reformation which ended, not in the separation of the church from the state, but in the subjection of the church to the state. To overthrow the ecclesiastical hierarchy, to deprive the clergy of all their privileges, to reduce the pope to the rank of a kind of president of a Christian republic, which governs itself, or rather submits to the government of Caesar—such is the dream formed in 1324 by two masters of the university of Paris.

When in 1326 Louis of Bavaria saw the arrival in Nuremberg of the two authors of the book dedicated to him, startled by the boldness of their political and religious theories, he was at first inclined to treat them as heretics. He soon changed his mind, however, and, admitting them to the circle of his intimates, loaded them with favours. Having become one of the chief inspirers of the imperial policy, Marsilius accompanied Louis of Bavaria to Italy, where he preached or circulated written attacks against the pope, especially at Milan, and where he came within the sight of the realization of his wildest utopias. To see a king of the Romans crowned emperor at Rome, not by the pope, but by those who claimed to be the delegates of the people (Jan. 17, 1328), to see John XXII. deposed by the head of the Empire (April 18), and a mendicant friar, Pietro de Corbara, raised by an imperial decree to the throne of St Peter (as Nicholas V.) after a sham of a popular election (May 12), all this was merely the application of principles laid down in the *Defensor pacis*. The two authors of this book played a most active part in the Roman Revolution. Marsilius, appointed imperial vicar, abused his power to persecute the clergy who had remained faithful to John XXII. In recompense for his services, he seems to have been appointed archbishop of Milan, while his collaborator, John of Jandun, obtained from Louis of Bavaria the bishopric of Ferrara.

Marsilius of Padua also composed a treatise *De translatione imperii romani*, which is merely a rearrangement of a work of Landolfo Colonna, *De jurisdictione imperatoris in causa matrimoniali*, intended to prove the exclusive jurisdiction of the emperor in matrimonial affairs, or rather, to justify the intervention of Louis of Bavaria, who, in the interests of his policy, had just annulled the marriage of the son of the king of Bohemia and the countess of Tirol. But, above all, in an unpublished work preserved at Oxford, the *Defensor minor*, Marsilius completed and elaborated in a curious manner certain points in the doctrine laid down in the *Defensor pacis*. In it he deals with ecclesiastical jurisdiction, penances, indulgences, crusades and pilgrimages, vows, excommunication, the pope and the council, marriage and divorce. Here his democratic theory still more clearly leads up to a proclamation of the imperial omnipotence.

Marsilius of Padua does not seem to have lived long after 1342. But the scandal provoked by his *Defensor pacis*, condemned by the court of Avignon in 1326, lasted much longer. Benedict XII. and Clement VI. censured it in turn; Louis of Bavaria disowned it. Translated into French, then into Italian (14th century) and into English (16th century), it was known by Wycliffe and Luther, and was not without an influence on the Reform movement.

See J. Sullivan, *American Historical Review*, vol. ii. (1896–1897), and *English Historical Review* for April 1905; *Histoire littéraire de la France* (1906), xxxiii. 528–623; Sigmund Riezler, *Die literarischen Widersacher der Päpste zur Zeit Ludwig des Baiers* (Leipzig, 1874).

There are numerous manuscripts of the *Defensor pacis* extant. We will here mention only one edition, that given by Goldast, in 1614, in vol. i. of his *Monarchia sacri imperii*; an unpublished last chapter was published by Karl Müller, in 1883, in the *Göttingische gelehrte Anzeigen*, pp. 923–925.

Count Lützow in *The Life and Times of Master John Hus* (London and New York, 1909), pp. 5–9, gives a good abstract of the *Defensor pacis* and the relations of Marsilius to other precursors of the Reformation. (N. V.)

MARSIVAN, or **Merzifun** (anc. *Phazemon*?), a town in the Amasia sanjak of the Sivas vilayet of Asia Minor, situated at the foot of the Tavshan Dagh. Pop. about 20,000, two-thirds Mussulman. It is a centre of American missionary and educational enterprise, and the seat of Anatolia College, a theological seminary, and schools which were partly destroyed in the anti-Armenian riots of 1893 and 1895. There is also a Jesuit school. Marsivan is an unusually European place both in its aspect and the commodities procurable in the bazaar.

MARS-LA-TOUR, a village of Lorraine, between Metz and the French frontier, which formed part of the battlefield of the 16th of August 1870. The battle is often called the battle of Mars-la-Tour, though it is more usually named after Vionville. (See Metz; and Franco-German War.) At Mars-la-Tour occurred the destruction of the German 38th brigade.

MARSTON, JOHN (*c.* 1575–1634), English dramatist and satirist, eldest son of John Marston of Coventry, at one time lecturer of the Middle Temple, was born in 1575, or early in 1576. Swinburne notes his affinities with Italian literature, which may be partially explained by his parentage, for his mother was the daughter of an Italian physician, Andrew Guarsi. He entered Brasenose College, Oxford, in 1592, taking his B.A. degree in 1594. The elder Marston in his will expresses regret that his son, to whom he left his law-books and the furniture of his rooms in the Temple, had not been willing to follow his profession. John Marston married Mary Wilkes, daughter of one of the royal chaplains, and Ben Jonson said that "Marston wrote his father-in-law's preachings, and his father-in-law his sermons." His first work was *The Metamorphosis of Pigmalions Image, and certaine Satyres* (1598). "Pigmalion" is an erotic poem in the metre of *Venus and Adonis*, and Joseph Hall attached a rather clumsy epigram to every copy that was exposed for sale in Cambridge. In the same year Marston published, under the pseudonym of W. Kinsayder, already employed in the earlier volume, his *Scourge of Villanie*, eleven satires, in the sixth of which he asserted that Pigmalion was intended to parody the amorous poetry of the time. Both this volume and its predecessor were burnt by order of the archbishop of Canterbury. The satires, in which Marston avowedly took Persius as his model, are coarse and vigorous. In addition to a general attack on the vices of his age he avenges himself on Joseph Hall who had assailed him in *Virgidemiae*. He had a great reputation among his contemporaries. John Weever couples his name with Ben Jonson's in an epigram; Francis Meres in *Palladis tamia* (1598) mentions him among the satirists; a long passage is devoted to "Monsieur Kinsayder" in the *Return from Parnassus* (1606), and Dr Brinsley Nicholson has suggested that *Furor poeticus* in that piece may be a satirical portrait of him. But his invective by its general tone, goes far to justify Mr W. J. Courthope's[1] judgment that "it is likely enough that in seeming to satirize the world without him, he is usually holding up the mirror to his own prurient mind."

On the 28th of September 1599 Henslowe notices in his diary that he lent "unto Mr Maxton, the new poete, the sum of forty shillings," as an advance on a play which is not named. Another hand has amended "Maxton" to "Mastone." The earliest plays to which Marston's name is attached are *The History of Antonio and Mellida. The First Part*; and *Antonio's Revenge. The Second Part* (both entered at Stationers' Hall in 1601 and printed 1602). The second part is preceded by a prologue which, in its gloomy forecast of the play, moved the admiration of Charles Lamb, who also compares the situation of Andrugio and Lucia to Lear and Kent, but the scene which he quotes gives a misleading idea of the play and of the general tenor of Marston's work.

The melodrama and the exaggerated expression of these two plays offered an opportunity to Ben Jonson, who had already twice ridiculed Marston, and now pilloried him as Crispinus in *The Poetaster* (1601). The quarrel was patched up, for Marston dedicated his *Malcontent* (1604) to Jonson, and in the next year he prefixed commendatory verses to *Sejanus*. Far greater restraint is shown in *The Malcontent* than in the earlier plays. It was printed twice in 1604, the second time with additions by John Webster. *The Dutch Courtezan* (1605) and *Parasitaster, or the Fawne* (1606) followed. In 1605 *Eastward Hoe*,[2] a gay comedy of London life, which gave offence to the king's Scottish friends, caused the playwrights concerned in its production—Marston, Chapman and Jonson—to be imprisoned at the instance of Sir James Murray. *The Wonder of Women, or the Tragedie of Sophonisba* (1606), seems to have been put forward by Marston as a model of what could be accomplished in tragedy. In the preface he mocks at those authors who make a parade of their authorities and their learning, and the next play, *What you Will* (printed 1607; but probably written much earlier), contains a further attack on Jonson. The tragedy of *The Insatiate Countesse* was printed in 1613, and again, this time anonymously, in 1616. It was not included in the collected edition of Marston's plays in 1633, and in the Duke of Devonshire's library there is a copy bearing the name of William Barksteed, the author of the poems, *Myrrha, the Mother of Adonis* (1607), and *Hiren and the Fair Greek* (1611). The piece contains many passages superior to anything to be found in Marston's well-authenticated plays, and Mr A. H. Bullen suggests that it may be Barksteed's version of an earlier one drafted by Marston. The character and history of Isabella are taken chiefly from "The Disordered Lyfe of the Countess of Celant" in William Paynter's *Palace of Pleasure*, derived eventually from Bandello. There is no certain evidence of Marston's authorship in *Histriomastix* (printed 1610, but probably produced before 1599), or in *Jacke Drums Entertainement, or the Comedie of Pasquil and Katherine* (1616), though he probably had a hand in both. Mr R. Boyle (*Englische Studien*, vol. xxx., 1901), in a critical study of Shakespeare's *Troilus and Cressida*, assigns to Marston's hand the whole of the action dealing with Hector, with the prologue and epilogue, and attributes to him the bombast and coarseness in the last scenes of the play. It will be seen that his undoubted dramatic work was completed in 1607. It is uncertain at what time he exchanged professions, but in 1616 he was presented to the living of Christchurch, Hampshire. He formally resigned his charge in 1631, and when his works were collected in 1633 the publisher, William Sheares, stated that the author "in his autumn and declining age" was living "far distant from this place." Nevertheless he died in London, in the parish of Aldermanbury, on the 25th of June 1634. He was buried in the Temple Church.

Marston's works were first published in 1633, once anonymously as *Tragedies and Comedies*, and then in the same year as *Workes of Mr John Marston*. *The Works of John Marston* (3 vols.) were reprinted by Mr J. O. Halliwell (Phillipps) in 1856, and again by Mr. A. H. Bullen (3 vols.) in 1887. His *Poems* (2 vols.) were edited by Dr A. B. Grosart in 1879. The British Museum Catalogue tentatively assigns to Marston *The Whipper of the Satyre his pennance in a white sheete; or, the Beadle's Confutation* (1601), a pamphlet in answer to *The Whipping of the Satyre*. For an account of the quarrel of Dekker and Marston with Ben Jonson see Dr R. A. Small, *The*

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[1] *Hist. of Eng. Poetry*, iii. 70.

[2] Revived at Drury Lane (1751) as *The Prentices*, in 1775 as *Old City Manners*, and said to have suggested Hogarth's "Industrious and Idle Prentices."

Stage Quarrel between Ben Jonson and the so-called Poetasters; in E. Koelbing, *Forschungen zur englischen Sprache und Litteratur*, pt. i. (1899). See also three articles *John Marston als Dramatiker*, by Ph. Aronstein in *Englische Studien* (vols. xx. and xxi., 1895), and "Quellenstudien zu den Dramen Ben Jonsons, John Marstons . . ." by Emil Koeppel (*Münchener Beiträge zur roman. und engl. Philologie*, pt. xi. 1895).

MARSTON, PHILIP BOURKE (1850–1887), English poet, was born in London on the 13th of August 1850. His father, JOHN WESTLAND MARSTON (1819–1890), of Lincolnshire origin, the friend of Dickens, Macready and Charles Kean, was the author of a series of metrical dramas which held the stage in succession to the ambitious efforts of John Tobin, Talfourd, Bulwer and Sheridan Knowles. His chief plays were *The Patrician's Daughter* (1841), *Strathmore* (1849), *A Hard Struggle* (1858) and *Donna Diana* (1863). He was looked up to as the upholder of the outworn tradition of the acted poetic drama, but his plays showed little vitality, and Marston's reviews for the *Athenaeum*, including one of Swinburne's *Atalanta in Calydon*, and his dramatic criticisms embodied in *Our Recent Actors* (1888) will probably claim a more enduring reputation. His *Dramatic and Poetical Works* were collected in 1876. The son, Philip Bourke, was born in a literary atmosphere. His sponsors were Philip James Bailey and Dinah Mulock (Mrs Craik). At his father's house near Chalk Farm he met authors and actors of his father's generation, and subsequently the Rossettis, Swinburne, Arthur O'Shaughnessy and Irving. From his earliest years his literary precocity was overshadowed by misfortunes. In his fourth year, in part owing to an accident, his sight began to decay, and he gradually became almost totally blind. His mother died in 1870. His *fiancée*, Mary Nesbit, died in 1871; his closest friend, Oliver Madox Brown, in 1874; his sister Cicely, his amanuensis, in 1878; in 1879 his remaining sister, Eleanor, who was followed to the grave after a brief interval by her husband, the poet O'Shaughnessy, and her two children. In 1882 the death of his chief poetic ally and inspirer, Rossetti, was followed closely by the tragedy of another kindred spirit, the sympathetic pessimist, James Thomson ("B. V."), who was carried dying from his blind friend's rooms, where he had sought refuge from his latest miseries early in June of the same year. It is said that Marston came to dread making new friendships, for fear of evil coming to the recipients of his affection. In the face of such calamities it is not surprising that Marston's verse became more and more sorrowful and melancholy. The idylls of flower-life such as the early and very beautiful "The Rose and the Wind" were succeeded by dreams of sleep and the repose of death. These qualities and gradations of feeling, reflecting the poet's successive ideals of action and quiescence, are traceable through his three published collections, *Songtide* (1871), *All in All* (1875) and *Wind Voices* (1883). The first and third, containing his best work, went out of print, but Marston's verse was collected in 1892 by Mrs Louise Chandler Moulton, a loyal and devoted friend, and herself a poet. Marston read little else but poetry; and of poetic values, especially of the intenser order, his judgment could not be surpassed in sensitiveness. He was saturated with Rossetti and Swinburne, and his imitative power was remarkable. In his later years he endeavoured to make money by writing short stories in *Home Chimes* and other American magazines, through the agency of Mrs Chandler Moulton. His popularity in America far exceeded that in his own country. His health showed signs of collapse from 1883; in January 1887 he lost his voice, and suffered intensely from the failure to make himself understood. He died on the 13th of February 1887.

He was commemorated in Dr Gordon Hake's "Blind Boy," and in a fine sonnet by Swinburne, beginning "The days of a man are threescore years and ten." There is an intimate sketch of the blind poet by a friend, Mr Coulson Kernahan, in *Sorrow and Song* (1894), p. 127. (T. SE.)

MARSTON MOOR, BATTLE OF, was fought on the 2nd of July 1644 on a moor (now enclosed) seven miles west of York, between the Royalist army under Prince Rupert and the Parliamentary and Scottish armies under the earl of Manchester, Lord Fairfax and Lord Leven. For the operations that preceded the battle see GREAT REBELLION. Rupert had relieved York and joined forces with the marquess of Newcastle's army that had defended that city, and the Parliamentarians and Scots who had besieged it had drawn off south-westward followed by the Royalists. On the morning of the 2nd of July, however, Rupert's attack on their rearguard forced them to halt and deploy on rising ground on the south edge of the moor, their position being defined on the right and left by Long Marston and Tockwith and divided from the Royalist army on the moor by a lane connecting these two villages. The respective forces were—Royalists about 18,000, Parliamentarians and Scots about 27,000. The armies stood front to front. On the Royalist right was half the cavalry under Rupert; the infantry was in the centre in two lines and the left wing of cavalry was under General (Lord) Goring. The lane along the front was held by skirmishers. On the other side the cavalry of the Eastern Association under Lieut.-General Cromwell and that of the Scots under Major-General Leslie (Lord Newark) formed the left, the infantry of the Eastern Association under Major-General Crawford, of the Scots under Lord Leven, and of the Yorkshire Parliamentarians under Lord Fairfax was in the centre and the Yorkshire cavalry under Sir Thomas Fairfax was on the right wing.

During the afternoon there was a desultory cannonade, but neither side advanced. At last, concluding from movements in the enemy's lines that there would be no fighting that day, Rupert and Newcastle strolled away to their coaches and their soldiers dismounted and lay down to rest. But seeing this Cromwell instantly advanced his wing to the attack (5 p.m.). His dragoons drove away the skirmishers along the lane, and the line cavalry crossed into the moor. The general forward movement spread along the Parliamentary line from left to right, the Eastern Association infantry being the first to cross the road. In Rupert's momentary absence, the surprised Royalist cavalry could make no head against Cromwell's charge, although the latter was only made piecemeal as each unit crossed the lane and formed to the front. Rupert soon galloped up with his fresh second line and drove back Cromwell's men, Cromwell himself being wounded, but Leslie and the Scots Cavalry, taking ground to their left, swung in upon Rupert's flank, and after a hard struggle the hitherto unconquered cavalry of the prince was broken and routed. Then, being unlike other cavalry of the time, a thoroughly disciplined force, the Eastern Association cavalry rallied, leaving the pursuit to the Scots light horse. On the Parliamentary right, Goring had swept away the Yorkshire horse, and although most of his troopers had followed in disorderly pursuit, Sir Charles Lucas with some squadrons was attacking the exposed right of Leven's infantry. At the same time the Parliamentary infantry had mostly crossed the lane and was fighting at close quarters and suffering severely, Newcastle's north-country "White-Coat" brigade driving back and finally penetrating their centre. Lord Leven gave up the battle as lost and rode away to Tadcaster. But the Scots on the right of the foot held firm against Lucas's attacks, and Cromwell and Leslie with their cavalry passed along the rear of the Royal army, guided by Sir Thomas Fairfax (who though wounded in the rout of his Yorkshire horse had made his way to the other flank). Then, on the ground where Goring had routed Fairfax, Cromwell and Leslie won an easy victory over Goring's scattered and disordered horsemen. The Eastern Association infantry had followed the horse and was now in rear of the Royalists. The original Parliamentary centre of foot, a remnant, but one containing only the bravest and steadiest men, held fast, and soon the Royalist infantry was broken up into isolated regiments and surrounded by the victorious horse and foot of the enemy. The White-Coats retreated into an enclosure and there defended themselves to the last man. The rest were cut down on the field or scattered in the pursuit and at nightfall the Royalist army had ceased to exist. Some of Rupert's foot regiments made their way to York, but the dispirited garrison only held out for a fortnight. Rupert rallied some six thousand of the men and escaped over the hills into Lancashire, thence rejoining King Charles in the south. But the Northern army, the main hope of the Royalist cause, was destroyed.

MARSUPIALIA (from Lat. *marsupium*, a "pouch," or "bag"), the group of mammals in which the young are usually carried for some time after birth in a pouch on the under-surface of the body of the female. The group, which has also the alternative title of Didelphia, is by some authorities regarded as a sub-class of the mammalia of equal rank with the Monotremata, while by others it is brigaded with the placentals, so that the two together form a sub-class of equal grade with the one represented by the monotremes. There is much to be urged in favour of either view; and in adopting the former alternative, it must be borne in mind that the difference between monotremes and marsupials is vastly greater than that which separates the latter from placentals. In elevating the marsupials to the rank of a sub-class the name Metatheria has been suggested as the title for the higher grade, with Marsupialia as the designation for the single order by which they are now represented. It is, however, less liable to cause confusion, and in many other ways more convenient to employ the better known term Marsupialia in both senses.

Marsupials may be defined as viviparous (that is non-egg-laying) mammals, in which the young are born in an imperfect condition, and almost immediately attached to the teats of the mammary glands; the latter being generally enclosed in a pouch, and the front edge of the pelvis being always furnished with epipubic or "marsupial" bones. As a rule there is no allantoic placenta forming the means of communication between the blood of the parent and the foetus, and when such a structure does occur its development is incomplete. In all cases a more or less full series of teeth is developed, these being differentiated into incisors, canines, premolars and molars, when all are present; but only a single pair of teeth in each jaw has deciduous predecessors.

The pouch from which the marsupials take their name is supported by the two epipubic bones, but does not correspond to the temporary breeding-pouch of the monotremes. It may open either forward or backwards; and although present in the great majority of the species, and enclosing the teats, it may, as in many of the opossums, be completely absent, when the teats extend in two rows along the whole length of the under-surface of the body. Whether a pouch is present or not, the young are born in an exceedingly imperfect state of development, after a very short period of gestation, and are immediately transferred by the female parent to the teats, where they remain firmly attached for a considerable time; the milk being injected into their mouths at intervals by means of a special muscle which compresses the glands. In the case of the great grey kangaroo, for instance, the period of gestation is less than forty days, and the newly-born embryo, which is blind, naked, and unable to use its bud-like limbs, is little more than an inch in length.

As additional features of the subclass may be mentioned the absence of a corpus callosum connecting the right and left hemispheres of the brain,[1] and of a fossa in the septum between the two auricles of the heart. In the skull there are always vacuities, or unossified spaces in the bones of the palate, while the "angle," or lower hind extremity of each half of the lower jaw is strongly bent inwards so as to form a kind of shelf, and the alisphenoid bone takes a share in the formation of the tympanum, or auditory bladder, or bulla. Didelphia, the alternative name of the group was given in allusion to the circumstance that the uterus has two separate openings; while other features are the inclusion of the openings of the alimentary canal and the urino-genital sinus in a common sphincter muscle, and the position of the scrotum in advance of the penis. The bandicoots alone possess a placenta. Lastly the number of trunk-vertebrae is always nineteen, while there are generally thirteen pairs of ribs.

As regards the teeth, in all cases except the wombats the number of upper incisors differs from that of the corresponding lower teeth. As already stated, there is no vertical displacement and succession of the functional teeth except in the case of a single tooth on each side of each jaw, which is the third of the premolar series, and is preceded by a tooth having more or less of the characters of a molar (see fig. 1). In some cases (as in rat-kangaroos) this tooth retains its place and function until the animal has nearly, if not quite, attained its full stature, and is not shed and replaced by its successor until after all the other teeth, including the molars, are in place and use. In others, as the thylacine, it is rudimentary, being shed or absorbed before any of the other teeth have cut the gum, and therefore functionless. It may be added that there are some marsupials, such as the wombat, koala, marsupial ant-eater and the dasyures, in which no such deciduous tooth, even in a rudimentary state, has been discovered. In addition to this replacement of a single pair of functional teeth in each jaw, it has been discovered that marsupials possess rudimentary tooth-germs which never cut the gum. According to one theory, these rudimentary teeth, together with the one pair of functional teeth in each jaw that has vertical successors, represent the milk-teeth of placental mammals. On the other hand, there are those who believe that the functional dentition (other than the replacing premolar and the molars) correspond to the milk-dentition of placentals, and that the rudimentary tooth-germs represent a "prelacteal" dentition. The question, however, is of academic rather than of practical interest, and whichever way it is answered does not affect our general conception of the nature and relationships of the group.

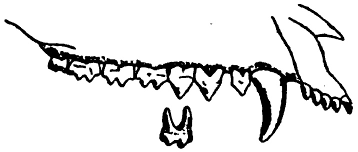

FIG. 1.—Teeth of Upper Jaw of Opossum (*Didelphys marsupialis*), all of which are unchanged, except the third premolar, the place of which is occupied in the young animal by a molariform tooth, represented in the figure below the line of the other teeth.

Unfortunately the homology of the functional series does not by any means end the uncertainty connected with the marsupial dentition; as there is also a difference of opinion with regard to the serial homology of some of the cheek-teeth. For instance, according to the older view, the dental formula in the thylacine or Tasmanian wolf is i. $\frac{4}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{4}{4}=46$. On the other hand, in the opinion of the present writer, this formula, so far as the cheek-teeth are concerned, should be altered to p. $\frac{4}{4}$, m. $\frac{3}{3}$, thus bringing it in accord, so far as these teeth are concerned, with the placental formula, and making the single pair of replacing teeth the third premolars. It may be added that the formula given above shows that the marsupial dentition may comprise more teeth than the 44 which form the normal full placental complement.

As regards geographical distribution, existing marsupials, with the exception of two families, *Didelphyidae* and *Epanorthidae*, are mainly limited to the Australian region, forming the chief mammalian fauna of Australia, New Guinea, and some of the adjacent islands. The *Didelphyidae* are almost exclusively Central and South American, only one or two species ranging into North America. Fossil remains of members of this family have also been found in Europe in strata of the Oligocene period.

History.—The origin and evolution of the Australian marsupials have been discussed by Mr B. A. Bensley. In broad contrast to the views of Dr A. R. Wallace, this author is of opinion that marsupials did not effect an entrance into Australia till about the middle of the Tertiary period, their ancestors being probably opossums of the American type. They were then arboreal; but they speedily entered upon a rapid, although short-lived, course of evolution, during which leaping terrestrial forms like the kangaroos were developed. The short period of this evolution is at least one factor in the primitive grade of even the most specialized members of the group. In the advance of their molar teeth from a tritubercular to a grinding type, the author traces a curious parallelism between marsupials and placentals. Taking opossums to have been the ancestors of the group, the author considers that the present writer may be right in his view that marsupials entered Australia from Asia by way of New Guinea. On the other hand there is nothing absolutely decisive against their origin being southern.

Again, taking as a text Mr L. Dollo's view that marsupials were originally arboreal, that, on account of their foot-structure, they could not have been the ancestors of placentals, and that they themselves are degenerate placentals, Mr Bensley contrasts this with Huxley's scheme of mammalian evolution. According to the latter, the early monotremes which became specialized into modern monotremes, gave rise to the ancestors of the modern marsupials; while the modern placentals are likewise an offshoot from the ancestral marsupial stock. This phylogeny, the author thinks, is the most probable of all. It is urged that the imperfect placenta of the bandicoots instead of being vestigial, may be an instance of parallelism, and that in marsupials generally the allantois failed to form a placental connexion. Owing to the antiquity of both placentals and marsupials, the arboreal character of the feet of the modern forms of the latter is of little importance. Further, it is considered that too much weight has been assigned to the characters distinguishing monotremes from other mammals, foetal marsupials showing a monotreme type of coracoid, while it is probable that in the long run it will be found impossible to maintain the essential dissimilarity between the milk-glands of monotremes and other mammals.

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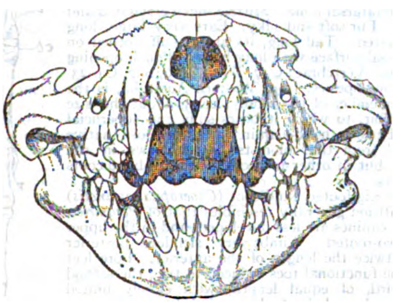
[1] The presence or absence of the corpus callosum has been much disputed; the latest researches, however, indicate its absence.

Another view is to regard both marsupials and placentals as derivates from implacental ancestors more or less nearly related to the creodont carnivora, or possibly as independently descended from anomodont reptiles (see Creodonta). Finally, there is the hypothesis that marsupials are the descendants of placentals, in which case, as was suggested by its discoverer, the placenta of the bandicoots would be a true vestigial structure.

Classification.

Existing marsupials may be divided into three main divisions or sub-orders, of which the first, or Polyprotodontia, is common to America and Australasia; the second, or Paucituberculata, is exclusively South American; while the third, or Diprotodonts, is as solely Australasian inclusive of a few in the eastern Austro-Malayan islands.

1. *Polyprotodonts.*—The Polyprotodonts are characterized by their numerous, small, sub-equal incisors, of which there are either five or four pairs in the upper and always three in the lower jaw, (fig. 2) and the generally strong and large canines, as well as by the presence of from four to five sharp cusps or tubercles on the crown of the molars. The pouch is often absent, and may open backwards. For the most part the species are carnivorous or insectivorous.



From Flower, *Quart. Jour. Geol. Soc.*

Fig. 2.—Front View of Skull of the Tasmanian Devil (*Sarcophilus ursinus*) to exhibit polyprotodont type of dentition.

The first family is that of the true or American opossums—*Didelphyidae*, in which there are five pairs of upper incisors, while the feet are of the presumed primitive arboreal type, the hind foot having the four outer toes subequal and separate, with the first opposable to them all. With the exception of the water-opossum, forming the genus *Chironectes*, all the living members of the family may be included in the genus *Didelphys*. The latter may, however, be split up into several sub-generic groups, such as *Metachirus*, *Philander*, *Marmosa* (*Micoureus* or *Grymaeomys*), *Peramys*, *Dromiciops*, &c. The small South American forms included in *Marmosa*, which lack the pouch, and have numerous teats, and molar teeth of a primitive type, are doubtless the most generalized representatives of the group (see Opossum; and Water-Opossum).

Nearly allied is the Australian family *Dasyuridae*, characterized by the presence of only four pairs of upper incisors, the generally small and rudimentary condition of the first hind toe, which can but seldom be opposed to the rest, and the absence of prehensile power in the tail; the pouch being either present or absent, and the fore feet always five-toed. The stomach is simple, and there is no caecum to the intestine, although this is present in the opossums.

The largest representative of the family is the Tasmanian wolf, or thylacine, alone representing the genus *Thylacinus*, in which the dentition numbers i. $\frac{4}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{4}{4}$ = 46; with the incisors small and vertical, the outer one in the upper jaw being larger than the others. Summits of the lower incisors, before they are worn, with a deep transverse groove, dividing it into an anterior and a posterior cusp. Canines long, strong and conical. Premolars with compressed crowns, increasing in size from before backwards. Molars in general characters resembling those of *Sarcophilus*, but of more simple form, the cusps being less distinct and not so sharply pointed. Deciduous molar very small, and shed before the animal leaves the mother's pouch. General form dog-like, with the head elongated, the muzzle pointed, and the ears moderate, erect and triangular. Fur short and closely applied to the skin. Tail of moderate length, thick at the base and tapering towards the apex, clothed with short hair. First hind toe (including the metacarpal bone) absent. Vertebrae: C. 7, D. 13, L. 6, S. 2, Ca. 23. Marsupial bones unossified. The gradual passage of the thick root of the tail into the body is a character common to the Tasmanian wolf and the aard-vark, and may be directly inherited from reptilian ancestors (see Thylacine).

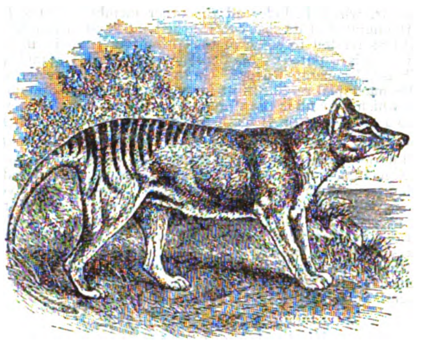


Fig. 3.—The Tasmanian Wolf, or Thylacine (*Thylacinus cynocephalus*).

The next genus is represented solely by the Tasmanian devil, *Sarcophilus* (or *Diabolus*) *ursinus*, a medium-sized animal with a dental formula similar to that of the dasyures, but with teeth (fig. 2) approximating to those of the thylacine, though markedly different in details. The first hind toe is absent.

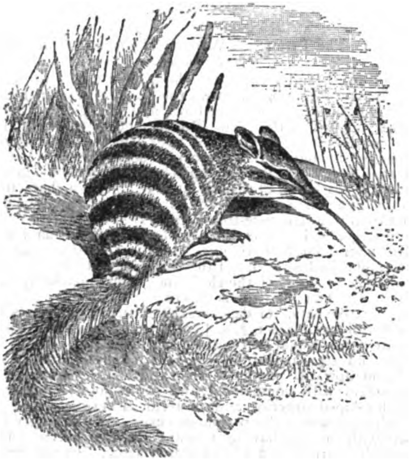
In the "native cats," or dasyures, constituting the genus *Dasyurus*, the dental formula is i. $\frac{4}{3}$, c. $\frac{1}{1}$, p. $\frac{2}{2}$, m. $\frac{4}{4}$: total 42. The upper incisors are nearly equal and vertical, with the first slightly longer, narrower, and separated from the rest. Lower incisors sloping forward and upward. Canines large and sharply pointed. First two premolars with compressed and sharp-pointed crowns, and slightly developed anterior and posterior accessory basal cusps. Molars with numerous sharp-pointed cusps. In the upper jaw the first two with crowns having a triangular free surface; the last small, simple, narrow and placed transversely. In the lower jaw the molars more compressed, with longer cusps; the last not notably smaller than the others. Ears of moderate size, prominent and obtusely pointed. First hind toe rudimentary, clawless or absent; its metatarsal bone always present. Tail generally long and well clothed with hair. Vertebrae: C. 7, D. 13, L. 6, S. 2, Ca. 18–20 (see Dasyure).

The genus *Phascologale* comprises a number of small marsupials, none exceeding a rat in size, differing from the dasyures in possessing an additional premolar—the dentition being i. $\frac{4}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{4}{4}$: total 46—and in having the teeth generally developed upon an insectivorous rather than a carnivorous pattern, the upper middle incisors being larger and inclined forward, the canines relatively smaller and the molars with broad crowns, armed with prickly tubercles. The muzzle is pointed. Ears moderately rounded, and nearly naked. Fore feet with five sub-equal toes, with compressed, slightly curved pointed claws. Hind feet with the four outer toes sub-equal, with claws similar to those in the fore feet; the first toe almost always distinct and partially opposable, though small and nailless, sometimes absent.

In some respects intermediate between the preceding and the next genus is *Dasyuroides byrnei*, of Central Australia, an animal of the size of a rat, with one lower premolar less than in *Phascologale*, without the first hind toe, and with a somewhat thickened tail. The pouch is incomplete, with two lateral folds, and the number of teats six.

Sminthopsis includes several very small species, with the same dental formula as *Phascologale*, but distinguished from that genus by the narrowness of the hind foot, in which the first toe is present, and the granulated or hairy (in place of broad, smooth and naked) soles. A pouch is present, and there are eight or ten teats. Nearly allied is the jumping *Antechinomys laniger*, of East Central Australia, an elegant mouse-like creature, with large oval ears, elongated limbs, a long and tufted tail and no first hind toe. In connexion with the large size of the ears is the excessive inflation of the auditory bulla of the skull.

From all other members of the family the marsupial, or banded, ant-eater (*Myrmecobius fasciatus*) differs by the presence of more than seven pairs of cheek-teeth in each jaw, as well as by the exceedingly long and protrusile tongue. Hence it is made the type of a distinct subfamily, the *Myrmecobiinae*, as distinct from the *Dasyurinae*, which includes all the other members of the family. From the number of its cheek-teeth, the banded ant-eater has been regarded as related to some of the primitive Jurassic mammals; but this view is disputed by Mr Bensley, who regards this multiplicity of teeth as a degenerate feature. On the other hand, it is noteworthy that this marsupial retains in its lower jaw the so-called mylo-hyoid groove, which is found in the aforesaid Jurassic mammals. *Myrmecobius* has a total of 52 or 54 teeth, which may be classed as i. $\frac{4}{3}$, c. $\frac{1}{1}$, p. + m. $\frac{8 \text{ or } 9}{8 \text{ or } 9}$. The teeth are all small and (except the four posterior inferior molars) separated from each other by an interval. Head elongated, but broad behind; muzzle long and pointed; ears of moderate size, ovate and rather pointed. Fore-feet with five toes, all having strong pointed, compressed claws, the second, third and fourth nearly equal, the fifth somewhat and the first considerably shorter. Hind-feet with no trace of first toe externally, but the metatarsal bone is present. Tail long, clothed with long hairs. Fur rather harsh and bristly. Female without pouch, the young when attached to the nipples being concealed by the long hair of the abdomen. Vertebrae: C. 7, D. 13, L. 6, S. 3, Ca. 23.



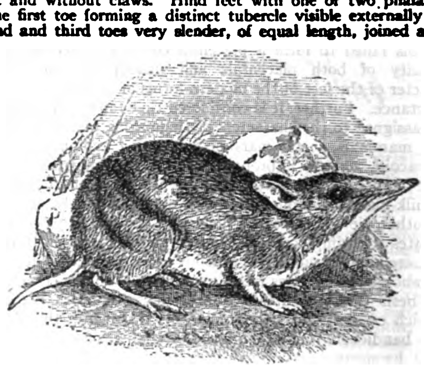
From Gould.

FIG. 4.—The Marsupial or Banded Ant-eater (*Myrmecobius fasciatus*).

The single species, which is a native of western and southern Australia, is about the size of an English squirrel, to which its long bushy tail gives it some resemblance; but it lives entirely on the ground, especially in sterile sandy districts, feeding on ants. Its prevailing colour is chestnut-red, but the hinder part of the back is marked with broad, white, transverse bands on a dark ground.

With the bandicoots, or *Peramelidae*, we come to a family of polyprotodonts which resemble the diprotodonts in the peculiarly specialized structure of their hind limbs; an adaptation which we must apparently regard as having been independently acquired in the two groups. The dentition is i. $\frac{5}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{4}{4}$; total, 48; the upper incisors being small, with short, broad crowns; the lower incisors moderate, narrow, proclivous; canines well developed. Premolars compressed, pointed; and the molars with quadrate tuberculated crowns. Deciduous premolar preceded by a minute molariform tooth, which remains in place until the animal is nearly full grown. Fore feet with two or three of the middle toes of nearly equal size, and provided with strong, sharp, slightly curved claws, the other toes rudimentary. Hind feet long and narrow; the first toe rudimentary or absent; the second and third very slender and united in a common integument; the fourth very large, with a stout elongated conical claw; the fifth smaller than the fourth (see fig. 6). The terminal phalanges of the large toes of both feet cleft at their extremities. Head elongated, with the muzzle long, narrow and pointed. Stomach simple. Caecum of moderate size. Pouch complete, generally opening backwards. Alone among marsupials bandicoots have no clavicles. More remarkable still is the development of a small allantoic placenta.

In the true bandicoots of the genus *Perameles* (fig. 5) the fore-feet have the three middle toes well developed, the third slightly larger than the second, the fourth somewhat shorter, provided with long, strong, slightly curved, pointed claws. First and fifth toes very short and without claws. Hind feet with one or two phalanges, in the first toe forming a distinct tubercle visible externally; the second and third toes very slender, of equal length, joined as far as the terminal phalange, but with distinct claws; the fifth intermediate in length between these and the largely developed fourth toe. Ears of moderate or small size, ovate, pointed. Tail rather short, clothed with short depressed hairs. Fur short and harsh. Pouch opening backwards. Vertebrae: C. 7, D. 13, L. 6, S. 1, Ca. 17. (see BANDICOOT.)



From Gould.

FIG. 5.—Gunn's Bandicoot (*Perameles gunni*).

The rabbit-bandicoot, *Peragale* (or *Thylacomys*) represents a genus in which the cheek-teeth are curved, with longer crowns and shorter roots than in the last. Hind extremities proportionally longer with inner toe represented only by a small metatarsal bone. Muzzle much elongated and narrow. Fur soft and silky. Ears very large, long and pointed. Tail long, its apical half-clothed on the dorsal surface with long hairs. Pouch opening forwards. Vertebrae: C. 7, D. 13, L. 6, S. 2, Ca. 23.

The one species, from Western Australia, is the largest member of the family, being about the size of a rabbit, to which it bears sufficient superficial resemblance to have acquired the name of "native rabbit" from the colonists. It burrows in the ground, but in other respects resembles bandicoots in habits.

In the pig-footed bandicoot (*Choeropus castanotis*) the dentition generally resembles that of *Perameles*, but the canines are less developed, and in the upper jaw two-rooted. Limbs very slender; posterior nearly twice the length of the anterior. Fore feet with the functional toes reduced to two, the second and third, of equal length, with closely united metacarpals and short, sharp, slightly curved, compressed claws. First toe represented by a minute rudiment of a metacarpal bone; the fourth by a metacarpal and two small phalanges without a claw, and not reaching the middle of the metacarpal of the third; fifth entirely absent. Hind foot long and narrow, mainly composed of the strongly developed fourth toe, terminating in a conical pointed nail, with a strong pad behind it; the first toe represented by a rudimentary metatarsal; the remaining toes completely developed, with claws, but exceedingly slender; the united second and third reaching a little way beyond the metatarso-phalangeal articulation of the fourth; the fifth somewhat shorter. Tail not quite so long as the body, and covered with short hairs. Ears large and pointed, and folded down when the animal is at rest. Fur soft and loose. Pouch opening backwards. Vertebrae: C. 7, D. 13, L. 6, S. 1, Ca. 20.

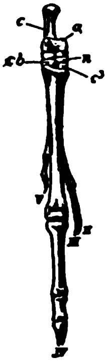
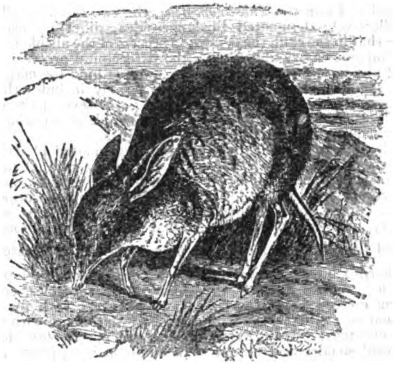


FIG. 6.—Skeleton of Hind Foot of *Choeropus castanotis*.

c, calcaneum; a, astragalus; cb, cuboid; n, navicular; c³, ectocuneiforme; II. and III. the conjoined second and third digits; IV. the large and only functional digit; V. the rudimentary fifth digit.

The only species of this genus is about the size of a small rat, found in the interior of Australia. Its general habits and food appear to resemble those of other bandicoots. A separate family, *Notoryctidae*, is represented by the marsupial mole (*Notoryctes typhlops*), of the deserts of south Central Australia, a silky, golden-haired, burrowing creature, with a curious leathery muzzle, and a short, naked stumpy tail. The limbs are five-toed, with the third and fourth toes of the front pair armed with enormous digging claws;

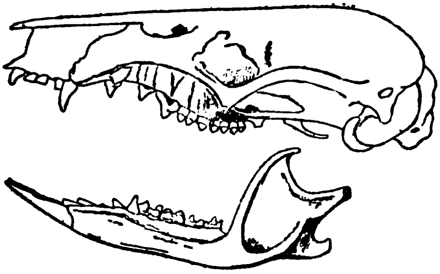
there are no external ear-conchs; and the dentition includes four pairs of upper, and three of lower, incisors, and distinctly tritubercular cheek-teeth. The small pouch, supported by the usual epipubic bones, opens backwards. In correlation with its burrowing habits, some of the vertebrae of the neck and of the loins are respectively welded together. The eyes have degenerated to a greater extent than those of any other burrowing mammal, the retina being reduced to a mass of simple cells, and the cornea and sclerotic (" white ") to a pear-shaped fibrous capsule enclosing a ball of pigment. The reason for this extreme degeneration is probably to be found in the sandy nature of the soil in which the creature burrows, a substance which would evidently irritate and inflame any functional remnant of an eye. The portion of the lachrymal duct communicating with the cavity of the nose has, on the other hand, been abnormally developed, apparently for the purpose of cleansing that chamber from particles of sand which may obtain an entrance while the animal is burrowing. (See MARSUPIAL MOLE.)



From Gould.

FIG. 7.—The Pig-footed Bandicoot (*Choeropus castanotis*).

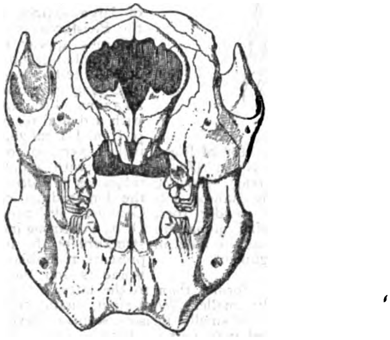
2. *Paucituberculates.*—The second suborder of marsupials, the Paucituberculata, is exclusively South American, and typically represented by the family *Epanorthidae*, the majority of the members of which are extinct, their remains being found in the probably Miocene Santa Cruz beds of Patagonia, although one existing genus (*Caenolestes*) survives in Ecuador and Colombia. One of the two living species was, indeed, described so long ago as the year 1863, under the preoccupied name of *Hyracodon*, but attracted little or no attention, as its affinities were not fully recognized. Externally *Caenolestes* has a shrew-like appearance. The elongated skull (fig. 8) has four pairs of upper incisors and long upper canines, while in the lower jaw there is a single pair of procumbent incisors, followed by several small teeth representing the canine and earlier premolars. The three pairs of molars in each jaw are, like the last premolar, quadritubercular oblong teeth. The five-toed feet are of normal structure, and the rat-like tail is prehensile towards the tip. The female has a small pouch. The extinct members of the family are represented by the genera *Epanorthus*, *Acdestis*, *Garzonia*, &c. In a second family—*Abderitidae*—also from the Patagonian Miocene, the penultimate premolar is developed into an enormous tooth, with a tall, secant and grooved crown, somewhat after the fashion of the enlarged premolar of *Plagiaulax*. From the structure of the skull, it is thought probable that *Abderites* had an elongated snout, like that of many Insectivora. As a sub-order, the Paucituberculata are characterized by the presence of four pairs of upper and three of lower incisor teeth; the enlargement and forward inclination of the first pair of lower incisors, and the presence of four or five sharp cusps on the cheek-teeth, coupled with the absence of "syndactylism" in the hind limbs.



After Thomas.

FIG. 8.—Skull of *Caenolestes obscurus*.

3. *Diprotodonts.*—The third and last sub-order of marsupials is the Diprotodontia, which is exclusively Australasian and includes the wombats, koala, cuscuses, kangaroos and their relatives. There are never more than three pairs of upper and one of lower incisors, of which the middle upper and the single lower pair are large and chisel-like (fig. 9); the canines are small or absent; the cheek-teeth have bluntly tuberculate or transversely-ridged crowns in most cases; and the hind-feet are syndactylous. With one exception, the intestine has a caecum, and the pouch is large and opens forwards. It should be added that Professor Elliot Smith has pointed out a certain peculiarity in its commissures whereby the brain of the diprotodonts differs markedly from that of the polyprotodonts and approximates to the placental type. Dr Einar Lönnberg has also recorded certain adaptive peculiarities in the stomach. Most of the species, particularly the specialized types, are more or less completely herbivorous.



From Flower, *Quart. Journ. Geol. Soc.*

FIG. 9.—Front view of Skull of the Koala (*Phascolarctus cinereus*) to exhibit Diprotodont type of dentition.

The first family, *Phascolomyidae*, is typified by the wombats; but according to the view adopted by Mr H. Winge, and endorsed by Professor Max Weber, is also taken to include the koala. In this wider sense the family may be characterized as follows. The tympanic process of the alisphenoid bone of the skull is short, not covering the cavity of the tympanum, nor reaching the paroccipital process. The tail is rudimentary, the first hind-toe opposable, the first pair of upper incisors very large, but the second and third either absent or small and placed partially behind the larger pair; and only five pairs of cheek-teeth in each jaw. The stomach has a cardiac gland, and the number of teats is two.

In the wombats (*Phascolomys*) the dentition is i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. + m. $\frac{5}{5}$, total 24; all the teeth growing from persistent pulps, and the incisors large and chisel-like, with enamel only on the front surface. The cheek-teeth strongly curved, forming from the base to the summit about a quarter of a circle, the concavity being directed outwards in the upper and inwards in the lower teeth. The first of the series (which appears to have no predecessor) single-lobed; the other four composed of two lobes, each subtriangular in section. Limbs equal, stout and short. Fore-feet with five distinct toes, each furnished with a long, strong and slightly curved nail, the first and fifth considerably shorter than the other three. Hind-feet with a very short nail-less first toe, the second, third and fourth toes partially united by integument, of nearly equal length, the fifth distinct and rather shorter; all four with long and curved nails. In the skeleton the second and third toes are distinctly more slender than the fourth, showing a tendency towards the character so marked in the following families. Tail rudimentary. Caecum very short and wide, with a vermiform appendage (see WOMBAT).

In addition to remains referable to the existing genus, the Pleistocene deposits of Australia have yielded evidence of an extinct giant wombat constituting the genus *Phascolonus* (*Sceparnodon*).

The koala, or " native bear " (*Phascolarctus cinereus*), which differs widely from the wombats in its arboreal habits, is less specialized as regards its dentition, of which the formula is i. $\frac{3}{1}$, c. $\frac{1}{0}$, p. + m. $\frac{5}{5}$, total 30. Upper incisors crowded together, cylindroidal, the first much larger than the others, with a bevelled cutting edge (fig. 9). Canine very small; a considerable interval between it and the first premolar, which is as long from before backwards but not so broad as the molars, and has a cutting edge, with a smaller parallel inner ridge. The molar-like teeth slightly diminishing in size from the first to the fourth, with square crowns, each bearing four pyramidal cusps. The lower incisors are partially inclined forwards, compressed and tapering, bevelled at the ends. Cheek-teeth in continuous series, as in the upper jaw. Fore-feet with the two inner toes slightly separated from and opposable to the remaining three, all with strong curved and much compressed claws. Hind-foot (fig. 10) with the first toe placed far back, large and broad, the second and third (united) toes considerably smaller than the other two; the fourth the largest. No external tail. Fur dense and woolly. Ears of moderate size, thickly clothed with long hair. Caecum very long and dilated, with numerous folds. Vertebrae: C. 7, D 11, L. 8, S. 2, Ca. 8. Ribs eleven pairs (see **Koala**).

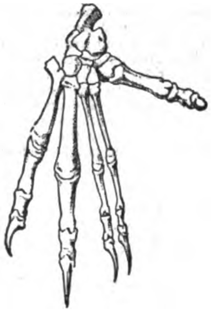


Fig. 10.—Skeleton of Right Hind-Foot of Koala (*Phascolarctus cinereus*), showing stout opposable hallux, followed by two slender toes, which in the living animal are enclosed as far as the nails in a common integument.

Here may be noticed three genera of large extinct marsupials from the Pleistocene of Australia whose affinities appear to ally them to the wombat-group on the one hand and to the phalangers on the other. The longest known is *Diprotodon*, an animal of the size of a rhinoceros, with a dental formula of i. $\frac{3}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{4}{4}$, total 28. The first upper incisor very large and chisel-like, molars with prominent transverse ridges, as in *Macropus*, but without the longitudinal connecting ridge. Complete skeletons disinterred by Dr E. C. Stirling indicate that in the structure of the feet this creature presents resemblances both to the wombats and the phalangers, but is nearer to the former than to the latter. On the other hand, the considerably smaller *Nototherium*, characterized by its sharp and broad skull and smaller incisors, seems to have been much more wombat-like, and may perhaps have possessed similar burrowing habits.

The last of the three is *Thylacoleo carnifex*, so named on account of its supposed carnivorous habits. In the adult the dentition (fig. 11) is i. $\frac{3}{1}$, c. $\frac{1}{0}$, p.+m. $\frac{4}{3}$, total 24. The first upper incisor is much larger than the others; canine and first two premolars rudimentary. In the lower jaw there are also one or two small and early deciduous premolars; third premolars of both jaws formed on the same type as that of the rat-kangaroos, but relatively much larger; molars rudimentary, tubercular. The functional teeth are reduced to one pair of large cutting incisors situated close to the middle line, and one great, cutting, compressed premolar, on each side above and below. As already mentioned, *Thylacoleo* was originally regarded as a carnivorous creature, but this view was subsequently disputed, and its diet supposed to consist of soft roots, bulbs and fruits, with an occasional small bird or mammal. Recently, however, the pendulum of opinion has swung back towards the original view: and Dr R. Broom believes *Thylacoleo* to have been "a purely carnivorous animal, and one which would be quite able to, and probably did, kill animals as large or larger than itself." The affinities of the creature are clearly with the phalangers.

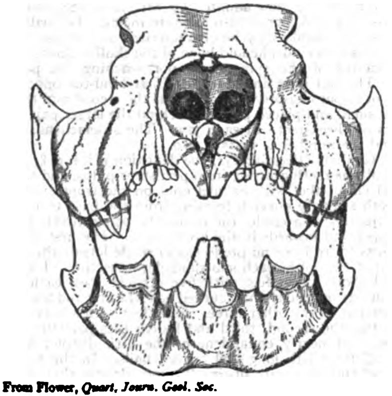

From Flower, *Quart. Journ. Geol. Soc.*

Fig. 11.—Front view of Skull of *Thylacoleo carnifex*, restored.

By means of the little musk-kangaroo, the cuscuses and phalangers constituting the family *Phalangeridae*, are so closely connected with the kangaroos, or *Macropodidae*, that in the opinion of some naturalists they ought all to be included in a single family, with three sub-families. Theoretically, no doubt, this is correct, but the typical members of the two groups are so different from one another that, as a matter of convenience, the retention of the two families seems advisable. From the *Phascolomyidae*, the two families which may be collectively designated Phalangeroidea, differ by the circumstance that in the skull the tympanic process of the alisphenoid covers the tympanic cavity and reaches the paroccipital process. The tail is long and in some cases prehensile; the first hind-toe may be either large, small or absent; the dentition usually includes three pairs of upper and one of lower incisors, and six or seven pairs of cheek-teeth in each jaw; the stomach is either simple or sacculated, without a cardiac gland; and there are four teats.

With the exception of the aberrant long-snouted phalanger, the members of the family *Phalangeridae* have the normal number of functional incisors, in addition to which there may be one or two rudimentary pairs in the lower jaw. The first in the upper jaw is strong, curved and cutting, the other two generally somewhat smaller; the single lower functional incisor large, more or less inclined forwards; canines $\frac{1}{1 \text{ or } 0}$, upper small or moderate, conical and sharp-pointed; lower absent or rudimentary; premolars variable; molars $\frac{4}{4}$, or $\frac{3}{3}$, with four obtuse tubercles, sometimes forming crescents. Limbs subequal. Fore-feet with five distinct subequal toes with claws. Hind-feet short and broad, with five well-developed toes; the first large, nailless and opposable; the second and third slender and united by a common integument as far as the claws. Caecum present (except in *Tarsipes*), and usually large. The lower jaw has no pocket on the outer side. All are animals of small or moderate size and arboreal habits, feeding on a vegetable or mixed diet, and inhabiting Australia, Papua and the Moluccan Islands.

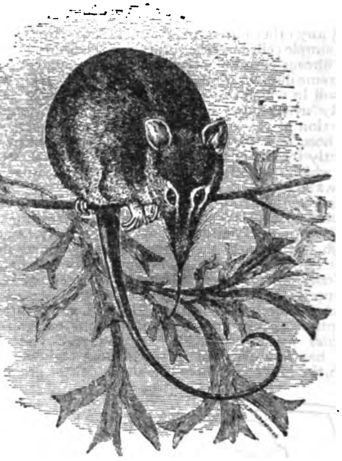

From Gould.

Fig. 12.—The Long-snouted Phalanger (*Tarsipes rostratus*).

As the first example of the group may be taken the elegant little long-snouted phalanger (*Tarsipes rostratus*, fig. 12), a west Australian creature of the size of a mouse, which may be regarded as representing by itself a sub-family (*Tarsipediinae*), characterized by the rudimentary teeth, the long and extensile tongue, and absence of a caecum. The head is elongated, with a slender muzzle and the mouth-opening small. The two lower incisors are long, very slender, sharp-pointed and horizontally placed. All the other teeth are simple, conical, minute and placed at considerable and irregular intervals apart in the jaws, the number appearing to vary in different individuals and even on different sides of the jaw of the same individuals. The formula in one specimen was i. $\frac{2-2}{1-1}$, c. $\frac{1-1}{0-0}$, p.+m. $\frac{3-4}{2-3}$; total 20. The lower jaw is slender, nearly straight, and without a coronoid process or inflected angle. Fore-feet with five well-developed toes, carrying small, flat, scale-like nails, not reaching the extremity of the digits. Hind-feet rather long and slender, with a well-developed opposable and nailless first toe;

second and third digits united, with sharp, compressed curved claws; the fourth and fifth free, with small flat nails. Ears of moderate size and rounded. Tail longer than the body and head, scantily clothed with short hairs, prehensile. Vertebrae: C. 7, D. 13, L. 5, S. 3, Ca. 24.

As indicated in the accompanying illustration, the long-snouted phalanger is arboreal in habits, extracting honey and probably small insects from long-tubed flowers by means of its extensile tongue.

The remaining members of the family may be included in the sub family *Phalangerinae*, characterized by the normal nature of the dentition (which shows rudimentary lower canines) and tongue. Cuscuses and phalangers form a numerous group, all the members of which are arboreal, and some of which are provided with lateral expansions of skin enabling them to glide from tree to tree like flying-squirrels. The typical members of the group are the cuscuses (*Phalanger*), ranging from the Moluccas and Celebes to New Guinea, in which the males are often different in colour from the females. The true phalangers, or opossums of the colonists, constitute the genus *Trichosurus*, while the ring-tailed species are known as *Pseudochirus*; the latter ranging to New Guinea. *Dactylopsila* is easily recognized by its attenuated fourth finger and parti-coloured fur; the flying species are classed as *Petauroides*, *Petaurus*, *Gymnobelideus* and *Acrobates*, the last no larger than a mouse; while *Dromicia*, *Dislaechurus* and *Acrobates* are allied types without parachutes (see PHALANGER).

An equally brief notice must suffice of the kangaroo tribe or *Macropodidae*, since these receive a special notice elsewhere. The dentition is i. $\frac{3}{1}$, c. $\frac{0 \text{ or } 1}{0}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$; the incisors being sharp and cutting, and those of the lower jaw frequently having a scissor-like action against one another. The broad molars are either bluntly tuberculated or transversely ridged; the outer side of the hind part of the lower jaw has a deep pocket; and the hind-limbs are generally very long, with the structure of the foot similar to that of the bandicoots. The family is connected with the *Phalangeridae* by means of the musk-kangaroo (*Hypsiprymnodon moschatus*); forming the sub-family *Hypsiprymnodontinae*. Then come the rat-kangaroos, or kangaroo-rats, constituting the sub-family *Potoroinae*, while the tree-kangaroos (*Dendrolagus*), rock-wallabies (*Petrogale*), and wallabies and kangaroos (*Macropus*) form the *Macropodinae* (see KANGAROO).

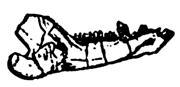
Extinct Marsupials

Reference has been made to the Australasian Pleistocene genera *Phascolonus*, *Diprotodon*, *Nototherium* and *Thylaçoleo*, whose affinities are with the wombats and phalangers. The same deposits have also yielded remains of extinct types of kangaroo, some of gigantic size, constituting the genera *Sthenurus*, *Procoptodon* and *Palorchestes*. Numerous types more or less nearly allied to the phalangers, such as *Burramys* and *Triclis* have also been described, as well as a flying form, *Palaeopetaurus*. It is also interesting to note that fossil remains indicate the former occurrence of thylacines and Tasmanian devils on the Australian mainland. Of more interest is the imperfectly known *Wynyardia*, from older Tertiary beds in Tasmania, which apparently presents points of affinity both to phalangers and dasyures. From the Oligocene deposits of France and southern England have been obtained numerous remains of opossums referable to the American family *Didelphyidae*. These ancient opossums have been separated generically from *Didelphys* (in its widest sense) on account of certain differences in the relative sizes of the lower premolars, but as nearly the whole of the species have been formed on lower jaws, of which some hundreds have been found, it is impossible to judge how far these differences are correlated with other dental or osteological characters. In the opinion of Dr H. Filhol, the fossils themselves represent two genera, *Peratherium*, containing the greater part of the species, about twenty in number, and *Amphiperatherium*, with three species only. All are comparatively small animals, few of them exceeding the size of a rat.

Besides these interesting European fossils, a certain number of didelphian bones have been found in the caves of Brazil, but these are either closely allied to or identical with the species now living in the same region.

The occurrence in the Santa Cruz beds of Patagonia of fossil marsupials allied to the living *Caenolestes* has been mentioned above. The alleged occurrence in the same beds of marsupials allied to the thylacine is based on remains now more generally regarded as referable to the creodont carnivores (see CREODONTA).

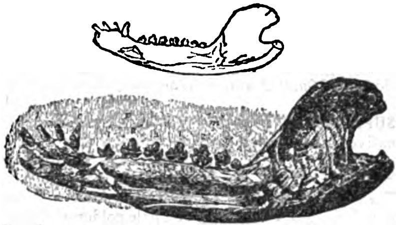
Mesozoic Mammals.—Under the heading of MULTITUBERCULATA will be found a brief account of certain extinct mammals from the Mesozoic formations of Europe and North America which have been regarded as more or less nearly related to the monotremes. The same deposits have yielded remains of small mammals whose dentition approximates more nearly to that of either polyprotodont marsupials or insectivores; and these may be conveniently noticed here without prejudice to their true affinities. Before proceeding further it may be mentioned that the remains of many of these mammals are very scarce, even in formations apparently in every way suitable to the preservation of such fossils, and it hence seems probable that these creatures are stragglers from a country where primitive small mammals were abundant. Not improbably this country was either "Gondwana-land," connecting Mesozoic India with Africa, or perhaps Africa itself. At any rate, there seems little doubt that it was the region where creodonts and other primitive mammals were first differentiated from their reptilian ancestors.



From Owen.

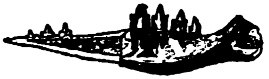
FIG. 13.—Lower Jaw of *Triconodon mordax* (nat. size).

Of the Old World forms, the family *Triconodontidae* is typified by the genus *Triconodon*, from the English Purbeck, in which the cheek-teeth carry three cutting cusps arranged longitudinally. There seems to have been a replacement of some of these teeth; and it has been suggested that this was of the marsupial type. To the same family are referred *Phascolotherium* (fig. 14), of the Lower Jurassic Stonesfield slate of England, and *Spalacotherium* (fig. 15), of the Dorsetshire Purbeck; the latter having the three cusps of the cheek-teeth rotated so as to assume a tritubercular type. Other genera are *Menacodon* and *Priacodon*, the former American, and the latter common to Europe and North America. By one authority *Amphilestes* (fig. 16), of the Stonesfield Slate, is included in the same group, while by a second it is regarded as representing a family by itself. *Amphitherium*, of the Stonesfield Slate, typifies the family *Amphitheriidae*, which includes the American *Dryolestes*, and in which some would class the European Purbeck genus *Amblotherium*, although Professor H. F. Osborn has made the last the type of a distinct family. Yet another family, according to the palaeontologist last named, is typified by the genus *Stylacodon*, of the English Purbeck. To mention the other forms which have received names will be unnecessary on this occasion.



From Owen.

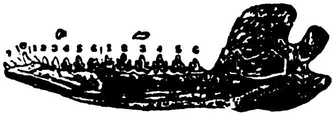
FIG. 14.—Lower Jaw and Teeth of *Phascolotherium bucklandi* (nat. size in outline).



From Owen.

FIG. 15.—*Spalacotherium tricuspidens* Purbeck beds.

It will be observed from the figures of the lower jaws, which are in most cases the only parts known, that in many instances the number of cheek-teeth exceeds that found in modern marsupials except *Myrmecobius*. The latter has indeed been regarded as the direct descendant of these Mesozoic forms; but as already stated, in the opinion of Mr B. A. Bensley, this is incorrect. It may be added that the division of these teeth into premolars and molars in figs. 14 and 16 is based upon the view of Sir R. Owen, and is not altogether trustworthy, while the restoration of some of the missing teeth is more or less conjectural. As regards the affinities of the creatures to which these jaws belonged, Professor Osborn has referred the *Triconodontidae* and *Amphitheriidae*, together with the *Curtodontidae* (as represented by the English Purbeck *Curtodon*), to a primitive group of marsupials, while he has assigned the *Amblotheriidae* and *Stylacodontidae* to an ancestral assemblage of Insectivora. On the other hand, in the opinion of Professor H. Winge, a large number of these creatures are primitive monotremes. Besides the above, in the Trias of North America we have *Dromatherium* and *Microconodon*, extremely primitive forms, representing the family



From Owen.

FIG. 16.—Lower Jaw and Teeth of *Amphilestes broderipi*.

Dromotheriidae, and apparently showing decided traces of reptilian affinity. It may be added that a few traces of mammals have been obtained from the English Wealden, among which an incisor tooth foreshadows the rodent type.

AUTHORITIES.—The above article is partly based on that by Sir W. H. Flower in the 9th edition of this work. See also O. Thomas, Catalogue of Monotremata and Marsupialia in the British Museum (1888); "On *Caenolestes*, a Survivor of the *Epanorthidae*," *Proc. Zool. Soc. London* (1895); J. D. Ogilby, Catalogue of Australian Mammals (Sydney, 1895); B. A. Bensley, "A Theory of the Origin and Evolution of the Australian Marsupialia," *American Naturalist* (1901); "On the Evolution of the Australian Marsupialia, &c.," *Trans. Linn. Soc.* (vol. ix., 1903); L. Dollo, "Arboreal Ancestry of Marsupials," *Miscell. Biologiques* (Paris, 1899); B. Spencer, "Mammalia of the Horn Expedition" (1896); "Wynyardia, a Fossil Marsupial from Tasmania," *Proc. Zool. Soc. London* (1900); J. P. Hill, "Contributions to the Morphology of the Female Urino-genital Organs in Marsupialia," *Proc. Linn. Soc. N. S. Wales*, vols. xxiv. and xxv.; "Contributions to the Embryology of the Marsupialia," *Quart. Journ. Micr. Science*, vol. xliii.; E. C. Stirling, "On *Notoryctes typhlops*," *Proc. Zool. Soc. London* (1891); "Fossil Remains of Lake Cadibona," Part I. *Diprotodon, Mem. R. Soc. S. Australia* (vol. i., 1889); R. Broom, "On the Affinities of *Thylacoleo*," *Proc. Linn. Soc. N. S. Wales* (1898); H. F. Osborn, "Mesozoic Mammalia," *Journ. Acad. Nat. Sci. Philadelphia* (vol. ix., 1888); E. S. Goodrich, "On the Fossil Mammalia from the Stonesfield Slate," *Quart. Journ. Micr. Science* (vol. xxxv., 1894). (R. L.*)

MARSUPIAL MOLE (*Notoryctes typhlops*), the "Ur-quamata" of the natives, an aberrant polyprotodont from central South Australia, constituting a family (*Notoryctidae*). This is a small burrowing animal, of a pale golden-yellow colour, with long silky hair, a horny shield on the nose, and a stumpy leathery tail. The feet are five-toed, and the third and fourth toes of the front pair armed with enormous claws adapted for digging. Neither ear-conches nor eyes are visible externally. There are but three pairs of incisor teeth in each jaw, and the upper molars are tricuspid. This animal spends most of its time burrowing in the sand in search of insects and their larvae, but occasionally makes its appearance on the surface.

Marsupial Mole (*Notoryctes typhlops*).

MARSUS, DOMITIUS, Latin poet, the friend of Virgil and Tibullus, and contemporary of Horace. He survived Tibullus (d. 19 B.C.), but was no longer alive when Ovid wrote (*c.* A.D. 12) the epistle from Pontus (*Ex Ponto*, iv. 16) containing a list of poets. He was the author of a collection of epigrams called *Cicuta* ("hemlock")[1] from their bitter sarcasm, and of a beautiful epitaph on the death of Tibullus; of elegiac poems, probably of an erotic character; of an epic poem *Amazonis*; and of a prose work on wit (*De urbanitate*). Martial often alludes to Marsus as one of his predecessors, but he is never mentioned by Horace, although a passage in the *Odes* (iv. 4, 19) is supposed to be an indirect allusion to the *Amazonis* (M. Haupt, *Opuscula*, iii. 332).

See J. A. Weichert, *Poetarum latinorum vitae et reliquiae* (1830); R. Unger, *De Dom. Marsi cicuta* (Friedland, 1861).

MARSYAS, in Greek mythology, a Phrygian god or Silenus, son of Hyagnis. He was originally the god of the small river of the same name near Celaenae, an old Phrygian town. He represents the art of playing the flute as opposed to the lyre—the one the accompaniment of the worship of Cybele, the other that of the worship of Apollo. According to the legend, Athena, who had invented the flute, threw it away in disgust, because it distorted the features. Marsyas found it, and having acquired great skill in playing it, challenged Apollo to a contest with his lyre. Midas, king of Phrygia, who had been appointed judge, declared in favour of Marsyas, and Apollo punished Midas by changing his ears into ass's ears. In another version, the Muses were judges and awarded the victory to Apollo, who tied Marsyas to a tree and flayed him alive. Marsyas, as well as Midas and Silenus, are associated in legend with Dionysus and belong to the cycle of legends of Cybele. A statue of Marsyas was set up in the Roman forum and colonies as a symbol of liberty. The contest and punishment of Marsyas were favourite subjects in Greek art, both painting and sculpture. In Florence there are several statues of Marsyas hanging on the tree as he is going to be flayed (see GREEK ART, fig. 54, Pl. II.); Apollo and the executioner complete the group. In the Lateran museum at Rome there is a statue representing Marsyas in the act of picking up the flute, a copy of a masterpiece by Myron (Hyginus, *Fab.* 167, 191; Apollodorus i. 4, 2; Ovid, *Metam.* vi. 382–400, xi. 145–193), for which see GREEK ART, fig. 64 (Pl. III.).

MARTABAN, a town in the Thaton district of Lower Burma, on the right bank of the Salween, opposite Moulmein. It is said to have been founded in A.D. 573, by the first king of Pegu, and was once the capital of a powerful Talaing kingdom; but it is now little more than a village. Martaban is frequently mentioned by European voyagers of the 16th century; and it has given the name of "Martavans" to a class of large vessels of glazed pottery, also known in India as "Pegu jars." It was twice captured by the British, in 1824 and 1852. The Bay of Martaban receives the rivers Irrawaddy and Salween.

MARTELLO TOWER, a kind of tower formerly used in English coast defence. The name is a corruption of Mortella. The Martello tower was introduced in consequence of an incident of the French revolutionary wars. In September 1793 a British squadron of three ships of the line and two frigates was ordered to support the Corsican insurgents. It was determined in the first place to take a tower on Cape Mortella which commanded the only secure anchorage in the Gulf of San Fiorenzo. This tower, according to James, was named "after its inventor"; but the real derivation appears to be the name of a wild myrtle which grew thickly around. The tower, which mounted one 24-pounder and two 18-pounders on its top, was bombarded for a short time by the frigates, was then deserted by its little garrison, and occupied by a landing party. The tower was afterwards retaken by the French from the Corsicans. So far it had done nothing to justify its subsequent reputation. In 1794, however, a fresh attempt was made to support the insurgents. On the 7th of February 1400 troops were landed, and the tower was attacked by land and sea on the 8th. The "Fortitude" and "Juno" kept up a cannonade for 2½ hours and then hauled off, the former being on fire and having sixty-two men killed and wounded. The fire from the batteries on shore produced no impression until a hot shot set fire to the "bass junk with which, to the depth of 5 ft., the immensely thick parapet was lined." The garrison of thirty-three men then surrendered. The armament was found to consist only of two 18-pounders and one 6-pounder. The strong resistance offered by these three guns seems to have led to the conclusion that towers of this description were specially formidable, and Martello towers were built in large numbers, and at heavy expense, along the shores of England, especially on the southern and eastern coasts, which in certain parts are lined with these towers at short intervals. They are structures of solid masonry, containing vaulted rooms for the garrison, and providing a platform at the top for two or three guns, which fire over a low masonry parapet. Access is provided by a ladder, communicating with a door about 20 ft. above the ground. In some cases a deep ditch is provided around the base. The chief defect of the tower was its weakness against vertical fire; its masonry was further liable to be cut through by breaching batteries. The French *tours modèles* were somewhat similar to the Martello towers; their chief use was to serve as keeps to unrevetted works. While the Martello tower owes its reputation and its widespread adoption in Great Britain to a single incident of modern warfare, the round masonry structure entered by a door raised high above the base is to be found in many lands, and is one of the earliest types of masonry fortification.

MARTEN, HENRY (1602–1680), English regicide, was the elder son of Sir Henry Marten, and was educated at University College, Oxford. As a public man he first became prominent in 1639 when he refused to contribute to a general loan, and in 1640 he entered parliament as one of the members for

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[1] According to others, a reed-pipe made of the stalks of hemlock; the reading *scutica* ("whip") has also been proposed.

Berkshire. In the House of Commons he joined the popular party, spoke in favour of the proposed bill of attainder against Strafford, and in 1642 was a member of the committee of safety. Some of his language about the king was so frank that Charles demanded his arrest and his trial for high treason. When the Great Rebellion broke out Marten did not take the field, although he was appointed governor of Reading, but in parliament he was very active. On one occasion his zeal in the parliamentary cause led him to open a letter from the earl of Northumberland to his countess, an impertinence for which, says Clarendon, he was "cudgelled" by the earl; and in 1643, on account of some remark about extirpating the royal family, he was expelled from parliament and was imprisoned for a few days. In the following year, however, he was made governor of Aylesbury, and about this time took some small part in the war. Allowed to return to parliament in January 1646, Marten again advocated extreme views. He spoke of his desire to prepare the king for heaven; he attacked the Presbyterians, and, supporting the army against the parliament, he signed the agreement of August 1647. He was closely associated with John Lilburne and the Levellers, and was one of those who suspected the sincerity of Cromwell, whose murder he is said personally to have contemplated. However, he acted with Cromwell in bringing Charles I. to trial; he was one of the most prominent of the king's judges and signed the death warrant. He was then energetic in establishing the republic and in destroying the remaining vestiges of the monarchical system. He was chosen a member of the council of state in 1649, and as compensation for his losses and reward for his services during the war, lands valued at £1000 a year were settled upon him. In parliament he spoke often and with effect, but he took no part in public life during the Protectorate, passing part of this time in prison, where he was placed on account of his debts. Having sat among the restored members of the Long Parliament in 1659, Marten surrendered himself to the authorities as a regicide in June 1660, and with some others he was excepted from the act of indemnity, but with a saving clause. He behaved courageously at his trial, which took place in October 1660, but he was found guilty of taking part in the king's death. Through the action, or rather the inaction of the House of Lords, he was spared the death penalty, but he remained a captive, and was in prison at Chepstow Castle when he died on the 9th of September 1680. Although a leading Puritan, Marten was a man of loose morals. He wrote and published several pamphlets, and in 1662 there appeared *Henry Marten's Familiar Letters to his Lady of Delight*, which contained letters to his mistress, Mary Ward.

Marten's father, Sir Henry Marten (*c.* 1562–1641), was born in London and was educated at Winchester school and at New College, Oxford, becoming a fellow of the college in 1582. Having become a barrister, he secured a large practice and soon came to the front in public life. He was sent abroad on some royal business, was made chancellor of the diocese of London, was knighted, and in 1617 became a judge of the admiralty court. Later he was appointed a member of the court of high commission and dean of the arches. He became a member of parliament in 1625, and in 1628 represented the university of Oxford, taking part in the debates on the petition of right.

See J. Forster, *Statesmen of the Commonwealth* (1840); M. Noble, *Lives of the English Regicides* (1798); the article by C. H. Firth in *Dict. Nat. Biog.* (1893); and S. R. Gardiner, *History of the Great Civil War* and *History of the Commonwealth and Protectorate.*

MARTEN,[1] a name originally belonging to the pine-marten (*Mustela martes*), but now applied to all members of the same genus of carnivorous mammals (see CARNIVORA) Martens are limited to the northern hemisphere, ranging throughout the greater part of the northern temperate regions of both Old and New Worlds, and southwards in America to 35° N. lat., while in Asia one species is met with in Java.

The species appear to be similar in their habits. They live in woods and rocky places, and spend most of their time in trees, although descending to the ground in quest of prey. They climb with great facility, and are agile and graceful in their movements. Some are said occasionally to resort to berries and other fruit for food, but as a rule they are carnivorous, feeding chiefly on birds and their eggs, small mammals, as squirrels, hares, rabbits and moles, but chiefly mice of various kinds, and occasionally snakes, lizards and frogs. In proportion to their size they are among the most bloodthirsty of animals, though less so than the weasels. The female makes her nest of moss, dried leaves and grass in the hollow of a tree, but sometimes in a hole among rocks or ruined buildings, and produces several young at a birth, usually from four to six. Though wild and untameable to a great degree if captured when fully grown, if taken young they are docile, and have frequently been made pets, not having the strong unpleasant odour of the smaller *Mustelidae*. The pine-marten appears to have been partially domesticated by the Greeks and Romans, and used to keep houses clear from rats and mice. In the same way, according to Brian Hodgson, the yellow-bellied weasel (*Putorius kathia*) "is exceedingly prized by the Nepalese for its service in ridding houses of rats. It is easily tamed; and such is the dread of it common to all murine animals that not one will approach a house where it is domiciled." It is, however, to the great value attached to the pelts of these animals that their importance to man is chiefly due. Though all yield fur of serviceable quality, the commercial value varies immensely, not only according to the species from which it is obtained, but according to individual variation, depending upon age, sex, season, and other circumstances. The skins from northern regions are more full and of a finer colour and gloss than those from more temperate climates, as are those of animals killed in winter compared to the same individuals in summer. Fashion has, moreover, set fictitious values upon slight shades of colour. Enormous numbers of animals are caught, chiefly in traps, to supply the demand of the fur trade, Siberia and North America being the principal localities from which they are obtained.

With the exception of the pekan (*M. pennanti*), the martens are much alike in size, general colouring and cranial and dental characters. The following description by Dr Elliott Coues of the American marten (*M. americana*) will apply almost equally well to most of the others. "It is almost impossible to describe the colour of the marten, except in general terms, without going into the details of the endless diversities occasioned by age, sex, season, or other incidents. The animal is 'brown,' of a shade from orange or tawny to quite blackish; the tail and feet are ordinarily the darkest, the head lightest, often quite whitish; the ears usually have a whitish rim, while on the throat there is usually a large tawny-yellowish or orange-brown patch, from the chin to the fore legs, sometimes entire, sometimes broken into a number of smaller, irregular blotches, sometimes wanting, sometimes prolonged on the whole under surface, when the animal is bicolor like a stoat in summer. The general 'brown' has a greyish cast, as far as the under fur is concerned, and is overlaid with rich lustrous blackish-brown in places where the long bristly hairs prevail. The claws are whitish; the naked nose pad and whiskers are black. The tail occasionally shows interspersed white hairs; or a white tip."

The following are the best-known species:—

Mustela foina: the beech-marten, stone-marten or white-breasted marten.—Distinguished from the following by the greater breadth of the skull, and some minute but constant dental characters, by the dull greyish-brown colour of the fur of the upper parts and the pure white of the throat and breast. It inhabits the greater part of the continent of Europe, but is more southern than the next in its distribution, not being found in Sweden or Norway.

M. martes, the pine-marten (see figure).—Fur rich dark brown; under fur reddish-grey, with clear yellow tips; breast spot usually yellow, varying from bright orange to pale cream-colour or yellowish-white. Length of head and body 16 to 18 in., of tail (including the hair) 9 to 12 in. This species is extensively distributed throughout northern Europe and Asia, and was formerly common in most parts of Great Britain and Ireland. It is still found in the northern counties of England and North Wales, but in decreasing numbers. In Scotland it is rare, but in Ireland may be found in almost every county occasionally. Though commonly called "pine-marten," it does not appear to have any special preference for coniferous trees.

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[1] By all old authors, as Ray, Pennant, Shaw and Fleming, the word is written "Martin," but this form of spelling is now generally reserved for the bird (see MARTIN). The word, as applied to the animal here described, occurs in most Germanic and Romanic languages: German, *marder*; Dutch, *marter*; Swedish, *mard*; Danish, *maar*; English, *marteron*, *martern*, *marten*, *martin* and *martlett*; French, *marte* and *martre*; Italian, *martora* and *martorella*; Spanish and Portuguese, *marta*. Its earliest known use is in the form *martes* (Martial, *Ep.* x. 37), but it can scarcely be an old Latin word, as it is not found in Pliny or other classical writers, and Martial often introduced foreign words into his Latin. Its etymology has been connected with the German "martern," to torment. A second Romanic name for the same animal is *fuina*, in French *fouine*. The term "Marten Cat" is also used.

The Pine-Marten (*Mustela martes*).

Next comes *M. sibellina*, the sable (German, *Zobel* and *Zebel*; Swedish, *sabel*; Russian, *sobel*, a word probably of Turanian origin), which closely resembles the last, if indeed it differs except in the quality of the fur—the most highly valued of that of all the group. The sable is found chiefly in eastern Siberia.

Very distinct is the brilliantly coloured orange-and-black Indian marten (*M. flavigula*), found from the Himalaya and Ceylon to Java.

The North American *M. americana* is closely allied to the pine-marten and Asiatic sable. The importance of the fur of this animal as an article of commerce may be judged of from the fact that 15,000 skins were sold in one year by the Hudson's Bay Company as long ago as 1743. It is ordinarily caught in wooden traps of simple construction, being little enclosures of stakes or brush in which the bait is placed upon a trigger, with a short upright stick supporting a log of wood, which falls upon its victim on the slightest disturbance. A line of such traps, several to a mile, often extends many miles. The bait is any kind of meat, a mouse, squirrel, piece of fish or bird's head. It is principally trapped during the colder months, from October to April, when the fur is in good condition, as it is nearly valueless during the shedding in summer. It maintains its numbers partly in consequence of its shyness, which keeps it away from the abodes of men, and partly because it is so prolific, bringing forth six to eight young at a litter. Its home is sometimes a den under ground or beneath rocks, but oftener the hollow of a tree, and it is said to take possession of a squirrel's nest, driving off or devouring the rightful proprietor.

The pekan or Pennant's marten, also called fisher marten, though there appears to be nothing in its habits to justify the appellation, is the largest of the group, the head and body measuring from 24 to 30 in., and the tail 14 to 18 in. It is also more robust in form than the others, its general aspect being more that of a fox than a weasel; in fact its usual name among the American hunters is "black fox." Its general colour is blackish, lighter by mixture of brown or grey on the head and upper fore part of the body, with no light patch on the throat, and unlike other martens generally darker below than above. It was generally distributed in wooded districts throughout the greater part of North America, as far north as Great Slave Lake, lat. 63° N., and Alaska, and extending south to the parallel of 35°; but at the present time is almost exterminated in the settled parts of the United States east of the Mississippi.

(W. H. F.)

MARTENS, FRÉDÉRIC FROMMHOLD DE (1845–1909), Russian jurist, was born at Pernau in Livonia. In 1868 he entered the Russian ministry of foreign affairs, was admitted in 1871 as a *Dozent* in international law in the university of St Petersburg, and in 1871 became lecturer and then (1872) professor of public law in the Imperial School of Law and the Imperial Alexander Lyceum. In 1874 when Prince Gorchakov, then imperial chancellor, needed assistance for certain kinds of special work, Martens was chosen to afford it. His book on *The Right of Private Property in War* had appeared in 1869, and had been followed in 1873 by that upon *The Office of Consul and Consular Jurisdiction in the East*, which had been translated into German and republished at Berlin. These were the first of a long series of studies which won for their author a world-wide reputation, and raised the character of the Russian school of international jurisprudence in all civilized countries. First amongst them must be placed the great *Recueil des traités et conventions conclus par la Russie avec les puissances étrangères* (13 vols., 1874–1902). This collection, published in Russian and French in parallel columns, contains not only the texts of the treaties but valuable introductions dealing with the diplomatic conditions of which the treaties were the outcome. These introductions are based largely on unpublished documents from the Russian archives. Of Martens' original works his *International Law of Civilized Nations* is perhaps the best known; it was written in Russian, a German edition appearing in 1884–1885, and a French edition in 1887–1888. It displays much judgment and acumen, though some of the doctrines which it defends by no means command universal assent. More openly "tendencious" in character are such treatises as *Russia and England in Central Asia* (1879); *Russia's Conflict with China* (1881), *The Egyptian Question* (1882), and *The African Conference of Berlin and the Colonial Policy of Modern States* (1887). In the delicate questions raised in some of these works Martens stated his case with learning and ability, even when it was obvious that he was arguing as a special pleader. Martens was repeatedly chosen to act in international arbitrations. Among the controversies which he helped to adjust were that between Mexico and the United States—the first case determined by the permanent tribunal of The Hague—and the difference between Great Britain and France in regard to Newfoundland in 1891. He played an important part in the negotiations between his own country and Japan, which led to the peace of Portsmouth (Aug. 1905) and prepared the way for the Russo-Japanese convention. He was employed in laying the foundations for The Hague Conferences. He was one of the Russian plenipotentiaries at the first conference and president of the fourth committee—that on maritime law—at the second conference. His visits to the chief capitals of Europe in the early part of 1907 were an important preliminary in the preparation of the programme. He was judge of the Russian supreme prize court established to determine cases arising during the war with Japan. He received honorary degrees from the universities of Oxford, Cambridge and Yale; he was also awarded the Nobel Peace Prize in 1902. In April 1907 he addressed a remarkable letter to *The Times* on the position of the second Duma, in which he argued that the best remedy for the ills of Russia would be the dissolution of that assembly and the election of another on a narrower franchise. He died suddenly on the 20th of June 1909.

See T. E. Holland, in *Journal of the Society of Comparative Legislation* for October 1909, where a list of the writings of Martens appears.

MARTENS, GEORG FRIEDRICH VON (1756–1821), German jurist and diplomatist, was born at Hamburg on the 22nd of February 1756. Educated at the universities of Göttingen, Regensburg and Vienna, he became professor of jurisprudence at Göttingen in 1783 and was ennobled in 1789. He was made a counsellor of state by the elector of Hanover in 1808, and in 1810 was president of the financial section of the council of state of the kingdom of Westphalia. In 1814 he was appointed privy cabinet-councillor (*Geheimer Kabinetsrat*) by the king of Hanover, and in 1816 went as representative of the king to the diet of the new German Confederation at Frankfort, where he died on the 21st of February 1821.

Of his works the most important is the great collection of treaties *Recueil des traités, &c.*) from 1761 onwards. Of this the first seven volumes were published at Göttingen (1791–1801), followed by four supplementary volumes partly edited by his nephew Karl von Martens (see below). These were followed by *Nouveau recueil*, of treaties subsequent to 1808, in 16 vols. (Göttingen, 1817–1842), of which G. F. von Martens edited the first four, the fifth being the work of K. von Martens, the others (6–9) by F. Saalfeld and (10–16) F. Murhard. A *Nouveau supplément*, in 3 vols., filling gaps in the previous collection, was also published by Murhard (Göttingen, 1839–1842). This was followed by *Nouveau recueil . . . continuation du grand recueil de Martens*, in 20 vols. (Göttingen, 1843–1875), edited in turn by F. Murhard, C. Murhard, J. Pinhas, C. Samwer and J. Hopf, with a general index of treaties from 1494 to 1874 (1876). This was followed by *Nouveau recueil, 2me série* (Göttingen, 1876–1896; vols. xxii.–xxxv., Leipzig, 1897–1908). From vol. xi. on this series was edited by Felix Störk, professor of public law at Greifswald. In 1909 appeared vol. i. of a further *Continuation* (*troisième série*) under the editorship of Professor Heinrich Triepel of Kiel University.

Of Martens' other works the most important are the *Précis du droit des gens modernes de l'Europe* (1789; 3rd ed., Göttingen, 1821; new ed., G. S. Pinheiro-Ferreira, 2 vols., 1858, 1864); *Erzählungen merkwürdiger Fälle des neueren europäischen Völkerrechts*, 2 vols. (Göttingen, 1800–1802); *Cours diplomatique ou tableau des relations des puissances de l'Europe*, 3 vols. (Berlin, 1801); *Grundriss einer diplomatischen Gesch. der europ. Staatshändel u. Friedensschlüsse seit dem Ende des 15. Jahrhunderts* (ibid. 1807).

His nephew Karl von Martens (1790–1863), who at his death was minister resident of the grand-duke of Weimar at Dresden, published a *Manuel diplomatique* (Leipzig, 1823), re-issued as *Guide diplomatique* in two vols. in 1832 (5th ed. by Geffcken, 1866), a valuable textbook of the rules and customs of the diplomatic service; *Causes célèbres du droit des gens* (2 vols., ibid., 1827) and *Nouvelles causes célèbres* (2 vols., ibid., 1843), both republished, in 5 vols. (1858–1861); *Recueil manuel et pratique de traités* (7 vols., ibid., 1846–1857); continued by Geffcken in 3 vols., 1885–1888).

MARTENSEN, HANS LASSEN (1808–1884), Danish divine, was born at Flensburg on the 19th of August 1808. He studied in Copenhagen, and was ordained in the Danish Church. At Copenhagen he was lektor in theology in 1838, professor extraordinarius in 1840, court preacher also in 1845, and professor ordinarius in 1850. In 1854 he was made bishop of Seeland. In his studies he had come under the influence of Schleiermacher, Hegel and Franz Baader; but he was a man of independent mind, and developed a peculiar speculative theology which showed a disposition towards mysticism and theosophy. His contributions to theological literature included treatises on Christian ethics and dogmatics, on moral philosophy, on baptism, and a sketch of the life of Jakob Boehme, who exercised so marked an influence on the mind of the great English theologian of the 18th century, William Law. Martensen was a distinguished preacher, and his works were translated into various languages. The "official" eulogy he pronounced upon Bishop Jakob P. Mynster (1775–1854) in 1854, brought down upon his head the invectives of the philosopher Sören Kierkegaard. He died at Copenhagen on the 3rd of February 1884.

Amongst his works are: *Grundriss des Systems der Moralphilosophie* (1841; 3rd ed., 1879; German, 1845), *Die christl. Taufe und die baptistische Frage* (2nd ed., 1847; German, 2nd ed., 1860), *Den Christelige Dogmatik* (4th ed., 1883; Eng. trans., 1866; German by himself, 4th ed., 1897); *Christliche Ethik* (1871; Eng. trans., Part I. 1873, Part II. 1881 seq.); *Hirtenspiegel* (1870–1872); *Katholizismus und Protestantismus* (1874); *Jacob Böhme* (1882; Eng. trans., 1885). An autobiography, *Aus meinem Leben*, appeared in 1883, and after his death the *Briefwechsel zwischen Martensen und Dorner* (1888).

MARTHA'S VINEYARD, an island including the greater part of Dukes county, Massachusetts, U.S.A., lying about 3 m. off the southern coast of that state. Its extreme length (east to west) is about 20 m., and its extreme width (north to south) about 9½ m. Along its north-west and a portion of its north-east shore lies Vineyard Sound. Its principal bays are Vineyard Haven Harbor, a deep indentation at the northernmost angle of the island; and, on the eastern coast, Edgartown Harbor and Katama Bay, both formed by the juxtaposition of Chappaquiddick Island. The surface is mainly flat, excepting a strip about 2 m. broad along the north-western coast, and the two western townships (Chilmark and Gay Head), which are hilly, with several eminences of 200 to 300 ft.—the highest, Prospect Peak, in Chilmark township, 308 ft. Gay Head Light, a beacon near the western extremity, stands among picturesque cliffs, 145 ft. above the sea. Along the southern coast are many ponds, all shut off from the ocean by a narrow strip of land, excepting Tisbury Great Pond, which has a small outlet to the sea. Others are Sengekontacket Pond on the eastern coast; Lagoon Pond, which is practically an arm of Vineyard Haven Harbor; and, about a mile east of the Harbor, Chappaquonsett Pond. Martha's Vineyard is divided into the following townships (from east to west): Edgartown (in the south-eastern part of the island), pop. (1910), 1191; area, 29·7 sq. m.; Oak Bluffs (north-eastern portion), pop. (1910), 1084; area, 7·9 sq. m.; Tisbury, pop. (1910), 1196; area, 7·1 sq. m.; West Tisbury, pop. (1910), 437; area, 30·5 sq. m.; Chilmark, pop. (1910), 282; area, 19·4 sq. m.; and Gay Head, pop. (1910), 162; area 5·2 sq. m. The population of the county, including the Elizabeth Ids. (Gosnold town, pop. 152), N. W. of Martha's Vineyard; Chappaquiddick Island (Edgartown township), and No Man's Land (a small island south-west of Martha's Vineyard), was 4561 in 1900 (of whom 645 were foreign-born, including 79 Portuguese and 72 English-Canadians, and 154 Indians), and in 1910, 4504. The principal villages are Oak Bluffs on the north-east coast, facing Vineyard Sound; Vineyard Haven, in Tisbury township, beautifully situated on the west shore of Vineyard Haven Harbor, and Edgartown on Edgartown Harbor—all summer resorts. No Man's Land, included politically in Chilmark township, lies about 6½ m. south of Gay Head. It is about 1½ m. long (east and west) and about 1 m. wide, is composed of treeless swamps, and is used mainly for sheep-grazing; the neighbouring waters are excellent fishing ground. Martha's Vineyard is served by steamship lines from Wood's Hole and New Bedford to Vineyard Haven, Oak Bluffs, and Edgartown. The Martha's Vineyard railway (from Oak Bluffs to the south-east extremity of the island, by way of Edgartown), opened in 1874, was not a financial success, and had been practically abandoned in 1909, but an electric line from Oak Bluffs to Vineyard Haven provides transit facilities for that part of the island.

For more than a century whale fishing was practically the sole industry of Martha's Vineyard. It was carried on at first from the shore in small boats; but by the first decade of the 18th century vessels especially built for the purpose were being used, and by 1760 shore fishing had been practically abandoned. The industry, seriously crippled by invasions of British troops during the War of American Independence—especially by a force which landed at Holmes's Hole (Vineyard Haven) in September 1778—and again during the War of 1812, revived and was at its height in 1840–1850, only to receive another setback during the Civil War. In the last part of the 19th century its decline was rapid, not only because of the increasing scarcity of whales, but because of the introduction of the mineral oils, and by the end of the century whaling had ceased to be of any economic importance. Herring fishing, on both the north and the south shore, occupies a small percentage of the inhabitants, and there is also some deep-sea fishing. Sheep-raising, especially for wool, is an industry of considerable importance, and Dukes county is one of the three most important counties of the state in this industry.

Martha's Vineyard was discovered in 1602 by Captain Bartholomew Gosnold, who landed (May 21) on the island now called No Man's Land, and named it Martha's Vineyard,[1] which name was subsequently applied to the larger island. Captain Gosnold rounded Gay Head, which he named Dover Cliff, and established on what is now Cuttyhunk Island, which he called Elizabeth Island, the first (though, as it proved, a temporary) English settlement in New England. The entire line of sixteen islands, of which Cuttyhunk is the westernmost of the larger ones, have since been called the Elizabeth Islands; they form the dividing line between Buzzards Bay and Vineyard Sound, and in 1864 were incorporated as Gosnold township (pop. in 1905, 161) of Dukes county.

The territory within the jurisdiction of the Council for New England was parcelled in 1635 among the patentees in such terms—owing to insufficient knowledge of the geography of the coast—that both William Alexander, earl of Stirling, and Sir Ferdinando Gorges, proprietor of Maine, claimed Martha's Vineyard. In 1641 Stirling's agent, Forrett, sold to Thomas Mayhew (1592–1682),[1] of Watertown, Massachusetts, for $200, the island of Nantucket, with several smaller neighbouring islands, and also Martha's Vineyard. It seems probable that Forrett acted without authority, and his successor, Forrester, was arrested by the Dutch in New Amsterdam and sent to Holland before he could confirm the transfer. In 1644 the Commissioners of the United Colonies, apparently at the request of the inhabitants of Martha's Vineyard, annexed the island to Massachusetts, but ten years later the islanders declared their independence of that colony, and apparently for the next decade managed their own affairs. Meanwhile Mayhew had recognized the jurisdiction of Maine;[2] and though the officials of that province showed no disposition to press their claim, it seems that this technical suzerainty continued until 1664, when the Duke of York received from his brother, Charles II., the charter for governing New York, New Jersey, and other territory, including Martha's Vineyard. In 1671 Governor Francis Lovelace, of New York, appointed Mayhew governor for life of Martha's Vineyard; in 1683, the island, with Nantucket, the Elizabeth Islands, No Man's Land, and Chappaquiddick Island were erected into Dukes county, and in 1695 the county was re-incorporated by Massachusetts with Nantucket excluded. Under the new charter of Massachusetts Bay (1691), after some dispute between Massachusetts and New York, Martha's Vineyard became a part of Massachusetts.

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[1] In the 17th century both "Martha's Vineyard" and "Martin's Vineyard" were used, and the latter appears in a book as early as 1638 and in another as late as 1699, and on a map as late as 1670. It seems probable that the original form was *Martin*, the name of one of Gosnold's crew; according to some authorities the name Martha's Vineyard was adopted by Mayhew in honour of his wife or daughter.

There is a tradition that the first settlement of Martha's Vineyard was made in 1632, at or near the present site of Edgartown village, by several English families forming part of a company bound for Virginia, their ship having put in at this harbour on account of heavy weather. It is certain, however, that in 1642, the year after Thomas Mayhew bought the island, his son, also named Thomas Mayhew (*c.* 1616–1657), and several other persons established a plantation on the site of what is now Edgartown village. This settlement was at first called "Great Harbor," but soon after Mayhew was appointed governor of the island it was named Edgartown, probably in honour of the only surviving son of the Duke of York. The younger Mayhew, soon after removing to Martha's Vineyard, devoted himself to missionary work among the Indians, his work beginning at about the same time as that of John Eliot; he was lost at sea in 1657 while on his way to secure financial assistance in England, and his work was continued successfully by his father.[3] The township of Edgartown was incorporated in 1671, and is the county-seat of Dukes county. In 1783 several Edgartown families joined the association made up of Martha's Vineyard, Nantucket, Providence and Newport whalers, who founded Hudson, on the Hudson river, in Columbia county, New York. Oak Bluffs had its origin as a settlement in the camp meetings, which were begun here in 1835, and by 1860 had grown to large proportions. As the village expanded it took the name of Cottage City. In 1880 the township was incorporated under that name, which it retained until January 1907, when the name (and that of the village also) was changed to Oak Bluffs. Tisbury township was bought from the Indians in 1669 and was incorporated in 1671. Its principal village, Vineyard Haven, was called "Holmes's Hole" (in honour of one of the early settlers) until 1871, when the present name was adopted. West Tisbury township was set off from Tisbury, and incorporated in 1892. Chilmark township was incorporated in 1694. Gay Head township was set off from Chilmark, and incorporated in 1870.

See C. Gilbert Hine, *The Story of Martha's Vineyard* (New York, 1908); Charles E. Banks, "Martha's Vineyard and the Province of Maine" in *Collections and Proceedings* of the Maine Historical Society, 2nd series, vol. ix. p. 123 (Portland, Maine, 1898); and Walter S. Tower, *A History of the American Whale Fishery* (Philadelphia, 1907). (G. G.*)

MARTÍ, JUAN JOSÉ (1570?–1604), Spanish novelist, was born at Orihuela (Valencia) about 1570. He graduated as bachelor of canon law at Valencia in 1591, and in 1598 took his degree as doctor of canon law; in the latter year he was appointed co-examiner in canon law at Valencia University, and held the post for six years. He died at Valencia, and was buried in the cathedral of that city on the 22nd of December 1604. Martí joined the Valencian *Academia de los nocturnos*, under the name of "Atrevimiento," but is best known by another pseudonym, Mateo Luján de Sayavedra, under which he issued an apocryphal continuation (1602) of Alemán's *Guzmán de Alfarache* (1599). Martí obtained access to Alemán's unfinished manuscript, and stole some of his ideas; this dishonesty lends point to the sarcastic congratulations which Alemán, in the genuine sequel (1604) pays to his rival's sallies: "I greatly envy them, and should be proud that they were mine." Martí's book is clever, but the circumstances in which it was produced account for its cold reception and afford presumption that the best scenes are not original.

It has been suggested that Martí is identical with Avellaneda, the writer of a spurious continuation (1614) to *Don Quixote*; but he died before the first part of *Don Quixote* was published (1605).

MARTIAL (MARCUS VALERIUS MARTIALIS), Latin epigrammatist, was born in one of the years A.D. 38–41, for in book x., of which the poems were composed in the years 95–98, he is found celebrating his fifty-seventh birthday (x. 24). Our knowledge of his career is derived almost entirely from himself. Reference to public events enables us approximately to fix the date of the publication of the different books of epigrams, and from these dates to determine those of various important events in his life. The place of his birth was Bilbilis, officially Augusta Bilbilis, in Spain. His name seems to imply that he was born a Roman citizen, but he speaks of himself as "sprung from the Celts and Iberians, and a countryman of the Tagus;" and, in contrasting his own masculine appearance with that of an effeminate Greek, he draws especial attention to "his stiff Spanish hair" (x. 65, 7). His parents, Fronto and Flaccilla, appear to have died in his youth (v. 34). His home was evidently one of rude comfort and plenty, sufficiently in the country to afford him the amusements of hunting and fishing, which he often recalls with keen pleasure, and sufficiently near the town to afford him the companionship of many comrades, the few survivors of whom he looks forward to meeting again after his four-and-thirty years' absence (x. 104). The memories of this old home, and of other spots, the rough names and local associations which he delights to introduce into his verse, attest the enjoyment which he had in his early life, and were among the influences which kept his spirit alive in the routine of social life in Rome. But his Spanish home could impart, not only the vigorous vitality which was one condition of his success as a wit and poet, but the education which made him so accomplished a writer. The literary distinction obtained by the Senecas, by Lucan, by Quintilian, who belonged to a somewhat older generation, and by his friends and contemporaries, Licinianus of Bilbilis, Decianus of Emerita, and Canius of Gades, proves how eagerly the novel impulse of letters was received in Spain in the first century of the empire. The success of his countrymen may have been the motive which induced Martial to remove to Rome when he had completed his education. This he did in A.D. 64, one year before the fall of Seneca and Lucan, who were probably his earliest patrons.

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[1] Mayhew was born at Tisbury, Wiltshire, was a merchant in Southampton, emigrated to Massachusetts about 1633, settled at Watertown, Mass., in 1635; was a member of the Massachusetts General Court in 1636–1644, and after 1644 or 1645 lived on Martha's Vineyard.

[2] It appears from a letter from Mayhew to Governor Andros in 1675 that about 1641 Mayhew obtained a conveyance to Martha's Vineyard from Richard Vines, agent of Gorges. See F. B. Hough, *Papers Relating to the Island of Nantucket, with Documents Relating to the Original Settlement of that Island, Martha's Vineyard, &c.* (Albany, N.Y., 1856).

[3] In 1901, a boulder memorial was erected to the younger Mayhew on the West Tisbury road, between the village of that name and Edgartown, marking the spot where the missionary bade farewell to several hundred Indians. The Martha's Vineyard Indians were subject to the Wampanoag tribe, on the mainland, were expert watermen, and were very numerous when the whites first came. Nearly all of them were converted to Christianity by the Mayhews, and they were friendly to the settlers during King Philip's war. By 1698 their numbers had been reduced to about 1000, and by 1764 to about 300. Soon after this they began to intermarry with negroes, and now only faint traces of them remain.

Of the details of his life for the first twenty years or so after he came to Rome we do not know much. He published some juvenile poems of which he thought very little in his maturer years, and he laughs at a foolish bookseller who would not allow them to die a natural death (i. 113). Martial had neither youthful passion nor youthful enthusiasm to make him precociously a poet. His faculty ripened with experience and with the knowledge of that social life which was both his theme and his inspiration; and many of his best epigrams are among those written in his last years. From many answers which he makes to the remonstrances of friends—among others to those of Quintilian—it may be inferred that he was urged to practise at the bar, but that he preferred his own lazy Bohemian kind of life. He made many influential friends and patrons, and secured the favour both of Titus and Domitian. From them he obtained various privileges, among others the *semestris tribunatus*, which conferred on him equestrian rank. He failed, however, in his application to the latter for more substantial advantages, although he commemorates the glory of having been invited to dinner by him, and also the fact that he procured the privilege of citizenship for many persons in whose behalf he appealed to him. The earliest of his extant works, that known by the name of *Liber spectaculorum*, was first published at the opening of the Colosseum in the reign of Titus, and relates to the theatrical performances given by him; but the book as it now stands was given to the world in or about the first year of Domitian, *i.e.* about A.D. 81. The favour of the emperor procured him the countenance of some of the worst creatures at the imperial court—among them of the notorious Crispinus, and probably of Paris, the supposed author of Juvenal's exile, for whose monument Martial afterwards wrote a eulogistic epitaph. The two books, numbered by editors xiii. and xiv., and known by the names of *Xenia* and *Apophoreta*—inscriptions in two lines each for presents,—were published at the Saturnalia of 84. In 86 he gave to the world the first two of the twelve books on which his reputation rests. From that time till his return to Spain in A.D. 98 he published a volume almost every year. The first nine books and the first edition of book x. appeared in the reign of Domitian; and book xi. at the end of A.D. 96, shortly after the accession of Nerva. A revised edition of book x., that which we now possess, appeared in A.D. 98, about the time of the entrance of Trajan into Rome. The last book was written after three years' absence in Spain, shortly before his death, which happened about the year A.D. 102 or 103.

These twelve books bring Martial's ordinary mode of life between the age of five-and-forty and sixty very fully before us. His regular home for five-and-thirty years was Rome. He lived at first up three pairs of stairs, and his "garret" overlooked the laurels in front of the portico of Agrippa. He had a small villa and unproductive farm near Nomentum, in the Sabine territory, to which he occasionally retired from the bores and noises of the city (ii. 38, xii. 57). In his later years he had also a small house on the Quirinal, near the temple of Quirinus. At the time when his third book was brought out he had retired for a short time to Cisalpine Gaul, in weariness, as he tells us, of his unremunerative attendance on the levées of the great. For a time he seems to have felt the charm of the new scenes which he visited, and in a later book (iv. 25) he contemplates the prospect of retiring to the neighbourhood of Aquileia and the Timavus. But the spell exercised over him by Rome and Roman society was too great; even the epigrams sent from Forum Corneli and the Aemilian Way ring much more of the Roman forum, and of the streets, baths, porticos and clubs of Rome, than of the places from which they are dated. So too his motive for his final departure from Rome in A.D. 98 was a weariness of the burdens imposed on him by his social position, and apparently the difficulties of meeting the ordinary expenses of living in the metropolis (x. 96); and he looks forward to a return to the scenes familiar to his youth. The well-known epigram addressed to Juvenal (xii. 18) shows that for a time his ideal was realized; but the more trustworthy evidence of the prose epistle prefixed to book xii. proves that his contentment was of short duration, and that he could not live happily away from the literary and social pleasures of Rome. The one consolation of his exile was the society of a lady, Marcella, of whom he writes rather as if she were his patroness—and it seems to have been a necessity of his being to have always a patron or patroness—than his wife or mistress.

During his life at Rome, although he never rose to a position of real independence, and had always a hard struggle with poverty, he seems to have known everybody, especially every one of any eminence at the bar or in literature. In addition to Lucan and Quintilian, he numbered among his friends or more intimate acquaintances Silius Italicus, Juvenal, the younger Pliny; and there were many others of high position whose society and patronage he enjoyed. The silence which he and Statius, although authors writing at the same time, having common friends and treating often of the same subjects, maintain in regard to one another may be explained by mutual dislike or want of sympathy. Martial in many places shows an undisguised contempt for the artificial kind of epic on which Statius's reputation chiefly rests; and it seems quite natural that the respectable author of the *Thebaid* and the *Silvae* should feel little admiration for either the life or the works of the Bohemian epigrammatist.

Martial's faults are of the most glaring kind, and are exhibited without the least concealment. Living under perhaps the worst of the many bad emperors who ruled the world in the 1st century, he addresses him and his favourites with the most servile flattery in his lifetime, censures him immediately after his death (xii. 6), and offers incense at the shrine of his successor. He is not ashamed to be dependent on his wealthy friends and patrons for gifts of money, for his dinner, and even for his dress. We cannot feel sure that even what seem his sincerest tributes of regard may not be prompted by the hope of payment. Further, there are in every book epigrams which cannot be read with any other feelings than those of extreme distaste.

These faults are so unmistakable and undeniable that many have formed their whole estimate of Martial from them, and have declined to make any further acquaintance with him. Even those who greatly admire his genius, and find the freshest interest in his representation of Roman life and his sketches of manners and character, do not attempt to palliate his faults, though they may partially account for them by reference to the morals of his age and the circumstances of his life. The age was one when literature had either to be silent or to be servile. Martial was essentially a man of letters: he was bound either to gain favour by his writings or to starve. Even Statius, whose writings are in other respects irreproachable, is nearly as fulsome in his adulation. The relation of client to patron had been recognized as an honourable one by the best Roman traditions. No blame had attached to Virgil or Horace on account of the favours which they received from Augustus and Maecenas, or of the return which they made for these favours in their verse. That old honourable relationship had, however, greatly changed between Augustus and Domitian. Men of good birth and education, and sometimes even of high official position (Juv. i. 117), accepted the dole (*sportula*). Martial was merely following a general fashion in paying his court to "a lord," and he made the best of the custom. In his earlier career he used to accompany his patrons to their villas at Baiae or Tibur, and to attend their morning levées. Later on he went to his own small country house, near Nomentum, and sent a poem, or a small volume of his poems, as his representative at the early visit. The fault of grossness Martial shares with nearly all ancient and many modern writers who treat of life from the baser or more ridiculous side. That he offends more than perhaps any of them is not, apparently, to be explained on the ground that he had to amuse a peculiarly corrupt public. Although there is the most cynical effrontery and want of self-respect in Martial's use of language, there is not much trace of the satyr in him—much less, many readers will think, than in Juvenal.

It remains to ask, What were those qualities of nature and intellect which enable us to read his best work—even the great body of his work—with the freshest sense of pleasure in the present day? He had the keenest capacity for enjoyment, the keenest curiosity and power of observation. He had also a very just discernment. It is rare to find any one endowed with so quick a perception of the ridiculous who is so little of a caricaturist. He was himself singularly free from cant, pedantry or affectation of any kind. Though tolerant of most vices, he had a hearty scorn of hypocrisy. There are few better satirists of social and literary pretenders in ancient or modern times. Living in a very artificial age, he was quite natural, hating pomp and show, and desiring to secure in life only what really gave him pleasure. To live one's own life heartily from day to day without looking before or after, and to be one's self without trying to be that for which nature did not intend him, is the sum of his philosophy. Further, while tolerant of much that is bad and base—the characters of Crispinus and Regulus, for instance—he shows himself genuinely grateful for kindness and appreciative of excellence. He has no bitterness, malice or envy in his composition. He professes to avoid personalities in his satire;—"Ludimus innocui" is the character he claims for it. Pliny, in the short tribute which he pays to him on hearing of his death, says, "He had as much good-nature as wit and pungency in his writings" (*Ep.* iii. 21).

Honour and sincerity (*fides* and *simplicitas*) are the qualities which he most admires in his friends. Though many of his epigrams indicate a cynical disbelief in the character of women, yet others prove that he could respect and almost reverence a refined and courteous lady. His own life in Rome afforded him no experience of domestic virtue; but his epigrams show that, even in the age which is known to modern readers chiefly from the *Satires* of Juvenal, virtue was recognized as the purest source of happiness. The tenderest element in Martial's nature seems, however, to have been his affection for children and for his dependents.

The permanent literary interest of Martial's epigrams arises not so much from their verbal brilliancy, though in this they are unsurpassed, as from the amount of human life and character which they contain. He, better than any other writer, enables us to revive the outward spectacle of the imperial Rome. If Juvenal enforces the lesson of that time, and has penetrated more deeply into the heart of society, Martial has sketched its external aspect with a much fairer pencil and from a much more intimate contact with it. Martial was to Rome in the decay of its ancient virtue and patriotism what Menander was to Athens in its decline. They were both men of cosmopolitan rather than of a national type, and had a closer affinity to the life of Paris or London in the 18th century than to that of Rome in the days of the Scipios or of Athens in the age of Pericles. The form of epigram was fitted to the critical temper of Rome as the comedy of manners was fitted to the dramatic genius of Greece. Martial professes to be of the school of Catullus, Pedo, and Marsus, and admits his inferiority only to the first. But, though he is a poet of a less pure and genuine inspiration he is a greater epigrammatist even than his master. Indeed the epigram bears to this day the form impressed upon it by his unrivalled skill.

Authorities.—The MSS. of Martial are divided by editors into three families according to the recension of the text which they offer. Of these the oldest and best is represented by three MSS. which contain only selected extracts. The second family is derived from an inferior source, a MS. which was edited in A.D. 401 by Torquatus Gennadius; it comprises four MSS. and contains the whole of the text. The third family, of which the MSS. are very numerous, also contains the whole of the text in a recension slightly different from that of the other two; the best representative of this family is the MS. preserved in the Advocates' Library at Edinburgh.

The best separate edition of the text is that of Lindsay (Oxford, 1902); earlier editions of importance are those of Schneidewin (1842 and 1853), and of Gilbert (Leipzig, 1886). The best commentary is that of L. Friedländer (Leipzig, 1886) in two volumes with German notes) and in the same scholar's *Sittengeschichte Roms* much will be found that explains and illustrates Martial's epigrams. There is a large selection from the epigrams with English notes by Paley and Stone (1875), a smaller selection with notes by Stephenson (1880); see also Edwin Post, *Selected Epigrams of Martial* (1908), with introduction and notes. The translation into English verse by Elphinston (London, 1782) is famous for its absurdity, which drew an epigram from Burns. (W. Y. S.)

MARTIALIS, QUINTUS GARGILIUS, a Latin writer on horticultural subjects. He has been identified by some with the military commander of the same name, mentioned in a Latin inscription of A.D. 260 (*C. I. L.* viii. 9047) as having lost his life in the colony of Auzia (*Aumale*) in Mauretania Caesariensis. Considerable fragments of his work (probably called *De hortis*), which treated of the cultivation of trees and vegetables, and also of their medicinal properties, have survived, chiefly in the body of and as an appendix to the *Medicina Plinii* (an anonymous 4th century handbook of medical recipes based upon Pliny, *Nat. Hist.* xx.-xxxii.). Extant sections treat of apples, peaches, quinces, almonds and chestnuts. Gargilius also wrote a treatise on the tending of cattle (*De curis boum*), and a biography of the emperor Alexander Severus is attributed by two of the Scriptores historiae Augustae (Aelius Lampridius and Flavius Vopiscus) to a Gargilius Martialis, who may be the same person.

Bibliography.—*Gargilii Martialis . . . fragmenta*, ed. A. Mai (1846); *Plinii secundi quae fertur medicina*, ed. V. Rose (1876); *De curis boum*, ed. E. Lommatzsch (1903) with Vegetius Renatus's *Mulomedicina*; "Gargilius Martialis und die Maurenkriege," C. Cichorius in G. Curtius, *Leipsiger Studien*. x. (1887), where the inscription referred to above is fully discussed; see also Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans.), § 380.

MARTIAL LAW. "Martial law" is an unfortunate term and in a sense a misnomer. It describes a suspension of ordinary law, rendered necessary by circumstances of war or rebellion. The confusion arose from the fact that the marshal's court administered military law before the introduction of articles of war, which were in their turn merged in the Army Act. But martial law is not a law in the proper sense of the term. It is the exercise of the will of the military commander, who takes upon himself the responsibility of suspending ordinary law in order to ensure the safety of the state. It is declared, by a proclamation issued by the executive, that ordinary law is inadequate to cope with the circumstances, and provides exceptional means of arrest and punishment of persons who resist the government or aid the enemy. But such a proclamation, while invariably issued in order to give publicity to the suspension of ordinary law, does not invest the step with the force of law. It is simply military authority exercised in accordance with the laws and usages of war, and is limited by military necessity. Yet in reality it is part of common law which justifies acts done by necessity for the defence of the commonwealth when there is war. H. W. Halleck in his work on International Law (i. 544), says, "Martial law originates either in the prerogative of the crown, as in Great Britain, or from the exigency of the occasion, as in other states: it is one of the rights of sovereignty, and is essential to the existence of a state, as is the right to declare or to carry on war."

This opinion, however, must be read, as regards the British Empire, with the passage in the Petition of Right which is reproduced in the preamble of each annual Army Act, and asserts the illegality of martial law in time of peace in the following terms:—"No man shall be fore-judged or subjected in time of peace to any kind of punishment within this realm by martial law." Therefore, whilst martial law is declared illegal in time of peace, it is indirectly declared lawful in time of war and intestinal commotion when the courts are closed, or when there is no time for their cumbrous action. C. M. Clode, in *Military Forces of the Crown*, argues that the words of the Petition of Right and of the Military Act since the reign of Anne are plain in this respect "that . . . the crown possesses the right of issuing commissions in war and rebellion." But he rightly adds that the military commander may permit the usual courts to continue their jurisdiction upon such subjects as he thinks proper. Legislative enactments have also sanctioned this special jurisdiction at various times, notably in 1798, 1799, 1801, and in 1803. These enactments lay down that exceptional powers may be exercised "whether the ordinary courts shall or shall not be open." As an invariable rule an act of indemnity has been passed on the withdrawal of martial law, but only to protect any person in charge of the execution of martial law who has exceeded his powers in good faith.

There has been much discussion as to whether, in districts where martial law has not been proclaimed, a person can be sent for trial from such district into a district where martial law was in operation. It is argued that if the ordinary courts were open and at work in the non-proclaimed district recourse should be had to them. The Privy Council in 1902 (*re* Marais) refused leave to appeal where the Supreme Court of Cape Colony had declined to issue a writ of Habeas Corpus in these circumstances. Mr Justice Blackburn in his charge in *R.* v. *Eyre* says, "I have come to the conclusion that, looking at what martial law was, the bringing of a person into the proclaimed district to be tried might, in a proper case, be justified." The learned judge admits that there should be a power of summary trial, observing all the substantials of justice, in order to stamp out an insurrection by speedy trial.

Whilst martial law is the will of the commanders, and is only limited by the customs of war and the discretion of those who administer it, still, as far as practicable, the procedure of military law is followed, and a military court is held on the same lines as a court-martial. Charges are simply framed without technicalities. The prisoner is present, the evidence of prosecution and prisoner is taken on oath, the proceedings are recorded, and the sentence of the court must be confirmed according to the rules of the Army Act. Sentences of death and penal servitude must be referred to headquarters for confirmation. In the South African War (1899–1902) these limits of procedure were observed, and when possible will always be.

Different Applications of Martial Law.

Entering more into detail, the term martial law has been employed in several senses:—(1) As applied to the military forces of the crown, apart from the military law under the old Mutiny Acts, and the present annual Army Acts. (2) As applied to the enemy. (3) As applied to rebels. (4) As applied to civilian subjects who are not in rebellion, but in a district where the ordinary course of civil life cannot be maintained owing to war or rebellion.

1. In regard to the military forces of the crown, the superseding of justice as administered under the Army Act could only occur in a time of great need; *e.g.* mutiny of five or six regiments in the field, with no time to take the opinion of any executive authority. The officer in command would then be bound to take measures for the purpose of suppressing such mutiny, even to putting soldiers to death if necessary. It would be a case where necessity forced immediate action.

2. Martial law as applied to the enemy or the population of the enemy's country, is in the words of the duke of Wellington, "the will of the general of the army, though it must be administered in accordance with the customs of war."

3, 4. But it is as affecting the subjects of the crown in rebellion that the subject of martial law really obtains its chief importance; and it is in this sense that the term is generally used; *i.e.* the suspension of ordinary law and the temporary government of the country, or parts of it, or all of it, by military tribunals. It has often been laid down that martial law in this sense is unknown to the law of England. A. V. Dicey, for instance, restricts martial law to only another expression for "the common right of the crown and its servants to repel force by force, in the case of invasion, insurrection, or riot, or generally of any violent resistance." But more than this is understood by the term martial law. When the proposition was laid down that martial law in this sense is unknown to the law of England, it is to be remembered that fortunately in England there never had been a state at all similar to that prevailing in Cape Colony in 1900–1902, and it may perhaps be questioned whether the statement would have been made with such certainty if similar events had been present to the writers' minds.

In the charge delivered by Mr Justice Blackburn in the Jamaica case the law as affecting the general question of martial law is well set out.

> "By the laws of this country," said Mr Justice Blackburn, "beginning at Magna Carta and getting more and more established, down to the time of the Revolution, when it was finally and completely established, the general rule was that a subject was not to be tried or punished except by due course of law; all crimes are to be determined by juries subject to the guidance of the judge; that is the general rule, and is established law. But from the earliest times there was this also which was the law, and is the law still, that when there was a foreign invasion or an insurrection, it was the duty of every good subject, in obedience to the officers and magistrates, to resist the rebels, . . . in such a case as that of insurrection prevailing so far that the courts of law cannot sit, there must really be anarchy unless there is some power to keep the people in order, . . . before that principle the crown claimed the prerogative to exercise summary proceedings by martial law . . . in time of war when this disturbance was going on, over others than the army. And further than that, the crown made this further claim against the insurgents, that whilst it existed, pending the insurrection and for a short time afterwards, the crown had . . . the power to proclaim martial law in the sense of using summary proceedings, to punish the insurgents and to check and stop the spread of the rebellion by summary proceedings against the insurgents, so as . . . to stamp out the rebellion. Now no doubt the extent to which the crown had power to do that has never been yet decided. Our law has been declared from time to time and has always been a practical science, that is, the judges have decided so much as was necessary for the particular case, and that has become part of the law. But it never has come to be decided what this precise power is."

So far as the United Kingdom is concerned the need has never arisen. It has always been found possible to employ the ordinary courts directly the rebels have been defeated in the field and have been made prisoners or surrendered. "Fortunately in England only three occasions have arisen since the Revolution when the authority of the civil power was for a time, and then only partially, suspended," 1715, 1745 and 1780. Clode, *Military Forces*, ii. 163, says: "Upon the threat of invasion followed by rebellion in 1715, the first action of the government was to issue a proclamation authorizing all officers, civil and military, by force of arms (if necessary) to suppress the rebellion." This, therefore, would only seem to fall within the limited sense in which Dicey understands martial law to be legal, "the right of the crown and its servants to repel force by force." There was no attempt to bring persons before courts-martial who ought to be tried by the common law, and all the extraordinary acts of the crown were sanctioned by parliament. After the rebellion had been suppressed two statutes were passed, one for indemnity and the other for pardon. Before the revolution of 1745 similar action was adopted, a proclamation charging civil magistrates to do their utmost to prevent and suppress all riots, and acts of parliament suspending Habeas Corpus, providing for speedy trials; and of indemnity. In the Gordon Riots of 1780 a very similar course was pursued, and nothing was done which would not fall within Dicey's limitation. No prisoners were tried by martial law.

In Ireland the ordinary law was suspended in 1798-1801 and in 1803. In 1798 an order in Council was issued to all general officers commanding H.M. forces to punish all persons acting in, aiding, or in any way assisting the rebellion, according to *martial law*, either by death or otherwise, as to them should seem expedient for the suppression and punishment of all rebels; but the order was communicated to the Irish houses of parliament, who expressed their approval by addresses to the viceroy. It was during the operation of this order that Wolfe Tone's case arose. Tone, a subject of the king, was captured on board a French man-of-war, and condemned to death by a court-martial. Curran, his counsel, applied to the king's bench at Dublin for a Habeas Corpus, on the grounds that only when war was raging could courts-martial be endured, not while the court of king's bench sat. The court granted his application; but no ultimate decision was ever given, as Tone died before it could be arrived at.

In 1799 application was made to parliament for express sanction to martial law. The preamble of the act declared that "The Rebellion still continues . . . and stopped the ordinary course of justice and of the common law; and that many persons . . . who had been taken by H.M. forces . . . have availed themselves of such partial restoration of the ordinary course of the common law to evade the punishment of their crimes, whereby it had become necessary for parliament to interfere." The act declared that martial law should prevail and be put in force whether the ordinary courts were or were not open, &c. And nothing in the act could be held to take away, abridge or eliminate the acknowledged prerogative of war, for the public safety to resort to the exercise of martial law against open enemies or traitors, &c.

After the suppression of the rebellion an act of indemnity was passed in 1801.

In 1803 a similar act was passed by the parliament of the United Kingdom as it was after the Act of Union. In introducing it Mr Pitt stated: "The bill is not one to enable the government in Ireland to declare martial law in districts where insurrection exists, for that is a power which His Majesty already possesses—the object will be to enable the lord-lieutenant, when any persons shall be taken in rebellion, to order them to be tried immediately by a court-martial."

During the 19th century martial law was proclaimed by the British government in the following places:—

1. Barbados, 1805–1816.
2. Demerara, 1823.
3. Jamaica, 1831–1832; 1865.
4. Canada, 1837–1838.
5. Ceylon, 1817 and 1848.
6. Cephalonia, 1848.
7. Cape of Good Hope, 1834; 1849–1851.
8. St Vincent, 1863.
9. South Africa, 1899–1901.

The proclamation was always based on the grounds of necessity, and where any local body of a representative character existed it would seem that its assent was given, and an act of indemnity obtained after the suppression of the rebellion. (JNO. S.)

MARTIGNAC, JEAN BAPTISTE SYLVERE GAY, VICOMTE DE (1778–1832), French statesman, was born at Bordeaux on the 20th of June 1778. In 1798 he acted as secretary to Sieyès; then after serving for a while in the army, he turned to literature, producing several light plays. Under the Empire he practised with success as an advocate at Bordeaux, where in 1818 he became advocate-general of the *cour royale*. In 1819 he was appointed *procureur-général* at Limoges, and in 1821 was returned for Marmande to the Chamber of Deputies, where he supported the policy of Villèle. In 1822 he was appointed councillor of state, in 1823 he accompanied the duc d'Angoulême to Spain as civil commissary; in 1824 he was created a viscount and appointed director-general of registration. In contact with practical politics his ultra-royalist views were gradually modified in the direction of the Doctrinaires, and on the fall of Villèle he was selected by Charles X. to carry out the new policy of compromise. On the 4th of January 1828 he was appointed minister of the interior, and, though not bearing the title of president, became the virtual head of the cabinet. He succeeded in passing the act abolishing the press censorship, and in persuading the king to sign the ordinances of the 16th of June 1828 on the Jesuits and the little seminaries. He was exposed to attack from both the extreme Left and the extreme Right, and when in April 1829 a coalition of these groups defeated him in the chamber, Charles X., who had never believed in the policy he represented, replaced him by the prince de Polignac. In March 1830 Martignac voted with the majority for the address protesting against the famous ordinances; but during the revolution that followed he remained true to his legitimist principles. His last public appearance was in defence of Polignac in the Chamber of Peers in December 1830. He died on the 3rd of April 1832.

Martignac published *Bordeaux au mois de Mars 1815* (Paris, 1830), and an *Essai historique sur les révolutions d'Espagne et l'intervention française de 1823* (Paris, 1832). See also E. Daudet, *Le Ministère de M. de Martignac* (Paris, 1875).

MARTIGUES, a port of south-eastern France in the department of Bouches-du-Rhône, on the southern shore of the lagoon of Berre, and at the eastern extremity of that of Caronte, by which the former is connected with the Mediterranean. Pop. (1906), 4,178. Martigues is 23 m. W.N.W. of Marseilles by rail. Divided into three quarters by canals, the place has been called the Venice of Provence. It has a harbour (used by coasting and fishing vessels), marine workshops, oil and soap manufactures and cod-drying works. A special industry consists in the preparation of *boutargue* from the roes of the grey mullet caught in the salt lagoons, which rivals Russian caviare.

Built in 1232 by Raymond Bérenger, count of Provence, Martigues was made a viscountship by Joanna I., queen of Naples. Henry IV. made it a principality, in favour of a princess of the house of Luxembourg. It afterwards passed into the hands of the duke of Villars.

MARTIN, ST (*c.* 316–400), bishop of Tours, was born of heathen parents at Sabaria (Stein am Agger) in Pannonia, about the year 316. When ten years old he became a catechumen, and at fifteen he reluctantly entered the army. While stationed at Amiens he divided his cloak with a beggar, and on the following night had the vision of Christ making known to his angels this act of charity to Himself on the part of "Martinus, still a catechumen." Soon afterwards he received baptism, and two years later, having left the army, he joined Hilary of Poitiers, who wished to make him a deacon, but at his own request ordained him to the humbler office of an exorcist. On a visit home he converted his mother, but his zeal against the Arians roused persecution against him and for some time he lived an ascetic life on the desert island of Gallinaria near Genoa. Between 360 and 370 he was again with Hilary at Poitiers, and founded in the neighbourhood the monasterium locociagense (Licugé). In 371–372 the people of Tours chose him for their bishop. He did much to extirpate idolatry from his diocese and from France, and to extend the monastic system. To obtain privacy for the maintenance of his personal religion, he established the monastery of Marmoutier-les-Tours (Martini monasterium) on the banks of the Loire. At Trèves, in 385, he entreated that the lives of the Priscillianist heretics should be spared, and he ever afterwards refused to hold ecclesiastical fellowship with those bishops who had sanctioned their execution. He died at Candes in the year 400, and is commemorated by the Roman Church on the 11th of November (duplex). He left no writings, the so-called *Confessio* being spurious. He is the patron saint of France and of the cities of Mainz and Würzburg. The *Life* by his disciple Sulpicius Severus is practically the only source for his biography, but it is full of legendary matter and chronological errors. Gregory of Tours gives a list of 206 miracles wrought by him after his death; Sidonius Apollinaris composed a metrical biography of him. The Feast of St Martin (Martinmas) took the place of an old pagan festival, and inherited some of its usages (such as the *Martinsmännchen*, *Martinsfeuer*, *Martinskorn* and the like, in various parts of Germany); by this circumstance is probably to be explained the fact that Martin is regarded as the patron of drinking and jovial meetings, as well as of reformed drunkards.

See A. Dupuy, *Geschichte des heiligen Martins* (Schaffhausen, 1855); J. G. Cazenove in *Dict. chr. biog.* iii. 838.

MARTIN (Martinus), the name of several popes.

MARTIN I. succeeded Theodore I. in June or July 649. He had previously acted as papal apocrisiarius at Constantinople, and was held in high repute for learning and virtue. Almost his first official act was to summon a synod (the first Lateran) for dealing with the Monothelite heresy. It met in the Lateran church, was attended by one hundred and five bishops (chiefly from Italy, Sicily and Sardinia, a few being from Africa and other quarters), held five sessions or "secretarii" from the 5th to the 31st of October 649, and in twenty canons condemned the Monothelite heresy, its authors, and the writings by which it had been promulgated. In this condemnation were included, not only the *Ecthesis* or exposition of faith of the patriarch Sergius for which the emperor Heraclius had stood sponsor, but also the Typus of Paul, the successor of Sergius, which had the support of the reigning emperor (Constans II.). Martin published the decrees of his Lateran synod in an encyclical, and Constans replied by enjoining his exarch to seize the pope and send him prisoner to Constantinople. Martin was arrested in the Lateran (June 15, 653), hurried out of Rome, and conveyed first to Naxos and subsequently to Constantinople (Sept. 17, 654). He was ultimately banished to Cherson, where he arrived on the 26th of March 655, and died on the 16th of September following. His successor was Eugenius I. (L. D.*)

A full account of the events of his pontificate will be found in Hefele's *Conciliengeschichte*, vol. iii. (1877).

Martin II., the name commonly given in error to Marinus I. (*q.v.*).

Martin III., see Marinus II.

Martin IV. (Simon Mompitié de Brion), pope from the 22nd of February 1281 to the 28th of March 1285, should have been named Martin II. He was born about 1210 in Touraine. He became a priest at Rouen and canon of St Martin's at Tours, and was made chancellor of France by Louis IX. in 1260 and cardinal-priest of Sta Cecilia by Urban IV. in 1261. As papal legate in France he held several synods for the reformation of the clergy and conducted the negotiations for the assumption of the crown of Sicily by Charles of Anjou. It was through the latter's influence that he succeeded Nicholas III., after a six-months' struggle between the French and Italian cardinals. The Romans at first declined to receive him, and he was consecrated at Orvieto on the 23rd of March 1281. Peaceful and unassuming, he relied completely on Charles of Anjou, and showed little ability as pope. His excommunication of the emperor Michael Palaeologus (Nov. 1281), who stood in the way of the French projects against Greece, weakened the union with the Eastern Christians, dating from the Lyons Council of 1274. He unduly favoured his own countrymen, and for three years after the Sicilian Vespers (Mar. 31, 1282) he employed all the spiritual and material resources at his command on behalf of his patron against Peter of Aragon. He was driven from Rome by a popular uprising and died at Perugia. His successor was Honorius IV. (C. H. Ha.)

His registers have been published in the *Bibliothèque des écoles françaises d'Athènes et de Rome* (Paris, 1901).

See A. Potthast, *Regesta pontif. roman.*, vol. 2 (Berlin, 1875); K. J. von Hefele, *Conciliengeschichte*, Bd. 6, 2nd ed.; F. Gregorovius, *Rome in the Middle Ages*, vol. 5, trans. by Mrs G. W. Hamilton (London, 1900–1902); H. H. Milman, *Latin Christianity*, vol. 6 (London, 1899); W. Norden, *Das Papsttum u. Byzanz* (Berlin, 1903); E. Choullier, "Recherches sur la vie du pape Martin IV.," in *Revue de Champagne*, vol. 4 (1878); *Processo istorico dell' insurrezione di Sicilia dell' anno 1282*, ed. by G. di Marzo (Palermo, 1882).

Martin V. (Otto Colonna) (1417–1431) was elected at Constance on St Martin's Day, in a conclave composed of twenty-three cardinals and thirty delegates from the five different "nations" of the council. Son of Agapito Colonna, who had himself become a bishop and cardinal, the new pope belonged to one of the greatest Roman families; to Urban VI. had been due his entry, as *referendarius*, upon an ecclesiastical career. Having become a cardinal under Innocent VII., he had seceded from Gregory XII. in 1408, and together with the other cardinals at Pisa, had taken part in the election of Alexander V. and afterwards of John XXIII. At Constance, his rôle had been chiefly that of an arbiter; he was a good and gentle man, leading a simple life, free from intrigue. While refraining from making any pronouncement as to the validity of the decrees of the fourth and fifth sessions, which had seemed to proclaim the superiority of the council over the pope, Martin V. nevertheless soon revealed his personal feelings by having a constitution read in consistory which forbade any appeal from the judgment of the sovereign pontiff in matters of faith (May 10, 1418). As to the reform, of which everybody felt the necessity, the fathers in council had not succeeded in arriving at any agreement. Martin V. himself settled a great number of points, and then passed a series of special concordats with Germany, France, Italy, Spain and England. Though this was not the thorough reform of which need was felt, the council itself gave the pope a *satisfecit*. When the council was dissolved Martin V. made it his task to regain Italy. After staying for long periods at Mantua and Florence, where the deposed pope, Baldassare Cossa (John XXIII.), came and made submission to him, Martin V. was enabled to enter Rome (Sept. 30, 1420) and measure the extent of the ruins left there by the Great Schism of the West. He set to work to restore some of these ruins, to reconstitute and pacify the Papal State, to put an end to the Schism, which showed signs of continuing in Aragon and certain parts of southern France; to enter into negotiations, unfortunately unfruitful, with the Greek Church also with a view to a return to unity, to organize the struggle against heresy in Bohemia; to interpose his pacific mediation between France and England, as well as between the parties which were rending France; and, finally, to welcome and act as patron to saintly reformers like Bernardino of Siena and Francesca Romana, foundress of the nursing sisterhood of the Oblate di Tor de' Specchi (1425).

In accordance with the decree *Frequens*, and the promises which he had made, Martin V., after an interval of five years, summoned a new council, which was almost immediately transferred from Pavia to Siena, in consequence of an epidemic (1423). But the small number of fathers who attended at the latter town, and above all, the disquieting tendencies which began to make themselves felt there, induced the pope to force on a dissolution of the synod. Pending the reunion of the new council which had been summoned at Basel for the end of a period of seven years, Martin V. himself endeavoured to effect a reformation in certain points, but he was carried off by apoplexy (Feb. 20, 1431), just as he had designated the young and brilliant Cardinal Giuliano Cesarini to preside in his place over the council of Basel.

See L. Pastor, *Geschichte der Päpste* (1901), i. 205–279; J. Guiraud, *L'État pontifical après le Grand Schisme* (1896); Müntz, *Les Arts à la cour des papes pendant le xv^{e} et le xvi^{e} siècle* (1878); N. Valois, *La Crise religieuse du xv^{e} siècle; le pape et le concile* (1909), vol. i. p. i.–xxix., 1–93. (N. V.)

MARTIN, BON LOUIS HENRI (1810–1883), French historian, was born on the 20th of February 1810 at St Quentin (Aisne), where his father was a judge. Trained as a notary, he followed this profession for some time but having achieved success with an historical romance, *Wolfthurm* (1830), he applied himself to historical research. Becoming associated with Paul Lacroix ("le Bibliophile Jacob"), he planned with him a history of France, to consist of excerpts from the chief chroniclers and historians, with original matter filling up gaps in the continuity. The first volume, which appeared in 1833, encouraged the author to make the work his own, and his *Histoire de France*, in fifteen volumes (1833–1836), was the result. This *magnum opus*, rewritten and further elaborated (4th ed., 16 vols. and index, 1861–1865) gained for the author in 1856 the first prize of the Academy, and in 1869 the grand biennial prize of 20,000 francs. A popular abridgment in seven volumes was published in 1867. This, together with the continuation, *Histoire de France depuis 1789 jusqu'à nos jours* (6 vols. 1878–1883), gives a complete history of France, and superseded Sismondi's *Histoire des Français*.

This work is in parts defective; Martin's descriptions of the Gauls are based rather on romance than on history, and in this respect he was too much under the influence of Jean Reynaud and his cosmogonic philosophy. However he gave a great impetus to Celtic and anthropological studies. His knowledge of the mddile ages is inadequate, and his criticisms are not discriminating. As a free-thinking republican, his prejudices often biassed his judgment on the political and religious history of the *ancien régime*. The last six volumes, devoted to the 17th and 18th centuries, are superior to the earlier ones. Martin sat in the *assemblée nationale* as deputy for Aisne in 1871, and was elected life senator in 1878, but he left no mark as a politician. He died in Paris on the 14th of December 1883.

Among his minor works may be mentioned—*De la France, de son génie et de ses destinées* (1847), *Daniel Manin* (1860), *La Russie et l'Europe* (1866); *Études d'archéologie celtique* (1872); *Les Napoléon et les frontières de la France* (1874). See his biography by Gabriel Hanotaux, *Henri Martin; sa vie, ses œuvres, son temps* (1885).

MARTIN, CLAUD (1735–1800), French adventurer and officer in the army of the English East India Company, was born at Lyons on the 4th of January 1735, the son of a cooper. He went out to India in 1751 to serve under Dupleix and Lally in the Carnatic wars. When Pondicherry fell in 1761, he seems, like others of his countrymen, to have accepted service in the Bengal army of the English, obtaining an ensign's commission in 1763, and steadily rising to the rank of major-general. He was employed on the building of the new Fort William at Calcutta, and afterwards on the survey of Bengal under Rennell. In 1776 he was allowed to accept the appointment of superintendent of the arsenal of the nawab of Oudh at Lucknow, retaining his rank but being ultimately placed on half pay. He acquired a large fortune, and on his death (Sept. 13, 1800) he bequeathed his residuary estate to found institutions for the education of European children at Lucknow, Calcutta and Lyons, all known by the name of "La Martinière." That at Lucknow is the best known. It was housed in the palace that he had built called Constantia, which, though damaged during the Mutiny, retains many personal memorials of its founder.

See S. C. Hill, *The Life of Claud Martin* (Calcutta, 1901).

MARTIN, FRANÇOIS XAVIER (1762–1846), American jurist and author, was born in Marseilles, France, on the 17th of March 1762, of Provençal descent. In 1780 he went to Martinique, and before the close of the American war of Independence went to North Carolina, where (in New Bern) he taught French and learnt English, and set up as a printer. He studied law, and was admitted to the North Carolina bar in 1789. He published various legal books, and edited *Acts of the North Carolina Assembly from 1715 to 1803* (2nd ed., 1809). He was a member of the lower house of the General Assembly in 1806–1807. In 1809 he was commissioned a judge of the superior court of the territory of Mississippi, and in March 1810 became judge of the superior court of the territory of Orleans. Here the law was in a chaotic condition, what with French law before O'Reilly's rule, then a Spanish code, and in 1808 the Digest of the Civil Laws, an adaptation by James Brown and Moreau Lislet of the code of Napoleon, which repealed the Spanish fueros, partidas, recopilationes and laws of the Indies only as they conflicted with its provisions. Martin published in 1811 and 1813 reports of cases decided by the superior court of the territory of Orleans. For two years from February 1813 Martin was attorney-general of the newly established state of Louisiana, and then until March 1846 was a judge and (from 1836 to 1846) presiding judge of the supreme court of the state. For the period until 1830 he published reports of the decisions of the supreme court; and in 1816 he published two volumes, one French and one English, of *A General Digest of the Acts of Legislatures of the Late Territory of Orleans and of the State of Louisiana*. He won the name of the "father of Louisiana jurisprudence" and his work was of great assistance to Edward Livingston, Pierre Derbigny and Moreau Lislet in the Louisiana codification of 1821–1826. Martin's eyesight had begun to fail when he was seventy, and after 1836 he could no longer write opinions with his own hand.[1] He died in New Orleans on the 11th of December 1846.

Martin translated Robert J. Pothier *On Obligations* (1802), and wrote *The History of Louisiana from the Earliest Period* (2 vols. 1827–1829) and *The History of North Carolina* (2 vols., 1829). There is a memoir by Henry A. Bullard in part ii. of B. F. French's *Historical Collections of Louisiana* (Philadelphia, 1850), and one by W. W. Howe in John F Condon's edition of Martin's *History of Louisiana* (New Orleans, 1882).

MARTIN, HOMER DODGE (1836–1897), American artist, was born at Albany, New York, on the 28th of October 1836. A pupil for a short time of William Hart, his earlier work followed the lines of the Hudson River School. He was elected as associate of the National Academy of Design, New York, in 1868, and a full academician in 1874. During a trip to Europe in 1876 he was captivated by the Barbizon school, and from 1882 to 1886 he lived in France spending much of the time in Normandy. At Villerville he painted his "Harp of the Winds," now at the Metropolitan Museum of Art, New York. Among his important canvases are "Westchester Hills," "Adirondack Scenery," "The Cinqueboeuf Church," "Sand Dunes," and "A Newport Landscape." Martin is generally spoken of as one of the great trio of American landscapists, the other two being Inness and Wyant, and examples of his work are in most of the important American collections. He died at St. Paul, Minnesota, on the 2nd of February 1897.

MARTIN, JOHN (1789–1854), English painter, was born at Haydon Bridge, near Hexham, on the 19th of July 1789. He was apprenticed by his father to a coachbuilder to learn heraldic painting, but owing to a quarrel the indentures were cancelled, and he was placed under Bonifacio Musso, an Italian artist, father of the enamel painter Charles Musso. With his master Martin removed to London in 1806, where he married at the age of nineteen, and supported himself by giving drawing lessons, and by painting in water colours, and on china and glass. His leisure was occupied in the study of perspective and architecture. His first picture, "Sadak in Search of the Waters of Oblivion," was exhibited in the Royal Academy of 1812, and sold for fifty guineas. It was followed by the "Expulsion" (1813), "Paradise" (1813), "Clytie" (1814), and "Joshua" (1815). In 1821 appeared his "Belshazzar's Feast," which excited much favourable and hostile comment, and was awarded a prize of £200 at the British Institution, where the Joshua had previously carried off a premium of £100. Then came the "Destruction of Herculaneum" (1822), the "Creation" (1824), the "Eve of the Deluge" (1841), and a series of other Biblical and imaginative subjects. In 1832–1833 Martin received £2000 for drawing and engraving a fine series of designs to Milton, and with Westall he produced a set of Bible illustrations. He was also occupied with schemes for the improvement of London, and published various pamphlets and plans dealing with the metropolitan water supply, sewage, dock and railway systems. During the last four years of his life he was engaged upon his large subjects of "The Judgment," the "Day of Wrath," and the "Plains of Heaven." He was attacked with paralysis while painting, and died in the Isle of Man on the 17th of February 1854.

MARTIN, LUTHER (1748–1826), American lawyer, was born in New Brunswick, New Jersey, on the 9th of February 1748. He graduated at the college of New Jersey (now Princeton University) at the head of a class of thirty-five in 1766, and immediately afterwards removed to Maryland, teaching at Queenstown in that colony until 1770, and being admitted to the bar in 1771. He practised law for a short time in Virginia, then returned to Maryland, and became recognized as the leader of the Maryland bar and as one of the ablest lawyers in the United States. From 1778 to 1805 he was attorney-general of Maryland; in 1814–1816 he was chief judge of the court of Oyer and Terminer for the city of Baltimore; and in 1818–1822 he was attorney-general of Maryland. He was one of Maryland's representatives in the Continental Congress in 1784–1785 and in the Constitutional Convention of 1787 at Philadelphia, but opposed the constitution and refused to affix his signature. He subsequently allied himself with the Federalists, and was an opponent of Thomas Jefferson, who in 1807 spoke of him as the "Federal Bull-Dog." His ability was shown in his famous defence of Judge Samuel Chase (*q.v.*) in the impeachment trial before the United States Senate in 1804–1805, and in his defence of Aaron

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[1] His holographic will in favour of his brother (written in 1844 and devising property worth nearly $400,000) was unsuccessfully contested by the state of Louisiana on the ground that the will was void as being a legal and physical impossibility, or as being an attempted fraud on the state, as under it the state would not receive a 10% tax if the property went to the heirs of Martin (as intestate) in France.

Burr (*q.v.*) against the charge of treason in 1807. He has been described by the historian Henry Adams, writing of the Chase trial, as at that time the "most formidable of American advocates." Though he received a large income, he was so improvident that he was frequently in want, and on the 22nd of February 1822 the legislature of Maryland passed a remarkable resolution—the only one of the kind in American history—requiring every lawyer in the state to pay an annual licence fee of five dollars, to be handed over to trustees appointed "for the appropriation of the proceeds raised by virtue of this resolution to the use of Luther Martin." This resolution was rescinded on the 6th of February 1823. Martin died at the home of Aaron Burr in New York on the 10th of July 1826. In 1783 he had married a daughter of the Captain Michael Cresap (1742–1775), who was unjustly charged by Jefferson, in his *Notes on Virginia*, with the murder of the family of the Indian chief, John Logan, and whom Martin defended in a pamphlet long out of print.

See the biographical sketch by Henry P. Goddard, *Luther Martin, the Federal Bull-Dog* (Baltimore, 1887), No. 24 of the "Peabody Fund Publications," of the Maryland Historical Society.

MARTIN, SIR THEODORE (1816–1909), British author and translator, the son of a solicitor, was born at Edinburgh on the 16th of September 1816, and educated at the Royal High School and the University, from which he subsequently received the honorary degree of LL.D. He practised for some time as a solicitor in Edinburgh, but in 1846 went to London, where he became senior partner in the firm of Martin & Leslie, parliamentary agents. He early contributed to *Fraser's Magazine* and *Tait's Magazine*, under the signature of "Bon Gaultier," and in 1856, in conjunction with Professor Aytoun, he published the *Book of Ballads* under the same pseudonym. This work at once obtained popular favour. In 1858 he published a volume of translations of the *Poems and Ballads of Goethe*, and this was followed by a rendering of the Danish poet Henrik Hertz's lyric drama, *King René's Daughter*. The principal character in this drama, Iolanthe, was sustained by Helena Faucit (*q.v.*), who in 1851 became the author's wife. Martin's translations of Öhlenschläger's dramas, *Correggio* (1854) and *Aladdin, or the Wonderful Lamp* (1857), widened the fame of the Danish poet in England. In 1860 appeared Martin's metrical translation of the *Odes of Horace*; and in 1870 he wrote a volume on *Horace* for the series of "Ancient Classics for English Readers." In 1882 his Horatian labours were concluded by a translation of the poet's whole works, with a life and notes, in two volumes. A poetical translation of *Catullus* was published in 1861, followed by a privately printed volume of *Poems, Original and Translated*, in 1863. The came translations of the *Vita Nuova* of Dante, and the first part of Goethe's *Faust*. A metrical translation of the second part of *Faust* appeared in 1866. Martin wrote a memoir of his friend Aytoun in 1867, and while engaged upon this work he was requested by Queen Victoria, to whom he was introduced by his friend Sir Arthur Helps, to undertake the *Life of His Royal Highness the Prince Consort*. The first volume of this well-known work was published in 1874. In 1878 Martin's translation of Heine's *Poems and Ballads* appeared. Two years later the *Life of the Prince Consort* was brought to a successful conclusion by the publication of the fifth volume. A knighthood was then conferred upon him. In the following November he was elected lord rector of the university of St Andrews. Martin's *Life of Lord Lyndhurst*, based upon papers furnished by the family, was published in 1883. In 1889 appeared *The Song of the Bell, and other Translations from Schiller, Goethe, Uhland, and Others*; in 1894 *Madonna Pia, a Tragedy, and three Other Dramas*; a translation of Leopardi's poems in 1905; and in 1901 he published a biography of his wife. The kindly relations which subsisted between Queen Victoria and Sir Theodore Martin were continued after the completion of the *Life* of the prince consort up to the queen's death. Sir Theodore's account of these relations was privately printed in 1902, and, with King Edward's consent, for general publication in 1908. This little book, *Queen Victoria as I knew her*, throws a good deal of light on the Queen's character and private life. Sir Theodore Martin died on the 18th of August 1909.

MARTIN, WILLIAM (1767–1810), English naturalist, the son of a hosier, was born at Mansfield, Nottinghamshire, in 1767. He studied drawing at an early age from James Bolton at Halifax, and gained from him a taste for the study of natural history. In 1805 he was appointed drawing master in the grammar school at Macclesfield. Meanwhile he cultivated his taste for natural history, and was in 1796 elected a fellow of the Linnaean Society. He is best known for his early works on British fossils, entitled *Petrifacta derbiensia or Figures and Descriptions of Petrifactions collected in Derbyshire* (1809); and *Outlines of an Attempt to establish a Knowledge of Extraneous Fossils on Scientific Principles* (1809). He died at Macclesfield on the 31st of May 1810.

MARTIN, SIR WILLIAM FANSHAWE (1801–1895), British admiral, son of Admiral of the Fleet Sir Thomas Byam Martin, comptroller of the navy, and grandson, on the mother's side, of Captain Robert Fanshawe, who commanded the "Namur" 90 in Rodney's victory of the 12th of April 1782, was born on the 5th of December 1801. Entering the navy at the age of twelve, his father's interest secured his rapid promotion: he was made a lieutenant on the 15th of December 1820; on the 8th of February 1823 he was promoted to be commander of the "Fly" sloop, his good service in which in support of the interests of British merchants at Callao secured his promotion as captain on the 5th of June 1824. He afterwards served in the Mediterranean and on the home station. In 1849–1852 he was commodore commanding the Channel squadron, and gave evidence of a remarkable aptitude for command. He was made rear-admiral in May 1853, and for the next four years was superintendent of Portsmouth dockyard. He was made vice-admiral in February 1858, and after a year as a lord of the admiralty, was appointed commander-in-chief in the Mediterranean. The discipline of the navy was then bad. It was a tradition sprung from the wholesale shipment of gaol-birds during the old war, that the men were to be treated without consideration; moreover the ships had been largely filled up with "bounty men" bought into the service with a £10 note without training. Out of this unpromising material Martin formed the fleet which was at that time the ideal of excellence. He had no war service, and, beyond the Italian disturbance of 1860–61, no opportunity for showing diplomatic ability. But his memory lives as that of the reformer of discipline and the originator of a comprehensive system of steam manœuvres. He became an admiral in November 1863, and on the 4th of December succeeded to the baronetcy which had been conferred on his grandfather. His last appointment was the command at Plymouth, 1866–1869, and in 1870 he was put on the retired list. In 1873 the G.C.B. was conferred on him, and in 1878 he was made rear-admiral. He died at Upton Grey, near Winchfield, on the 24th of March 1895. He was twice married, and left, besides daughters, one son, who succeeded to the baronetcy.

MARTIN OF TROPPAU, or MARTIN THE POLE (d. 1278), chronicler, was born at Troppau, and entered the order of St Dominic at Prague. Afterwards he went to Rome and became papal chaplain under Clement IV. and other popes. In 1278 Pope Nicholas III. appointed him archbishop of Gnesen, but he died at Bologna whilst proceeding to Poland to take up his new duties. Martin wrote some sermons and some commentaries on the canon law; but more important is his *Chronicon pontificum et imperatorum*, a history of the popes and emperors to 1277. Written at the request of Clement IV. the *Chronicon* is jejune and untrustworthy, and was mainly responsible for the currency of the legend of Pope Joan, and the one about the institution of seven electors by the pope. Nevertheless it enjoyed an extraordinary popularity and found many continuators, but its value to students arises solely from the fact that it was used by numerous chroniclers during the 14th, 15th and 16th centuries. In the 15th century it was translated into French, and as part of the *Chronique martiniane* was often quoted by controversialists. It has also been translated into German, Italian and Bohemian.

The Latin text is printed, with introduction by L. Weiland, in Band XXII. of the *Monumenta Germaniae historica* (Hanover and Berlin, 1826 seq.). See G. Waitz, H. Brosien and others in the *Neues Archiv der Gesellschaft für ältere deutsche Geschichtskunde* (Hanover, 1876 seq.); W. Wattenbach, *Deutschlands Geschichtsquellen*, Band II. (Berlin, 1894); and A. Molinier, *Les Sources de l'histoire de France*, Tome III. (Paris, 1903).

MARTIN [1] (Fr. *Martinet*), the *Hirundo urbica* of Linnaeus and *Chelidon urbica* of modern ornithologists, a bird well known throughout Europe, including even Lapland, where it is abundant, retiring in winter to the south of Africa. It also inhabits the western part of Asia, and appears from time to time in large flocks in India. The martin (or house-martin, as it is often called, to distinguish it from the sand-martin) commonly reaches its summer quarters a few days later than the Swallow (*q.v.*), with which it is often confused in spite of the differences between them, the martin's white rump and lower parts being conspicuous as it flies or clings to its nest attached to houses. This nest, made of the same material as the swallow's, is, however, a more difficult structure to rear, and a week or more is often occupied in laying its foundations—the builders clinging to the wall while depositing the mud of which it is composed. The base once fixed, the superstructure is often quickly added, till the whole takes the shape of the half or quarter of a hemisphere, and is finished with a lining of feathers mixed with a few bents or straws. The martin builds soon after its return, and a nest that has outlasted the winter is almost at once re-occupied. The bird usually in the course of the summer raises a second, or rarely a third, brood of offspring—though the latest broods often die in the nest, apparently through failure of food. What seem to be adults are observed in England every year so late as November, and sometimes within a few days of the winter solstice, but these late birds are almost certainly strangers.

The sand-martin, *Hirundo riparia* of Linnaeus and *Cotile riparia* of modern writers, differs much in appearance and habits from the former. Its smaller size, mouse-coloured upper surface and jerking flight distinguish it from the other British *Hirundinidae*; but it is seldom discriminated, and, being the first of the family to return to its northern home, the so-called "early swallow" is nearly always of this species. Instead of the clay-built nest of the house-martin, this bird bores horizontal galleries in an escarpment. When beginning its excavation, it clings to the face of the bank, and with its bill loosens the earth, working from the centre outwards, and often hanging head downwards. The tunnel may extend to 4, 6, or even 9 ft. The gallery seems intended to be straight, but inequalities of the ground, and especially the meeting with stones, often causes it to take a sinuous course. At the end is formed a nest lined with a few grass-stalks and feathers. The sand-martin has several broods in the year, and is more regular than other *Hirundinidae* in its departure for the south. The kind of soil needed for its nesting habits makes it somewhat local, but no species of the order *Passeres* has a geographical range that can compare with this. In Europe it is found nearly to the North Cape, and thence to the Sea of Okhotsk. In winter it visits many parts of India and South Africa to the Transvaal. In America its range extends (having due regard to the season) from Melville Island to Caiçara in Brazil, and from Newfoundland to Alaska.

The purple martin of America, *Progne purpurea*, is a favourite in Canada and the United States. Naturally breeding in hollow trees, it readily adapts itself to the nest-boxes which are commonly set up for it; but its numbers are in some years and places diminished in a manner unexplained. The limits of its range in winter are not determined, chiefly owing to the differences of opinion as to the validity of certain supposed kindred species found in South America; but according to some authorities it reaches the border of Patagonia, while in summer it is known to inhabit lands within the Arctic Circle. The male is almost wholly of a glossy steel-blue, while the female is duller in colour above, and beneath of a brownish-grey.

Birds that may be called martins occur almost all over the world except in New Zealand, which is not regularly inhabited by any member of the family. The ordinary martin of Australia is the *Petrochelidon nigricans* of most ornithologists, and another and more beautiful form is the ariel or fairy-martin of the same country, *Petrochelidon ariel*. This last builds a bottle-shaped nest of mud, as does also the rock-martin of Europe, *Cotile rupestris*. The eggs of martins are from four to seven in number, and generally white, while those of swallows usually have brown, grey or lilac markings. (A. N.)

MARTINEAU, HARRIET (1802–1876), English writer, was born at Norwich, where her father was a manufacturer, on the 12th of June 1802. The family was of Huguenot extraction (see Martineau, James) and professed Unitarian views. The atmosphere of her home was industrious, intellectual and austere; she herself was clever, but weakly and unhappy; she had no sense of taste or smell, and moreover early grew deaf. At the age of fifteen the state of her health and nerves led to a prolonged visit to her father's sister, Mrs Kentish, who kept a school at Bristol. Here, in the companionship of amiable and talented people, her life became happier. Here, also, she fell under the influence of the Unitarian minister, Dr Lant Carpenter, from whose instructions, she says, she derived "an abominable spiritual rigidity and a truly respectable force of conscience strangely mingled together." From 1819 to 1830 she again resided chiefly at Norwich. About her twentieth year her deafness became confirmed. In 1821 she began to write anonymously for the *Monthly Repository*, a Unitarian periodical, and in 1823 she published *Devotional Exercises and Addresses, Prayers and Hymns*.

In 1826 her father died, leaving a bare maintenance to his wife and daughters. His death had been preceded by that of his eldest son, and was shortly followed by that of a man to whom Harriet was engaged. Mrs Martineau and her daughters soon after lost all their means by the failure of the house where their money was placed. Harriet had to earn her living, and, being precluded by deafness from teaching, took up authorship in earnest. Besides reviewing for the *Repository* she wrote stories (afterwards collected as *Traditions of Palestine*), gained in one year (1830) three essay-prizes of the Unitarian Association, and eked out her income by needlework. In 1831 she was seeking a publisher for a series of tales designed as *Illustrations of Political Economy*. After many failures she accepted disadvantageous terms from Charles Fox, to whom she was introduced by his brother, the editor of the *Repository*. The sale of the first of the series was immediate and enormous, the demand increased with each new number, and from that time her literary success was secured. In 1832 she moved to London, where she numbered among her acquaintance Hallam, Milman, Malthus, Monckton Milnes, Sydney Smith, Bulwer, and later Carlyle. Till 1834 she continued to be occupied with her political economy series and with a supplemental series of *Illustrations of Taxation*. Four stories dealing with the poor-law came out about the same time. These tales, direct, lucid, written without any appearance of effort, and yet practically effective, display the characteristics of their author's style. In 1834, when the series was complete, Miss Martineau paid a long visit to America. Here her open adhesion to the Abolitionist party, then small and very unpopular, gave great offence, which was deepened by the publication, soon after her return, of *Society in America* (1837) and a *Retrospect of Western Travel* (1838). An article in the *Westminster Review*, "The Martyr Age of the United States," introduced English readers to the struggles of the Abolitionists. The American books were followed by a novel, *Deerbrook* (1839)—a story of middle-class country life. To the same period belong a few little handbooks, forming parts of a *Guide to Service*. The veracity of her *Maid of All Work* led to a widespread belief, which she regarded with some complacency, that she had once been a maid of all work herself.

In 1839, during a visit to the Continent, Miss Martineau's health broke down. She retired to solitary lodgings in Tyne-mouth, and remained an invalid till 1844. Besides a novel, *The Hour and the Man* (1840), *Life in the Sickroom* (1844), and the *Playfellow* (1841), she published a series of tales for children containing some of her most popular work: *Settlers at Home*, *The Peasant and the Prince*, *Feats on the Fiord*, &c. During this illness she for a second time declined a pension on the civil list, fearing to compromise her political independence. Her letter on the subject was published, and some of her friends raised a small annuity for her soon after.

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[1] The older English form, martlet (French, *Martelet*), is, except in heralds' language, almost obsolete, and when used is now applied in some places to the Swift (*q.v.*). The bird called martin by French colonists in the Old World is a mynah (*Acridotheres*). (See Grackle.)

In 1844 Miss Martineau underwent a course of mesmerism, and in a few months was restored to health. She eventually published an account of her case, which had caused much discussion, in sixteen *Letters on Mesmerism*. On her recovery she removed to Ambleside, where she built herself "The Knoll," the house in which the greater part of her after life was spent. In 1845 she published three volumes of *Forest and Game Law Tales*. In 1846 she made a tour with some friends in Egypt, Palestine and Syria, and on her return published *Eastern Life, Present and Past* (1848). This work showed that as humanity passed through one after another of the world's historic religions, the conception of the Deity and of Divine government became at each step more and more abstract and indefinite. The ultimate goal Miss Martineau believed to be philosophic atheism, but this belief she did not expressly declare. She published about this time *Household Education*, expounding the theory that freedom and rationality, rather than command and obedience, are the most effectual instruments of education. Her interest in schemes of instruction led her to start a series of lectures, addressed at first to the school children of Ambleside, but afterwards extended, at their own desire, to their elders. The subjects were sanitary principles and practice, the histories of England and North America, and the scenes of her Eastern travels. At the request of Charles Knight she wrote, in 1849, *The History of the Thirty Years' Peace, 1816–1846*—an excellent popular history written from the point of view of a "philosophical Radical," completed in twelve months.

In 1851 Miss Martineau edited a volume of *Letters on the Laws of Man's Nature and Development*. Its form is that of a correspondence between herself and H. G. Atkinson, and it expounds that doctrine of philosophical atheism to which Miss Martineau in *Eastern Life* had depicted the course of human belief as tending. The existence of a first cause is not denied, but is declared unknowable, and the authors, while regarded by others as denying it, certainly considered themselves to be affirming the doctrine of man's moral obligation. Atkinson was a zealous exponent of mesmerism, and the prominence given to the topics of mesmerism and clairvoyance heightened the general disapprobation of the book, which caused a lasting division between Miss Martineau and some of her friends.

She published a condensed English version of the *Philosophie Positive* (1853). To the *Daily News* she contributed regularly from 1852 to 1866. Her *Letters from Ireland*, written during a visit to that country in the summer of 1852, appeared in that paper. She was for many years a contributor to the *Westminster Review*, and was one of the little band of supporters whose pecuniary assistance in 1854 prevented its extinction or forced sale. In the early part of 1855 Miss Martineau found herself suffering from heart disease. She now began to write her autobiography, but her life, which she supposed to be so near its close, was prolonged for twenty years. She died at "The Knoll" on the 27th of June 1876.

She cultivated a tiny farm at Ambleside with success, and her poorer neighbours owed much to her. Her busy life bears the consistent impress of two leading characteristics—industry and sincerity. The verdict which she records on herself in the autobiographical sketch left to be published by the *Daily News* has been endorsed by posterity. She says—"Her original power was nothing more than was due to earnestness and intellectual clearness within a certain range. With small imaginative and suggestive powers, and therefore nothing approaching to genius, she could see clearly what she did see, and give a clear expression to what she had to say. In short, she could popularize while she could neither discover nor invent." Her judgment on large questions was clear and sound, and was always the judgment of a mind naturally progressive and Protestant.

See her *Autobiography, with Memorials by Maria Weston Chapman* (1877) and Mrs. Fenwick Miller, *Harriet Martineau* (1884, "Eminent Women Series").

MARTINEAU, JAMES (1805–1900), English philosopher and divine, was born at Norwich on the 21st of April 1805, the seventh child of Thomas Martineau and Elizabeth Rankin, the sixth, his senior by almost three years, being his sister Harriet (see above). He was descended from Gaston Martineau, a Huguenot surgeon and refugee, who married in 1693 Marie Pierre, and settled soon afterwards in Norwich. His son and grandson—respectively the great-grandfather and grandfather of James Martineau—were surgeons in the same city, while his father was a manufacturer and merchant. James was educated at Norwich Grammar School under Edward Valpy, as good a scholar as his better-known brother Richard. But the boy proving too sensitive for the life of a public day school, was sent to Bristol to the private academy of Dr Lant Carpenter, under whom he studied for two years. On leaving he was apprenticed to a civil engineer at Derby, where he acquired "a store of exclusively scientific conceptions,"[1] but also experienced the hunger of mind which forced him to look to religion for satisfaction. Hence came his "conversion," and the sense of vocation for the ministry which impelled him in 1822 to enter Manchester College, then lodged at York. Here he "woke up to the interest of moral and metaphysical speculations." Of his teachers, one, the Rev. Charles Wellbeloved, was, Martineau said, "a master of the true Lardner type, candid and catholic, simple and thorough, humanly fond indeed of the counsels of peace, but piously serving every bidding of sacred truth." "He never justified a prejudice; he never misdirected our admiration; he never hurt an innocent feeling or overbore a serious judgment; and he set up within us a standard of Christian scholarship to which it must ever exalt us to aspire."[2] The other, the Rev. John Kenrick, he described as a man so learned as to be placed by Dean Stanley "in the same line with Blomfield and Thirlwall,"[3] and as "so far above the level of either vanity or dogmatism, that cynicism itself could not think of them in his presence."[4]

On leaving the college in 1827 Martineau returned to Bristol to teach in the school of Lant Carpenter; but in the following year he was ordained for a Unitarian church in Dublin, whose senior minister was a relative of his own. But his career there was in 1832 suddenly cut short by difficulties growing out of the "regium donum," which had on the death of the senior minister fallen to him. He conceived it as "a religious monopoly" to which "the nation at large contributes," while "Presbyterians alone receive," and which placed him in "a relation to the state" so "seriously objectionable" as to be "impossible to hold."[5] The invidious distinction it drew between Presbyterians on the one hand, and Catholics, Friends, freethinking Christians, unbelievers and Jews on the other, who were compelled to support a ministry they "conscientiously disapproved," offended his always delicate conscience; while possibly the intellectual and ecclesiastical atmosphere of the city proved uncongenial to his liberal magnanimity. From Dublin he was called to Liverpool, and there for a quarter of a century he exercised extraordinary influence as a preacher, and achieved a high reputation as a writer in religious philosophy. In 1840 he was appointed professor of mental and moral philosophy and political economy in Manchester New College, the seminary in which he had himself been educated, and which had now removed from York to the city after which it was named. This position he held for forty-five years. In 1853 the college removed to London, and four years later he followed it thither. In 1858 he was called to occupy the pulpit of Little Portland Street chapel in London, which he did at first for two years in conjunction with the Rev. J. J. Tayler, who was also his colleague in the college, and then for twelve years alone. In 1866 the chair of the philosophy of mind and logic in University College, London, fell vacant, and Martineau became a candidate. But potent opposition was offered to the appointment of a minister of religion, and the chair went to George Croom Robertson—then an untried man—between whom and Martineau a cordial friendship came to exist. In 1885 he retired, full of years and honours, from the principalship of the college he had so long served and adorned. Martineau, who was in his youth denied the benefit of a university education, yet in his age found famous universities eager to confer upon him their highest distinctions. He was made LL.D. of Harvard in 1872, S.T.D. of Leiden in 1874, D.D. of Edinburgh in 1884, D.C.L. of Oxford in 1888 and D.Litt. of Dublin in 1891. He died in London on the 11th of January 1900.

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[1] *Types of Ethical Theory*, i. 8.

[2] *Essays, Reviews and Addresses*, iv. 54.

[3] Ibid. i. 397.

[4] *Essays, Reviews and Addresses*, i. 419.

[5] Martineau's "Letter to the Dissenting Congregation of Eustace Street" (Dublin).

The life of Martineau was so essentially the life of the thinker, and was so typical of the century in which he lived and the society within which he moved, that he can be better understood through his spoken mind than through his outward history. He was a man happy in his ancestry; he inherited the dignity, the reserve, the keen and vivid intellect, and the picturesque imagination of the French Huguenot, though they came to him chastened and purified by generations of Puritan discipline exercised under the gravest ecclesiastical disabilities, and of culture maintained in the face of exclusion from academic privileges. He had the sweet and patient temper which knew how to live, unrepining and unsoured, in the midst of the most watchful persecution, public and private; and it is wonderful how rarely he used his splendid rhetoric for the purposes of invective against the spirit and policy from which he must have suffered deeply, while, it may be added, he never hid an innuendo under a metaphor or a trope. He was fundamentally too much a man of strong convictions to be correctly described as open-minded, for if nature ever determined any man's faith, it was his; the root of his whole intellectual life, which was too deep to be disturbed by any superficial change in his philosophy, being the feeling for God. He has, indeed, described in graphic terms the greatest of the more superficial changes he underwent; how he had "carried into logical and ethical problems the maxims and postulates of physical knowledge," and had moved within the narrow lines drawn by the philosophical instructions of the class-room "interpreting human phenomena by the analogy of external nature"; how he served in willing captivity "the 'empirical' and 'necessarian' mode of thought," even though "shocked" by the dogmatism and acrid humours "of certain distinguished representatives";[1] and how in a period of "second education" at Berlin, "mainly under the admirable guidance of Professor Trendelenburg," he experienced "a new intellectual birth" which "was essentially the gift of fresh conceptions, the unsealing of hidden openings of self-consciousness, with unmeasured corridors and sacred halls behind; and, once gained, was more or less available throughout the history of philosophy, and lifted the darkness from the pages of Kant and even Hegel."[2] But though this momentous change of view illuminated his old beliefs and helped him to re-interpret and re-articulate them, yet it made him no more of a theist than he had been before. And as his theism was, so was his religion and his philosophy. Certainly it was true of him, in a far higher degree than of John Henry Newman, that the being of God and himself were to his mind two absolutely self-luminous truths—though both his God and his self were almost infinitely remote from Newman's. And as these truths were self-evident, so the religion he deduced from them was sufficient, not only for his own moral and intellectual nature, but also for man as he conceived him, for history as he knew it, and for society as he saw it.

We may, alternatively, describe Martineau's religion as his applied philosophy or his philosophy as his explicated religion, and both as the expression of his singularly fine ethical and reverent nature. But to understand these in their mutual and explanatory relations it will be necessary to exhibit the conditions under which his thought grew into consistency and system. His main function made him in his early life a preacher even more emphatically than a teacher. In all he said and all he thought he had the preacher's end in view. He was, indeed, no mere orator or speaker to multitudes. He addressed a comparatively small and select circle, a congregation of thoughtful and devout men, who cultivated reverence and loved religion all the more that their own beliefs were limited to the simplest and sublimest truths. He felt the majesty of these truths to be the greater that they so represented to him not only the most fundamental of human beliefs, but also all that man could be reasonably expected to believe, though to believe with his whole reason. Hence the beliefs he preached were never to him mere speculative ideas, but rather the ultimate realities of being and thought, the final truths as to the character and ways of God interpreted into a law for the government of conscience and the regulation of life. And so he became a positive religious teacher by virtue of the very ideas that made the words of the Hebrew prophets so potent and sublime. But he did more than interpret to his age the significance of man's ultimate theistic beliefs, he gave them vitality by reading them through the consciousness of Jesus Christ. His religion was what he conceived the personal religion of Jesus to have been; and He was to him more a person to be imitated than an authority to be obeyed, rather an ideal to be revered than a being to be worshipped.

Martineau's mental qualities fitted him to fulfil these high interpretative functions. He had the imagination that invested with personal being and ethical qualities the most abstruse notions. To him space became a mode of divine activity, alive with the presence and illuminated by the vision of God; time was an arena where the divine hand guided and the divine will reigned. And though he did not believe in the Incarnation, yet he held deity to be in a sense manifest in humanity; its saints and heroes became, in spite of innumerable frailties, after a sort divine; man underwent an apotheosis, and all life was touched with the dignity and the grace which it owed to its source. The 19th century had no more reverent thinker than Martineau; the awe of the Eternal was the very atmosphere that he breathed, and he looked at man with the compassion of one whose thoughts were full of God.

To his function as a preacher we owe some of his most characteristic and stimulating works, especially the discourses by which it may be said he won his way to wide and influential recognition—*Endeavours after the Christian Life*, 1st series, 1843; 2nd series, 1847; *Hours of Thought*, 1st series, 1876; 2nd series, 1879; the various hymn-books he issued at Dublin in 1831, at Liverpool in 1840, in London in 1873; and the *Home Prayers* in 1891. But besides the vocation he had freely selected and assiduously laboured to fulfil, two more external influences helped to shape Martineau's mind and define his problem and his work; the awakening of English thought to the problems which underlie both philosophy and religion, and the new and higher opportunities offered for their discussion in the periodical press. The questions which lived in the earlier and more formative period of his life concerned mainly the idea of the church, the historical interpretation of the documents which described the persons who had created the Christian religion, especially the person and work of its founder; but those most alive in his later and maturer time chiefly related to the philosophy of religion and ethics. In one respect Martineau was singularly happy; he just escaped the active and, on the whole, belittling period of the old Unitarian controversy. When his ministry began its fires were slowly dying down, though the embers still glowed. We feel its presence in his earliest notable work, *The Rationale of Religious Enquiry*, 1836; and may there see the rigour with which it applied audacious logic to narrow premisses, the tenacity with which it clung to a limited literal supernaturalism which it had no philosophy to justify, and so could not believe without historical and verbal authority. This traditional conservatism survived in the statement, which, while it caused vehement discussion when the book appeared, was yet not so much characteristic of the man as of the school in which he had been trained, that "in no intelligible sense can any one who denies the supernatural origin of the religion of Christ be termed a Christian," which term, he explained, was used not as "a name of praise," but simply as "a designation of belief."[3] He censured the German rationalists "for having preferred, by convulsive efforts of interpretation, to compress the memoirs of Christ and His apostles into the dimensions of ordinary life, rather than admit the operation of miracle on the one hand, or proclaim their abandonment of Christianity on the other."[4] The echoes of the dying controversy are thus distinct and not very distant in this book, though it also offers in its larger outlook, in the author's evident uneasiness under the burden of inherited beliefs, and his inability to reconcile them with his new standpoint and accepted principles, a curious forecast of his later development, while in its positive premisses it presents a still more instructive contrast to the conclusions of his later dialectic. Nor did the sound of the ancient controversy ever cease to be audible to him. In 1839 he sprang to the defence of Unitarian doctrine, which had been assailed by certain Liverpool clergymen, of whom Fielding Ould was the most active and Hugh McNeill the most famous. As his share in the controversy, Martineau published five discourses, in which he discussed "the Bible as the great autobiography of human nature from its infancy to its perfection," "the Deity of Christ," "Vicarious Redemption," "Evil," and "Christianity without Priest and without Ritual."[1] He remained to the end a keen and vigilant apologist of the school in which he had been nursed. But the questions proper to the new day came swiftly upon his quick and susceptible mind—enlarged, deepened and developed it. Within his own fold new light was breaking. To W. E. Channing (*q.v.*), whom Martineau had called "the inspirer of his youth," Theodore Parker had succeeded, introducing more radical ideas as to religion and a more drastic criticism of sacred history. Blanco White, "the rationalist A'Kempis," who had dared to appear as "a religious sceptic in God's presence," had found a biographer and interpreter in Martineau's friend and colleague, John Hamilton Thom. Within the English Church men with whom he had both personal and religious sympathy rose—Whately, of whom he said, "We know no living writer who has proved so little and disproved so much";[2] and Thomas Arnold, "a man who could be a hero without romance";[3] F. D. Maurice, whose character, marked by "religious realism," sought in the past "the witness to eternal truths, the manifestation by time-samples of infinite realities and unchanging relations";[4] and Charles Kingsley, "a great teacher," though one "certain to go astray the moment he becomes didactic."[5] Beside these may be placed men like E. B. Pusey and J. H. Newman, whose mind Martineau said was "critical, not prophetic, since without immediateness of religious vision," and whose faith is "an escape from an alternative scepticism, which receives the *veto* not of his reason but of his will,"[6] as men for whose teachings and methods he had a potent and stimulating antipathy. The philosophic principles and religious deductions of Dean Mansel he disliked as much as those of Newman, but he respected his arguments more. Apart from the Churches, men like Carlyle and Matthew Arnold—with whom he had much in common—influenced him; while Herbert Spencer in England and Comte in France afforded the antithesis needful to the dialectical development of his own views. He came to know German philosophy and criticism, especially the criticism of Baur and the Tübingen school, which affected profoundly his construction of Christian history. And these were strengthened by French influences, notably those of Renan and the Strassburg theologians. The rise of evolution, and the new scientific way of looking at nature and her creative methods, compelled him to rethink and reformulate his theistic principles and conclusions, especially as to the forms under which the relation of God to the world and His action within it could be conceived. Under the impulses which came from these various sides Martineau's mind lived and moved, and as they successively rose he promptly, by appreciation or criticism, responded to the dialectical issues which they raised.

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[1] *Types of Ethical Theory*, i. pp. vii.-ix.

[2] Ibid. p. xiii.

[3] *Rationale*, 2nd ed., pref., p. vii.

[4] Ibid. p. 133.

In the discussion of these questions the periodical press supplied him with the opportunity of taking an effective part. At first his literary activity was limited to sectional publications, and he addressed his public, now as editor and now as leading contributor, in the *Monthly Repository*, the *Christian Reformer*, the *Prospective*, the *Westminster* and the *National Review*. Later, especially when scientific speculation had made the theistic problem urgent, he was a frequent contributor to the literary monthlies. And when in 1890 he began to gather together the miscellaneous essays and papers written during a period of sixty years, he expressed the hope that, though "they could lay no claim to logical consistency," they might yet show "beneath the varying complexion of their thought some intelligible moral continuity," "leading in the end to a view of life more coherent and less defective than was presented at the beginning."[7] And though it is a proud as well as a modest hope, no one could call it unjustified. For his essays are fine examples of permanent literature appearing in an ephemeral medium, and represent work which has solid worth for later thought as well as for the speculation of their own time. There is hardly a name or a movement in the religious history of the century which he did not touch and illuminate. It was in this form that he criticized the "atheistic mesmerism" to which his sister Harriet had committed herself, and she never forgave his criticism. But his course was always singularly independent, and, though one of the most affectionate and most sensitive of men, yet it was his fortune to be so fastidious in thought and so conscientious in judgment as often to give offence or create alarm in those he deeply respected or tenderly loved.

The theological and philosophical discussions which thus appeared he later described as "the tentatives which gradually prepared the way for the more systematic expositions of the *Types of Ethical Theory* and *The Study of Religion*, and, in some measure, of *The Seat of Authority in Religion*."[8] These books expressed his mature thought, and may be said to contain, in what he conceived as a final form, the speculative achievements of his life. They appeared respectively in 1885, 1888 and 1890, and were without doubt remarkable feats to be performed by a man who had passed his eightieth year. Their literary and speculative qualities are indeed exceptionally brilliant; they are splendid in diction, elaborate in argument, cogent yet reverent, keen while fearless in criticism. But they have also most obvious defects: they are unquestionably the books of an old man who had thought much as well as spoken and written often on the themes he discusses, yet who had finally put his material together in haste at a time when his mind had lost, if not its dialectic vigour, yet its freshness and its sense of proportion; and who had been so accustomed to amplify the single stages of his argument that he had forgotten how much they needed to be reduced to scale and to be built into an organic whole. In the first of these books his nomenclature is unfortunate; his division of ethical theories into the "unpsychological," "idiopsychological," and the "hetero-psychological," is incapable of historical justification; his exposition of single ethical systems is, though always interesting and suggestive, often arbitrary and inadequate, being governed by dialectical exigencies rather than historical order and perspective. In the second of the above books his idea of religion is somewhat of an anachronism; as he himself confessed, he "used the word in the sense which it invariably bore half a century ago," as denoting "belief in an ever-living God, a divine mind and will ruling the universe and holding moral relations with mankind." As thus used, it was a term which governed the problems of speculative theism rather than those connected with the historical origin, the evolution and the organization of religion. And these are the questions which are now to the front. These criticisms mean that his most elaborate discussions came forty years too late, for they were concerned with problems which agitated the middle rather than the end of the 19th century. But if we pass from this criticism of form to the actual contents of the two books, we are bound to confess that they constitute a wonderfully cogent and persuasive theistic argument. That argument may be described as a criticism of man and his world used as a basis for the construction of a reasoned idea of nature and being. Man and nature, thought and being, fitted each other. What was implicit in nature had become explicit in man; the problem of the individual was one with the problem of universal experience. The interpretation of man was therefore the interpretation of his universe. Emphasis was made to fall on the reason, the conscience and the will of the finite personality; and just as these were found to be native in him they were held to be immanent in the cause of his universe. What lived in time belonged to eternity; the microcosm was the epitome of the macrocosm; the reason which reigned in man interpreted the law that was revealed in conscience and the power which governed human destiny, while the freedom which man realized was the direct negation both of necessity and of the operation of any fortuitous cause in the cosmos.

It was not possible, however, that the theistic idea could be discussed in relation to nature only. It was necessary that it should be applied to history and to the forces and personalities active within it. And of these the greatest was of course the Person that had created the Christian religion. What did Jesus signify? What authority belonged to Him and to the books that contain His history and interpret His person? This was the problem which Martineau attempted to deal with in *The Seat of Authority in Religion*. The workmanship of the book is unequal: historical and literary criticism had never been Martineau's strongest point, although he had almost continuously maintained an amount of New Testament study, as his note-books show. In its speculative parts the book is quite equal to those that had gone before, but in its literary and historical parts there are indications of a mind in which a long-practised logic had become a rooted habit. While a comparison of his expositions of the Pauline and Johannine Christologies with the earlier Unitarian exegesis in which he had been trained shows how wide is the interval, the work does not represent a mind that had throughout its history lived and worked in the delicate and judicial investigations he here tried to conduct.

Martineau's theory of the religious society or church was that of an idealist rather than of a statesman or practical politician. He stood equally remote from the old Voluntary principle, that "the State had nothing to do with religion," and from the sacerdotal position that the clergy stood in an apostolic succession, and either constituted the Church or were the persons into whose hands its guidance had been committed. He hated two things intensely, a sacrosanct priesthood and an enforced uniformity. He may be said to have believed in the sanity and sanctity of the state rather than of the Church. Statesmen he could trust as he would not trust ecclesiastics. And so he even propounded a scheme, which fell still-born, that would have repealed uniformity, taken the church out of the hands of a clerical order, and allowed the coordination of sects or churches under the state. Not that he would have allowed the state to touch doctrine, to determine polity or discipline; but he would have had it to recognize historical achievement, religious character and capacity, and endow out of its ample resources those societies which had vindicated their right to be regarded as making for religion. His ideal may have been academic, but it was the dream of a mind that thought nobly both of religion and of the state.

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[1] They stand as Lectures ii., v., vi., xi., xii. in the volume *Unitarianism Defended*, 1839.

[2] *Essays, Reviews and Addresses*, ii. 10.

[3] Ibid. i. 46.

[4] Ibid. i. 258, 262.

[5] Ibid. ii. 285.

[6] Ibid. i. 233.

[7] *Essays, Reviews and Addresses*, i., iii.

[8] Ibid. iii., pref., p. vi.

See *Life and Letters* by J. Drummond and C. B. Upton (2 vols., 1901); J. E. Carpenter, *James Martineau, Theologian and Teacher* (1905); J. Crawford, *Recollections* of James Martineau (1903); A. W. Jackson, *James Martineau, a Biography and a Study* (Boston, 1900); H. Sidgwick, *Lectures on the Ethics of Green, Spencer and Martineau* (1902); and J. Hunt, *Religious Thought in England in the 19th Century.* (A. M. F.)

MARTINET, a military term (more generally used in a disparaging than in a complimentary sense) implying a strict disciplinarian or drill-master. The term originated in the French army about the middle of Louis XIV.'s reign, and was derived from Jean Martinet (d. 1672), who as lieutenant-colonel of the King's regiment of foot and inspector-general of infantry drilled and trained that arm in the model regular army created by Louis and Louvois between 1660 and 1670. Martinet seems also to have introduced the copper pontoons with which Louis bridged the Rhine in 1672. He was killed, as a *maréchal de camp*, at the siege of Duisburg in the same year, being accidentally shot by his own artillery while leading the infantry assault. His death, and that of the Swiss captain Soury by the same discharge gave rise to a *bon mot*, typical of the polite ingratitude of the age, that Duisburg had only cost the king a martin and a mouse. The "martin" as a matter of fact shares with Vauban and other professional soldiers of Louis XIV. the glory of having made the French army the first and best regular army in Europe. Great nobles, such as Turenne, Condé and Luxemburg, led this army and inspired it, but their fame has obscured that of the men who made it manageable and efficient. It was about this time that the soldier of fortune, who joined a regiment with his own arms and equipment and had learned his trade by varied experience, began to give place to the soldier regularly enlisted as a recruit in permanent regiments and trained by his own officers. The consequence of this was the introduction of a uniform, or nearly uniform system of drill and training, which in all essentials has endured to the present day. Thus Martinet was the forerunner of Leopold of Dessau and Frederick William, just as Jean Jacques de Fourilles, the organizer of the cavalry, who was forced into an untimely charge at Seneffe (1674) by a brutal taunt of Condé, and there met his death, was the forerunner of Zieten and Seydlitz. These men, while differing from the creators of the Prussian army in that they contributed nothing to the tactics of their arms, at least made tactics possible by the thorough drilling and organization they imparted to the formerly heterogeneous and hardly coherent elements of an army.

MARTÍNEZ DE LA ROSA, FRANCISCO DE PAULA (1789–1862), Spanish statesman and dramatist, was born on the 10th of March 1789 at Granada, and educated at the university there. He won popularity with a series of epigrams on local celebrities published under the title of *El Cementerio de momo.* During the struggle against Napoleon he took the patriotic side, was elected deputy, and at Cadiz produced his first play, *Lo que puede un empleo*, a prose comedy in the manner of the younger Moratin. *La Viuda de Padilla* (1814), a tragedy modelled upon Alfieri, was less acceptable to the Spanish public. Meanwhile the author became more and more engulfed in politics, and in 1814 was banished to Africa, where he remained till 1820, when he was suddenly recalled and appointed prime minister. During the next three years he was the most unpopular man in Spain; denounced as a revolutionist by the Conservatives and as a reactionary by the Liberals, he alienated the sympathies of all parties, and his rhetoric earned for him the contemptuous nickname of *Rosita la Pastelera.* Exiled in 1823, he took refuge in Paris, where he issued his *Obras literarias* (1827), including his *Arte poética*, in which he exaggerated the literary theories already promulgated by Luzán. Returning to Spain in 1831, he became prime minister on the death of Ferdinand VII., but proved incapable of coping with the insurrectionary movement and resigned in 1834. He was ambassador at Paris in 1839–1840 and at Rome in 1842–1843, joined the Conservative party, held many important offices, and was president of congress and director of the Spanish academy at the time of his death, which took place at Madrid on the 7th of February 1862. As a statesman, Martínez de la Rosa never rose above mediocrity. It was his misfortune to be in place without real power, to struggle against a turbulent pseudo-democratic movement promoted by unscrupulous soldiers, and to contend with the intrigues of the king, the court camarilla and the clergy. But circumstances which hampered him in politics favoured his career in literature. He was not a great natural force; his early plays and poems are influenced by Moratin or by Meléndez Valdés; his *Espíritu del siglo* (1835) is an elegant summary of all the commonplaces concerning the philosophy of history; his *Doña Isabel de Solís* (1837–1846) is a weak imitation of Walter Scott's historical novels. Still his place in the history of Spanish literature is secure, if not eminent. Through the happy accident of his exile at Paris he was thrown into relations with the leaders of the French romantic movement, and was so far impressed with the innovations of the new school as to write in French a romantic piece entitled *Aben-Humeya* (1830), which was played at the Porte Saint-Martin. The experiment was not unsuccessful, and on his return to Madrid Martínez de la Rosa produced *La Conjuración de Venecia* (April 23, 1834), which entitles him to be called the pioneer of the romantic drama in Spain. The play is more reminiscent of Casimir Delavigne than of Victor Hugo; but it was unquestionably effective, and smoothed the way for the bolder essays of Rivas, García Gutiérrez and Hartzenbusch.

MARTINI, GIOVANNI BATTISTA (1706–1784), Italian musician, was born at Bologna on the 24th of April 1706. His father, Antonio Maria Martini, a violinist, taught him the elements of music and the violin; later he learned singing and harpsichord playing from Padre Pradieri, and counterpoint from Antonio Riccieri. Having received his education in classics from the fathers of the oratory of San Filippo Neri, he afterwards entered upon a noviciate at the Franciscan monastery at Lago, at the close of which he was received as a Minorite on the 11th of September 1722. In 1725, though only nineteen years old, he received the appointment of chapel-master in the Franciscan church at Bologna, where his compositions attracted attention. At the invitation of amateurs and professional friends he opened a school of composition at which several celebrated musicians were trained; as a teacher he consistently declared his preference for the traditions of the old Roman school of composition. Padre Martini was a zealous collector of musical literature, and possessed an extensive musical library. Burney estimated it at 17,000 volumes; after Martini's death a portion of it passed to the Imperial library at Vienna, the rest remaining in Bologna, now in the Liceo Rossini. Most contemporary musicians speak of Martini with admiration, and Mozart's father consulted him with regard to the talents of his son. Abt Vogler, however, makes reservations in his praise, condemning his philosophical principles as too much in sympathy with those of Fox, which had already been expressed by P. Vallotti. He died at Bologna on the 4th of August 1784. His *Elogio* was published by Pietro della Valle at Bologna in the same year.

The greater number of Martini's sacred compositions remain unprinted. The Liceo of Bologna possesses the MSS. of two oratorios; and a requiem, with some other pieces of church music, are now in Vienna. *Litaniae atque antiphonae finales B. V. Mariae* were published at Bologna in 1734, as also twelve *Sonate d'intavolatura*; six *Sonate per l'organo ed il cembalo* in 1747; and *Duetti da camera* in 1763. Martini's most important works are his *Storia della musica* (Bologna, 1757–1781) and his *Saggio di contrapunto* (Bologna, 1774–1775). The former, of which the three published volumes relate wholly to ancient music, and thus represent a mere fragment of the author's vast plan, exhibits immense reading and industry, but is written in a dry and unattractive style, and is overloaded with matter which cannot be regarded as historical. At the beginning and end of each chapter occur puzzle-canons, wherein the primary part or parts alone are given, and the reader has to discover the canon that fixes the period and the interval at which the response is to enter. Some of these are exceedingly difficult, but Cherubini solved the whole of them. The *Saggio* is a learned and valuable work, containing an important collection of examples from the best masters of the old Italian and Spanish schools, with excellent explanatory notes. It treats chiefly of the tonalities of the plain chant, and of counterpoints constructed upon them. Besides being the author of several controversial works, Martini drew up a *Dictionary of Ancient Musical Terms*, which appeared in the second volume of G. B. Doni's *Works*; he also published a treatise on *The Theory of Numbers as applied to Music*. His celebrated canons, published in London, about 1800, edited by Pio Cianchettini, show him to have had a strong sense of musical humour.

MARTINI, SIMONE (1283–1344), Sienese painter, called also Simone di Martino, and more commonly, but not correctly, Simon Memmi,[1] was born in 1283. He followed the manner of painting proper to his native Siena, as improved by Duccio, which is essentially different from the style of Giotto and his school, and the idea that Simone was himself a pupil of Giotto is therefore wide of the mark. The Sienese style is less natural, dignified and reserved than the Florentine; it has less unity of impression, has more tendency to pietism, and is marked by exaggerations which are partly related to the obsolescent Byzantine manner, and partly seem to forebode certain peculiarities of the fully developed art which we find prevalent in Michelangelo. Simone, in especial, tended to an excessive and rather affected tenderness in his female figures; he was more successful in single figures and in portraits than in large compositions of incident. He finished with scrupulous minuteness, and was elaborate in decorations of patterning, gilding, &c.

The first known fresco of Simone is the vast one which he executed in the hall of the Palazzo Pubblico in Siena—the "Madonna Enthroned, with the Infant," and a number of angels and saints; its date is 1315, at which period he was already an artist of repute throughout Italy. In S. Lorenzo Maggiore of Naples he painted a life-sized picture of King Robert crowned by his brother Lewis, bishop of Toulouse; this also is extant, but much damaged. In 1320 he painted for the high altar of the church of S. Caterina in Pisa the Virgin and Child between six saints; above are archangels, apostles and other figures. The compartmented portions of this work are now dispersed, some of them being in the academy of Siena. Towards 1321 he executed for the church of S. Domenico in Orvieto a picture of the bishop of Savona kneeling before the Madonna attended by saints, now in the Fabriceria of the cathedral. Certain frescoes in Assisi in the chapel of San Martino, representing the life of that saint, ascribed by Vasari to Puccio Capanna, are now, upon internal evidence, assigned to Simone. He painted also, in the south transept of the lower church of the same edifice, figures of the Virgin and eight saints. In 1328 he produced for the sala del consilio in Siena a striking equestrian portrait of the victorious general Guidoriccio Fogliani de' Ricci.

Simone had married in 1324 Giovanna, the daughter of Memmo (Guglielmo) di Filippuccio. Her brother, named Lippo Memmi, was also a painter, and was frequently associated with Simone in his work; and this is the only reason why Simone has come down to us with the family-name Memmi. They painted together in 1333 the "Annunciation" which is now in the Uffizi gallery. Simone kept a bottega (or shop), undertaking any ornamental work, and his gains were large. In 1339 he settled at the papal court in Avignon, where he made the acquaintance of Petrarch and Laura; and he painted for the poet a portrait of his lady, which gave occasion for two of Petrarch's sonnets, in which Simone is eulogized. He also illuminated for the poet a copy of the commentary of Servius upon Virgil, now preserved in the Ambrosian library of Milan. He was largely employed in the decorations of the papal buildings in Avignon, and several of his works still remain—in the cathedral, in the hall of the consistory, and, in the two chapels of the palace, the stories of the Baptist, and of Stephen and other saints. One of his latest productions (1342) is the picture of "Christ Found by his Parents in the Temple," now in the Liverpool Gallery. Simone died in Avignon in July 1344.

Some of the works with which Simone's name and fame have been generally identified are not now regarded as his. Such are the compositions, in the Campo Santo of Pisa, from the legend of S. Ranieri, and the "Assumption of the Virgin"; and the great frescoes in the Cappellone degli Spagnuoli, in S. Maria Novella, Florence, representing the Triumph of Religion through the work of the Dominican order, &c. (W. M. R.)

MARTINIQUE, an island of the West Indies, belonging to the chain of the Lesser Antilles, and constituting a French colony, between the British islands of Dominica and St Lucia, 25 m. S. of the one and 20 m. N. of the other, about 14° 40′ N., 61° W. Its length is 40 m., its greatest width 21 m.; and the area comprises 380 sq. m. A cluster of volcanic mountains in the north, a similar group in the south, and a line of lower heights between them, form the backbone of the island. Its deep ravines and precipitous escarpments are reduced in appearance to gentle undulations by the drapery of the forests. The massif of Mont Pelé in the north is the culminating point of the island (4430 ft.); that of Carbet is little inferior (3963 ft.), but the mountains in the south are much lower. Mont Pelé is notorious for an appalling eruption in May 1902.

Of the numerous streams which traverse the few miles of country between the watershed and the sea (the longest radiating from Mount Carbet), about seventy-five are of considerable size, and in the rainy season become deep and often destructive torrents. On the north-west and north the coast is elevated and bold; and similarly on the south, where a lateral range, branching from the backbone of the island, forms a blunt peninsula bounding the low-shored western bay of Fort de France on the south. Another peninsula, called Caravelle, projects from the middle part of the east coast, and south of this the coast is low and fretted, with many islets and cays lying off it. Coral reefs occur especially in this locality. Plains, most numerous and extensive in the south, occupy about one-third of the total area of the island.

The mean annual temperature is 80° F. in the coast region, the monthly mean for June being 83°, and that for January 77°. Of the annual rainfall of 87 in., August has the heaviest share (11·3 in.), though the rainy season extends from June to October; March, the driest month, has 3·7. Martinique enjoys a marked immunity from hurricanes. The low coastal districts are not very healthy for Europeans in the hotter months, but there are numerous sanatoria in the forest region at an elevation of about 1500 ft., where the average temperature is some 10° F. lower than that already quoted. The north winds which prevail from November to February are comparatively fresh and dry; those from the south (July to October) are damp and warm. From March to June easterly winds are prevalent.

The population increased from 162,861 in 1878 to 175,863 in 1888 and 203,781 in 1901. In 1902 the great eruption of Mont Pelé occurred, and in 1905 the population was only 182,024. The bulk of the population consists of Creole negroes and half-castes of various grades, ranging from the "Saccatra," who has retained hardly any trace of Caucasian blood, to the so-called "Sangmêlé," with only a suspicion of negro commixture. The capital of the island is Fort de France, on the west-coast bay of the same name, with a fine harbour defended by three forts, and a population of 18,000. The other principal centres of population are, on the west coast Lamentin, on the same bay as the capital, and on the east coast Le François and Le Robert. The colony is administered by a governor and a general council, and returns a senator and two deputies. There are elective municipal councils. The chief product is sugar, and some coffee, cocoa, tobacco and cotton are grown. The island is served by British, French and American steamship lines, and local communications are carried on by small coasting steamers and by subsidized mail coaches, as there are excellent roads. In 1905 the total value of the exports, consisting mainly of sugar, rum and cocoa, was £725,460, France taking by far the greater part, while imports were valued at £596,294, of which rather more than one-half by value came from France, the United States of America being the next principal importing country. In 1903, the year following the eruption of Mont Pelé, exports were valued at £604,163.

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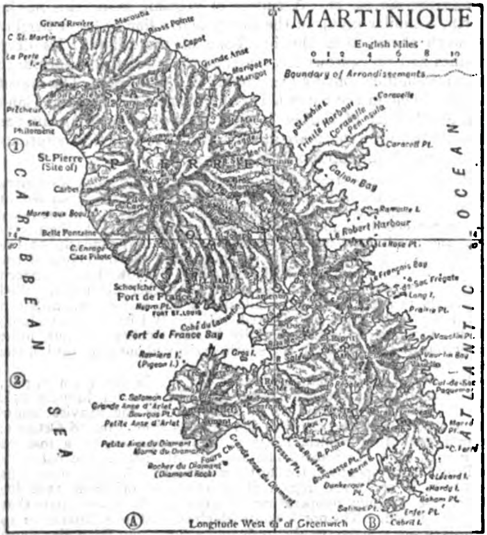
[1] The ordinary account of Simone is that given by Vasari, and since repeated in a variety of forms. Modern research shows that it is far from correct, the incidents being erroneous, and the paintings attributed to Simone in various principal instances not his. We follow the authority of Crowe and Cavalcaselle.

Martinique, the name of which may be derived from a native form Madiana or Mantinino, was probably discovered by Columbus on the 15th of June 1502; although by some authorities its discovery is placed in 1493. It was at that time inhabited by Caribs who had expelled or incorporated an older stock. It was not until the 25th of June 1635 that possession was taken of the island in the náme of the French *Compagnie des Îles d'Amérique*. Actual settlement was carried out in the same year by Pierre Belain, Sieur d'Esnambuc, captain-general of the island of St Christopher. In 1637 his nephew Dyel Duparquet (d. 1658) became captain-general of the colony, now numbering seven hundred men, and subsequently obtained the seigneurie of the island by purchase from the company under the authority of the king of France. In 1654 welcome was given to three hundred Jews expelled from Brazil, and by 1658 there were at least five thousand people exclusive of the Caribs, who were soon after exterminated. Purchased by the French government from Duparquet's children for 120,000 livres, Martinique was assigned to the West India Company, but in 1674 it became part of the royal domain. The *habitants* (French landholders) at first devoted themselves to the cultivation of cotton and tobacco; but in 1650 sugar plantations were begun, and in 1723 the coffee plant was introduced. Slave labour having been introduced at an early period of the occupation, there were 60,000 blacks in the island by 1736. This slavery was abolished in 1860. Martinique had a full share of wars. In early days the Caribs were not brought under subjection without severe struggles. In 1666 and 1667 the island was attacked by the British without success, and hostilities were terminated by the treaty of Breda. The Dutch made similar attempts in 1674, and the British again attacked the island in 1693. Captured by Rodney in 1762, Martinique was next year restored to the French; but after the conquest by Sir John Jervis and Sir Charles Grey in 1793 it was retained for eight years; and, seized again in 1809, it was not surrendered till 1814. The island was the birth-place of the Empress Josephine.



Emery Walker sc.

Martinique has suffered from occasional severe storms, as in 1767, when 1600 persons perished, and M. de la Pagerie, father of the Empress Josephine, was practically ruined, and in 1839, 1891 and 1903, when much damage was done to the sugar crop. Earthquakes have also been frequent, but the most terrible natural disaster was the eruption of Mont Pelé in 1902, by which the town of St Pierre, formerly the chief commercial centre of the island, was destroyed. During the earlier months of the year various manifestations of volcanic activity had occurred; on the 25th of April there was a heavy fall of ashes, and on the 2nd and 3rd of May a heavy eruption destroyed extensive sugar plantations north of St Pierre, and caused a loss of some 150 lives. A few days later the news that the Souffrière in St Vincent was in eruption reassured the inhabitants of St Pierre, as it was supposed that this outbreak might relieve the volcano of Pelé. But on the 8th of May the final catastrophe came without warning; a mass of fire, compared to a flaming whirlwind, swept over St Pierre, destroying the ships in the harbour, among which, however, one, the "Roddam" of Scrutton, escaped. A fall of molten lava and ashes followed the flames, accompanied by dense gases which asphyxiated those who had thus far escaped. The total loss of life was estimated at 40,000. Consternation was caused not only in the West Indies, but in France and throughout the world, and at first it was seriously suggested that the island should be evacuated, but no countenance was lent to this proposal by the French government. Relief measures were undertaken and voluntary subscriptions raised. The material losses were estimated at £4,000,000; but, besides St Pierre, only one-tenth of the island had been devastated, and although during July there was further volcanic activity, causing more destruction, the economic situation recovered more rapidly than was expected.

See *Annuaire de la Martinique* (Fort de France); H. Mouet, *La Martinique* (Paris, 1892); M. J. Guët, *Origines de la Martinique* (Vannes, 1893); G. Landes, *Notice sur la Martinique* (with full bibliography), (Paris, 1900); M. Dumoret, *Au pays du sucre* (Paris, 1902); and on the eruption of 1902, A. Heilprin, *Mont Pelée and the Tragedy of Martinique* (Philadelphia and London, 1903); A. Lacroix, *La Montagne Pelée et ses éruptions* (Paris, 1904); and the report of Drs J. S. Flett and T. Anderson (November 20, 1902), who investigated the eruptions on behalf of the Royal Society; cf. T. Anderson, "Recent Volcanic Eruptions in the West Indies," in *Geographical Journal*, vol. xxi. (1903).

MARTINSBURG, a town and the county-seat of Berkeley county, West Virginia, U.S.A., about 74 m. W.N.W. of Washington, D.C. Pop. (1890) 7226; (1900) 7564 (678 negroes); (1910) 10,698. It is served by the Baltimore & Ohio and the Cumberland Valley railways; the former has repair shops here. It lies in the Lower Shenandoah Valley at the foot of Little North mountain, in the midst of a fruit-growing region, peaches and apples being the principal crops. Slate and limestone also abound in the vicinity. The town has a fine Federal Building and a King's Daughters' hospital. There are grain elevators, and various manufactures, including hosiery, woollen goods, dressed lumber, &c. Martinsburg owns its waterworks, the supply being derived from a neighbouring spring. A town was laid out here a short time before the War of Independence and was named Martinstown in honour of Colonel Thomas Bryan Martin, a nephew of Thomas, Lord Fairfax (1692–1782); in 1778 it was incorporated under its present name. During the Civil War Martinsburg was occupied by several different Union and Confederate forces.

MARTINS FERRY, a city of Belmont county, Ohio, U.S.A., on the Ohio River, nearly opposite Wheeling, West Virginia. Pop. (1890), 6250; (1900), 7760, including 1033 foreign-born and 252 negroes; (1910), 9133. It is served by the Pennsylvania (Cleveland & Pittsburg Division), the Baltimore & Ohio, and the Wheeling & Lake Erie (Wabash System) railways, and by several steamboat lines. The city is situated on two plateaus; the lower is occupied chiefly by factories, the upper by dwellings. Coal mining and manufacturing are the principal industries; among factory products are iron, steel, tin, stoves, machinery and glassware. The municipality owns and operates the waterworks and an electric-lighting plant. A settlement was attempted here in 1785, but was abandoned on account of trouble with the Indians. In 1795 a town was laid out by Absalom Martin and was called Jefferson, but this, too, was abandoned, on account of its not being made the county-seat. The town was laid out again in 1835 by Ebenezer Martin (son of Absalom Martin) and was called Martinsville; the present name was substituted a few years later. The Martins and other pioneers are buried in Walnut Grove Cemetery within the city limits. Martins Ferry was incorporated as a town in 1865 and chartered as a city in 1885.

MARTINUZZI, GEORGE [György Utiešenović] (1482–1551), Hungarian statesman, who, since he usually signed himself "Frater Georgius," is known in Hungarian history as Frater György or simply The Frater, was born at Kamičic in Croatia, the son of Gregory Utiešenović, a Croatian gentleman. His mother was a Martinuzzi, a Venetian patrician family. From his eighth to his twentieth year he was attached to the court of John Corvinus; subsequently, entering the service of the Zapolya family, he saw something of warfare under John Zapolya but, tiring of a military life, he entered the Paulician Order in his twenty-eighth year. His historical career began when his old patron Zapolya, now king of Hungary, forced to fly before his successful rival Ferdinand, afterwards the emperor Ferdinand I., sent him on a diplomatic mission to Hungary. It was due to his tact and ability that John recovered Buda (1529), and henceforth Frater György became his treasurer and chief counsellor. In 1534 he became bishop of Grosswardein; in 1538 he concluded with Austria the peace of Grosswardein, whereby the royal title and the greater part of Hungary were conceded to Zapolya. King John left the Frater the guardian of his infant son John Sigismund, who was proclaimed and crowned king of Hungary, the Frater acting as regent. He frustrated all the attempts of the queen mother, Isabella, to bring in the Austrians, and when, in 1541, an Austrian army appeared beneath the walls of Buda, he arrested the queen and applied to the Porte for help. On the 28th of August 1541, the Frater did homage to the sultan, but during his absence with the baby king in the Turkish camp, the grand vizier took Buda by subtlety. Then only the Frater recognized the necessity of a composition with both Austria and Turkey. He attained it by the treaty of Gyula (Dec. 29, 1541), whereby western Hungary fell to Ferdinand, while Transylvania, as an independent principality under Turkish suzerainty, reverted to John Sigismund. It included, besides Transylvania proper, many Hungarian counties on both sides of the Theiss, and the important city of Kassa. It was the Frater's policy to preserve Transylvania neutral and intact by cultivating amicable relations with Austria without offending the Porte. It was a difficult policy, but succeeded brilliantly for a time. In 1545, encouraged by the growing unpopularity of Ferdinand, owing to his incapacity to defend Hungary against the Turks, the Frater was tempted to unite Austrian Hungary to Transylvania and procure the election of John Sigismund as the national king. But recognizing that this was impossible, he aimed at an alliance with Ferdinand on terms of relative equality, and to this system he adhered till his death. Queen Isabella, who hated the Frater and constantly opposed him, complained of him to the sultan, who commanded that either the traitor himself or his head should be sent to Constantinople (1550). A combination was then formed against him of the queen, the hospodars of Moldavia and Wallachia and the Turks, but the Frater shut the queen up in Gyula-Fehérvár, drove the hospodars out of Transylvania, defeated the Turks at Déva, and finally compelled Isabella to accept a composition with Austria very profitable to her family and to Transylvania, at the same time soothing the rage of the sultan by flatteries and gifts. This compact, a masterpiece of statesmanship, was confirmed by the diet of Kolozsvár in August 1551. The Frater retained the governorship of Transylvania, and was subsequently consecrated archbishop of Esztergom and received the red hat. Thus Hungary was once more reunited, but the inability of Ferdinand to defend it against the Turks, as promised, forced the Frater, for the common safety, to resume the payment of tribute to the Porte in December 1551 Unfortunately, the Turks no longer trusted a diplomatist they could not understand, while Ferdinand suspected him of an intention to secure Hungary for himself. When the Turks (in 1551) took Csanád and other places, the Frater and the imperial generals Castaldo and Pallavicini combined their forces against the common foe; but when the Frater privately endeavoured to mediate between the Turks and the Hungarians, Castaldo represented him to Ferdinand as a traitor, and asked permission to kill him if necessary. The Frater's secretary Marco Aurelio Ferrari was hired, and stabbed his master from behind at the castle of Alvinczy while reading a letter, on the 18th of December 1551; but the cardinal, though in his sixty-ninth year, fought for his life, and was only despatched with the aid of Pallavicini and a band of bravos. Ferdinand took the responsibility of the murder on himself. He sent to Julius III. an accusation of treason against the Frater in eighty-seven articles, and after long hesitation, and hearing one hundred and sixteen witnesses, the pope exonerated Ferdinand of blame.

See A. Bechet, *Histoire du ministère du cardinal Martinusius* (Paris, 1715); O. M. Utiešenović, *Lebensgeschichte des Cardinals Georg Utiesenović* (Vienna, 1881); *Codex epistolaris Fratris Georgii 1535-1551*, ed. A. Károlyi (Budapest, 1881). But the most vivid presentation of Frater is to be found in M. Jókai's fine historical romance, *Brother George* (Hung.) (Budapest, 1893). (R. N. B.)

MARTIUS, CARL FRIEDRICH PHILIPP VON (1794–1868), German botanist and traveller, was born on the 17th of April 1794 at Erlangen, where he graduated M.D. in 1814, publishing as his thesis a critical catalogue of plants in the botanic garden of the university. He afterwards devoted himself to botanical study, and in 1817 he and J. B. von Spix were sent to Brazil by the king of Bavaria. They travelled from Rio de Janeiro through several of the southern and eastern provinces of Brazil, and ascended the river Amazon to Tabatinga, as well as some of its larger affluents. On his return to Europe in 1820 he was appointed conservator of the botanic garden at Munich, and in 1826 professor of botany in the university there, and held both offices till 1864. He devoted his chief attention to the flora of Brazil, and in addition to numerous short papers he published the *Nova Genera et Species Plantarum Brasiliensium* (1823–1832, 3 vols.) and *Icones selectae Plantarum Cryptogamicarum Brasiliensium* (1827), both works being finely illustrated. An account of his travels in Brazil appeared in 3 vols. 4to, 1823–1831, with an atlas of plates, but probably the work by which he is best known is his *Historia Palmarum* (1823–1850) in 3 large folio volumes, of which one describes the palms discovered by himself in Brazil. In 1840 he began the *Flora Brasiliensis*, with the assistance of the most distinguished European botanists, who undertook monographs of the various orders. Its publication was continued after his death under the editorship of A. W. Eichler (1839–1887) until 1887, and subsequently of Ignaz von Urban. He also edited several works on the zoological collections made in Brazil by Spix, after the death of the latter in 1826. On the outbreak of potato disease in Europe he investigated it and published his observations in 1842. He also published works and short papers on the aborigines of Brazil, on their civil and social condition, on their past and probable future, on their diseases and medicines, and on the languages of the various tribes, especially the Tupi. He died at Munich on the 13th of December 1868.

MARTOS, CHRISTINO (1830–1893), Spanish politician, was born at Granada on the 13th of September 1830. He was educated there and at Madrid University, where his Radicalism soon got him into trouble, and he narrowly escaped being expelled for his share in student riots and other demonstrations against the governments of Queen Isabella. He distinguished himself as a journalist on *El Tribuno*. He joined O'Donnell and Espartero in 1854 against a revolutionary cabinet, and shortly afterwards turned against O'Donnell to assist the Democrats and Progressists under Prim, Rivero, Castelar, and Sagasta in the unsuccessful movements of 1866, and was obliged to go abroad. His political career had not prevented Martos from rising into note at the bar, where he was successful for forty years. After remaining abroad three years, he returned to Spain to take his seat in the Cortes of 1869 after the revolution of 1868. Throughout the revolutionary period he represented in cabinets with Prim, Serrano and Ruiz Zorilla, and lastly under King Amadeus, the advanced Radical tendencies of the men who wanted to give Spain a democratic monarchy. After the abdication of Amadeus of Savoy, Martos played a prominent part in the proclamation of the federal republic, in the struggle between the executive of that republic and the permanent committee of the Cortes, backed by the generals and militia, who nearly put an end to the executive and republic in April 1873. When the republicans triumphed Martos retired into exile, and soon afterwards into private life. He reappeared for a few months after General Pavia's *coup d'état* in January 1874, to join a coalition cabinet formed by Marshal Serrano, with Sagasta and Ulloa. Martos returned to the Bar in May 1874, and quietly looked on when the restoration took place at the end of that year. He stuck to his democratic ideals for some years, even going to Biarritz in 1881 to be present at a republican congress presided over by Ruiz Zorilla. Shortly afterwards Martos joined the dynastic Left organized by Marshal Serrano, General Lopez Dominguez, and Moret, Becerra, Balaguer, and other quondam revolutionaries. He sat in several parliaments of the reign of Alphonso XII. and of the regency of Queen Christina, joined the dynastic Liberals under Sagasta, and gave Sagasta not a little trouble when the latter allowed him to preside over the House of Deputies. Having failed to form a rival party against Sagasta, Martos subsided into political insignificance, despite his great talent as an orator and debater, and died in Madrid on the 16th of January 1893.

MARTOS, a town of southern Spain, in the province of Jaen, 16 m. W.S.W. of Jaen, by the Jaen-Lucena railway. Pop. (1900), 17,078. Martos is situated on an outlying western peak of the Jabalcuz mountains, which is surmounted by a ruined castle and overlooks the plain of Andalusia. In the neighbourhood are two sulphurous springs with bathing establishments. The local trade is almost exclusively agricultural.

Martos perhaps stands on or near the site of the *Tucci* of Ptolemy, which was fortified and renamed *Colonia Augusta Gemella* by the Romans. By Ferdinand III. it was taken from the Moors in 1225, and given to the knights of Calatrava; it was here that the brothers Carvajal, commanders of the order, were in 1312 executed by command of Ferdinand IV. Before their death they summoned Ferdinand to meet them within thirty days at the judgment-seat of God. Ferdinand died a month later and thus received the popular name of *el Emplazado*—"the Summoned."

MARTYN, HENRY (1781–1812), English missionary to India, was born on the 18th of February 1781, at Truro, Cornwall. His father, John Martyn, was a "captain" or mine-agent at Gwennap. The lad was educated at Truro grammar school under Dr Cardew, entered St John's College, Cambridge, in the autumn of 1797, and was senior wrangler and first Smith's prizeman in 1801. In 1802 he was chosen a fellow of his college. He had intended to go to the bar, but in the October term of 1802 he chanced to hear Charles Simeon speaking of the good done in India by a single missionary, William Carey, and some time afterwards he read the life of David Brainerd, the apostle of the Indians of North America. He resolved, accordingly, to become a Christian missionary. On the 22nd of October, 1803, he was ordained deacon at Ely, and afterwards priest, and served as Simeon's curate at the church of Holy Trinity, taking charge of the neighbouring parish of Lolworth. He was about to offer his services to the Church Missionary Society, when a disaster in Cornwall deprived him and his unmarried sister of the provision their father had made for them, and rendered it necessary that he should obtain a salary that would support her as well as himself. He accordingly obtained a chaplaincy under the East India Company and left for India on the 5th of July 1805. For some months he was stationed at Aldeen, near Serampur; in October 1806 he proceeded to Dinapur, where he was soon able to conduct worship among the natives in the vernacular, and established schools. In April 1809 he was transferred to Cawnpore, where he preached in his own compound, in spite of interruptions and threats. He occupied himself in linguistic study, and had already, during his residence at Dinapur, been engaged in revising the sheets of his Hindostani version of the New Testament. He now translated the whole of the New Testament into Hindi also, and into Persian twice. He translated the Psalms into Persian, the Gospels into Judaeo-Persic, and the Prayer-book into Hindostani, in spite of ill-health and "the pride, pedantry and fury of his chief munshi Sabat." Ordered by the doctors to take a sea voyage; he obtained leave to go to Persia and correct his Persian New Testament, whence he wished to go to Arabia, and there compose an Arabic version. Accordingly, on the 1st of October 1810, having seen his work at Cawnpore crowned on the previous day by the opening of a church, he left for Calcutta, whence he sailed on the 7th of January 1811, for Bombay, which he reached on his thirtieth birthday. From Bombay he set out for Bushire, bearing letters from Sir John Malcolm to men of position there, as also at Shiraz and Isfahan. After an exhausting journey from the coast he reached Shiraz, and was soon plunged into discussion with the disputants of all classes, "Sufi, Mahommedan, Jew, and Jewish-Mahommedan, even Armenian, all anxious to test their powers of argument with the first English priest who had visited them." Having made an unsuccessful journey to Tabriz to present the shah with his translation of the New Testament, he was seized with fever, and after a temporary recovery, had to seek a change of climate. On the 12th of September 1812, he started with two Armenian servants, crossed the Araxes, rode from Tabriz to Erivan, from Erivan to Kars, from Kars to Erzerum, from Erzerum to Chiflik, urged on from place to place by a thoughtless Tatar guide, and, though the plague was raging at Tokat (near Eski-Shehr in Asia Minor), he was compelled by prostration to stop there. On the 6th of October he died. Macaulay's youthful lines, written early in 1813, testify to the impression made by his career.

His *Journals and Letters* were published by Samuel Wilberforce in 1837. See also *Lives* by John Sargent (1819; new ed. 1885), and G. Smith (1892); and *The Church Quarterly Review* (Oct. 1881).

MARTYN, JOHN (1699–1768), English botanist, was born in London on the 12th of September 1699. Originally intended for a business career, he abandoned it in favour of medical and botanical studies. He was one of the founders (with J. J. Dillen and others) and the secretary of a botanical society which met for a few years in the Rainbow Coffee-house, Watling Street; he also started the *Grub Street Journal*, a weekly satirical review, which lasted from 1730 to 1737. In 1732 he was appointed professor of botany in Cambridge University, but, finding little encouragement and hampered by lack of appliances, he soon discontinued lecturing. He retained his professorship, however, till 1762, when he resigned in favour of his son Thomas (1735–1825), author of *Flora rustica* (1792–1794). Although he had not taken a medical degree, he long practised as a physician at Chelsea, where he died on the 29th of January 1768. His reputation chiefly rests upon his *Historia plantarum rariorum* (1728–1737), and his translation, with valuable agricultural and botanical notes, of the *Eclogues* (1749) and *Georgics* (1741) of Virgil. On resigning the botanical chair at Cambridge he presented the university with a number of his botanical specimens and books.

See memoir by Thomas Martyn in *Memoirs of John Martyn and Thomas Martyn*, by G. C. Gorham (1830).

MARTYR (Gr *μάρτυρ* or *μάρτυς*), a word meaning literally "witness" and often used in that sense in the New Testament *e.g.* Matt. xviii. 16; Mark xiv. 63. During the conflict between Paganism and Christianity when many Christians "testified" to the truth of their convictions by sacrificing their lives, the word assumed its modern technical sense. The beginnings of this use are to be seen in such passages as Acts xxii. 20; Rev ii. 13, xiii. 6. During the first three centuries the fortitude of these "witnesses" won the admiration of their brethren. Ardent spirits craved the martyr's crown, and to confess Christ in persecution was to attain a glory inferior only to that won by those who actually died. Confessors were visited in prison, martyrs' graves were scenes of pilgrimage, and the day on which they suffered was celebrated as the birthday of their glory. Martyrology was the most popular literature in the early Church. While the honour paid to martyrdom was a great support to early champions of the faith, it was attended by serious evils. It was thought that martyrdom would atone for sin, and imprisoned confessors not only issued to the Churches commands which were regarded almost as inspired utterances, but granted pardons in rash profusion to those who had been excommunicated by the regular clergy, a practice which caused Cyprian and his fellow bishops much difficulty. The zeal of Ignatius (*c.* 115), who begs the Roman Church to do nothing to avert from him the martyr's death, was natural enough in a spiritual knight-errant, but with others in later days, especially in Phrygia and North Africa, the passion became artificial. Fanatics sought death by insulting the magistrates or by breaking idols, and in their enthusiasm for martyrdom became self-centred and forgetful of their normal duty. None the less it is true that these men and women endured torments, often unthinkable in their cruelty, and death rather than abandon their faith. The same phenomena have been witnessed, not only in the conflicts within the Church that marked the 13th to the 16th centuries, but in the different mission fields, and particularly in Madagascar and China.

See A. J. Mason, *The Historic Martyrs of the Primitive Church* (London, 1905); H. B. Workman, *Persecution in the Early Church* (London, 1906); Paul Allard, *Ten Lectures on the Martyrs* (London, 1907); John Foxe, *The Book of Martyrs*; Mary I. Bryson, *Cross and Crown* (London, 1904).

MARTYROLOGY, a catalogue or list of *martyrs*, or, more exactly, of *saints*, arranged in the order of their anniversaries. This is the now accepted meaning in the Latin Church. In the Greek Church the nearest equivalent to the martyrology is the Synaxarium (*q.v.*). As regards form, we should distinguish between simple martyrologies, which consist merely of an enumeration of names, and historical martyrologies, which also include stories or biographical details. As regards documents, the most important distinction is between local and general martyrologies. The former give a list of the festivals of some particular Church; the latter are the result of a combination of several local martyrologies. We may add certain compilations of a factitious character, to which the name of martyrology is given by analogy, *e.g.* the *Martyrologe universel* of Châtelain (1709). As types of local martyrologies we may quote that of Rome, formed from the *Depositio martyrum* and the *Depositio episcoporum* of the chronograph of 354; the Gothic calendar of Ulfila's Bible, the calendar of Carthage published by Mabillon, the calendar of fasts and vigils of the Church of Tours, going back as far as Bishop Perpetuus (d. 490), and preserved in the *Historia francorum* (xi. 31) of Gregory of Tours. The Syriac martyrology discovered by Wright (*Journal of Sacred Literature*, 1866) gives the idea of a general martyrology. The most important ancient martyrology preserved to the present day is the compilation falsely attributed to St Jerome, which in its present form goes back to the end of the 6th century. It is the result of the combination of a general martyrology of the Eastern Churches, a local martyrology of the Church of Rome, some general martyrologies of Italy and Africa, and a series of local martyrologies of Gaul. The task of critics is to distinguish between its various constituent elements. Unfortunately, this document has reached us in a lamentable condition. The proper names are distorted, repeated or misplaced, and in many places the text is so corrupt that it is impossible to understand it. With the exception of a few traces of borrowings from the Passions of the martyrs, the compilation is in the form of a simple martyrology. Of the best-known historical martyrologies the oldest are those which go under the name of Bede and of Florus (*Acta sanctorum Martii*, vol. ii.); of Wandelbert, a monk of Prüm (842); of Rhabanus Maurus (*c.* 845); of Ado (d. 875); of Notker (896); and of Wolfhard (*c.* 896 v. *Analecta bollandiana*, xvii. 11). The most famous is that of Usuard (*c.* 875), on which the Roman martyrology was based. The first edition of the Roman martyrology appeared at Rome in 1583 The third edition, which appeared in 1584, was approved by Gregory XIII., who imposed the Roman martyrology upon the whole Church. In 1586 Baronius published his annotated edition, which in spite of its omissions and inaccuracies is a mine of valuable information.

The chief works on the martyrologies are those of Rosweyde, who in 1613 published at Antwerp the martyrology of Ado (also edition of Giorgi, Rome, 1745); of Sollerius, to whom we owe a learned edition of Usuard (*Acta sanctorum Junii*, vols. vi. and vii.); and of Fiorentini, who published in 1688 an annotated edition of the *Martyrology of St Jerome*. The critical edition of the latter by J. B. de Rossi and Mgr. L. Duchesne, was published in 1894, in vol. ii. of the *Acta sanctorum Novembris*. The historical martyrologies taken as a whole have been studied by Dom Quentin (1908). There are also numerous editions of calendars or martyrologies of less universal interest, and commentaries upon them. Mention ought to be made of the famous calendar of Naples, commented on by Mazocchi (Naples, 1744) and Sabbatini (Naples, 1744).

See C. de Smedt, *Introductio generalis ad historiam ecclesiasticam* (Gandavi, 1876), pp. 127–156; H. Matagne and V. de Buck in De Backer, *Bibliothèque des écrivains de la Compagnie de Jésus*, 2nd ed., vol. iii. pp. 369–387; De Rossi-Duchesne, *Les Sources du martyrologe hiéronymien* (Rome, 1885); H. Achelis, *Die Martyrologien, ihre Geschichte und ihr Wert* (Berlin, 1900); H. Delehaye, "Le Témoignage des martyrologes," in *Analecta bollandiana*, xxvi. 78–99 (1907); H. Quentin, *Les Martyrologes historiques du moyen âge* (Paris, 1908). (H. De.)

MARULLUS, MICHAEL TARCHANIOTA (d. 1500), Greek scholar, poet, and soldier, was born at Constantinople. In 1453, when the Turks captured Constantinople, he was taken to Ancona in Italy, where he became the friend and pupil of J. J. Pontanus, with whom his name is associated by Ariosto (*Orl. Fur.* xxxvii. 8). He received his education at Florence, where he obtained the patronage of Lorenzo de' Medici. He was the author of epigrams and *hymni naturales*, in which he happily imitated Lucretius. He took no part in the work of translation, then the favourite exercise of scholars, but he was understood to be planning some great work when he was drowned, on the 10th of April 1500, in the river Cecina near Volterra. He was a bitter enemy of Politian, whose successful rival he had been in the affections of the beautiful and learned Alessandra Scala. He is remembered chiefly for the brilliant emendations on Lucretius which he left unpublished; these were used for the Juntine edition (Munro's *Lucretius*, Introduction).

The hymns, some of the epigrams, and a fragment, *De Principum institutione*, were reprinted in Paris by C. M. Sathas in *Documents inédits relatifs à l'histoire de la Grèce au moyen âge*, vol. vii. (1888).

MARUM, MARTIN VAN (1750–1837), Dutch man of science, was born on the 20th of March 1750 at Groningen, where he graduated in medicine and philosophy. He began to practise medicine at Haarlem, but devoted himself mainly to lecturing on physical subjects. He became secretary of the scientific society of that city, and under his management the society was advanced to the position of one of the most noted in Europe. He was also entrusted with the care of the collection left to Haarlem by P. Teyler van der Hulst (1702–1778). His name is not associated with any discovery of the first order, but his researches (especially in connexion with electricity) were remarkable for their number and variety. He died at Haarlem on the 26th of December 1837.

MARUTS, in Hindu mythology, storm-gods. Their numbers vary in the different scriptures, usually thrice seven or thrice sixty. In the Vedas they are called the sons of Rudra. They are the companions of Indra, and associated with him in the wielding of thunderbolts, sometimes as his equals, sometimes as his servants. They are armed with golden weapons and lightnings. They split drought (*Vritra*) and bring rain, and cause earthquakes. Various myths surround their birth. A derivative word, Maruti or Maroti, is the popular name throughout the Deccan for Hanuman (*q.v.*).

MARVELL, ANDREW (1621–1678), English poet and satirist, son of Andrew Marvell and his wife Anne Pease, was born at the rectory house, Winestead, in the Holderness division of Yorkshire, on the 31st of March 1621. In 1624 his father exchanged the living of Winestead for the mastership of Hull grammar school. He also became lecturer at Holy Trinity Church and master of the Charterhouse in the same town. Thomas Fuller (*Worthies of England*, ed. 1811, i. 165) describes him as "a most excellent preacher." The younger Marvell was educated at Hull grammar school until his thirteenth year, when he matriculated on the 14th of December 1633 (according to a doubtful statement in Wood's *Athen. oxon.*) at Trinity College, Cambridge. It is related by his early biographer, Thomas Cooke, that he was induced by some Jesuit priests to leave the university. After some months he was discovered by his father in a bookseller's shop in London, and returned to Cambridge.[1] He contributed two poems to the *Musa cantabrigiensis* in 1637, and in the following year he received a scholarship at Trinity College, and took his B.A. degree in 1639. His father was drowned in 1640 while crossing the Humber in company with the daughter of a Mrs Skinner, almost certainly connected with the Cyriack Skinner to whom two of Milton's sonnets are addressed. It is said that Mrs Skinner adopted Marvell and provided for him at her death. The Conclusion Book of Trinity College, Cambridge, registers the decision (Sept. 24, 1641) that he with others should be excluded from further advantages from the college either because they were married, or did not attend their "days" or "acts." He travelled for four years on the Continent, visiting Holland, France, Italy and Spain. In Rome he met Richard Flecknoe, whom he satirized in the amusing verses on "Flecnoe, an English priest at Rome."

Although Marvell ranks as a great Puritan poet his sympathies were at first with Charles I., and in the lines on "Tom May's Death" he found no words too strong to express his scorn for the historian of the Long Parliament. He himself was no partisan, but had a passion for law and order. He acquiesced, accordingly, in the strong rule of Cromwell, but in his famous "Horatian Ode upon Cromwell's Return from Ireland" (1650)[2] he inserts a tribute to the courage and dignity of Charles I., which forms the best-known section of the poem. In 1650 he became tutor to Lord Fairfax's daughter Mary, afterwards duchess of Buckingham, then in her twelfth year. During his life with the Fairfaxes at Nunappleton, Yorkshire, he wrote the poems "Upon the Hill and Grove at Billborow" and "On Appleton House." Doubtless the other poems on country life, and his exquisite "garden poetry" may be referred to this period. "Clorinda and Damon" and "The Nymph complaining for the Death of her Faun" are good examples of the beauty and simplicity of much of this early verse. But he had affinities with John Donne and the metaphysical poets, and could be obscure on occasion.

Marvell was acquainted with Milton probably through their common friends, the Skinners, and in February 1653 Milton sent him with a letter to the lord president of the council, John Bradshaw, recommending him as "a man of singular desert for the state to make use of," and suggesting his appointment as assistant to himself in his duties as foreign secretary. The appointment was, however, given at the time to Philip Meadows, and Marvell became tutor to Cromwell's ward, William Dutton. In 1653 he was established with his pupil at Eton in the house of John Oxenbridge, then a fellow of the college, but formerly a minister in the Bermudas. No doubt the well-known verses, "Bermudas," were inspired by intercourse with the Oxenbridges. At Eton he enjoyed the society of John Hales, then living in retirement. He was employed by Milton in 1654 to convey to Bradshaw a copy of the *Defensio secunda*, and the letter to Milton in which he describes the reception of the gift is preserved. When the secretaryship again fell vacant in 1657 Marvell was appointed, and retained the appointment until the accession of Charles II. During this period he wrote many political poems, all of them displaying admiration for Cromwell. His "Poem upon the Death of his late Highness the Lord Protector" has been unfavourably compared to Edmund Waller's "Panegyric," but Marvell's poem is inspired with affection.

Marvell's connexion with Hull had been strengthened by the marriages of his sisters with persons of local importance, and in January 1659 he was elected to represent the borough in parliament. He was re-elected in 1660, again in 1661, and continued to represent the town until his death. According to Milton's nephew, Edward Phillips, the poet owed his safety at the Restoration largely to the efforts of Marvell, who "made a considerable party for him" in the House of Commons. From 1663 to 1665 he acted as secretary to Charles Howard, 1st earl of Carlisle, on his difficult and unsuccessful embassy to Muscovy, Sweden, and Denmark; and this is the only official post he filled during the reign of Charles. With the exception of this absence, for which he had leave from his constituents, and of shorter intervals of travel on private business which took him to Holland, Marvell was constant in his parliamentary attendance to the day of his death. He seldom spoke in the House, but his parliamentary influence is established by other evidence. He was an excellent man of affairs, and looked after the special interests of the port of Hull. He was a member of the corporation of Trinity House, both in London and Hull, and became a younger warden of the London Trinity House. His correspondence with his constituents, from 1660 to 1678, some 400 letters in all, printed by Dr Grosart (*Complete Works*, vol. ii.), forms a source of information all the more valuable because by a resolution passed at the Restoration the publication of the proceedings of the House without leave was forbidden. He made it a point of duty to write at each post—that is, every two or three days—both on local interests and on all matters of public interest. The discreet reserve of these letters, natural at a time when the post office was a favourite source of information to the government, contrasts curiously with the freedom of the few private letters which state opinions as well as facts. Marvell's constituents, in their turn, were not unmindful of their member. He makes frequent references to their presents, usually of Hull ale and of salmon, and he regularly drew from them the wages of a member, six-and-eightpence a day during session.

The development of Marvell's political opinions may be traced in the satirical verse he published during the reign of Charles II., and in his private letters. With all his admiration for Cromwell he had retained his sympathies with the royal house, and had loyally accepted the Restoration. In 1667 the Dutch fleet sailed up the Thames, and Marvell expressed his wrath at the gross mismanagement of public affairs in "Last Instructions to a Painter," a satire which was published as a broadside and of course remained anonymous. Edmund Waller had published in 1665 a gratulatory poem on the duke of York's victory in that year over the Dutch as "Instructions to a Painter for the drawing up and posture of his Majesty's forces at sea. . ." A similar form was adopted in Sir John Denham's four satirical "Directions to a Painter," and Marvell writes on the same model. His indignation was well grounded, but he had no scruples in the choice of the weapons he employed in his warfare against the corruption of the court, which he paints even blacker than do contemporary memoir writers; and his satire often descends to the level of the lampoon. The most inexcusable of his scandalous verses are perhaps those on the duchess of York. In the same year he attacked Lord Clarendon, evidently hoping that with the removal of the "betrayer of England and Flanders" matters would improve. But in 1672 when he wrote his "Poem on the Statue in the Stocks-Market" he had no illusions left about Charles, whom he describes as too often "purchased and sold," though he concludes with "Yet we'd rather have him than his bigoted brother." "An Historical Poem," "Advice to a Painter," and "Britannia and Raleigh" urge the same advice in grave language. In the last-named poem, probably written early in 1674, Raleigh pleads that "'tis god-like good to save a fallen king," but Britannia has at length decided that the tyrant cannot be divided from the Stuart, and proposes to reform the state on the republican model of Venice. These and other equally bold satires were probably handed round in MS., or secretly printed, and it was not until after the Revolution that they were collected with those of other writers in *Poems on Affairs of State* (3 pts., 1689; 4 pts., 1703–1707). Marvell's controversial prose writings are wittier than his verse satires, and are free from the scurrility which defaces the "Last Instructions to a Painter." A short and brilliant example of his irony is "His Majesty's Most Gracious Speech to both Houses of Parliament "(printed in *Grosart*, ii. 431 seq.),in which Charles is made to take the house into the friendliest confidence on his domestic affairs.

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[1] There is an allusion to this escapade addressed by another anxious parent to the elder Marvell in the Hull Corporation Records (No. 498) [see Grosart, i. xxviii.]. The document is without address or signature, but the identification seems safe.

[2] This poem has been highly praised by Goldwin Smith (T. H. Ward's *English Poets*, ii. 383 (1880)). It was first printed, so far as we know, in 1776, and the only external testimony to Marvell's authorship is the statement of Captain Thompson, who had included many poems by other writers in his edition of Marvell, that this ode was in poet's own handwriting. The internal evidence in favour of Marvell may, however, be accepted as conclusive.

Marvell was among the masters of Jonathan Swift, who, in the "Apology" prefixed to the *Tale of a Tub*, wrote that his answer to Samuel Parker could be still read with pleasure, although the pamphlets that provoked it were long since forgotten. Parker had written a *Discourse of Ecclesiastical Politye* (1670) and other polemics against Dissenters, to which Marvell replied in *The Rehearsal Transposed* (2 pts., 1672 and 1673). The book contains some passages of dignified eloquence, and some coarse vituperation, but the prevailing tone is that of grave and ironical banter of Parker as "Mr Bayes." Parker was attacked, says Bishop Burnet (*Hist. of His Own Time*, ed. 1823, i. 451), "by the liveliest droll of the age, who writ in a burlesque strain, but with so peculiar and entertaining a conduct, that, from the king down to the tradesman, his books were read with great pleasure." He certainly humbled Parker, but whether this effect extended, as Burnet asserts, to the whole party, is doubtful. Parker had intimated that Milton had a share in the first part of Marvell's reply. This Marvell emphatically denied (*Grosart*, iii. 498). He points out that Parker had, like Milton, profited by the royal clemency, and that he had first met him at Milton's house. He takes the opportunity to praise Milton's "great learning and sharpness of wit," and to the second edition of *Paradise Lost* (1674) he contributed some verses of just and eloquent praise.

His *Mr Smirke, or the Divine in Mode* . . . (1676) was a defence of Herbert Croft, bishop of Hereford, against the criticisms of Dr Francis Turner, master of St John's College, Cambridge. A far more important work was *An Account of the Growth of Popery and Arbitrary Government in England, more particularly from the Long Prorogation of Parliament* . . . (1677). This pamphlet was written in the same outspoken tone as the verse satires, and brought against the court the indictment of nursing designs to establish absolute monarchy and the Roman Catholic religion at the same time. A reward was offered for the author, whose identity was evidently suspected, and it is said that Marvell was in danger of assassination. He died on the 16th of August 1678 in consequence of an overdose of an opiate taken during an attack of ague. He was buried in the church of St Giles-in-the Fields, London. Joint administration of his estate was granted to one of his creditors, and to his widow, Mary Marvell, of whom we have no previous mention.

As a humorist, and as a great "parliament man," no name is of more interest to a student of the reign of Charles II. than that of Marvell. He had friends among the republican thinkers of the times. Aubrey says that he was intimate with James Harrington, the author of *Oceana*, and he was probably a member of the "Rota" club. In the heyday of political infamy, he, a needy man, obliged to accept wages from his constituents, kept his political virtue unspotted, and he stood throughout his career as the champion of moderate and tolerant measures. There is a story that his old schoolfellow, Danby, was sent by the king to offer the incorruptible poet a place at court and a gift of £1000, which Marvell refused with the words: "I live here to serve my constituents: the ministry may seek men for their purpose; I am not one." When self-indulgence was the ordinary habit of town life, Marvell was a temperate man. His personal appearance is described by John Aubrey: "He was of a middling stature, pretty strong set, roundish faced, cherry cheeked, hazel eyed, brown haired. In his conversation he was modest and of very few words." ("Lives of Eminent Persons," printed in *Letters* . . . .*in the 17th and 18th Centuries*, 1813).

Among Marvell's works is also a *Defence of John Howe on God's Prescience* . . . (1678), and among the spurious works fathered on him are *A Seasonable Argument* . . . *for a new Parliament* (1677), *A Seasonable Question and a Useful Answer* . . (1676), *A Letter from a Parliament Man* . . . (1675), and a translation of *Suetonius* (1672). Marvell's satires were no doubt first printed as broadsides, but very few are still extant in that form. Such of his poems as were printed during his lifetime appeared in collections of other men's works. The earliest edition of his non-political verse is *Miscellaneous Poems* (1681), edited by his wife, Mary Marvell. The political satires were printed as *A Collection of Poems on Affairs of State, by A—— M——l, Esq. and other Eminent Wits* (1689), with second and third parts in the same year. The works of Andrew Marvell contained in these two publications were also edited by Thomas Cooke (2 vols., 1726), who added some letters. Cooke's edition was reprinted by Thomas Davies in 1772. Marvell's next editor was Captain Thompson of Hull, who was connected with the poet's family, and made further additions from a commonplace book since lost. Other editions followed, but were superseded by Dr A. B. Grosart's laborious work, which, in spite of many defects of style, remains indispensable to the student. *The Complete Works in Verse and Prose of Andrew Marvell, M.P.* (4 vols., 1872–1875) forms part of his "Fuller Worthies Library." See also the admirable edition of the *Poems and Satires of Andrew Marvell*. . . (2 vols., 1892) in the "Muses' Library," where a full bibliography of his works and of the commentaries on them is provided; also *The Poems and some Satires of Andrew Marvell* (ed. Edward Wright, 1904), and *Andrew Marvell* (1905), by Augustine Birrell in the "English Men of Letters" series.

MARX, HEINRICH KARL (1818–1883), German socialist, and head of the International Working Men's Association, was born on the 5th of May 1818 in Trèves (Rhenish Prussia). His father, a Jewish lawyer, in 1824 went over to Christianity, and he and his whole family were baptized as Christian Protestants. The son went to the high grammar school at Trèves, and from 1835 to the universities of Bonn and Berlin. He studied first law, then history and philosophy, and in 1841 took the degree of doctor of philosophy. In Berlin he had close intimacy with the most prominent representatives of the young Hegelians—the brothers Bruno and Edgar Bauer and their circle, the so-called "Freien." He at first intended to settle as a lecturer at Bonn University, but his Radical views made a university career out of the question, and he accepted work on a Radical paper, the *Rheinische Zeitung*, which expounded the ideas of the most advanced section of the Rhenish Radical *bourgeoisie*. In October 1842 he became one of the editors of this paper, which, however, after an incessant struggle with press censors, was suppressed in the beginning of 1843. In the summer of this year Marx married Jenny von Westphalen, the daughter of a high government official. Through her mother Jenny von Westphalen was a lineal descendant of the earl of Argyle, who was beheaded under James II. She was a most faithful companion to Marx during all the vicissitudes of his career, and died on the 2nd of December 1881; he outliving her only fifteen months.

Already in the *Rheinische Zeitung* some socialist voices had been audible, couched in a somewhat philosophical strain. Marx, though not accepting these views, refused to criticize them until he had studied the question thoroughly. For this purpose he went in the autumn of 1843 to Paris, where the socialist movement was then at its intellectual zenith, and where he, together with Arnold Ruge, the well-known literary leader of Radical Hegelianism, was to edit a review, the *Deutsch-französische Jahrbücher*, of which, however, only one number appeared. It contained two articles by Marx—a criticism of Bruno Bauer's treatment of the Jewish question, and an introduction to a criticism of Hegel's philosophy of the law. The first concluded that the social emancipation of the Jews could only be achieved together with the emancipation of society from Judaism, *i.e.* commercialism. The second declared that in Germany no partial political emancipation was possible; there was now only one class from which a real and reckless fight against authority was to be expected—namely, the proletariate. But the proletariate could not emancipate itself except by breaking all the chains, by dissolving the whole constituted society, by recreating man as a member of the human society in the place of established states and classes. "Then the day of German resurrection will be announced by the crowing of the Gallican cock." Both articles thus relegated the solution of the questions then prominent in Germany to the advent of socialism, and so far resembled in principle other socialist publications of the time. But the way of reasoning was different, and the final words of the last quoted sentence pointed to a political revolution, to begin in France as soon as the industrial evolution had created a sufficiently strong proletariate. In contradistinction to most of the socialists of the day, Marx laid stress upon the political struggle as the lever of social emancipation. In some letters which formed part of a correspondence between Marx, Ruge, Ludwig Feuerbach, and Mikhail Bakunin, published as an introduction to the review, this opposition of Marx to socialistic "dogmatism" was enunciated in a still more pronounced form: "Nothing prevents us," he said, "from combining our criticism with the criticism of politics, from participating in politics, and consequently in real struggles. We will not, then, oppose the world like doctrinarians with a new principle: here is truth, kneel down here! We expose new principles to the world out of the principles of the world itself. We don't tell it: 'Give up your struggles, they are rubbish, we will show you the true war-cry.' We explain to it only the real object for which it struggles, and consciousness is a thing it *must* acquire even if it objects to it."

In Paris Marx met **Friedrich Engels** (1820–1895), from whom the *Deutsch-französische Jahrbücher* had two articles—a powerfully written outline of a criticism of political economy, and a letter on Carlyle's *Past and Present*. Engels, the son of a wealthy cotton-spinner, was born in 1820 at Barmen. Although destined by his father for a commercial career, he attended a classical school, and during his apprenticeship and whilst undergoing in Berlin his one year's military service, he had given up part of his free hours to philosophical studies. In Berlin he had frequented the society of the "Freien," and had written letters to the *Rheinische Zeitung*. In 1842 he had gone to England, his father's firm having a factory near Manchester, and had entered into connexion with the Owenite and Chartist movements, as well as with German communists. He contributed to Owen's *New Moral World* and to the Chartist *Northern Star*, gave up much of his abstract speculative reasoning for a more positivist conception of things, and took to economic studies. Now, in September 1844, on a short stay in Paris, he visited Marx, and the two found that in regard to all theoretical points there was perfect agreement between them. From that visit dates the close friendship and uninterrupted collaboration and exchange of ideas which lasted during their lives, so that even some of Marx's subsequent works, which he published under his own name, are more or less also the work of Engels. The first result of their collaboration was the book *Die heilige Familie oder Kritik der kritischen Kritik, gegen Bruno Bauer und Konsorten*, a scathing exposition of the perverseness of the high-sounding speculative radicalism of Bauer and the other Berlin "Freie." By aid of an analysis, which, though not free from exaggeration and a certain diffuseness, bears testimony to the great learning of Marx and the vigorous discerning faculty of both the authors, it is shown that the supposed superior criticism—the "critical criticism" of the Bauer school, based upon the doctrine of a "self-conscious" idea, represented by or incarnated in the critic—was in fact inferior to the older Hegelian idealism. The socialist and working-class movements in Great Britain, France and Germany are defended against the superior criticism of the "holy" Bauer family.

In Paris, where he had very intimate intercourse with Heinrich Heine, who always speaks of him with the greatest respect, and some of whose poems were suggested by Marx, the latter contributed to a Radical magazine, the *Vorwärts*; but in consequence of a request by the Prussian government, nearly the whole staff of the magazine soon got orders to leave France. Marx now went to Brussels, where he shortly afterwards was joined by Engels. In Brussels he published his second great work, *La Misère de la philosophie*, a sharp rejoinder to the *Philosophie de la misère ou contradictions économiques* of J. P. Proudhon. In this he deals with Proudhon, whom in the former work he had defended against the Bauers, not less severely than with the latter. It is shown that in many points Proudhon is inferior to both the middle-class economists and the socialists, that his somewhat noisily proclaimed discoveries in regard to political economy were made long before by English socialists, and that his main remedies, the "constitution of the labour-value" and the establishment of exchange bazaars, were but a repetition of what English socialists had already worked out much more thoroughly and more consistently. Altogether the book shows remarkable knowledge of political economy. In justice to Proudhon, it must be added that it is more often his mode of speaking than the thought underlying the attacked sentences that is hit by Marx's criticism. In Brussels Marx and Engels also wrote a number of essays, wherein they criticized the German literary representatives of that kind of socialism and philosophic radicalism which was mainly influenced by the writings of Ludwig Feuerbach, and deduced its theorems or postulates from speculations on the "nature of man." They mockingly nicknamed this kind of socialism "German or True Socialism," and ridiculed the idea that by disregarding historical and class distinctions a conception of society and socialism superior to that of the English and French workers and theorists could be obtained. Some of these essays were published at the time, two or three, curiously enough, by one of the attacked writers in his own magazine; one, a criticism of Feuerbach himself, was in a modified form published by Engels in 1885, but others have remained in manuscript. They were at first intended for publication in two volumes as a criticism of post-Hegelian German philosophy, but the Revolution of 1848 postponed for a time all interest in theoretical discussions.

In Brussels Marx and Engels came into still closer contact with the socialist working-class movement. They founded a German workers' society, acquired a local German weekly, the *Brüsseller deutsche Zeitung*, and finally joined a communistic society of German workers, the "League of the Just," a secret society which had its main branches in London, Paris, Brussels and several Swiss towns. For this league, which till then had adhered to the rough-and-ready communism of the gifted German workman Wilhelm Weitling, but which now called itself "League of the Communists," and gave up its leanings towards conspiracy and became an educational and propagandistic body, Marx and Engels at the end of 1847 wrote their famous pamphlet, *Manifest der Kommunisten*. It was a concise exposition of the history of the working-class movement in modern society according to their views, to which was added a critical survey of the existing socialist and communist literature, and an explanation of the attitude of the Communists towards the advanced opposition parties in the different countries. Scarcely was the manifesto printed when, in February 1848, the Revolution broke out in France, and "the crowing of the Gallican cock" gave the signal for an upheaval in Germany such as Marx had prophesied. After a short stay in France, Marx and Engels went to Cologne in May 1848, and there with some friends they founded the *Neue rheinische Zeitung*, with the sub-title "An Organ of Democracy," a political daily paper on a large scale, of which Marx was the chief editor. They took a frankly revolutionary attitude, and directed their criticism to a great extent against the middle-class democratic parties, who, by evading all decisive issues, delayed the achievement of the upheaval. When in November 1848 the king of Prussia dissolved the National Assembly, Marx and his friends advocated the non-payment of taxes and the organization of armed resistance. Then the state of siege was declared in Cologne, the *Neue rheinische Zeitung* was suspended, and Marx was put on trial for high treason. He was unanimously acquitted by a middle-class jury, but in May 1849 he was expelled from Prussian territory. He went to Paris, but was soon given the option of either leaving France or settling at a small provincial place. He preferred the former, and went to England. He settled in London, and remained there for the rest of his life.

At first he tried to reorganize the Communist League; but soon a conflict broke out in its ranks, and after some of its members had been tried in Germany and condemned for high treason, Marx, who had done everything to save the accused, dissolved the Communist League altogether. Nor was a literary enterprise, a review, also called the *Neue rheinische Zeitung*, more successful; only six numbers of it were issued. It contained, however, some very remarkable contributions; and a series of articles on the career of the French Revolution of 1848, which first appeared there, was in 1895 published by Engels in book form under the title of *Die Klassenkämpfe in Frankreich von 1848* "by Karl Marx." Carlyle's *Latter Day Pamphlets*, published at that time, met with a very vehement criticism in the *Neue rheinische Zeitung*. The endeavours of Ernest Jones and others to revive the Chartist movement were heartily supported by Marx, who contributed to several of the Chartist journals of the period, mostly, if not wholly, without getting or asking payment. He lived at this time in great financial straits, occupied a few small rooms in Dean Street, Soho, and all his children then born died very young. At length he was invited to write letters for the *New York Tribune*, whose staff consisted of advanced democrats and socialists of the Fourierist school. For these letters he was paid at the rate of a guinea each. Part of them, dealing with the Eastern Question and the Crimean War, were republished in 1897 (London, Sonnenschein). Some were even at the time reprinted in pamphlet form. The co-operation of Marx, who was determinedly anti-Russian, since Russia was the leading reactionary power in Europe, was obtained by David Urquhart and his followers. A number of Marx's articles were issued as pamphlets by the Urquhartite committees, and Marx wrote a series of articles on the diplomatic history of the 18th century for the Urquhartite *Free Press* (Sheffield and London, 1856–1857). When in 1859 the Franco-Austrian War about Italy broke out, Marx denounced it as a Franco-Russian intrigue, directed against Germany on the one hand and the revolutionary movement in France on the other. He opposed those democrats who supported a war which in their eyes aimed at the independence of the Italian nation and promised to weaken Austria, whose superiority in Germany was the hindrance to German unity. Violent derogatory remarks directed against him by the well-known naturalist Karl Vogt gave occasion to a not less violent rejoinder, *Herr Vogt*, a book full of interesting material for the student of modern history. Marx's contention, that Vogt acted as an agent of the Bonapartist clique, seems to have been well founded, whilst it must be an open question how far Vogt acted from dishonourable motives. The discussions raised by the war also resulted in a great estrangement between Marx and Ferdinand Lassalle. Lassalle had taken a similar view of the war to that advocated by Vogt, and fought tooth and nail for it in letters to Marx. In the same year, 1859, Marx published as a first result of his renewed economic studies the book *Zur Kritik der politischen Ökonomie*. It was the first part of a much larger work planned to cover the whole ground of political economy. But Marx found that the arrangement of his materials did not fully answer his purpose, and that many details had still to be worked out. He consequently altered the whole plan and sat down to rewrite the book, of which in 1867 he published the first volume under the title *Das Kapital*.

In the meantime, in 1864, the International Working Men's Association was founded in London, and Marx became in fact though not in name, the head of its general council. All its addresses and proclamations were penned by him and explained in lectures to the members of the council. The first years of the International went smoothly enough. Marx was then at his best. He displayed in the International a political sagacity and toleration which compare most favourably with the spirit of some of the publications of the Communist League. He was more of its teacher than an agitator, and his expositions of such subjects as education, trade unions, the working day, and co-operation were highly instructive. He did not hurry on extreme resolutions, but put his proposals in such a form that they could be adopted by even the more backward sections, and yet contained no concessions to reactionary tendencies. But this condition of things was not permitted to go on. The anarchist agitation of Bakunin, the Franco-German War, and the Paris Commune created a state of things before which the International succumbed. Passions and prejudices ran so high that it proved impossible to maintain any sort of centralized federation. At the congress of the Hague, September 1872, the general council was removed from London to New York. But this was only a makeshift, and in July 1876 the rest of the old International was formally dissolved at a conference held in Philadelphia. That its spirit had not passed away was shown by subsequent international congresses, and by the growth and character of socialist labour parties in different countries. They have mostly founded their programmes on the basis of its principles, but are not always in their details quite in accordance with Marx's views. Thus the programme which the German socialist party accepted at its congress in 1875 was very severely criticized by Marx. This criticism, reprinted in 1891 in the review *Die neue Zeit*, is of great importance for the analysis of Marx's conception of socialism.

The dissolution of the International gave Marx an opportunity of returning to his scientific work. He did not, however, succeed in publishing further volumes of *Das Kapital*. In order to make it—and especially the part dealing with property in land—as complete as possible, he took up, as Engels tells us, a number of new studies, but repeated illness interrupted his researches, and on the 14th of March 1883 he passed quietly away.

From the manuscripts he left Engels compiled a second and a third volume of *Das Kapital* by judiciously and elaborately using complete and incomplete chapters, rough copies and excerpts, which Marx had at different times written down. Much of the copy used dates back to the 'sixties, *i.e.* represents the work as at first conceived by Marx, so that, *e.g.*, the matter published as the third volume was in the main written much earlier than the matter which was used for compiling the second volume. The same applies to the fourth volume. Although the work thus comprises the four volumes promised in the preface to the book, it can only in a very restricted sense be regarded as complete. In substance and demonstration it must be regarded as a torso. And it is perhaps not quite accidental that it should be so. Marx, if he had lived longer and had enjoyed better health, would have given the world a much greater amount of scientific work of high value than is now the case. But it seems doubtful whether he would have brought *Das Kapital*, his main work, to a satisfactory conclusion.

Das Kapital proposes to show up historically and critically the whole mechanism of capitalist economy. The first volume deals with the processes of producing capital, the second with the circulation of capital, the third with the movements of capital as a whole, whilst the fourth gives the history of the theories concerning capital. Capital is, according to Marx, the means of appropriating *surplus-value* as distinguished from ground rent (rent on every kind of terrestrial property, such as land, mines, rivers, &c., based upon the monopolist nature of such property). Surplus-value is created in the process of production only, it is this part of the value of the newly created product which is not given to the workman as a return—the *wage*—of the labour-force he expended in working. If at first taken by the employer, it is in the different phases of economic intercourse split up into the profit of industrial enterprise, commercial or merchants' profit, interest and ground rent. The value of every commodity consists in the labour expended on it, and is measured according to the time occupied by the labour employed on its production. Labour in itself has no value, being only the measure of value, but the labour-force of the workman has a value, the value of the means required to maintain the worker in normal conditions of social existence. Thus, in distinction to other commodities, in the determination of the value of labour-force, besides the purely economical, a *moral* and *historical* element enter. If to-day the worker receives a wage which covers the bare necessaries of life, he is underpaid—he does not receive the real value of his labour-force. For the value of any commodity is determined by its socially necessary costs of production (or in this case, maintenance). "Socially necessary" means, further, that no more labour is embodied in a commodity than is required by applying labour-force, tools, &c., of average or normal efficiency, and that the commodity is produced in such quantity as is required to meet the effective demand for it. As this generally cannot be known in advance, the market value of a commodity only gravitates round its (abstract) value. But in the long run an equalization takes place, and for his further deductions Marx assumes that commodities exchange according to their value.

That part of an industrial capital which is employed for installations, machines, raw and auxiliary materials, is called by Marx *constant capital*, for the value of it or of its wear and tear reappears in equal proportions in the value of the new product. It is otherwise with labour. The new value of the product must by necessity be always higher than the value of the employed labour-force. Hence the capital employed in buying labour-force, *i.e.* in wages, is called *variable capital*. It is the tendency of capitalist production to reduce the amount spent in wages and to increase the amount invested in machines, &c. For with natural and social, legal and other limitations of the working day, and the opposition to unlimited reduction of wages, it is not possible otherwise to cheapen production and beat competition. According to the proportion of constant to variable capital, Marx distinguishes capitals of *lowest average* and *highest composition*, the highest composition being that where proportionately the least amount of variable (wages) capital is employed.

The ratio of the wages which workmen receive to the surplus-value which they produce Marx calls the *rate of surplus-value*, that of the surplus-value produced to the whole capital employed is the *rate of profit*. It is evident, then, that at the same time the rate of surplus-value can increase and the rate of profit decrease, and this in fact is the case. There is a continuous tendency of the rates of profit to decrease, and only by some counteracting forces is their decrease temporarily interrupted, protracted, or even sometimes reversed. Besides, by competition and movement of capitals the rates of profit in the different branches of trade are pressed towards an *equalization* in the shape of an *average rate of profits*. This average rate or profits, added to the actual cost price of a given commodity, constitutes its *price of production*, and it is this price of production which appears to the empirical mind of the business man as the value of the commodity. The real law of value, on the contrary, disappears from the surface in a society where, as to-day, commodities are bought and sold against money and not exchanged against other commodities. Nevertheless, according to Marx, it is also to-day this law of value ("labour-value") which in the last resort rules the prices and profits.

The tendency to cheapen production by increasing the relative proportion of constant capital—the fixed capital of the classical economist plus that portion of the circulating capital which consists of raw and auxiliary materials, &c.—leads to a continuous increase in the size of private enterprises, to their growing concentration. It is the larger enterprise that beats and swallows the smaller. The number of dependent workmen—"proletarians"—is thus continually growing, whilst employment only periodically keeps pace with their number. Capital alternately attracts and repels workmen, and creates a constant surplus-population of workmen—a *reserve-army* for its requirements—which helps to lower wages and to keep the whole class in economic dependency. A decreasing number of capitalists usurp and monopolize all the benefits of industrial progress, whilst the mass of misery, of oppression, of servitude, of depravation, and of exploitation increases. But at the same time the working class continuously grows in numbers, and is disciplined, united and organized by the very mechanism of the capitalist mode of production. The centralization of the means of production and the socialization of the mode of production reach a point where they will become incompatible with their capitalist integument. Then the knell of capitalist private property will have been rung. Those who used to expropriate will be expropriated. Individual property will again be established based upon co-operation and common ownership of the earth and the means of production produced by labour.

These are the principal outlines of *Das Kapital*. Its purely economic deductions are dominated throughout by the *theory of surplus-value*. Its leading sociological principle is the *materialist conception of history*. This theory is in *Das Kapital* only laid down by implication, but it has been more connectedly explained in the preface of *Zur Kritik* and several works of Engels. According to it the material basis of life, the manner in which life and its requirements are produced, determines in the last instance the social ideas and institutions of the time or historical epoch, so that fundamental changes in the former produce in the long run also fundamental changes in the latter. A set of social institutions answer to a given mode of production, and periods where the institutions no longer answer to the mode of production are periods of social revolution, which go on until sufficient adjustment has taken place. The main *subjective* forces of the struggle between the old order and the new are *the classes* into which society is divided after the dissolution of the communistic or semi-communistic tribes and the creation of states. And as long as society is divided into classes a class war will persist, sometimes in a more latent or disguised, sometimes in a more open or acute form, according to circumstances. In advanced capitalist society the classes between whom the decisive war takes place are the capitalist owners of the means of production and the non-propertied or wage-earning workers, the "proletariate." But the proletariate cannot free itself without freeing all other oppressed classes, and thus its victory means the end of exploitation and political repression altogether. Consequently the state as a repressive power will die out, and a free association will take its place.

Almost from the first *Das Kapital* and the publications of Marx and Engels connected with it have been subjected to all kinds of criticisms. The originality of its leading ideas has been disputed, the ideas themselves have been declared to be false or only partially true, and consequently leading to wrong conclusions; and it has been said of many of Marx's statements that they are incorrect, and that many of the statistics upon which he bases his deductions do not prove what he wants them to prove. In regard to the first point, it must be conceded that the *disjecta membra* of Marx's value theory and of his materialist conception of history are already to be found in the writings of former socialists and sociologists. It may even be said that just those points of the Marxist doctrine which have become popular are in a very small degree the produce of Marx's genius, and that what really belongs to Marx, the methodical conjunction and elaboration of these points, as well as the finer deductions drawn from their application, are generally ignored. But this is an experience repeated over and over again in the history of deductive sciences, and is quite irrelevant for the question of Marx's place in the history of socialism and social science.

It must further be admitted that in several places the statistical evidence upon which Marx bases his deductions is insufficient or inconclusive. Moreover—and this is one of the most damaging admissions—it repeatedly happens that he points out all the phenomena connected with a certain question, but afterwards ignores some of them and proceeds as if they did not exist. Thus, *e.g.*, he speaks at the end of the first volume, where he sketches the historical tendency of capitalist accumulation, of the decreasing number of magnates of capital as of an established fact. But all statistics show that the number of capitalists does not decrease, but increase; and in other places in *Das Kapital* this fact is indeed fully admitted, and even accentuated. Marx was, as the third volume shows, also quite aware that limited liability companies play an important part in the distribution of wealth. But he leaves this factor, too, quite out of sight, and confuses the concentration of private enterprises with the centralization of fortunes and capitals. By these and other omissions, quite apart from developments he could not well foresee, he announces a coming evolution which is very unlikely to take place in the way described.

In this and in other features of his work a *dualism* reveals itself which is also often observable in his actions in life—the alternating predominance of the spirit of the scholar and the spirit of the radical revolutionary. Marx originally entitled his great social work *Criticism of Political Economy*, and this is still the sub-title of *Das Kapital*. But the conception of *critic* or *criticize* has with Marx a very pronounced meaning. He uses them mostly as identical with fundamentally opposing. Much as he had mocked the "critical criticism" of the Bauers, he is in this respect yet of their breed and relapses into their habits. He retained in principle the Hegelian dialectical method, of which he said that in order to be rationally employed it must be "turned upside down," *i.e.* put upon a materialist basis. But as a matter of fact he has in many respects contravened against this prescription. Strict materialist dialectics cannot conclude much beyond actual facts. Dialectical materialism is revolutionary in the sense that it recognizes no finality, but otherwise it is necessarily positivist in the general meaning of that term. But Marx's opposition to modern society was fundamental and revolutionary, answering to that of the proletarian to the *bourgeois*. And here we come to the main and fatal contradiction of his work. He wanted to proceed, and to a very great extent did proceed, scientifically. Nothing was to be deduced from preconceived ideas; from the observed evolutionary laws and forces of modern society alone were conclusions to be drawn. And yet the final conclusion of the work, as already noted, *is* a preconceived idea; it is the announcement of a state of society logically opposed to the given one. Imperceptibly the dialectical movement of *ideas* is substituted for the dialectical movement of facts, and the real movement of facts is only considered so far as is compatible with the former. Science is violated in the service of speculation. The picture given at the end of the first volume answers to a conception arrived at by speculative socialism in the 'forties. True, Marx calls this chapter "the historical tendency of capitalist accumulation," and "tendency" does not necessarily mean realization in every detail. But on the whole the language used there is much too absolute to allow of the interpretation that Marx only wanted to give a speculative picture of the goal to which capitalist accumulation would lead if unhampered by socialist counteraction. The epithet "historical" indicates rather that the passage in question was meant to give in the main the true outline of the forthcoming social revolution. We are led to this conclusion also by the fact that, in language which is not in the least conditional, it is there said that the change of capitalist property into social property will mean "only the expropriation of a few usurpers by the mass of the people." In short, the principal reason for the undeniable contradictions in *Das Kapital* is to be found in the fact that where Marx has to do with details or subordinate subjects he mostly notices the important changes which actual evolution had brought about since the time of his first socialist writings, and thus himself states how far their presuppositions have been corrected by facts. But when he comes to general conclusions, he adheres in the main to the original propositions based upon the old uncorrected presuppositions. Besides, the complex character of modern society is greatly underestimated, so that, *e.g.*, such important features as the influence of the changes of traffic and aggregation on modern life are scarcely considered at all; and industrial and political problems are viewed only from the aspect of class antagonism, and never under their administrative aspect. With regard to the theory of surplus-value and its foundation, the theory of labour-value, so much may be safely said that, its premisses accepted, it is most ingeniously and most consistently worked out. And since its principal contention is in any case so far true that the wage-earning workers as a whole produce more than they receive, the theory has the great merit of demonstrating in an admirably lucid way the relations between wages and surplus-produce and the growth and movements of capital. But the theory of labour-value as the determining factor of the exchange or market value of commodities can with justification be disputed, and is surely not more true than those theories of value based on social demand or utility. Marx himself, in placing in the third volume what he calls the *law of value* in the background and setting out the formation of the "price of production" as the empirical determinator of prices in modern society, justifies those who look upon the conception of labour-value as an abstract formula which does not apply to individual exchanges of commodities at all, but which only serves to show an imagined typical example of what in reality to-day is only true with regard to the production of the whole of social wealth. Thus understood, the conception of labour-value is quite unobjectionable, but it loses much of the significance attributed to it by most of the disciples of Marx and occasionally by Marx himself. It is a means of analysing and exemplifying surplus labour, but quite inconclusive as to the proof of the surplus value, or as an indication of the degree of the exploitation of the workers. This becomes the more apparent the more the reader advances in the second and third volumes of *Das Kapital*, where commercial capital, money capital and ground rent are dealt with. Though full of fine observations and deductions, they form, from a revolutionary standpoint, an anti-climax to the first volume. It is difficult to see how, after all that is explained there on the functions of the classes that stand between industrial employers and workers, Marx could have returned to those sweeping conclusions with which the first volume ends.

The great scientific achievement of Marx lies, then, not in these conclusions, but in the *details* and yet more in the *method* and *principles* of his investigations in his *philosophy of history*. Here he has, as is now generally admitted, broken new ground and opened new ways and new outlooks. Nobody before him had so clearly shown the rôle of the productive agencies in historical evolution; nobody so masterfully exhibited their great determining influence on the forms and ideologies of social organisms. The passages and chapters dealing with this subject form, notwithstanding occasional exaggerations, the crowning parts of his works. If he has been justly compared with Darwin, it is in these respects that he ranks with that great genius, not through his value theory, ingenious though it be. With the great theorist of biological transformation he had also in common the indefatigable way in which he made painstaking studies of the minutest details connected with his researches. In the same year as Darwin's epoch-making work on the origin of species there appeared also Marx's work *Zur Kritik der politischen Ökonomie*, where he explains in concise sentences in the preface that philosophy of history which has for the theory of the transformation or evolution of social organisms the same significance that the argument of Darwin had for the theory of the transformation of biological organisms.

Bibliography.—The main writings of Karl Marx and Friedrich Engels are as follow (we give only the titles of the original works and of their English translations): (1) Of Karl Marx alone: *La Misère de la philosophie, réponse à la philosophie de la misère de M. Proudhon* (Paris, 1847; new ed., 1892; English ed., *The Poverty of Philosophy*, London, 1900); *Lohnarbeit und Kapital*, pamphlet, written 1848 (new ed., Berlin, 1891); English ed., *Wage, Labour and Capital* (London, 1900); *Die Klassenkämpfe in Frankreich, 1848 to 1850* (Berlin, 1895); *Der Achtzehnte Brumaire des Louis Bonaparte* (New York, 1852; 3rd ed., Hamburg, 1889; Eng. ed., New York, 1889); *Enthüllungen über den Kölner Kommunistenprozess* (Basel, 1852; new ed., Zürich-Berlin, 1885); "European Revolutions and Counter-Revolutions" (reprints from the *New York Tribune*, 1851–1852; London, 1897); "The Eastern Question" (reprints from the *New York Tribune*, 1853–1856; London, 1898); *Zur Kritik der politischen Ökonomie* (Berlin, 1859; new ed., Stuttgart, 1897); *Herr Vogt* (London, 1860); *Inaugural Address of the International Working Men's Association* (London, 1864); *Value, Price and Profit* (written 1865, published London, 1898); *Das Kapital, Kritik der politischen Ökonomie* (3 vols., Hamburg, 1867, 1885 and 1895; Eng. ed. of 1st vol., 1886); *The Civil War in France, 1871* (London, 1871; new ed., 1894); *L'Alliance de la démocratie socialiste* (London, 1873); articles printed or reprinted in *Rheinische Zeitung* (1842–1843), *Deutsch-französische Jahrbücher* (Paris, 1844), *Das westphälische Dampfboot* (Bielefeld und Paderborn, 1845–1848), *Der Gesellschaftsspiegel* (Elberfeld, 1846), *Deutsche brüsseler Zeitung* (Brussels, 1847), *Neue rheinische Zeitung* (daily, Cologne, 1848–1849; monthly, Hamburg, 1850), *The People* (London, 1852–1858), *The New York Tribune* (New York, 1853–1860), *The Free Press* (Sheffield and London, 1856–1857), *Das Volk* (London, 1859); *Der Vorbote* (Geneva, 1866–1875), *Der Volkstaat* (Leipzig, 1869–1876), *Die Neue Zeit* (Stuttgart, 1883, sqq.); *Sozialistische Monatshefte* (Berlin, 1895, sqq.). (2) Of Friedrich Engels alone: *Die Lage der arbeitenden Klassen in England* (Leipzig, 1845; new ed., Stuttgart, 1892; Eng. ed., London, 1892); *Zur Wohnungsfrage* (Leipzig, 1873–1874; new ed., Zürich-Berlin, 1887); *Herrn Eugen Dührings Umwälzung der Wissenschaft* (Leipzig, 1877; 3rd ed., Stuttgart, 1894). Three chapters of the first-named are published in English under the title *Socialism, Utopian and Scientific* (London, 1892). *Der Ursprung des Eigenthums, der Familie und des Staates* (Zürich and Stuttgart, 1885 and 1892); *Ludwig Feuerbach und der Ausgang der klassischen deutschen Philosophie* (Stuttgart, 1886). Introductions to most of the posthumous works of K. Marx and articles in the same periodicals as Marx. (3) Of Karl Marx and Friedrich Engels together: *Die heilige Familie oder Kritik der kritischen Kritik* (Frankfurt, 1845); *Manifest der kommunistischen Partei* (London, 1848; Eng. ed., 1848 and 1888). (4) With regard to Marx generally, his theory and his school, see J. Stammhammer, *Bibliographie des Sozialismus und Kommunismus* (Jena, 1893); and Th. G. Masaryk, *Die philosophischen und soziologischen Grundlagen des Marxismus* (Vienna, 1899). Much biographical and bibliographical information on Marx and Engels is to be found in Dr Franz Mehring, *Geschichte der deutschen Sozialdemokratie* (Stuttgart, 1897–1898), and in the collection, edited also by Dr Fr. Mehring, *Aus dem literarischen Nachlass von Karl Marx, Friedrich Engels und Ferdinand Lassalle* (Stuttgart, 1902). Of the criticisms of Marx's economics, one of the most comprehensive is E. von Boehm-Bawerk's *Karl Marx and the Close of his System* (London, 1898). Marx's historic theory is, apart from Masaryk, very exhaustively analysed by R. Stammler in *Wirthschaft und Recht* (Leipzig, 1896). (E. Bn.)

MARY[1] (Μαρία Μαριάμ), the mother of Jesus. At the time when the gospel history begins, she had her home in Galilee, at the village of Nazareth. Of her parentage nothing is recorded in any extant historical document of the 1st century, for the genealogy in Luke iii. (cf. i. 27) is manifestly that of Joseph. In early life she became the wife of Joseph (*q.v.*) and the mother of Jesus Christ; that she afterwards had other children is a natural inference from Matt. i. 25, which the evangelists, who frequently allude to "the brethren of the Lord," are at no pains to obviate. The few incidents mentioned in Scripture regarding her show that she followed our Lord to the very close of His earthly career with unfailing motherliness, but the "Magnificat" assigned to her in Luke i. is the only passage which would distinctly imply on her part a high prophetic appreciation of His divine mission. It is however doubtful whether Luke really intended to assign this hymn to Mary or to Elizabeth (cf. especially *Niceta of Remesiana* by A. E. Burn, Cambridge, 1905; Harnack's "Das Magnificat der Elizabeth" in the *Sitzungsberichte* of the Berlin Academy for 1900, and Burkitt's "Who spoke the Magnificat?" in the *Journal of Theological Studies*, Jan. 1906). The original text of Luke probably mentioned no name in introducing the Magnificat; scribes supplied the ambiguity by inserting, some Mary, others Elizabeth. It is doubtful which represents the intention of the writer: there is perhaps more to be said for the view that he meant to assign the Magnificat to Elizabeth. Mary was present at the Crucifixion, where she was commended by Jesus to the care of the apostle John (John xix. 26, 27), Joseph having apparently died before this time. Mary is mentioned in Acts i. 14 as having been among those who continued in prayer along with the apostles at Jerusalem during the interval between the Ascension and Pentecost. There is no allusion in the New Testament to the time or place of her death.

The subsequent growth of ecclesiastical tradition and belief regarding Mary will be traced most conveniently under the separate heads of (1) her perpetual virginity, (2) her absolute sinlessness, (3) her peculiar relation to the Godhead, which specially fits her for successful intercession on behalf of mankind.

Her Perpetual Virginity.—This doctrine was, to say the least, of no importance in the eyes of the evangelists, and so far as extant writings go there is no evidence of its having been anywhere taught within the pale of the Catholic Church of the first three centuries. On the contrary, to Tertullian the fact of

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[1] The name (Heb. מִרְיָם), that of the sister of Moses and Aaron, is of uncertain etymology; many interpretations have been suggested, including *Stella maris* ("star of the sea"), which, though it has attained considerable currency through Jerome (the *Onomasticon*), may be at once dismissed. It seems to have been very common among the Jews in New Testament times: besides the subject of the present notice there are mentioned (1) "Mary (the wife) of Clopas," who was perhaps the mother of James "the little" (ὁ μικρός) and of Joses; (2) Mary Magdalene, *i.e.* of Magdala; (3) Mary of Bethany, sister of Martha and Lazarus; (4) Mary, the mother of Mark; and (5) Mary, an otherwise unknown benefactress of the apostle Paul (Rom. xvi. 6).

Mary's marriage after the birth of Christ is a useful argument for the reality of the Incarnation against gnostic notions, and Origen relies upon the references to the Lord's brethren as disproving the Docetism with which he had to contend. The *ἀειπαρθενία* though very ancient, is in reality a doctrine of non-Catholic origin, and first occurs in a work proscribed by the earliest papal *Index librorum prohibitorum* (attributed to Gelasius) as heretical,—the so-called *Protevangelium Jacobi*, written, it is generally admitted, within the 2nd century. According to this very early source, which seems to have formed the basis of the later *Liber de infantia Mariae et Christi salvatoris* and *Evangelium de nativitate Mariae*, the name of Mary's father was Joachim (in the *Liber de infantia* a shepherd of the tribe of Judah, living in Jerusalem); he had long been married to Anna her mother, whose continual childlessness had become a cause of much humiliation and sorrow to them both. The birth of a daughter was at last angelically predicted to each parent separately. From her third to her twelfth year "Mary was in the Temple as if she were a dove that dwelt there, and she received food from the hand of an angel." When she became of nubile age a guardian was sought for her by the priests among the widowers of Israel "lest she should defile the sanctuary of the Lord"; and Joseph, an elderly man with a family, was indicated for this charge by a miraculous token. Some time afterwards the annunciation took place; when the Virgin's pregnancy was discovered, Joseph and she were brought before the high priest, and, though asserting their innocence in all sincerity, were acquitted only after they had been tried with "the water of the ordeal of the Lord" (Num. v. 11). Numerous details regarding the birth at Bethlehem are then given. The perpetual physical virginity of Mary, naïvely insisted upon in this apocryphon, is alluded to only with a half belief and a "some say" by Clement of Alexandria (*Strom.* vii. 16), but became of much importance to the leaders of the Church in the 4th century, as for example to Ambrose, who sees in Ezek. xliv. 1-3 a prophetic indication of so great a mystery.[1] Those who continued to believe that Mary, after the miraculous birth of Jesus, had become the mother of other children by Joseph came accordingly to be spoken of as her enemies—Antidicomarianitae (Epiphanius) or Antidicomaritae (Augustine)—and the first-mentioned author devotes a whole chapter (ch. 78) of his great work upon heresies to their confutation. For holding the same view Bonosus of Sardica was condemned by the synod of Capua in 391. To Jerome the perpetual virginity not only of Mary but even of Joseph appeared of so much consequence that while a young man he wrote (387) the long and vehement tract *Against Helvidius*, in which he was the first to broach the theory (which has since gained wide currency) that the brethren of our Lord were children neither of Mary by her husband nor of Joseph by a former marriage, but of another Mary, sister to the Virgin and wife of Clopas or Alphaeus. At last the epithet of ἀεὶ παρθένος was authoritatively applied to the Virgin by the council of Chalcedon in 451, and the doctrine implied has ever since been an undisputed point of orthodoxy both in the Eastern and in the Roman Churches, some even seeking to hold the Anglican Church committed to it on account of the general declaration (in the *Homilies*) of concurrence in the decisions of the first four general councils.

Her Absolute Sinlessness.—While much of the apocryphal literature of the early sects in which she is repeatedly spoken of as "undefiled before God" would seem to encourage some such doctrine as this, many passages from the acknowledged fathers of the Church could be cited to show that it was originally quite unknown to Catholicism. Even Augustine repeatedly asserts that she was born in original sin (*De gen. ad lit.* x. 18); and the *locus classicus* regarding her possible immunity from actual transgression, on which the subsequent doctrine of Lombardus and his commentators was based, is simply an extremely guarded passage (*De nat. et grat.* ch. 36), in which, while contradicting the assertion of Pelagius that many had lived free from sin, he wishes exception to be made in favour of "the holy Virgin Mary, of whom out of honour to the Lord I wish no question to be made where sins are treated of—for how do we know what mode of grace wholly to conquer sin may have been bestowed upon her who was found meet to conceive and bear Him of whom it is certain that He had no sin." A writer so late as Anselm (*Cur deus homo*, ii. 16) declares that "the Virgin herself whence He (Christ) was assumed was conceived in iniquity, and in sin did her mother conceive her, and with original sin was she born, because she too sinned in Adam in whom all sinned," and the same view was expressed by Damiani. For the growth of the modern Roman doctrine of the immaculate conception from the time in the 12th century, when the canons of Lyons sought to institute a festival in honour of her "holy conception," and were remonstrated with by Bernard, see IMMACULATE CONCEPTION. The epithets applied to her in the Greek Church are such as ἀμόλυντος, πάναγνος, ἁγία, παναγία; but in the East generally no clear distinction is drawn between immunity from actual sin and original sinlessness.

Her Peculiar Relation to the Godhead, which specially fits Her for Successful Intercession on Behalf of Mankind.—It seems probable that the epithet θεοτόκος ("Mother of God") was first applied to Mary by theologians of Alexandria towards the close of the 3rd century; but it does not occur in any genuine extant writing of that period, unless we are to assign an early date to the apocryphal *Transitus Mariae*, in which the word is of frequent occurrence. In the 4th century it is met with frequently, being used by Eusebius, Athanasius, Didymus and Gregory of Nazianzus,—the latter declaring that the man who believes not Mary to have been θεοτόκος has no part in God (*Orat.* li. p. 738).[2] If its use was first recommended by a desire to bring into prominence the divinity of the Incarnate Word, there can be no doubt that latterly the expression came to be valued as directly honourable to Mary herself and as corresponding to the greatly increased esteem in which she personally was held throughout the Catholic world, so that when Nestorius and others began to dispute its propriety, in the following century, their temerity was resented, not as an attack upon the established orthodox doctrine of the Nicene creed, but as threatening a more vulnerable and more tender part of the popular faith. It is sufficient in illustration of the drift of theological opinion to refer to the first sermon of Proclus, preached on a certain festival of the Virgin (πανήγυρις παρθενική) at Constantinople about the year 430 or to that of Cyril of Alexandria delivered in the church of the Virgin Mary at the opening of the council of Ephesus in 431. In the former the orator speaks of "the holy Virgin and Mother of God" as "the spotless treasure-house of virginity, the spiritual paradise of the second Adam; the workshop in which two natures were welded together . . . . the one bridge between God and men";[3] in the latter she is saluted as the "mother and virgin," "through whom (δι' ἧς) the Trinity is glorified and worshipped, the cross of the Saviour exalted and honoured, through whom heaven triumphs, the angels are made glad, devils driven forth, the tempter overcome, and the fallen creature raised up even to heaven." The response which such language found in the popular heart was sufficiently shown by the shouts of joy with which the Ephesian mob heard of the deposition of Nestorius, escorting his judges with torches and incense to their homes, and celebrating the occasion by a general illumination. The causes which in the preceding century had led to this exaltation of the Mother of God in the esteem of the Catholic world are not far to seek. On the one hand the solution of the Arian controversy, however correct it may have been theoretically, undoubtedly had the practical effect of relegating the God-man redeemer for ordinary minds into a far away region of "remote and awful Godhead," so that the need for a mediator to deal with the very Mediator could not fail to be felt. On the other hand, the religious instincts of mankind are very ready to pay worship, in grosser or more refined forms, to the idea of womanhood; at all events many of those who became professing Christians at the political fall of Paganism entered the Church with such instincts (derived from the nature-religions in which they had been brought up) very fully developed. Probably it ought to be added that the comparative colourlessness with which the character of Mary is presented, not only in the canonical gospels but even in the most copious of the apocrypha, left greater scope for the untrammelled exercise of devout imagination than was possible in the case of Christ, in the circumstances of whose humiliation and in whose recorded utterances there were many things which the religious consciousness found difficulty in understanding or in adapting to itself. At all events, from the time of the council of Ephesus, to exhibit figures of the Virgin and Child became the approved expression of orthodoxy, and the relationship of motherhood in which Mary had been formally declared to stand to God[1] was instinctively felt to give the fullest and freest sanction of the Church to that invocation of her aid which had previously been resorted to only hesitatingly and occasionally. Previously to the council of Ephesus, indeed, the practice had obtained complete recognition, so far as we know, in those circles only in which one or other of the numerous redactions of the *Transitus Mariae* passed current.[2] There we read of Mary's prayer to Christ: "Do Thou bestow Thine aid upon every man calling upon, or praying to, or naming the name of Thine handmaid"; to which His answer is, "Every soul that calls upon Thy name shall not be ashamed, but shall find mercy and support and confidence both in the world that now is and in that which is to come in the presence of My Father in the heavens." But Gregory of Nazianzus also, in his panegyric upon Justina, mentions with incidental approval that in her hour of peril she "implored Mary the Virgin to come to the aid of a virgin in her danger."[3] Of the growth of the Marian cultus, alike in the East and in the West, after the decision at Ephesus it would be impossible to trace the history, however slightly, within the limits of the present article. Justinian in one of his laws bespeaks her advocacy for the empire, and he inscribes the high altar in the new church of St Sophia with her name. Narses looks to her for directions on the field of battle. The emperor Heraclius bears her image on his banner. John of Damascus speaks of her as the sovereign lady to whom the whole creation has been made subject by her son. Peter Damian recognizes her as the most exalted of all creatures, and apostrophizes her as deified and endowed with all power in heaven and in earth, yet not forgetful of our race.[4] In a word, popular devotion gradually developed the entire system of doctrine and practice which Protestant controversialists are accustomed to call by the name of Mariolatry. With reference to this much-disputed phrase it is always to be kept in mind that the directly authoritative documents, alike of the Greek and of the Roman Church, distinguish formally between *latria* and *dulia*, and declare that the "worship" to be paid to the mother of God must never exceed that superlative degree of *dulia* which is vaguely described as *hyperdulia*. But the comparative reserve shown by the council of Trent in its decrees, and even in its catechism,[5] on this subject has not been observed by individual theologians, and in view of the fact of the canonization of some of these (such as Liguori)—a fact guaranteeing the absence of erroneous teaching from their writings—it does not seem unfair, to hold the Roman Church responsible for the natural interpretations and just inferences which may be drawn even from apparently exaggerated expressions in such works as the well-known *Glories of Mary* and others frequently quoted in controversial literature. There is a good *résumé* of Catholic developments of the cultus of Mary in Pusey's *Eirenicon*.

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[1] *De Inst. Virg.*, "quæ est hæc porta nisi Maria? . . . per quam Christus intravit in hunc mundum, quando virginali fusus est partu et genitalia virginitatis claustra non solvit."

[2] See Gieseler (*KG.*, Bd. i. Abth. 1), who points out instances in which anti-Arianizing zeal went so far as to call David θεοπάτωρ and James ἀδελφόθεος.

[3] Labbé, *Conc.* iii. 51. Considerable extracts are given by Augusti (*Denkw.* iii.); see also Milman (*Lat. Christ.* i. 185), who characterises much of it as a "wild labyrinth of untranslatable metaphor."

The following are the principal feasts of the Virgin in the order in which they occur in the ecclesiastical year. (1) That of the Presentation (*Praesentatio B. V. M., τὰ εἰσόδια τῆς θεοτόκου*), to commemorate the beginning of her stay in the Temple, as recorded in the *Protevangelium Jacobi*. It is believed to have originated in the East in the 8th century, the earliest allusion to it being made by George of Nicomedia (9th century); Manuel Comnenus made it universal for the Eastern Empire, and in the modern Greek Church it is one of the five great festivals in honour of the Deipara. It was introduced into the Western Church late in the 14th century, and, after having been withdrawn from the calendar by Pius V., was restored by Sixtus V., the day observed in both East and West being the 21st of November. It is not mentioned in the English calendar. (2) the Feast of the Conception (*Conceptio B. V. M., Conceptio immaculata B. V. M., σύλληψις τῆς ἁγίας Ἄννης*), observed by the Roman Catholic Church on the 8th of December, and by all the Eastern Churches on the 9th of December, has already been explained; in the Greek Church it only ranks as one of the middle festivals of Mary. (3) The Feast of the Purification (*Occursus, Obviatio, Praesentatio, Festum SS Simeonis et Annae, Purificatio, Candelaria, ὑπαπαντή, ὑπαντή*) is otherwise known as CANDLEMAS. (4) The Feast of the Annunciation of the Virgin Mary (*Annunciatio, Εὐαγγελισμός*). It may be mentioned that at the council of Toledo in 656 it was decreed that this festival should be observed on the 18th of December, in order to keep clear of Lent. (5) The Feast of the Visitation (*Visitatio B. V. M.*) was instituted by Urban VI., promulgated in 1389 by Boniface IX., and reappointed by the council of Basel in 1441 in commemoration of the visit paid by Mary to Elizabeth. It is observed on the 2nd of July, and has been retained in the English calendar. (6) The Feast of the Assumption (*Dormitio, Pausatio, Transitus, Depositio, Migratio, Assumptio, κοίμησις, μετάστασις, ἀνάληψις*) has reference to the apocryphal story related in several forms in various documents of the 4th century condemned by Pope Gelasius. Their general purport is that as the time drew nigh for "the most blessed Virgin" (who is also spoken of as "Holy Mary," "the queen of all the saints," "the holy spotless Mother of God") to leave the world, the apostles were miraculously assembled round her deathbed at Bethlehem on the Lord's Day, whereupon Christ descended with a multitude of angels and received her soul. After "the spotless and precious body" had been laid in the tomb, "suddenly there shone round them (the apostles) a miraculous light," and it was taken up into heaven. The first Catholic writer who relates this story is Gregory of Tours (*c.* 590); Epiphanius two centuries earlier had declared that nothing was known as to the circumstances of Mary's death and burial; and one of the documents of the council of Ephesus implies a belief that she was buried in that city. The Sleep of the Theotokos is observed in the Greek Church as a great festival on the 15th of August; the Armenian Church also commemorates it, but the Ethiopic Church celebrates her death and burial on two separate days. The earliest allusion to the existence of such a festival in the Western Church seems to be that found in the proceedings of the synod of Salzburg in 800; it is also spoken of in the thirty-sixth canon of the reforming synod of Mainz, held in 813. It was not at that time universal, being mentioned as doubtful in the capitularies of Charlemagne. The doctrine of the bodily assumption of the Virgin into heaven, although extensively believed, and indeed flowing as a natural theological consequence from that of her sinlessness, has never been declared to be "de fide" by the Church of Rome, and is still merely a "pia sententia." (7) The Nativity of Mary (*Nativitas*, *γενέθλιον τῆς θεοτόκου*) observed on the 8th of September, is first mentioned in one of the homilies of Andrew of Crete (*c.* 750), and with the Feasts of the Purification, the Annunciation and the Assumption, it was appointed to be observed by the synod of Salzburg in 800, but seems to have been unknown at that time in the Gallican Church, and even two centuries later it was by no means general in Italy. In the Roman Catholic Church a large number of minor festivals in honour of the Virgin are locally celebrated; and all the Saturdays of the year as well as the entire month of May are also regarded as sacred to her.

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[1] The term θεοτόκος does not actually occur in the canons of Ephesus. It is found, however, in the creed of Chalcedon.

[2] It is true that Irenaeus (*Haer.* v. 19, 1) in the passage in which he draws his well-known parallel and contrast between the first and second Eve (cf. Justin, *Dial. c. Tryph.* 100), to the effect that "as the human race fell into bondage to death by a virgin, so is it rescued by a virgin," takes occasion to speak of Mary as the "advocata" of Eve; but it seems certain that this word is a translation of the Greek συνήγορος, and implies hostility and rebuke rather than advocacy.

[3] It is probable that the commemorations and invocations of the Virgin which occur in the present texts of the ancient liturgies of "St James" and "St Mark" are due to interpolation. In this connexion ought also to be noted the chapter in Epiphanius (*Haer.*, 79) against the "Collyridians," certain women in Thrace, Scythia and Arabia, who were in the habit of worshipping the Virgin (ἀεὶ παρθένον) as a goddess, the offering of a cake (κολλυρίδα τινα) being one of the features of their worship. He rebukes them for offering the worship which was due to the Trinity alone; "let Mary be held in honour, but by no means worshipped." The cultus was probably a relic of heathenism; cf. Jer. xliv. 19.

[4] "Numquid quia ita deificata, ideo nostrae humanitatis oblita es? Nequaquam, Domina. . . . Data est tibi omnis potestas in coelo et in terra. Nil tibi impossibile." *Serm. de nativ. Mariae*, ap. Gieseler, *KG.*, Bd. ii. Abth. 1.

[5] The points taught in the catechism are—that she is truly the Mother of God, and the second Eve, by whose means we have received blessing and life; that she is the Mother of Pity, and very specially our advocate; that her merits are highly exalted, and that her dispositions towards us are extremely gracious; that her images are of the utmost utility. In the *Missal* her intercessions (though alluded to in the canon and elsewhere) are seldom directly appealed to except in the Litany and in some of the later offices, such as those for the 8th of September and for the Festival of the Seven Sorrows (decree by Benedict XIII. in 1727). Noteworthy are the versicles in the office for the 8th of December (The Feast of the Immaculate Conception), "Tota pulchra es, Maria, et macula originalis non est in te," and "Gloriosa dicta sunt de te, Maria, quia fecit tibi magna qui potens est."

The chief apocryphal writings concerned with Mary are the following: (1) The *Portevangelium Jacobi*, with its derivatives the *De nativitate Mariae*, the *Evangelium Ps.-Matthaei*, the *Historia Josephi fabri lignarii* (all edited by Tischendorf, *Evangelia apocrypha*; cf. Harnack, *Geschichte der altchristlichen Litteratur*, p. 20 seq. and *Chronologie*, i. 598 sqq.). (2) *Evangelium Mariae* (see *Sitzungsberichte der Berlinischen Akademie der Wissenschaften* 1896, pp. 839–847). (3) *Ἰωάννου τοῦ θεολόγου λόγος εἰς τὴν κοίμησιν τῆς θεοτόκου*, which appears in Latin under the title of the *Transitus Mariae* (ed. Tischendorf, *Apocalypses apocryphae* and *Evangelia apocrypha*, and see Bonnet, *Zeitschr. f. wissensch. Theol.*, 1880, pp. 222–247).

(J. S. Bl.; K. L.)

MARY, known as **Mary Magdalene**, a woman mentioned in the Gospels, first in Luke viii. 2, as one of a company who "healed of evil spirits and infirmities . . . ministered unto them (Jesus and the apostles) of their substance." It is said that seven demons were cast out of her, but this need not imply simply one occasion. Her name implies that she came from Magdala (el-Mejdel, 3 m. N.W. from Tiberias: in Matt. xv. 39 the right reading is not Magdala but Magadan). She went with Jesus on the last journey to Jerusalem, witnessed the Crucifixion, followed to the burial, and returned to prepare spices. John xx. gives an account of her finding the tomb empty and of her interview with the risen Jesus. Mary of Magdala has been confounded (1) with the unnamed fallen woman who in Simon's house anointed Christ's feet (Luke vii. 37); (2) with Mary of Bethany, sister of Lazarus and Martha.

MARY I., queen of England (1516–1558), unpleasantly remembered as "the Bloody Mary" on account of the religious persecutions which prevailed during her reign, was the daughter of Henry VIII. and Catherine of Aragon, born in the earlier years of their married life, when as yet no cloud had darkened the prospect of Henry's reign. Her birth occurred at Greenwich, on Monday, the 18th February 1516, and she was baptized on the following Wednesday, Cardinal Wolsey standing as her godfather. She seems to have been a singularly precocious child, and is reported in July 1520, when scarcely four and a half years old, as entertaining some visitors by a performance on the virginals. When she was little over nine she was addressed in a complimentary Latin oration by commissioners sent over from Flanders on commercial matters, and replied to them in the same language "with as much assurance and facility as if she had been twelve years old" (Gayangos, iii. pt. 1, 82). Her father was proud of her achievements. About the same time that she replied to the commissioners in Latin he was arranging that she should learn Spanish, Italian and French. A great part, however, of the credit of her early education was undoubtedly due to her mother, who not only consulted the Spanish scholar Vives upon the subject, but was herself Mary's first teacher in Latin. She was also well instructed in music, and among her principal recreations as she grew up was that of playing on the virginals and lute.

It was a misfortune that she shared with high-born ladies generally in those days that her prospects in life were made a matter of sordid bargaining from the first. Mary was little more than two years old when she was proposed in marriage to the dauphin, son of Francis I. Three years afterwards the French alliance was broken off, and in 1522 she was affianced to her cousin the young emperor Charles V. by the Treaty of Windsor. No one, perhaps, seriously expected either of these arrangements to endure; and, though we read in grave state papers of some curious compliments and love tokens (really the mere counters of diplomacy) professedly sent by the girl of nine to her powerful cousin, not many years passed away before Charles released himself from this engagement and made a more convenient match. In 1526 a rearrangement was made of the royal household, and it was thought right to give Mary an establishment of her own along with a council on the borders of Wales, for the better government of the Marches. For some years she accordingly kept her court at Ludlow, while new arrangements were made for the disposal of her hand. She was now proposed as a wife, not for the dauphin as before, but for his father Francis I., who had just been redeemed from captivity at Madrid, and who was only too glad of an alliance with England to mitigate the severe conditions imposed on him by the emperor. Wolsey, however, on this occasion, only made use of the princess as a bait to enhance the terms of the compact, and left Francis free in the end to marry the emperor's sister.

It was during this negotiation, as Henry afterwards pretended, that the question was first raised whether Henry's own marriage with Catherine was a lawful one. Grammont, bishop of Tarbes, who was one of the ambassadors sent over by Francis to ask the princess in marriage, had, it was said, started an objection that she might possibly be considered illegitimate on account of her mother having been once the wife of her father's brother. The statement was a mere pretence to shield the king when the unpopularity of the divorce became apparent. It is proved to be untrue by the strongest evidence, for we have pretty full contemporary records of the whole negotiation. On the contrary, it is quite clear that Henry, who had already for some time conceived the project of a divorce, kept the matter a dead secret, and was particularly anxious that the French ambassadors should not know it, while he used his daughter's hand as a bait for a new alliance. The alliance itself, however, was actually concluded by a treaty dated Westminster, the 30th of April 1527, in which it was provided, as regards the Princess Mary, that she should be married either to Francis himself or to his second son Henry duke of Orleans. But the real object was only to lay the foundation of a perfect mutual understanding between the two kings, which Wolsey soon after went into France to confirm.

During the next nine years the life of Mary, as well as that of her mother, was rendered miserable by the conduct of Henry VIII. in seeking a divorce. During most of that period mother and daughter seem to have been kept apart. Possibly Queen Catherine had the harder trial; but Mary's was scarcely less severe. Removed from court and treated as a bastard, she was, on the birth of Anne Boleyn's daughter, required to give up the dignity of princess and acknowledge the illegitimacy of her own birth. On her refusal her household was broken up, and she was sent to Hatfield to act as lady-in-waiting to her own infant half-sister. Nor was even this the worst of her trials; her very life was in danger from the hatred of Anne Boleyn. Her health, moreover, was indifferent, and even when she was seriously ill, although Henry sent his own physician, Dr Buttes, to attend her, he declined to let her mother visit her. So also at her mother's death, in January 1536, she was forbidden to take a last farewell of her. But in May following another change occurred. Anne Boleyn, the real cause of all her miseries, fell under the king's displeasure and was put to death. Mary was then urged to make a humble submission to her father as the means of recovering his favour, and after a good deal of correspondence with the king's secretary, Cromwell, she actually did so. The terms exacted of her were bitter in the extreme, but there was no chance of making life tolerable otherwise, if indeed she was permitted to live at all, and the poor friendless girl, absolutely at the mercy of a father who could brook no contradiction, at length subscribed an act of submission, acknowledging the king as "Supreme Head of the Church of England under Christ," repudiating the pope's authority, and confessing that the marriage between her father and mother "was by God's law and man's law incestuous and unlawful."

No act, perhaps, in the whole of Henry's reign gives us a more painful idea of his revolting despotism. Mary was a high-spirited girl, and undoubtedly popular. All Europe looked upon her at that time as the only legitimate child of her father, but her father himself compelled her to disown the title and pass an unjust stigma on her own birth and her mother's good name. Nevertheless Henry was now reconciled to her, and gave her a household in some degree suitable to her rank. During the rest of the reign we hear little about her except in connexion with a number of new marriage projects taken up and abandoned successively, one of which, to the count palatine Philip, duke of Bavaria, was specially repugnant to her in the matter of religion. Her privy purse expenses for nearly the whole of this period have been published, and show that Hatfield, Beaulieu or Newhall in Essex, Richmond and Hunsdon were among her principal places of residence. Although she was still treated as of illegitimate birth, it was believed that the king, having obtained from parliament the extraordinary power to dispose of the crown by will, would restore her to her place in the succession, and three years before his death, she was so restored by statute, but still under conditions to be regulated by her father's will.

Under the reign of her brother, Edward VI. she was again subjected to severe trials, which at one time made her seriously meditate taking flight and escaping abroad. Edward himself indeed seems to have been personally not unkind to her, but the religious revolution in his reign assumed proportions such as it had not done before, and Mary, who had done sufficient violence to her own convictions in submitting to a despotic father, was not disposed to yield an equally tame obedience to authority exercised by a factious council in the name of a younger brother not yet come to years of discretion. Besides, the cause of the pope was naturally her own. In spite of the forced declaration formerly wrung from herself, no one really regarded her as a bastard, and the full recognition of her rights depended on the recognition of the pope as head of the Church. Hence, when Edward's parliament passed an Act of Uniformity enjoining services in English and communion in both kinds, the law appeared to her totally void of authority, and she insisted on having Mass in her own private chapel under the old form. When ordered to desist, she appealed for protection to the emperor Charles V., who, being her cousin, intervened for some time not ineffectually, threatening war with England if her religious liberty was interfered with. But Edward's court was composed of factions of which the most violent eventually carried the day. Lord Seymour, the admiral, was attainted of treason and beheaded in 1549. His brother, the Protector Somerset, met with the same fate in 1552. Dudley, duke of Northumberland, then became paramount in the privy council, and easily obtained the sanction of the young king to those schemes for altering the succession which led immediately after his death to the usurpation of Lady Jane Grey. Dudley had, in fact, overawed all the rest of the privy council, and when the event occurred he took such energetic measures to give effect to the scheme that Lady Jane was actually recognized as queen for some days, and Mary had even to fly from Hunsdon into Norfolk. But the country was really devoted to her cause, as indeed her right in law was unquestionable, and before many days she was royally received in London, and took up her abode within the Tower.

Her first acts at the beginning of her reign displayed a character very different from that which she still holds in popular estimation. Her clemency towards those who had taken up arms against her was altogether remarkable. She released from prison Lady Jane's father, Suffolk, and had difficulty even in signing the warrant for the execution of Northumberland. Lady Jane herself she fully meant to spare, and did spare till after Wyatt's formidable insurrection. Her conduct, indeed, was in every respect conciliatory and pacific, and so far as they depended on her personal character the prospects of the new reign might have appeared altogether favourable. But unfortunately her position was one of peculiar difficulty, and the policy on which she determined was far from judicious. Inexperienced in the art of governing, she had no trusty councillor but Gardiner; every other member of the council had been more or less implicated in the conspiracy against her. And though she valued Gardiner's advice she was naturally led to rely even more on that of her cousin, the emperor, who had been her mother's friend in adversity, and had done such material service to herself in the preceding reign. Following the emperor's guidance she determined almost from the first to make his son Philip her husband, though she was eleven years his senior. She was also strongly desirous of restoring the old religion and wiping out the stigma of illegitimacy upon her birth, so that she might not seem to reign by virtue of a mere parliamentary settlement.

Each of these different objects was attended by difficulties or objections peculiar to itself; but the marriage was the most unpopular of all. A restoration of the old religion threatened to deprive the new owners of abbey lands of their easy and comfortable acquisitions; and it was only with an express reservation of their interests that the thing was actually accomplished. A declaration of her own legitimacy necessarily cast a slur on that of her sister Elizabeth, and cut her off from the succession. But the marriage promised to throw England into the arms of Spain and place the resources of the kingdom at the command of the emperor's son. The Commons sent her a deputation to entreat that she would not marry a foreigner, and when her resolution was known insurrections broke out in different parts of the country. Suffolk, whose first rebellion had been pardoned, proclaimed Lady Jane Grey again in Leicestershire, while young Wyatt raised the county of Kent and, though denied access by London Bridge, led his men round by Kingston to the very gates of London before he was repulsed. In the midst of the danger Mary showed great intrepidity, and the rebellion was presently quelled; after which, unhappily, she got leave to pursue her own course unchecked. She married Philip, restored the old religion, and got Cardinal Pole to come over and absolve the kingdom from its past disobedience to the Holy See.

It was a more than questionable policy thus to ally England with Spain—a power then actually at war with France. By the treaty, indeed, England was to remain neutral; but the force of events, in the end, compelled her, as might have been expected, to take part in the quarrel. Meanwhile the country was full of faction, and seditious pamphlets of Protestant origin inflamed the people with hatred against the Spaniards. Philip's Spanish followers met with positive ill-usage everywhere, and violent outbreaks occurred. A year after his marriage Philip went over to Brussels to receive from his father the government of the Low Countries and afterwards the kingdom of Spain. Much to Mary's distress, his absence was prolonged for a year and a half, and when he returned in March 1557 it was only to commit England completely to the war; after which he went back to Brussels in July, to return no more to England.

Hostilities with France were inevitable, because France had encouraged disaffection among Mary's subjects, even during the brief truce of Vaucelles. Conspiracies had been hatched by English refugees in Paris, and an attempt to seize Scarborough had been made with the aid of vessels from the Seine. But perhaps the strangest thing about the situation was that the pope took part with France against Spain; and so the very marriage which Mary had contracted to bring England back to the Holy See made her the wife of the pope's enemy. It was, moreover, this war with France that occasioned the final calamity of the loss of Calais, which sank so deeply into Mary's heart some time before she died.

The cruel persecution of the Protestants, which has cast so much infamy upon her reign, was not due, as commonly supposed, to inhumanity on her part. When the kingdom was reconciled to Rome and absolved by Cardinal Pole, it followed, almost as a matter of necessity, that the old heresy laws should be revived, as they were then by Act of Parliament. They had been abolished by the Protector Somerset for the express purpose of promoting changes of doctrine which did violence to what was still the prevailing religious sentiment; and now the old religion required to be protected from insult and fanatical outrages. Doubts were felt as to the result even from the first; but the law having been once passed could not be relaxed merely because the victims were so numerous; for that would only have encouraged the irreverence which it was intended to check. No doubt there were milder men among the heretics, but as a class their stern fanaticism and ill-will to the old religion made them dangerous, even to the public peace. Rogers, the first of the martyrs, was burnt on the 4th of February 1555. Hooper, bishop of Gloucester, had been condemned six days before, and suffered the same fate upon the 9th. From this time the persecution went on uninterrupted for three years and three quarters, numbering among its victims Ridley, Latimer and Cranmer. It came to an end at last on the death of Mary. It seems to have been more severe in the eastern and southern parts of England, and the largest number of sufferers was naturally in the diocese of Bonner, bishop of London. From first to last nearly three hundred victims are known to have perished at the stake; and their fate certainly created a revulsion against Rome that nothing else was likely to have effected.

Mary was of weak constitution and subject to frequent illnesses, both before and after her accession. One special infirmity caused her to believe a few months after her marriage that she was with child, and thanksgiving services were ordered throughout the diocese of London in November 1554. The same delusion recurred in March 1558, when though she did not make her expectation public, she drew up a will in anticipation of the dangers of childbirth, constituting her husband regent during the minority of her prospective heir. To this she added a codicil on the 28th of October following, when the illness that was to be her last had set in, showing that she had ceased to have much expectation of maternity, and earnestly entreating her "next heir and successor by the laws" (whom she did not name) to allow execution of the instrument. She died on the 17th of November.

Her name deserved better treatment than it has generally met with; for she was far from cruel. Her kindness to poor people is undoubted, and the severe execution of her laws seemed only a necessity. Even in this matter, moreover, she was alive to the injustice with which the law was usually strained in behalf of the prerogative; and in appointing Sir Richard Morgan chief justice of the Common Pleas she charged him "not to sit in judgment otherwise for her highness than for her subjects," and to avoid the old error of refusing to admit witnesses against the Crown (Holinshed III. 1112). Her conduct as queen was certainly governed by the best possible intentions; and it is evident that her very zeal for goodness caused most of the trouble she brought upon herself. Her subjects were entirely released, even by papal authority, from any obligation to restore the confiscated lands of the Church. But she herself made it an object, at her own expense, to restore several of the monasteries; and courtiers who did not like to follow her example, encouraged the fanatics to spread an alarm that it would even yet be made compulsory. So the worldly minded joined hands with the godly heretics in stirring up enmity against her. (J. Ga.)

MARY II. (1662–1694), queen of England and wife of king William III., elder daughter of James, duke of York, afterwards King James II., by his first wife, Anne, daughter of Edward Hyde, 1st earl of Clarendon, was born in London on the 30th of April 1662. She was educated as a Protestant, and as it was probable that she would succeed to the English throne after the deaths of her uncle, Charles II., and her father, the choice of a husband for her was a political event of high importance. About 1672 the name of William, prince of Orange, was mentioned in this connexion; and after some hesitation on both sides caused by the condition of European politics, the betrothal of William and Mary took place in October 1677, and was quickly followed by their marriage in London on the 4th of November. Mary's married life in Holland does not appear to have been a happy one. Although she soon became popular among the Dutch, she remained childless, while William treated her with neglect and even with insult; and her troubles were not diminished after her father became king of England in 1685. James had treated his daughter very shabbily in money matters; and it was increasingly difficult for her to remain loyal to both father and husband when they were so divergent in character and policy. Although Mary never entirely lost her affection for her father the wife prevailed over the daughter; and after the birth of her half-brother, the prince of Wales, in 1688, she regarded the dethronement of James as inevitable. It cannot be said, however, that William merited this confidence. Possibly he was jealous of his wife as the heiress of the English throne, contrasting her future position with his own; but according to Burnet, who was then staying at the Hague, this cause of difference was removed by the tactful interference of Burnet himself. The latter asserts that having divined the reason of the prince's jealousy he mentioned the matter to the princess, who in her ignorance of statecraft had never considered the relative positions of herself and her husband with regard to the English throne; and that Mary, by telling the prince "she would be no more but his wife, and that she would do all that lay in her power to make him king for life" (Burnet, *Supplement*, ed. Foxcroft, p. 309), probably mollified her husband's jealousy. On the other hand Macaulay's statement that henceforward there was "entire friendship and confidence" between them must be taken with some reserve. Mary shared heartily in the events which immediately preceded William's expedition to England in 1688. After the success of the undertaking she arrived in London in February 1689; and by her faithful adherence to her promise made a satisfactory settlement of the English crown possible. William and Mary were together proclaimed king and queen of England, and afterwards of Scotland, and were crowned on the 11th of April 1689. During the king's absence from England the queen, assisted by a committee of the privy council, was entrusted with the duties of government, duties which she performed faithfully, but which she gladly laid down on William's return. In these times of danger, however, she acted when necessary with courage and promptitude, as when in 1690 she directed the arrest of her uncle Henry Hyde, 2nd earl of Clarendon; but she was constantly anxious for William's safety, and unable to trust many of her advisers. She was further distressed by a quarrel with her sister Anne in 1692 following the dismissal of Marlborough, and this event somewhat diminished her popularity, which had hitherto been one of the mainstays of the throne. Weak in body and troubled in mind, the queen died at Kensington Palace from small-pox on the 28th of December 1694, and was buried in Westminster Abbey. Mary was a woman of a remarkably modest and retiring disposition, whose outstanding virtue was perhaps her unswerving loyalty to William. Burnet has passed a remarkable panegyric upon her character. She was extremely pious and charitable; her blameless private life was in marked contrast with her surroundings, both in England and Holland; without bigotry she was greatly attached to the Protestant faith and to the Church of England; and she was always eager to improve the tone of public morals, and to secure a better observance of Sunday. Greenwich Hospital for Seamen was founded in her honour.

For the political events of Mary's life see William III. For her private life see Sir John Dalrymple, *Memoirs of Great Britain and Ireland* (London, 1790); Countess Bentinck, *Lettres et mémoires de Marie, reine d'Angleterre* (The Hague, 1880); *Memoires and Letters of Mary Queen of England* (ed. by R. Doebner, Leipzig, 1886); F. J. L. Krämer, *Maria II. Stuart* (Utrecht, 1890); Agnes Strickland, *Lives of the Queens of England*, vols. x. and xi. (London, 1847); G. Burnet, *History of my own Time* (Oxford, 1833); and O. Klopp, *Der Fall des Hauses Stuart* (Vienna, 1875–1888).

MARY QUEEN OF SCOTS[1] (1542–1587), daughter of King James V. and his wife Mary of Lorraine, was born in December 1542, a few days before the death of her father, heart-broken by the disgrace of his arms at Solway Moss, where the disaffected nobles had declined to encounter an enemy of inferior force in the cause of a king whose systematic policy had been directed against the privileges of their order, and whose representative on the occasion was an unpopular favourite appointed general in defiance of their ill-will. On the 9th of September following the ceremony of coronation was duly performed upon the infant. A scheme for her betrothal to Edward, prince of Wales, was defeated by the grasping greed of his father, whose obvious ambition to annex the crown of Scotland at once to that of England aroused instantly the general suspicion and indignation of Scottish patriotism. In 1548 the queen of six years old was betrothed to the dauphin Francis, and set sail for France, where she arrived on the 15th of August. The society in which the child was thenceforward reared is known to readers of Brantôme as well as that of imperial Rome at its worst is known to readers of Suetonius or Petronius as well as that of papal Rome at its worst is known to readers of the diary kept by the domestic chaplain of Pope Alexander VI. Only in their pages can a parallel be found to the gay and easy record which reveals without sign of shame or suspicion of offence the daily life of a court compared to which the court of King Charles II. is as the court of Queen Victoria to the society described by Grammont. Debauchery of all kinds, and murder in all forms, were the daily matter of excitement or of jest to the brilliant circle which revolved around Queen Catherine de' Medici. After ten years' training under the tutelage of the woman whose main instrument of policy was the corruption of her own children, the queen of Scots, aged fifteen years and five months, was married to the eldest and feeblest of the brood on the 24th of April 1558. On the 17th of November Elizabeth became queen of England, and the princes of Lorraine—Francis the great duke of Guise, and his brother the cardinal—induced their niece and her husband to assume, in addition to the arms of France and Scotland, the arms of a country over which they asserted the right of Mary Stuart to reign as legitimate heiress of Mary Tudor. Civil strife broke out in Scotland between John Knox and the queen-dowager—between the self-styled "congregation of the Lord" and the adherents of the regent, whose French troops repelled the combined forces of the Scotch and their English allies from the beleaguered walls of Leith, little more than a month before the death of their mistress in the castle of Edinburgh, on the 10th of June 1560. On the 25th of August Protestantism was proclaimed and Catholicism suppressed in Scotland by a convention of states assembled without the assent of the absent queen. On the 5th of December Francis II. died; in August 1561 his widow left France for Scotland, having been refused a safe-conduct by Elizabeth on the ground of her own previous refusal to ratify the treaty made with England by her commissioners in the same month of the preceding year. She arrived nevertheless in safety at Leith, escorted by three of her uncles of the house of Lorraine, and bringing in her train her future biographer, Brantôme, and Chastelard, the first of all her voluntary victims. On the 21st of August she first met the only man able to withstand her; and their first passage of arms left, as he has recorded, upon the mind of John Knox an ineffaceable impression of her "proud mind, crafty wit and indurate heart against God and His truth." And yet her acts of concession and conciliation were such as no fanatic on the opposite side could have approved. She assented, not only to the undisturbed maintenance of the new creed, but even to a scheme for the endowment of the Protestant ministry out of the confiscated lands of the Church. Her half-brother, Lord James Stuart, shared the duties of her chief counsellor with William Maitland of Lethington, the keenest and most liberal thinker in the country. By the influence of Lord James, in spite of the earnest opposition of Knox, permission was obtained for her to hear Mass celebrated in her private chapel—a licence to which, said the Reformer, he would have preferred the invasion of ten thousand Frenchmen. Through all the first troubles of her reign the young queen steered her skilful and dauntless way with the tact of a woman and the courage of a man. An insurrection in the north, headed by the earl of Huntly under pretext of rescuing from justice the life which his son had forfeited by his share in a homicidal brawl, was crushed at a blow by the Lord James against whose life, as well as against his sister's liberty, the conspiracy of the Gordons had been aimed, and on whom, after the father had fallen in fight and the son had expiated his double offence on the scaffold, the leading rebel's earldom of Murray was conferred by the gratitude of the queen. Exactly four months after the battle of Corrichie, and the subsequent execution of a criminal whom she is said to have "loved entirely," had put an end to the first insurrection raised against her, Pierre de Boscosel de Chastelard, who had returned to France with the other companions of her arrival, and in November 1562 had revisited Scotland, expiated with his head the offence or the misfortune of a second detection at night in her bed-chamber. In the same month, twenty-five years afterwards, the execution of his mistress, according to the verdict of her contemporaries in France, avenged the blood of a lover who had died without uttering a word to realize the apprehension which (according to Knox) had before his trial impelled her to desire her brother "that, as he loved her, he would slay Chastelard, and let him never speak word." And in the same month, two years from the date of Chastelard's execution, her first step was unconsciously taken on the road to Fotheringhay, when she gave her heart at first sight to her kinsman Henry, Lord Darnley, son of Matthew Stuart, earl of Lennox, who had suffered an exile of twenty years in expiation of his intrigues with England, and had married the niece of King Henry VIII., daughter of his sister Margaret, the widow of James IV., by her second husband, the earl of Angus. Queen Elizabeth, with the almost incredible want of tact or instinctive delicacy which distinguished and disfigured her vigorous intelligence, had recently proposed as a suitor to the queen of Scots her own low-born favourite, Lord Robert Dudley, the widower if not the murderer of Amy Robsart; and she now protested against the project of marriage between Mary and Darnley. Mary who had already married her kinsman in secret at Stirling Castle with Catholic rites celebrated in the apartment of David Rizzio, her secretary for correspondence with France, assured the English ambassador, in reply to the protest of his mistress, that the marriage would not take place for three months, when a dispensation from the pope would allow the cousins to be publicly united without offence to the Church. On the 29th of July 1565 they were accordingly remarried at Holyrood. The hapless and worthless bridegroom had already incurred the hatred of two powerful enemies, the earls of Morton and Glencairn; but the former of these took part with the queen against the forces raised by Murray, Glencairn and others, under the nominal leadership of Hamilton, duke of Chatelherault, on the double plea of danger to the new religion of the country, and of the illegal proceeding by which Darnley had been proclaimed king of Scots without the needful constitutional assent of the estates of the realm. Murray was cited to attend the "raid" or array levied by the king and queen, and was duly denounced by public blast of trumpet for his non-appearance. He entered Edinburgh with his forces, but failed to hold the town against the guns of the castle, and fell back upon Dumfries before the advance of the royal army, which was now joined by James Hepburn, earl of Bothwell, on his return from a thr outlawed exile in France. He had been accused in 1562 of a plot to seize the queen and put her into the keeping of the earl of Arran, whose pretensions to her hand ended only when his insanity could no longer be concealed. Another new adherent was the son of the late earl of Huntly, to whom the forfeited honours of his house were restored a few months before the marriage of his sister to Bothwell. The queen now appealed to France for aid; but Castelnau, the French ambassador, replied to her passionate pleading by sober and earnest advice to make peace with the malcontents. This counsel was rejected, and in October 1565 the queen marched an army of 18,000 men against them from Edinburgh; their forces dispersed in face of superior numbers, and Murray, on seeking shelter in England, was received with contumely by Elizabeth, whose half-hearted help had failed to support his enterprise, and whose intercession for his return found at first no favour with the queen of Scots. But the conduct of the besotted boy on whom at their marriage she had bestowed the title of king began at once to justify the enterprise and to play into the hands of all his enemies alike. His father set him on to demand the crown matrimonial, which would at least have assured to him the rank and station of independent royalty for life. Rizzio, hitherto his friend and advocate, induced the queen to reply by a reasonable refusal to this hazardous and audacious request. Darnley at once threw himself into the arms of the party opposed to the policy of the queen and her secretary—a policy which at that moment was doubly and trebly calculated to exasperate the fears of the religious and the pride of the patriotic. Mary was invited if not induced by the king of Spain to join his league for the suppression of Protestantism; while the actual or prospective endowment of Rizzio with Morton's office of chancellor, and the projected attainder of Murray and his allies, combined to inflame at once the anger and the apprehension of the Protestant nobles. According to one account, Darnley privately assured his uncle George Douglas of his wife's infidelity; he had himself, if he might be believed, discovered the secretary in the queen's apartment at midnight, under circumstances yet more unequivocally compromising than those which had brought Chastelard to the scaffold. Another version of the pitiful history represents Douglas as infusing suspicion of Rizzio into the empty mind of his nephew, and thus winning his consent to a deed already designed by others. A bond was drawn in which Darnley pledged himself to support the confederates who undertook to punish "certain privy persons" offensive to the state, "especially a strange Italian, called Davie"; another was subscribed by Darnley and the banished lords, then biding their time in Newcastle, which engaged him to procure their pardon and restoration, while pledging them to insure to him the enjoyment of the title he coveted, with the consequent security of an undisputed succession to the crown, despite the counter claims of the house of Hamilton, in case his wife should die without issue—a result which, intentionally or not, he and his fellow-conspirators did all that brutality could have suggested to accelerate and secure. On the 9th of March the palace of Holyrood was invested by a troop under the command of Morton, while Rizzio was dragged by force out of the queen's presence and slain without trial in the heat of the moment. The parliament was discharged by proclamation issued in the name of Darnley as king; and in the evening of the next day the banished lords, whom it was to have condemned to outlawry, returned to Edinburgh. On the day following they were graciously received by the queen, who undertook to sign a bond for their security, but delayed the subscription till next morning under plea of sickness. During the night she escaped with Darnley, whom she had already seduced from the party of his accomplices, and arrived at Dunbar on the third morning after the slaughter of her favourite. From thence they returned to Edinburgh on the 28th of March, guarded by two thousand horsemen under the command of Bothwell, who had escaped from Holyrood on the night of the murder, to raise a force on the queen's behalf with his usual soldierly promptitude. The slayers of Rizzio fled to England, and were outlawed; Darnley was permitted to protest his innocence and denounce his accomplices; after which he became the scorn of all parties alike, and few men dared or cared to be seen in his company. On the 19th of June a son was born to his wife, and in the face of his previous protestations he was induced to acknowledge himself the father. But, as Murray and his partisans returned to favour and influence no longer incompatible with that of Bothwell and Huntly, he grew desperate enough with terror to dream of escape to France. This design was at once frustrated by the queen's resolution. She summoned him to declare his reasons for it in presence of the French ambassador and an assembly of the nobles; she besought him for God's sake to speak out, and not spare her; and at last he left her presence with an avowal that he had nothing to allege. The favour shown to Bothwell had not yet given occasion for scandal, though his character as an adventurous libertine was as notable as his reputation for military hardihood; but as the summer advanced his insolence increased with his influence at court and the general aversion of his rivals. He was richly endowed by Mary from the greater and lesser spoils of the Church; and the three wardenships of the border, united for the first time in his person, gave the lord high admiral of Scotland a position of unequalled power. In the gallant discharge of its duties he was dangerously wounded by a leading outlaw, whom he slew in single combat; and while yet confined to Hermitage Castle he received a visit of two hours from the queen, who rode thither from Jedburgh and back through 20 miles of the wild borderland where her person was in perpetual danger from the freebooters whom her father's policy had striven and had failed to extirpate. The result of this daring ride was a ten days' fever, after which she removed by short stages to Craigmillar, where a proposal for her divorce from Darnley was laid before her by Bothwell, Murray, Huntly, Argyle and Lethington, who was chosen spokesman for the rest. She assented on condition that the divorce could be lawfully effected without impeachment of her son's legitimacy; whereupon Lethington undertook in the name of all present that she should be rid of her husband without any prejudice to the child—at whose baptism a few days afterwards Bothwell took the place of the putative father, though Darnley was actually residing under the same roof, and it was not till after the ceremony that he was suddenly struck down by a sickness so violent as to excite suspicions of poison. He was removed to Glasgow, and left for the time in charge of his father; but on the news of his progress towards recovery a bond was drawn up for execution of the sentence of death which had secretly been pronounced against the twice-turned traitor who had earned his doom at all hands alike. On the 22nd of the next month (Jan. 1567) the queen visited her husband at Glasgow and proposed to remove him to Craigmillar Castle, where he would have the benefit of medicinal baths; but instead of this resort he was conveyed on the last day of the month to the lonely and squalid shelter of the residence which was soon to be made memorable by his murder. Between the ruins of two sacred buildings, with the town-wall to the south and a suburban hamlet known to ill fame as the Thieves' Row to the north of it, a lodging was prepared for the titular king of Scotland, and fitted up with tapestries taken from the Gordons after the battle of Corrichie. On the evening of Sunday, the 9th of February, Mary took her last leave of the miserable boy who had so often and so mortally outraged her as consort and as queen. That night the whole city was shaken out of sleep by an explosion of gunpowder which shattered to fragments the building in which he should have slept and perished; and the next morning the bodies of Darnley and a page were found strangled in a garden adjoining it, whither they had apparently escaped over a wall, to be despatched by the hands of Bothwell's attendant confederates.

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[1] In a letter dated the 4th of April 1882, referring to the publication of his drama *Mary Stuart*, Swinburne wrote to Edmund Clarence Stedman: "*Mary Stuart* has procured me two satisfactions which I prefer infinitely to six columns of adulation in *The Times* and any profit thence resulting. (1) A letter from Sir Henry Taylor . . . (2) An application from the editor of the *Encyclopaedia Britannica*—who might, I suppose, as in Macaulay's time, almost command the services of the most eminent scholars and historians of the country—to me, a mere poet, proposing that I should contribute to that great repository of erudition the biography of Mary Queen of Scots. I doubt if the like compliment was ever paid before to one of our 'idle trade.'" The present article is the biography contributed by the poet to the 9th ed. in response to the invitation referred to in this letter.

Upon a view which may be taken of Mary's conduct during the next three months depends the whole debateable question of her character. According to the professed champions of that character, this conduct was a tissue of such dastardly imbecility, such heartless irresolution and such brainless inconsistency as for ever to dispose of her time-honoured claim to the credit of intelligence and courage. It is certain that just three months and six days after the murder of her husband she became the wife of her husband's murderer. On the 11th of February she wrote to the bishop of Glasgow, her ambassador in France, a brief letter of simple eloquence, announcing her providential escape from a design upon her own as well as her husband's life. A reward of two thousand pounds was offered by proclamation for discovery of the murderer. Bothwell and others, his satellites or the queen's, were instantly placarded by name as the criminals. Voices were heard by night in the streets of Edinburgh calling down judgment on the assassins. Four days after the discovery of the bodies, Darnley was buried in the chapel of Holyrood with secrecy as remarkable as the solemnity with which Rizzio had been interred there less than a year before. On the Sunday following, Mary left Edinburgh for Seton Palace, 12 miles from the capital, where scandal asserted that she passed the time merrily in shooting-matches with Bothwell for her partner against Lords Seton and Huntly; other accounts represent Huntly and Bothwell as left at Holyrood in charge of the infant prince. Gracefully and respectfully, with statesmanlike yet feminine dexterity, the demands of Darnley's father for justice on the murderers of his son were accepted and eluded by his daughter-in-law. Bothwell, with a troop of fifty men, rode through Edinburgh defiantly denouncing vengeance on his concealed accusers. As weeks elapsed without action on the part of the royal widow, while the cry of blood was up throughout the country, raising echoes from England and abroad, the murmur of accusation began to rise against her also. Murray, with his sister's ready permission, withdrew to France. Already the report was abroad that the queen was bent on marriage with Bothwell, whose last year's marriage with the sister of Huntly would be dissolved, and the assent of his wife's brother purchased by the restitution of his forfeited estates. According to the *Memoirs* of Sir James Melville, both Lord Herries and himself resolved to appeal to the queen in terms of bold and earnest remonstrance against so desperate and scandalous a design; Herries, having been met with assurances of its unreality and professions of astonishment at the suggestion, instantly fled from court; Melville, evading the danger of a merely personal protest without backers to support him, laid before Mary a letter from a loyal Scot long resident in England, which urged upon her consideration and her conscience the danger and disgrace of such a project yet more freely than Herries had ventured to do by word of mouth; but the sole result was that it needed all the queen's courage and resolution to rescue him from the violence of the man for whom, she was reported to have said, she cared not if she lost France, England and her own country, and would go with him to the world's end in a white petticoat before she would leave him. On the 28th of March the privy council, in which Bothwell himself sat, appointed the 12th of April as the day of his trial, Lennox, instead of the crown, being named as the accuser, and cited by royal letters to appear at "the humble request and petition of the said Earl Bothwell," who, on the day of the trial, had 4000 armed men behind him in the streets, while the castle was also at his command. Under these arrangements it was not thought wonderful that Lennox discreetly declined the danger of attendance, even with 3000 men ready to follow him, at the risk of desperate street fighting. He pleaded sickness, asked for more time, and demanded that the accused, instead of enjoying special favour, should share the treatment of other suspected criminals. But, as no particle of evidence on his side was advanced, the protest of his representative was rejected, and Bothwell, acquitted in default of witnesses against him, was free to challenge any persistent accuser to the ancient ordeal of battle. His wealth and power were enlarged by gift of the parliament which met on the 14th and rose on the 19th of April—a date made notable by the subsequent supper at Ainslie's tavern, where Bothwell obtained the signatures of its leading members to a document affirming his innocence, and pledging the subscribers to maintain it against all challengers, to stand by him in all his quarrels and finally to promote by all means in their power the marriage by which they recommended the queen to reward his services and benefit the country. On the second day following Mary went to visit her child at Stirling, where his guardian, the earl of Mar, refused to admit more than two women in her train. It was well known in Edinburgh that Bothwell had a body of men ready to intercept her on the way back, and carry her to Dunbar—not, as was naturally inferred, without good assurance of her consent. On the 24th of April, as she approached Edinburgh, Bothwell accordingly met her at the head of 800 spearmen, assured her (as she afterwards averred) that she was in the utmost peril, and escorted her, together with Huntly, Lethington and Melville, who were then in attendance, to Dunbar Castle. On the 3rd of May Lady Jane Gordon, who had become countess of Bothwell on the 22nd of February of the year preceding, obtained, on the ground of her husband's infidelities, a separation which, however, would not under the old laws of Catholic Scotland have left him free to marry again; on the 7th, accordingly, the necessary divorce was pronounced, after two days' session, by a clerical tribunal which ten days before had received from the queen a special commission to give judgment on a plea of somewhat apocryphal consanguinity alleged by Bothwell as the ground of an action for divorce against his wife. The fact was studiously evaded or concealed that a dispensation had been granted by the archbishop of St Andrews for this irregularity, which could only have arisen through some illicit connexion of the husband with a relative of the wife between whom and himself no affinity by blood or marriage could be proved. On the day when the first or Protestant divorce was pronounced, Mary and Bothwell returned to Edinburgh with every prepared appearance of a peaceful triumph. Lest her captivity should have been held to invalidate the late legal proceedings in her name, proclamation was made of forgiveness accorded by the queen to her captor in consideration of his past and future services, and her intention was announced to reward them by further promotion; and on the same day (May 12), he was duly created duke of Orkney and Shetland. The duke, as a conscientious Protestant, refused to marry his mistress according to the rites of her Church, and she, the chosen champion of its cause, agreed to be married to him, not merely by a Protestant but by one who before his conversion had been a Catholic bishop, and should therefore have been more hateful and contemptible in her eyes than any ordinary heretic, had not religion as well as policy, faith as well as reason, been absorbed or superseded by some more mastering passion or emotion. This passion or emotion, according to those who deny her attachment to Bothwell, was simply terror—the blind and irrational prostration of an abject spirit before the cruel force of circumstances and the crafty wickedness of men. Hitherto, according to all evidence, she had shown herself on all occasions, as on all subsequent occasions she indisputably showed herself, the most fearless, the most keen-sighted, the most ready-witted, the most high-gifted and high-spirited of women; gallant and generous, skilful and practical, never to be cowed by fortune, never to be cajoled by craft; neither more unselfish in her ends nor more unscrupulous in her practice than might have been expected from her training and her creed. But at the crowning moment of trial there are those who assert their belief that the woman who on her way to the field of Corrichie had uttered her wish to be a man, that she might know all the hardship and all the enjoyment of a soldier's life, riding forth "in jack and knapscull"—the woman who long afterwards was to hold her own for two days together without help of counsel against all the array of English law and English statesmanship, armed with irrefragable evidence and supported by the resentment of a nation—showed herself equally devoid of moral and of physical resolution; too senseless to realize the significance and too heartless to face the danger of a situation from which the simplest exercise of reason, principle or courage must have rescued the most unsuspicious and inexperienced of honest women who was not helplessly deficient in self-reliance and self-respect. The famous correspondence produced next year in evidence against her at the conference of York may have been, as her partisans affirm, so craftily garbled and falsified by interpolation, suppression, perversion, c absolute forgery as to be all but historically worthless. Its acceptance or its rejection does not in any degree whatever affect, for better or for worse, the rational estimate of her character. The problem presented by the simple existence of the facts just summed up remains in either case absolutely the same.

That the coarse and imperious nature of the hardy and able ruffian who had now become openly her master should no less openly have shown itself even in the first moments of their inauspicious union is what any bystander of common insight must inevitably have foreseen. Tears, dejection and passionate expressions of a despair "wishing only for death," bore fitful and variable witness to her first sense of a heavier yoke than yet had galled her spirit and her pride. At other times her affectionate gaiety would give evidence as trustworthy of a fearless and improvident satisfaction. They rode out in state together, and if he kept cap in hand as a subject she would snatch it from him and clap it on his head again; while in graver things she took all due or possible care to gratify his ambition, by the insertion of a clause in their contract of marriage which made their joint signature necessary to all documents of state issued under the sign-manual. She despatched to France a special envoy, the bishop of Dumblane, with instructions setting forth at length the unparalleled and hitherto ill-requited services and merits of Bothwell, and the necessity of compliance at once with his passion and with the unanimous counsel of the nation—a people who would endure the rule of no foreign consort, and whom none of their own countrymen were so competent to control, alike by wisdom and by valour, as the incomparable subject of her choice. These personal merits and this political necessity were the only pleas advanced in a letter to her ambassador in England. But that neither plea would avail her for a moment in Scotland she had ominous evidence on the thirteenth day after her marriage, when no response was made to the usual form of proclamation for a raid or levy of forces under pretext of a campaign against the rievers of the border. On the 6th or 7th of June Mary and Bothwell took refuge in Borthwick Castle, twelve miles from the capital, where the fortress was in the keeping of an adherent whom the diplomacy of Sir James Melville had succeeded in detaching from his allegiance to Bothwell. The fugitives were pursued and beleaguered by the earl of Morton and Lord Hume, who declared their purpose to rescue the queen from the thraldom of her husband. He escaped, leaving her free to follow him or to join the party of her professed deliverers. But whatever cause she might have found since marriage to complain of his rigorous custody and domineering brutality was insufficient to break the ties by which he held her. Alone, in the disguise of a page, she slipped out of the castle at midnight, and rode off to meet him at a tower two miles distant, whence they fled together to Dunbar. The confederate lords on entering Edinburgh were welcomed by the citizens, and after three hours' persuasion Lethington, who had now joined them, prevailed on the captain of the castle to deliver it also into their hands. Proclamations were issued in which the crime of Bothwell was denounced, and the disgrace of the country, the thraldom of the queen and the mortal peril of her infant son, were set forth as reasons for summoning all the lieges of the chief cities of Scotland to rise in arms on three hours' notice and join the forces assembled against the one common enemy. News of his approach reached them on the night of June 14, and they marched before dawn with 2200 men to meet him near Musselburgh. Mary meanwhile had passed from Dunbar to Haddington, and thence to Seton, where 1600 men rallied to her side. On the 15th of June, one month from their marriage day, the queen and Bothwell, at the head of a force of fairly equal numbers but visibly inferior discipline, met the army of the confederates at Carberry Hill, some six miles from Edinburgh. Du Croc, the French ambassador, obtained permission through the influence of Maitland to convey to the queen the terms proposed by their leaders—that she and Bothwell should part, or that he should meet in single combat a champion chosen from among their number. Bothwell offered to meet any man of sufficient quality; Mary would not assent. As the afternoon wore on their force began to melt away by desertion and to break up for lack of discipline. Again the trial by single combat was proposed, and thrice the proposal fell through, owing to objections on this side or on that. At last it was agreed that the queen should yield herself prisoner, and Bothwell be allowed to retire in safety to Dunbar with the few followers who remained to him. Mary took leave of her first and last master with passionate anguish and many parting kisses; but in face of his enemies, and in hearing of the cries which burst from the ranks, demanding her death by fire as a murderess and harlot, the whole heroic and passionate spirit of the woman, represented by her admirers as a spiritless imbecile, flamed out in responsive threats to have all the men hanged and crucified, in whose power she now stood helpless and alone. She grasped the hand of Lord Lindsay as he rode beside her, and swore "by this hand" she would "have his head for this." In Edinburgh she was received by a yelling mob, which flaunted before her at each turn a banner representing the corpse of Darnley with her child beside it invoking on his knees the retribution of divine justice. From the violence of a multitude in which women of the worst class were more furious than the men she was sheltered in the house of the provost, where she repeatedly showed herself at the window, appealing aloud with dishevelled hair and dress to the mercy which no man could look upon her and refuse. At nine in the evening she was removed to Holyrood, and thence to the port of Leith, where she embarked under guard, with her attendants, for the island castle of Lochleven. On the 20th a silver casket containing letters and French verses, miscalled sonnets, in the handwriting of the queen, was taken from the person of a servant who had been sent by Bothwell to bring it from Edinburgh to Dunbar. Even in the existing versions of the letters, translated from the lost originals and retranslated from this translation of a text which was probably destroyed in 1603 by order of King James on his accession to the English throne—even in these possibly disfigured versions, the fiery pathos of passion, the fierce and piteous fluctuations of spirit between love and hate, hope and rage and jealousy, have an eloquence apparently beyond the imitation or invention of art (see CASKET LETTERS[1]). Three days after this discovery Lord Lindsay, Lord Ruthven and Sir Robert Melville were despatched to Lochleven, there to obtain the queen's signature to an act of abdication in favour of her son, and another appointing Murray regent during his minority. She submitted, and a commission of regency was established till the return from France of Murray, who, on the 15th of August, arrived at Lochleven with Morton and Athole. According to his own account, the expostulations as to her past conduct which preceded his admonitions for the future were received with tears, confessions and attempts at extenuation or excuse; but when they parted next day on good terms she had regained her usual spirits. Nor from that day forward had they reason to sink again, in spite of the close keeping in which she was held, with the daughters of the house for bedfellows. Their mother and the regent's, her father's former mistress, was herself not impervious to her prisoner's lifelong power of seduction and subjugation. Her son George Douglas fell inevitably under the charm. A rumour transmitted to England went so far as to assert that she had proposed him to their common half-brother Murray as a fourth husband for herself; a later tradition represented her as the mother of a child by him. A third report, at least as improbable as either, asserted that a daughter of Mary and Bothwell, born about this time, lived to be a nun in France. It is certain that the necessary removal of George Douglas from Lochleven enabled him to devise a method of escape for the prisoner on the 25th of March, 1568, which was frustrated by detection of her white hands under the disguise of a laundress. But a younger member of the household, Willie Douglas, aged eighteen, whose devotion was afterwards remembered and his safety cared for by Mary at a time of utmost risk and perplexity to herself, succeeded on the 2nd of May in assisting her to escape by a postern gate to the lake-side, and thence in a boat to the mainland, where George Douglas, Lord Seton and others were awaiting her. Thence they rode to Seton's castle of Niddry, and next day to Hamilton palace, round which an army of 6000 men was soon assembled, and whither the new French ambassador to Scotland hastened to pay his duty. The queen's abdication was revoked, messengers were despatched to the English and French courts, and word was sent to Murray at Glasgow that he must resign the regency, and should be pardoned in common with all offenders against the queen. But on the day when Mary arrived at Hamilton Murray had summoned to Glasgow the feudatories of the Crown to take arms against the insurgent enemies of the infant king. Elizabeth sent conditional offers of help to her kinswoman, provided she would accept of English intervention and abstain from seeking foreign assistance; but the messenger came too late. Mary's followers had failed to retake Dunbar Castle from the regent, and made for Dumbarton instead, marching two miles south of Glasgow, by the village of Langside. Here Murray, with 4500 men, under leaders of high distinction, met the 6000 of the queen's army, whose ablest man, Herries, was as much distrusted by Mary as by every one else, while the Hamiltons could only be trusted to think of their own interests, and were suspected of treasonable designs on all who stood between their house and the monarchy. On the 13th of May the battle or skirmish of Langside determined the result of the campaign in three-quarters of an hour. Kirkaldy of Grange, who commanded the regent's cavalry, seized and kept the place of vantage from the beginning, and at the first sign of wavering on the other side shattered at a single charge the forces of the queen with a loss of one man to three hundred. Mary fled 60 miles from the field of her last battle before she halted at Sanquhar, and for three days of flight, according to her own account, had to sleep on the hard ground, live on oatmeal and sour milk, and fare at night like the owls, in hunger, cold and fear. On the third day from the rout of Langside she crossed the Solway and landed at Workington in Cumberland, May 16, 1568. On the 20th Lord Scrope and Sir Francis Knollys were sent from court to carry messages and letters of comfort from Elizabeth to Mary at Carlisle. On the 11th of June Knollys wrote to Cecil at once the best description and the noblest panegyric extant of the queen of Scots—enlarging, with a brave man's sympathy, on her indifference to form and ceremony, her daring grace and openness of manner, her frank display of a great desire to be avenged of her enemies, her readiness to expose herself to all perils in hope of victory, her delight to hear of hardihood and courage, commending by name all her enemies of approved valour, sparing no cowardice in her friends, but above all things athirst for victory by any means at any price, so that for its sake pain and peril seemed pleasant to her, and wealth and all things, if compared with it, contemptible and vile. What was to be done with such a princess, whether she were to be nourished in one's bosom, above all whether it could be advisable or safe to try any diplomatic tricks upon such a lady, Knollys left for the minister to judge. It is remarkable that he should not have discovered in her the qualities so obvious to modern champions of her character—easiness, gullibility, incurable innocence and invincible ignorance of evil, incapacity to suspect or resent anything, readiness to believe and forgive all things. On the 15th of July, after various delays interposed by her reluctance to leave the neighbourhood of the border, where on her arrival she had received the welcome and the homage of the leading Catholic houses of Northumberland and Cumberland, she was removed to Bolton Castle in North Yorkshire. During her residence here a conference was held at York between her own and Elizabeth's commissioners and those appointed to represent her son as a king of Scots. These latter, of whom Murray himself was the chief, privately laid before the English commissioners the contents of the famous casket. On the 24th of October the place of the conference was shifted from York to London, where the inquiry was to be held before Queen Elizabeth in council. Mary was already aware that the chief of the English commissioners, the duke of Norfolk, was secretly an aspirant to the peril of her hand; and on the 21st of October she gave the first sign of assent to the suggestion of a divorce from Bothwell. On the 26th of October the charge of complicity in the murder of Darnley was distinctly brought forward against her in spite of Norfolk's reluctance and Murray's previous hesitation. Elizabeth, by the mouth of her chief justice, formally rebuked the audacity of the subjects who durst bring such a charge against their sovereign, and challenged them to advance their proofs. They complied by the production of an indictment under five heads, supported by the necessary evidence of documents. The number of English commissioners was increased, and they were bound to preserve secrecy as to the matters revealed. Further evidence was supplied by Thomas Crawford, a retainer of the house of Lennox, tallying so exactly with the text of the casket letters as to have been cited in proof that the latter must needs be a forgery. Elizabeth, on the close of the evidence, invited Mary to reply to the proofs alleged before she could be admitted to her presence; but Mary simply desired her commissioners to withdraw from the conference. She declined with scorn the proposal made by Elizabeth through Knollys, that she should sign a second abdication in favour of her son. On the 10th of January, 1569, the judgment given at the conference acquitted Murray and his adherents of rebellion, while affirming that nothing had been proved against Mary—a verdict accepted by Murray as equivalent to a practical recognition of his office as regent for the infant king. This position he was not long to hold; and the fierce exultation of Mary at the news of his murder gave to those who believed in her complicity with the murderer, on whom a pension was bestowed by her unblushing gratitude, fresh reason to fear, if her liberty of correspondence and intrigue were not restrained, the likelihood of a similar fate for Elizabeth. On the 26th of January 1569 she had been removed from Bolton Castle to Tutbury in Staffordshire, where proposals were conveyed to her, at the instigation of Leicester, for a marriage with the duke of Norfolk, to which she gave a graciously conditional assent; but the discovery of these proposals consigned Norfolk to the Tower, and on the outbreak of an insurrection in the north Mary, by Lord Hunsdon's advice, was again removed to Coventry, when a body of her intending deliverers was within a day's ride of Tutbury. On the 23rd of January following Murray was assassinated; and a second northern insurrection was crushed in a single sharp fight by Lord Hunsdon. In October Cecil had an interview with Mary at Chatsworth, when the conditions of her possible restoration to the throne in compliance with French demands were debated at length. The queen of Scots, with dauntless dignity, refused to yield the castles of Edinburgh and Dumbarton into English keeping, or to deliver up her fugitive English partisans then in Scotland; upon other points they came to terms, and the articles were signed the 16th of October. On the same day Mary wrote to Elizabeth, requesting with graceful earnestness the favour of an interview which might reassure her against the suggestion that this treaty was a mere pretence. On the 28th of November she was removed to Sheffield Castle, where she remained for the next fourteen years in charge of the earl of Shrewsbury. The detection of a plot, in which Norfolk was implicated, for the invasion of England by Spain on behalf of Mary, who was then to take him as the fourth and most contemptible of her husbands, made necessary the reduction of her household and the stricter confinement of her person. On the 28th of May 1572 a demand from both houses of parliament for her execution as well as Norfolk's was generously rejected by Elizabeth; but after the punishment of the traitorous pretender to her hand, on whom she had lavished many eloquent letters of affectionate protestation, she fell into "a passion of sickness" which convinced her honest keeper of her genuine grief for the ducal caitiff. A treaty projected on the news of the massacre of St Bartholomew, by which Mary should be sent back to Scotland for immediate execution, was broken off by the death of the earl of Mar, who had succeeded Lennox as regent; nor was it found possible to come to acceptable terms on a like understanding with his successor Morton, who in 1577 sent a proposal to Mary for her restoration, which she declined, in suspicion of a plot laid to entrap her by the policy of Sir Francis Walsingham, the most unscrupulously patriotic of her English enemies, who four years afterwards sent word to Scotland that the execution of Morton, so long the ally of England, would be answered by the execution of Mary. But on that occasion Elizabeth again refused her assent either to the trial of Mary or to her transference from Sheffield to the Tower. In 1581 Mary accepted the advice of Catherine de' Medici and Henry III. that she should allow her son's title to reign as king of Scotland conjointly with herself when released and restored to a share of the throne. This plan was but part of a scheme including the invasion of England by her kinsman the duke of Guise, who was to land in the north and raise a Scottish army to place the released prisoner of Sheffield beside her son on the throne of Elizabeth. After the overthrow of the Scottish accomplices in this notable project, Mary poured forth upon Elizabeth a torrent of pathetic and eloquent reproach for the many wrongs she had suffered at the hands of her hostess, and pledged her honour to the assurance that she now aspired to no kingdom but that of heaven. In the spring of 1583 she retained enough of this saintly resignation to ask for nothing but liberty, without a share in the government of Scotland; but Lord Burghley not unreasonably preferred, if feasible, to reconcile the alliance of her son with the detention of his mother. In 1584 the long-suffering earl of Shrewsbury was relieved of his fourteen years' charge through the involuntary good offices of his wife, whose daughter by her first husband had married a brother of Darnley; and their orphan child Arabella, born in England, of royal descent on the father's side, was now, in the hopeful view of her grandmother, a more plausible claimant than the king or queen of Scots to the inheritance of the English throne. In December 1583 Mary had laid before the French ambassador her first complaint of the slanders spread by Lady Shrewsbury and her sons, who were ultimately compelled to confess the falsehood of their imputations on the queen of Scots and her keeper. It was probably at the time when a desire for revenge on her calumniatress made her think the opportunity good and safe for discharge of such a two-edged dart at the countess and the queen that Mary wrote, but abstained from despatching, the famous and terrible letter in which, with many gracious excuses and professions of regret and attachment, she transmits to Elizabeth a full and vivid report of the hideous gossip retailed by Bess of Hardwick regarding her character and person at a time when the reporter of these abominations was on friendly terms with her husband's royal charge. In the autumn of 1584 she was removed to Wingfield Manor under charge of Sir Ralph Sadler and John Somers, who accompanied her also on her next removal to Tutbury in January 1585. A letter received by her in that cold, dark and unhealthy castle, of which fifteen years before she had made painful and malodorous experience, assured her that her son would acknowledge her only as queen-mother, and provoked at once the threat of a parent's curse and an application to Elizabeth for sympathy. In April 1585 Sir Amyas Paulet was appointed to the office of which Sadler, accused of careless indulgence, had requested to be relieved; and on Christmas Eve she was removed from the hateful shelter of Tutbury to the castle of Chartley in the same county. Her correspondence in cipher from thence with her English agents abroad, intercepted by Walsingham and deciphered by his secretary, gave eager encouragement to the design for a Spanish invasion of England under the prince of Parma,—an enterprise in which she would do her utmost to make her son take part, and in case of his refusal would induce the Catholic nobles of Scotland to betray him into the hands of Philip, from whose tutelage he should be released only on her demand, or if after her death he should wish to return, nor then unless he had become a Catholic. But even these patriotic and maternal schemes to consign her child and re-consign the kingdom to the keeping of the Inquisition, incarnate in the widower of Mary Tudor, were superseded by the attraction of a conspiracy against the throne and life of Elizabeth. Anthony Babington, in his boyhood a ward of Shrewsbury, resident in the household at Sheffield Castle, and thus subjected to the charm before which so many victims had already fallen, was now induced to undertake the deliverance of the queen of Scots by the murder of the queen of England. It is maintained by those admirers of Mary who assume her to have been an almost absolute imbecile, gifted with the power of imposing herself on the world as a woman of unsurpassed ability, that, while cognisant of the plot for her deliverance by English rebels and an invading army of foreign auxiliaries, she might have been innocently unconscious that this conspiracy involved the simultaneous assassination of Elizabeth. In the conduct and detection of her correspondence with Babington, traitor was played off against traitor, and spies were utilized against assassins, with as little scruple as could be required or expected in the diplomacy of the time. As in the case of the casket letters, it is alleged that forgery was employed to interpolate sufficient evidence of Mary's complicity in a design of which it is thought credible that she was kept in ignorance by the traitors and murderers who had enrolled themselves in her service,—that one who pensioned the actual murderer of Murray and a would-be murderer of Elizabeth was incapable of approving what her keen and practised intelligence was too blunt and torpid to anticipate as inevitable and inseparable from the general design. In August the conspirators were netted, and Mary was arrested at the gate of Tixall Park, whither Paulet had taken her under pretence of a hunting party. At Tixall she was detained till her papers at Chartley had undergone thorough research. That she was at length taken in her own toils even such a dullard as her admirers depict her could not have failed to understand; that she was no such dastard as to desire or deserve such defenders the whole brief course of her remaining life bore consistent and irrefragable witness. Her first thought on her return to Chartley was one of loyal gratitude and womanly sympathy. She cheered the wife of her English secretary, now under arrest, with promises to answer for her husband to all accusations brought against him, took her new-born child from the mother's arms, and in default of clergy baptized it, to Paulet's Puritanic horror, with her own hands by her own name. The next or the twin-born impulse of her indomitable nature was, as usual in all times of danger, one of passionate and high-spirited defiance on discovering the seizure of her papers. A fortnight afterwards her keys and her money were confiscated, while she, bedridden and unable to move her hand, could only ply the terrible weapon of her bitter and fiery tongue. Her secretaries were examined in London, and one of them gave evidence that she had first heard of the conspiracy by letter from Babington, of whose design against the life of Elizabeth she thought it best to take no notice in her reply, though she did not hold herself bound to reveal it. On the 25th of September she was removed to the strong castle of Fotheringay in Northamptonshire. On the 6th of October she was desired by letter from Elizabeth to answer the charges brought against her before certain of the chief English nobles appointed to sit in commission on the cause. In spite of her first refusal to submit, she was induced by the arguments of the vice-chamberlain, Sir Christopher Hatton, to appear before this tribunal on condition that her protest should be registered against the legality of its jurisdiction over a sovereign, the next heir of the English crown.

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[1] It is to be observed that the above conclusion as to the authenticity of the Casket Letters is the same as that arrived at upon different grounds by the most recent research on the subject.—ED. E. B.

On the 14th and 15th of October 1586 the trial was held in the hall of Fotheringay Castle. Alone, "without one counsellor on her side among so many," Mary conducted the whole of her own defence with courage incomparable and unsurpassable ability. Pathos and indignation, subtlety and simplicity, personal appeal and political reasoning, were the alternate weapons with which she fought against all odds of evidence or inference, and disputed step by step every inch of debatable ground. She repeatedly insisted on the production of proof in her own handwriting as to her complicity with the project of the assassins who had expiated their crime on the 20th and 21st of the month preceding. When the charge was shifted to the question of her intrigues with Spain, she took her stand resolutely on her own right to convey whatever right she possessed, though now no kingdom was left her for disposal, to whomsoever she might choose. One single slip she made in the whole course of her defence; but none could have been more unluckily characteristic and significant. When Burghley brought against her the unanswerable charge of having at that moment in her service, and in receipt of an annual pension, the instigator of a previous attempt on the life of Elizabeth, she had the unwary audacity to cite in her justification the pensions allowed by Elizabeth to her adversaries in Scotland, and especially to her son. It is remarkable that just two months later, in a conversation with her keepers, she again made use of the same extraordinary argument in reply to the same inevitable imputation, and would not be brought to admit that the two cases were other than parallel. But except for this single instance of oversight or perversity her defence was throughout a masterpiece of indomitable ingenuity, of delicate and steadfast courage, of womanly dignity and genius. Finally she demanded, as she had demanded before, a trial either before the estates of the realm lawfully assembled or else before the queen in council. So closed the second day of the trial; and before the next day's work could begin a note of two or three lines hastily written at midnight informed the commissioners that Elizabeth had suddenly determined to adjourn the expected judgment and transfer the place of it to the star-chamber. Here, on the 25th of October, the commissioners again met; and one of them alone, Lord Zouch, dissented from the verdict by which Mary was found guilty of having, since the 1st of June preceding, compassed and imagined divers matters tending to the destruction of Elizabeth. This verdict was conveyed to her, about three weeks later, by Lord Buckhurst and Robert Beale, clerk of the privy council. At the intimation that her life was an impediment to the security of the received religion, "she seemed with a certain unwonted alacrity to triumph, giving God thanks, and rejoicing in her heart that she was held to be an instrument" for the restoration of her own faith. This note of exultation as in martyrdom was maintained with unflinching courage to the last. She wrote to Elizabeth and the duke of Guise two letters of almost matchless eloquence and pathos, admirable especially for their loyal and grateful remembrance of all her faithful servants. Between the date of these letters and the day of her execution wellnigh three months of suspense elapsed. Elizabeth, fearless almost to a fault in face of physical danger, constant in her confidence even after discovery of her narrow escape from the poisoned bullets of household conspirators, was cowardly even to a crime in face of subtler and more complicated peril. She rejected with resolute dignity the intercession of French envoys for the life of the queen-dowager of France; she allowed the sentence of death to be proclaimed and welcomed with bonfires and bell-ringing throughout the length of England; she yielded a respite of twelve days to the pleading of the French ambassador, and had a charge trumped up against him of participation in a conspiracy against her life; at length, on the 1st of February 1587, she signed the death-warrant, and then made her secretaries write word to Paulet of her displeasure that in all this time he should not of himself have found out some way to shorten the life of his prisoner, as in duty bound by his oath, and thus relieve her singularly tender conscience from the guilt of bloodshed. Paulet, with loyal and regretful indignation, declined the disgrace proposed to him in a suggestion "to shed blood without law or warrant"; and on the 7th of February the earls of Shrewsbury and Kent arrived at Fotheringay with the commission of the council for execution of the sentence given against his prisoner. Mary received the announcement with majestic tranquillity, expressing in dignified terms her readiness to die, her consciousness that she was a martyr for her religion, and her total ignorance of any conspiracy against the life of Elizabeth. At night she took a graceful and affectionate leave of her attendants, distributed among them her money and jewels, wrote out in full the various legacies to be conveyed by her will, and charged her apothecary Gorion with her last messages for the king of Spain. In these messages the whole nature of the woman was revealed. Not a single friend, not a single enemy, was forgotten; the slightest service, the slightest wrong, had its place assigned in her faithful and implacable memory for retribution or reward. Forgiveness of injuries was as alien from her fierce and loyal spirit as forgetfulness of benefits; the destruction of England and its liberties by Spanish invasion and conquest was the strongest aspiration of her parting soul. At eight next morning she entered the hall of execution, having taken leave of the weeping envoy from Scotland, to whom she gave a brief message for her son; took her seat on the scaffold, listened with an air of even cheerful unconcern to the reading of her sentence, solemnly declared her innocence of the charge conveyed in it and her consolation in the prospect of ultimate justice, rejected the professional services of Richard Fletcher, dean of Peterborough, lifted up her voice in Latin against his in English prayer, and when he and his fellow-worshippers had fallen duly silent prayed aloud for the prosperity of her own church, for Elizabeth, for her son, and for all the enemies whom she had commended overnight to the notice of the Spanish invader; then, with no less courage than had marked every hour and every action of her life, received the stroke of death from the wavering hand of the headsman.

Mary Stuart was in many respects the creature of her age, of her creed, and of her station; but the noblest and most noteworthy qualities of her nature were independent of rank, opinion or time. Even the detractors who defend her conduct on the plea that she was a dastard and a dupe are compelled in the same breath to retract this implied reproach, and to admit, with illogical acclamation and incongruous applause, that the world never saw more splendid courage at the service of more brilliant intelligence, that a braver if not "a rarer spirit never did steer humanity." A kinder or more faithful friend, a deadlier or more dangerous enemy, it would be impossible to dread or to desire. Passion alone could shake the double fortress of her impregnable heart and ever-active brain. The passion of love, after very sufficient experience, she apparently and naturally outlived; the passion of hatred and revenge was as inextinguishable in her inmost nature as the emotion of loyalty and gratitude. Of repentance it would seem that she knew as little as of fear, having been trained from her infancy in a religion where the Decalogue was supplanted by the Creed. Adept as she was in the most exquisite delicacy of dissimulation, the most salient note of her original disposition was daring rather than subtlety. Beside or behind the voluptuous or intellectual attractions of beauty and culture, she had about her the fresher charm of a fearless and frank simplicity, a genuine and enduring pleasure in small and harmless things no less than in such as were neither. In 1562 she amused herself for some days by living "with her little troop" in the house of a burgess of St Andrews "like a burgess's wife," assuring the English ambassador that he should not find the queen there,—"nor I know not myself where she is become." From Sheffield Lodge, twelve years later, she applied to the archbishop of Glasgow and the cardinal of Guise for some pretty little dogs, to be sent her in baskets very warmly packed,—"for besides reading and working, I take pleasure only in all the little animals that I can get." No lapse of reconciling time, no extent of comparative indulgence, could break her in to resignation, submission, or toleration of even partial restraint. Three months after the massacre of St Bartholomew had caused some additional restrictions to be placed upon her freedom of action, Shrewsbury writes to Burghley that "rather than continue this imprisonment she sticks not to say she will give her body, her son, and country for liberty"; nor did she ever show any excess of regard for any of the three. For her own freedom of will and of way, of passion and of action, she cared much; for her creed she cared something; for her country she cared less than nothing. She would have flung Scotland with England into the hell fire of Spanish Catholicism rather than forgo the faintest chance of personal revenge. Her profession of a desire to be instructed in the doctrines of Anglican Protestantism was so transparently a pious fraud as rather to afford confirmation than to arouse suspicion of her fidelity to the teaching of her church. Elizabeth, so shamefully her inferior in personal loyalty, fidelity and gratitude, was as clearly her superior on the one all-important point of patriotism. The saving salt of Elizabeth's character, with all its wellnigh incredible mixture of heroism and egotism, meanness and magnificence, was simply this, that, overmuch as she loved herself, she did yet love England better. Her best though not her only fine qualities were national and political, the high public virtues of a good public servant; in the private and personal qualities which attract and attach a friend to his friend and a follower to his leader, no man or woman was ever more constant and more eminent than Mary Queen of Scots. (A. C. S.)

Bibliography.—The biography of Mary Stuart being virtually the history of Scotland during the period covered by her life, with which the history of England at the same period is also largely concerned, the chief events in which she figured are related in all the general *Histories* of both countries. The most important original authorities are the voluminous *State Papers* of the period, with other MS. documents preserved at the British Museum, the Cambridge University Library, Hatfield and elsewhere. See especially the *Reports* of the Hist. MSS. Commission; *Calendar of State Papers relating to Scotland and Mary Queen of Scots* (Scottish Record Publ. 1898); *Calendar of Letters and State Papers relating to English Affairs, principally in the Archives at Simancas* (vols. i.–iv., 1392–1899); and the *Calendars of State Papers: Domestic Series, Edw. VI.–James I.; Foreign Series, Elizabeth; Venice Series.* The most important unofficial contemporary works are the *Histories* of John Knox, Bishop John Lesley, George Buchanan, and Robert Lindsay of Pitscottie; the *Diurnal of Remarkable Occurrents from the death of James IV. till 1575* (Bannatyne Club, 1833); Robert Birrell's "Diary" in Sir J. G. Dalzell's *Fragments of Scottish History* (Edinburgh, 1798); *History of Mary Stuart*, by her secretary Claude Nau, ed. by J. Stevenson (Edinburgh, 1883); Sir James Melville's *Memoirs of his own Life* (Bannatyne Club, 1827); Richard Bannatyne, *Memoriales of Transactions in Scotland* (Edinburgh, 1836); William Camden's *Annales* (Eng. trans., London, 1635); Michel de Castelnau's *Mémoires* (Brussels, 1731); the *Mémoires* of Brantôme (ed. by L. Lalanne, 12 vols., Paris, 1864–1896); *Relations politiques de la France et de l'Espagne avec l'Ecosse au 16e siècle* (ed. by J. B. A. Teulet, 5 vols., Paris, 1862), containing important original letters and documents; Thomas Wright's *Queen Elizabeth and her Times* (2 vols., London, 1838), consists of private letters of Elizabethan statesmen many of which refer to Mary Stuart, and others are to be found in Sir Henry Ellis's *Original Letters illustrative of English History* (London, 1825–1846); much of Mary's own correspondence will be found in Prince A. Labanoff's *Lettres inédites, 1558–1587* (Paris, 1839), and *Lettres, instructions, et mémoires de Marie Stuart* (7 vols., London, 1844), selections from which have been translated into English by W. Turnbull in *Letters of Mary Queen of Scots* (London, 1845), and by Agnes Strickland in *Letters of Mary Queen of Scots and Documents connected with her Personal History* (3 vols., London, 1842).

Among authorities not actually contemporary but written within a century of Mary's death are David Calderwood's *Hist. of the Kirk of Scotland* (8 vols., Edinburgh, 1842–1849); Archbishop Spottiswoode's *Hist. of the Church of Scotland* (ed. by M. Russell, 3 vols., Edinburgh, 1847–1851), and Robert Keith's *Hist. of Affairs of Church and State in Scotland* (Spottiswoode Society ed., 1844); to which should be added the modern classic, George Grub's *Ecclesiastical History of Scotland* (4 vols., Edinburgh, 1861).

Of modern general histories those of chief importance on the subject are the *Histories of England* by Hume, Lingard and Froude; and the *Histories of Scotland* by Robertson, P. F. Tytler, John Hill Burton, Malcolm Laing and Andrew Lang. Numerous biographies of Mary Stuart have been published, as well as essays and treatises dealing with particular episodes in her life, of which the most worthy of mention are: George Chalmers, *Life of Mary Queen of Scots*, (2 vols., London, 1818); Henry Glassford Bell, *Life of Mary Queen of Scots* (2 vols., Edinburgh, 1828–1831); the "Life" in Agnes Strickland's *Lives of the Queens of Scotland* (8 vols., Edinburgh, 1850); J. D. Leader, *Mary Queen of Scots in Captivity* (Sheffield, 1880); Colin Lindsay, *Mary Queen of Scots and her Marriage with Bothwell* (London, 1883); Mrs Maxwell-Scott, *The Tragedy of Fotheringay* (London, 1895); F. A. M. Mignet, *Histoire de Marie Stuart* (2 vols., Brussels, 1851); Martin Philippson, *Histoire du règne de Marie Stuart* (3 vols., Paris, 1891); Sir John Skelton, *Mary Stuart* (London, 1893), *Maitland of Lethington and the Scotland of Mary Stuart* (2 vols., Edinburgh, 1887), *The Impeachment of Mary Stuart* (Edinburgh, 1878), and *Essays in History and Biography, including the Defence of Mary Stuart* (Edinburgh, 1883); Joseph Stevenson, *Mary Stuart: The First Eighteen Years of her Life* (Edinburgh, 1886); D. Hay Fleming, *Mary Stuart* (2nd ed. 1898); Jane Stoddart, *Girlhood of Mary Queen of Scots.*

With special reference to the controversy concerning the Casket Letters, in addition to the article Casket Letters and the above-mentioned works by Sir John Skelton, the following should be consulted: Walter Goodall, *Examination of the Letters said to be written by Mary Queen of Scots to Bothwell* (2 vols., Edinburgh, 1754), which contains the letters themselves; William Tytler, *Inquiry into the Evidence against Mary Queen of Scots* (2 vols., London, 1790); John Whitaker, *Mary Queen of Scots Vindicated* (3 vols., London, 1788); F. de Peyster, *Mary Stuart, Bothwell and the Casket Letters* (London, 1890); T. F. Henderson, *The Casket Letters and Mary Queen of Scots* (Edinburgh, 1889); Andrew Lang, *The Mystery of Mary Stuart* (London, 1900).

In 1690 Giovanni Francesco Savaro published a play *La Maria Stuarda*, and since then the story of the Queen of Scots has been the subject of numerous poems and dramas, of which the most celebrated are Schiller's *Maria Stuart*, and three tragedies by A. C. Swinburne—*Chastelard* (1865), *Bothwell* (1874), and *Mary Stuart* (1881).

MARY (1457–1482), duchess of Burgundy, only child of Charles the Bold, duke of Burgundy, and his wife Isabella of Bourbon, was born on the 13th of February 1457. As heiress of the rich Burgundian domains her hand was eagerly sought by a number of princes. When her father fell upon the field of Nancy, on the 5th of January 1477, Mary was not yet twenty years of age. Louis XI. of France seized the opportunity afforded by his rival's defeat and death to take possession of the duchy of Burgundy as a fief lapsed to the French crown, and also of Franche Comté, Picardy and Artois. He was anxious that Mary should marry the Dauphin Charles and thus secure the inheritance of the Netherlands for his descendants. Mary, however, distrusted Louis; declined the French alliance, and turned to her Netherland subjects for help. She obtained the help only at the price of great concessions. On the 11th of February 1477 she was compelled to sign a charter of rights, known as "the Great Privilege," by which the provinces and towns of the Netherlands recovered all the local and communal rights which had been abolished by the arbitrary decrees of the dukes of Burgundy in their efforts to create in the Low Countries a centralized state. Mary had to undertake not to declare war, make peace, or raise taxes without the consent of the States, and not to employ any but natives in official posts. Such was the hatred of the people to the old régime that two influential councillors of Charles the Bold, the Chancellor Hugonet and the Sire d'Humbercourt, having been discovered in correspondence with the French king, were executed at Ghent despite the tears and entreaties of the youthful duchess. Mary now made her choice among the many suitors for her hand, and selected the archduke Maximilian of Austria, afterwards the emperor Maximilian I., and the marriage took place at Ghent on the 18th of August 1477. Affairs now went more smoothly in the Netherlands, the French aggression was checked, and internal peace was in a large measure restored, when the duchess met her death by a fall from her horse on the 27th of March 1482. Three children had been the issue of her marriage, and her elder son, Philip, succeeded to her dominions under the guardianship of his father.

See E. Münch, *Maria von Burgund, nebst d. Leben v. Margaretha v. York* (2 vols., Leipzig, 1832), and the *Cambridge Mod. Hist.* (vol. i., c. xii., bibliography, 1903).

MARY (1496–1533), queen of France, was the daughter of Henry VII. of England and Elizabeth of York. At first it was intended to marry her to Charles of Austria, the future emperor Charles V., and by the treaty of Calais (Dec. 21, 1507) it was agreed that the marriage should take place when Charles should have attained the age of fourteen, the contract being secured by bonds taken from various princes and cities in the Low Countries. On the 17th of December 1508 the Sieur de Bergues, who had come over as Charles's representative at the head of a magnificent embassy, married the princess by proxy. The contract, originally made by Henry VII., was renewed on the 17th of October 1513 by Henry VIII. at a meeting with Margaret of Savoy at Lille, the wedding being fixed for the following year. But the emperor Maximilian I., to whom Louis XII. had proposed his daughter Renée as wife for Charles, with Brittany for dowry, postponed the match with the English princess in a way that left no doubt of his intention to withdraw from the contract altogether. He was forestalled by the diplomacy of Wolsey, at whose instance peace was signed with France on the 7th of August 1514, and on the same date a treaty was concluded for the marriage of Mary Tudor with Louis XII., who had recently lost his wife Anne of Brittany. The marriage was celebrated at Abbeville on the 9th of October. The bridegroom was a broken man of fifty-two; the bride a beautiful, well-educated and charming girl of eighteen, whose heart was already engaged to Charles Brandon, duke of Suffolk, her future husband. The political marriage was, however, no long one. Mary was crowned queen of France on the 5th of November 1514; on the 1st of January following King Louis died. Mary had only been induced to consent to the marriage with Louis by the promise that, on his death, she should be allowed to marry the man of her choice. But there was danger that the agreement would not be kept. In France the dukes of Lorraine and Savoy were mentioned as possible suitors, and meanwhile the new king, Francis I., was making advances to her, and only desisted when she confessed to him her previous attachment to Suffolk. The duke himself was at the head of the embassy which came from England to congratulate the new king, and to the detriment of his political mission he used the opportunity to win the hand of the queen. Francis good-naturedly promised to use his influence in his favour; Henry VIII. himself was not averse to the match, but Mary feared the opposition of the lords of the council, and, in spite of Suffolk's promise to the king not to take any steps in the matter until after his return, she persuaded him to marry her secretly before he left Paris. On their return to England in April, Suffolk was for a while in serious danger from the king's indignation, but was ultimately pardoned through Wolsey's intercession, on payment of a heavy fine and the surrender of all the queen's jewels and plate. The marriage was publicly solemnized at Greenwich on the 13th of May 1515. Suffolk had been already twice married, and his first wife was still alive. He thought it necessary later on (1528) to obtain a bull from Pope Clement VII. declaring his marriage with his first wife invalid and his union with Mary therefore canonical. Mary's life after this was comparatively uneventful. She lived mainly in the retirement of the country, but shared from time to time in the festivities of the court, and was present at the Field of the Cloth of Gold. She died on the 24th of June 1533. By the duke of Suffolk she had three children: Henry, born on the 11th of March 1516, created earl of Lincoln (1525), who died young; Frances, born on the 16th of July 1517, the wife of Henry Grey, marquess of Northampton, and mother of Lady Jane Grey (*q.v.*); and Eleanor.

See *Lettres de Louis XII. et du cardinal Géorges d'Amboise* (Brussels, 1712); *Letters and Papers of Henry VIII.* (Cal. State Pap.); M. A. E. Green, *Lives of the Princesses of England* (vol. v., 1849–1855); Life by James Gairdner in *Dict. Nat. Biog.*

MARY OF LORRAINE (1515–1560), generally known as MARY OF GUISE, queen of James V. and afterwards regent of Scotland, was born at Bar on the 22nd of November 1515. She was the eldest child of Claude of Guise and Antoinette of Bourbon, and married in 1534 Louis II. of Orleans, duke of Longueville, to whom in 1535 she bore a son, Francis (d. 1551). The duke died in June 1537, and Mary was sought in marriage by James V., whose wife Magdalene died in July, and by Henry VIII. after the death of Jane Seymour. Henry persisted in his offers after the announcement of her betrothal to James V. Mary, who was made by adoption a daughter of France, received a papal dispensation for her marriage with James, which was celebrated by proxy in Paris (May 1538) and at St Andrews on her arrival in Scotland. Her two sons, James (b. May 1540) and Robert or Arthur (b. April 1541), died within a few days of one another in April 1541, and her husband died in December 1542, within a week of the birth of his daughter and heiress, Mary, Queen of Scots. Cardinal David Beton, the head of the French and Catholic party and therefore Mary of Lorraine's friend and ally, produced a will of the late king in which the primacy in the regency was assigned to himself. John Knox accused the queen of undue intimacy with Beton, and a popular report of a similar nature, probably unfounded, was revived in 1543 by Sir Ralph Sadler, the English envoy. Beton was arrested and the regency fell to the heir presumptive James, earl of Arran, whose inclinations were towards England and the Protestant party, and who hoped to secure the hand of the infant princess for his own son. Mary of Lorraine was approached by the English commissioner, Sir Ralph Sadler, to induce her to further her daughter's marriage contract with Edward VI. She informed Sadler that Arran had asked her whether Henry had made propositions of marriage to herself, and that she had stated that "if Henry should mind or offer her such an honour she must account herself much bounden." Sadler further learnt that she was "singularly well affected to Henry's desires." The marriage treaty between Mary, not then one year old, and Edward VI. was signed on the 1st of July at Greenwich, and guaranteed that Mary should be placed in Henry's keeping when she was ten years old. The queen dowager and her daughter were carefully watched at Linlithgow, but on the 23rd of July 1543 they escaped, with the help of Cardinal Beton, to the safer walls of Stirling castle. After the queen's coronation in September Mary of Lorraine was made principal member of the council appointed to direct the affairs of the kingdom. She was constantly in communication with her kinsmen in France, and was already planning to secure for her daughter a French alliance, which was opposed on different grounds by all her advisers. She made fresh alliances with the earl of Angus and Sir George Douglas, and in 1544 she made a premature attempt to seize the regency; but a reconciliation with Arran was brought about by Cardinal Beton. The assassination of Beton left her the cleverest politician in Scotland. The English invasions of 1547, undertaken with a view to enforcing the English marriage, gave Mary the desired pretext for a French alliance. In June 1548 a French fleet, with provisions and 5000 soldiers on board, under the command of André de Montalembert, seigneur d'Essé, landed at Leith to reinforce the Scots army, and laid siege to Haddington, then in the hands of the English. The Scottish parliament agreed to the marriage of the young queen with the dauphin of France, and, on the plea of securing her safety from English designs, she set sail from Dumbarton in August 1548 to complete her education at the French court.

Mary of Lorraine now gave her energies to the expulsion of the English and to the difficult task of keeping the peace between the Scots and their French auxiliaries. In September 1550 she visited France and obtained from Henry II. the confirmation of the dukedom and revenues of Châtelherault for the earl of Arran, in the hope of inducing him to resign the regency. On her way back to Scotland she was driven by storms to Portsmouth harbour and paid a friendly visit to Edward VI. Arran refused, however, to relinquish the regency until April 1554, when he resigned after receiving an assurance of his rights to the succession. The new regent had to deal with an empty exchequer and with a strong opposition to her daughter's marriage with the dauphin. The gift of high offices of state to Frenchmen lent to the Protestant opposition the aspect of a national resistance to foreign domination. The hostility of Arran and his brother Archbishop Hamilton forced Mary into friendly relations with the lords who favoured the Protestant party. Soon after her marriage miners had been brought from Lorraine to dig for gold at Crawford Moor, and she now carried on successful mining enterprises for coal and lead, which enabled her to meet the expenses of her government. In 1554 she took into her service William Maitland of Lethington, who as secretary of state gained very great influence over her. She also provoked a dangerous enemy in John Knox by her expressed contempt for a letter which he had written to her, but the first revolt against her authority arose from an attempt to establish a standing army. When she provoked a war with England in 1557 the nobles refused to cross the border. In matters of religion she at first tried to hold the balance between the Catholic and Protestant factions and allowed the Presbyterian preachers the practice of their religion so long as they refrained from public preachings in Edinburgh and Leith. The marriage of Francis II. and her daughter Mary in 1558 strengthened her position, and in 1559 she relinquished her conciliatory tactics to submit to the dictation of her relatives, the Guises, by falling more into line with their religious policy. She was reconciled with Archbishop Hamilton, and took up arms against the Protestants of Perth, who, incited by Knox, had destroyed the Charterhouse, where many of the Scottish kings were buried. The reformers submitted on condition that no foreign garrison was to be imposed on Perth and that the religious questions in dispute should be brought before the Scottish parliament. Mary of Lorraine broke the spirit of this agreement by garrisoning Perth with Scottish troops in the pay of France. The lords of the Congregation soon assembled in considerable force on Cupar Muir. Mary retreated to Edinburgh and thence to Dunbar, while Edinburgh opened its gates to the reformers, who issued a proclamation (Oct. 21, 1559) claiming that the regent was deposed. The lords of the Congregation sought help from Elizabeth, while the regent had recourse to France, where an expedition under her brother, René of Lorraine, marquis of Elbeuf, was already in preparation. Mary, with the assistance of a French contingent, began to fortify Leith. The strength of her opponents was increased by the defection of Châtelherault and his son Arran; and an even more serious danger was the treachery of her secretary Maitland, who betrayed her plans to the lords of the Congregation. In October 1559 they made an unsuccessful attack on Leith and the seizure of an English convoy on the way to their army by James Hepburn, earl of Bothwell, increased their difficulties. Mary entered Edinburgh and conducted a campaign in Fife. Meanwhile Maitland of Lethington had been at the English court, and an English fleet under William Winter was sent to the Forth in January 1560 to waylay Elbeuf's fleet, which was, however, driven back by a storm to Calais. Elbeuf had been commissioned by Francis I. and Mary to take over Mary's regency on account of her failing health. An English army under Lord Grey entered Scotland on the 29th of March 1560, and the regent received an asylum in Edinburgh castle, which was held strictly neutral by John Erskine. When she knew that she was dying Mary sent for the lords of the Congregation, with whom she pleaded for the maintenance of the French alliance. She even consented to listen to the exhortations of the preacher John Willock. She died on the 11th of June 1560. Her body was taken to Reims and buried in the church of the nunnery of St Peter, of which her sister was abbess.

The chief sources for her history are the Calendar of State Papers for the reigns of Henry VIII. and Edward VI. in the Rolls Series; A. Teulet, *Papiers d'état . . . relatifs à l'histoire de l'Écosse au XVI^e siècle* (Paris, 3 vols., 1851), for the Bannatyne Club; *Hamilton Papers*, ed. J. Bain (Edinburgh, 2 vols., 1890–1899); *Calendar of State Papers relating to Scotland and Mary Queen of Scots, 1547–1603* (Edinburgh, 2 vols., 1898–1900), &c. There is a Life in Miss Strickland's *Queens of Scotland* (vols. i.–ii.) based on original documents.

MARY OF MODENA [MARIA BEATRICE ANNE MARGARET ISABEL D'ESTE] (1658–1718), queen of the English king James II., was the daughter of Alphonso IV., duke of Modena, and the Duchess Laura, of the Roman family Martinozzi. She was born at Modena on the 5th of October 1658. Her education was strict, and her own wish was to be a nun in a convent of the order of the Visitation founded by her mother. As a princess she was not free to choose for herself, and was selected, mainly by the king of France, Louis XIV., as the wife of James, duke of York, heir-presumptive to the English throne. The duke had become a Roman Catholic, and it was a point of policy with the French king to provide him with a Roman Catholic wife. Mary Beatrice of Este was chosen partly on the ground of her known religious zeal, but also because of her beauty. The marriage was celebrated by proxy on the 30th of September 1673. She reached England in November. In later life she confessed that her first feelings towards her husband could only be expressed by tears. In England the duchess, who was commonly spoken of as Madam East, was supposed to be an agent of the pope, who had indeed exerted himself to secure her consent. Her beauty and her fine manners secured her the respect of her brother-in-law, Charles II., and she lived on good terms with her husband's daughters by his first marriage, but she was always disliked by the nation. The birth of her first son (who died in infancy) on the 16th of January 1675 was regretted. During the Popish Plot, to which her secretary Coleman was a victim, she went abroad with her husband. After her husband's accession she suffered much domestic misery through his infidelity. Her influence on him was unfortunate, for she was a strong supporter of the Jesuit party which was in favour of extreme measures. Her second son, James Francis Edward, was born on the 10th of June (o.s.) 1688. The public refused to believe that the baby was Mary's child, and declared that a fraud had been perpetrated to secure a Roman Catholic heir. When the revolution had broken out she made the disastrous mistake of consenting to escape to France (Dec. 10, 1688) with her son. She urged her husband to follow her to France when it was his manifest interest to stay in England, and when he went to Ireland she pressed incessantly for his return. Her daughter, Louisa Maria, was born at St Germain on the 28th of June 1692. When her husband died on the 6th of September 1701, she succeeded in inducing King Louis to recognize her son as king of England, an act which precipitated the war of the Spanish Succession. Queen Mary survived her husband for seventeen years and her daughter for two. She received a pension of 100,000 crowns, which was largely spent in supporting Jacobite exiles. At the close of her life she had some success in obtaining payment of her jointure. She lived at St Germain or at Chaillot, a religious house of the Visitation. Her death occurred on the 7th of May 1718, and is said by Saint-Simon to have been that of a saint.

See Miss Strickland, *Queens of England* (vols. 9 and 10, London, 1846); Campana di Cavelli, *Les Derniers Stuarts à Saint-Germain-en-Laye* (London, 1871); and Martin Haile *Mary of Modena* (London, 1905).

MARY OF ORANGE (1631–1660), eldest daughter of the English king Charles I., was born in London on the 4th of November 1631. Her father wished her to marry a son of Philip IV., king of Spain, while her cousin, the elector palatine, Charles Louis, was also a suitor for her hand, but both proposals fell through and she became the wife of a Dutch prince, William, son of Frederick Henry, prince of Orange. The marriage took place in London on the 2nd of May 1641, but owing to the tender years of the bride it was not consummated for several years. However in 1642 Mary crossed over to Holland with her mother, Queen Henrietta Maria, and in 1644, as the daughter-in-law of the stadtholder, she began to take her place in public life. In 1647 her husband, William II., succeeded his father as stadtholder, but three years later, just after his attempt to capture Amsterdam, he died; a son, afterwards the English king William III., being born to him a few days later (Nov. 14, 1650). Mary was obliged to share the guardianship of her infant son with his grandmother Amelia, the widow of Frederick Henry, and with Frederick William, elector of Brandenburg; moreover, she was unpopular with the Dutch owing to her sympathies with her kinsfolk, the Stuarts, and at length public opinion having been further angered by the hospitality which she showed to her brothers, Charles II. and James, duke of York, she was forbidden to receive her relatives. From 1654 to 1657 the princess passed most of her time away from Holland. In 1657 she was appointed regent on behalf of her son for the principality of Orange, but the difficulties of her position led her to implore the assistance of Louis XIV., and the French king answered by seizing Orange himself. The position both of Mary and of her son in Holland was greatly bettered through the restoration of Charles II. in Great Britain. In September 1660 Mary journeyed to England. She was taken ill of small-pox, and died in London on the 24th of December 1660, her death, says Bishop Burnet, being "not much lamented."

MARYBOROUGH, a market town and the county town of Queen's County, Ireland. Pop. (1901), 2957. It lies in the broad lowland east of the Slieve Bloom mountains, on the river Triogue, an affluent of the Barrow, and on the main line of the Great Southern & Western railway, by which it is 51 m. W.S.W. of Dublin. The town was chosen as county town in the reign of Mary (1556), in whose honour both town and county received their names. Its charter was granted in 1570, but its present appearance, save a bastion of the ancient castle, is wholly modern. There are flour-mills and a considerable general trade. Maryborough returned two members to the Irish parliament from 1585 until the union in 1800. The singular lofty rock of Dunamase or Dunmall, about 3 m. from the town, bears on its summit extensive ruins of a castle, originally belonging to the kings of Leinster, but probably built in the main by William Bruce (*c.* 1200) and dismantled in 1650 by Cromwell's troops.

MARYBOROUGH, a town of March county, Queensland, Australia, on the left bank and 25 m. from the mouth of the Mary river, 180 m. by rail N. of Brisbane. Pop. (1901), 10,159. Besides a handsome court-house and town hall, the principal buildings are the hospital, a technical college, a library, the Anglican Church of St Paul with a fine tower and peal of bells, and the grammar schools. There is a large shipbuilding yard, and breweries, distilleries, a tannery, boot factories, soap works, saw-mills, flour-mills, carriage works and iron foundries, besides extensive sugar factories in the neighbourhood. The largest smelting works in Australia are 5 m. distant, in which ore from all the states is treated. Maryborough is the port of shipment for a wide agricultural district yielding maize and sugar, and also for the Gympie gold-fields. Timber abounds in the neighbourhood and is exported. Maryborough is also the second coaling port in Queensland, the government railway wharf being in direct communication with the Burrum coal-fields.

MARYBOROUGH, a municipal town of Talbot county, Victoria, Australia, 112 m. by rail N.W. of Melbourne. Pop. (1901), 5633. It has fine government buildings, a town hall, a botanical garden, and numerous park lands. It is an important railway centre, and has extensive railway workshops, as well as coach factories, breweries and foundries. The gold mining of the district is deep alluvial. Wheat, oats and wine are the chief agricultural products of the neighbourhood.

MARYLAND, a South Atlantic state of the United States, and one of the original thirteen, situated between latitudes 37° 53′ and 39° 44′ N. and longitudes 75° 4′ and 79° 33′ W. (the precise western boundary has not been determined). It is bounded N. by Pennsylvania and Delaware; E. by Delaware and the Atlantic Ocean; S. and W. by the Potomac river and its north branch, which separate it, except on the extreme W. border, from Virginia and West Virginia; W., also, by West Virginia. It is one of the small states of the Union—only seven are smaller—its total area being 12,327 sq. m. of which 2386 sq. m. are water surface.

Physical Features.—Maryland is crossed from north to south by each of the leading topographical regions of the east section of the United States—the Coastal Plain, the Piedmont Plateau, the Appalachian Mountains, and the Appalachian Plateau—hence its great diversity of surface. The portion within the Coastal Plain embraces nearly the whole of the south-east half of the state and is commonly known as tide-water Maryland. It is marked off from the Piedmont Plateau by a "Fall Line" extending from Washington (D.C.) north-east through Baltimore to a point a little south of the north-east corner of the state, and is divided by the Chesapeake Bay into two parts known as the East Shore and the West Shore. The East Shore is a low level plain, the least elevated section of the state. Along its entire Atlantic border extends the narrow sandy Sinepuxent Beach, which encloses a shallow lagoon or bay also called Sinepuxent at the north, where, except in the extreme north, it is very narrow, and Chincoteague at the south, where its width is in most places from 4 to 5 m. Between this and the Chesapeake to the west and north-west there is a slight general rise, a height of about 100 ft. being reached in the extreme north. A water-parting extending from north-east to south-west and close to the Atlantic border separates the East Shore into two drainage systems, though that next to the Atlantic is insignificant. That on the Chesapeake side is drained chiefly by the Pocomoke, Nanticoke, Choptank and Chester rivers, together with their numerous branches, the general direction of all of which is south-west. The branches as well as the upper parts of the main streams flow through broad and shallow valleys; the middle courses of the main streams wind their way through reed-covered marshes, the water ebbing and flowing with the tide; in their lower courses they become estuarine and the water flows between low banks. The West Shore is somewhat more undulating than the East and also more elevated. Its general slope is from north-west to south-east; along the west border are points 300 ft. or more in height. The principal rivers crossing this section are the Patuxent, Patapsco and Gunpowder, with which may be grouped the Potomac, forming the state's southern boundary. These rivers, lined in most instances with terraces 30 to 40 ft. high on one or both sides, flow south-east into the Chesapeake Bay through valleys bounded by low hills. The Fall Line, which forms the boundary between the Coastal Plain and the Piedmont Plateau, is a zone in which a descent of about 100 ft. or more is made in many places within a few miles and in consequence is marked by waterfalls, cascades and rapids.

The part of Maryland within the Piedmont Plateau extends west from the Fall Line to the base of Catoctin Mountain, or the west border of Frederick county, and has an area of about 2500 sq. m. In general it has a broad rolling surface. It is divided into two sections by an elevated strip known as Parr's Ridge, which extends from north-east to south-west a short distance west of the middle. The east section rises from about 450 ft. along the Fall Line to from 850 to 900 ft. along the summit of Parr's Ridge. Its principal streams are those that cross the West Shore of the Coastal Plain and here wind their way from Parr's Ridge rapidly toward the south-east in narrow steep-sided gorges through broad limestone valleys. To the west of Parr's Ridge the surface for the most part slopes gently down to the east bank of the Monocacy river (which flows nearly at a right angle with the streams east of the Ridge), and then from the opposite bank rises rapidly toward the Catoctin Mountain; but just above the mouth of the Monocacy on the east side of the valley is Sugar Loaf Mountain, which makes a steep ascent of 1250 ft.

The portion of the state lying within the Appalachian Region is commonly known as Western Maryland. To the eastward it abounds in mountains and valleys; to the westward it is a rolling plateau. West of Catoctin Mountain (1800 ft.) is Middletown Valley, with Catoctin Creek running through it from north to south, and the Blue Ridge Mountains (2400 ft.), near the Pennsylvania border, forming its west slope. Farther west the serrated crests of the Blue Ridge overlook the Greater Appalachian Valley, here 73 m. in width, the broad gently-rolling slopes of the Great Cumberland or Hagerstown Valley occupying its eastern and the Appalachian Ridges its western portion. Through the eastern portion Antietam Creek to the east and Conococheague Creek to the west flow rapidly in meandering trenches that in places exceed 75 ft. in depth. The Appalachian Ridges of the western portion begin with North Mountain on the east and end with Wills Mountain on the west. They are long, narrow, uniformly-sloping and level-crested mountains, extending along parallel lines from north-east to south-west, and reaching a maximum height in Martin's Ridge of more than 2000 ft. Overlooking them from the west are the higher ranges of the Alleghenies, among which the Savage, Backbone and Negro Mountains reach elevations of 3000 ft. or more. In the extreme west part of the state these mountains merge, as it were, into a rolling plateau, the Appalachian Plateau, having an average elevation of 2500 ft. All rivers of Western Maryland flow south into the Potomac except in the extreme west, where the waters of the Youghiogheny and its tributaries flow north into the Monongahela.

Fauna and Flora.—In primitive times deer, ducks, turkeys, fish and oysters were especially numerous, and wolves, squirrels and crows were a source of annoyance to the early settlers. Deer, black bears and wild cats (lynx) are still found in some uncultivated sections. Much more numerous are squirrels, rabbits, "groundhogs" (woodchucks), opossums, skunks, weasels and minks. Many species of ducks are also still found; and the reed-bird (bobolink), "partridge" (elsewhere called quail or "Bob White"), ruffed grouse (elsewhere called partridge), woodcock, snipe, plover and Carolina rail still abound. The waters of the Chesapeake Bay are especially rich in oysters and crabs, and there, also, shad, alewives, "striped" (commonly called "rock") bass, menhaden, white perch and weak-fish ("sea-trout") occur in large numbers. Among the more common trees are several species of oak, pine, hickory, gums and maple, and the chestnut, the poplar, the beech, the cypress and the red cedar; the merchantable pine has been cut, but the chestnut and other hard woods of West Maryland are still a product of considerable value. Among wild fruit-trees are the persimmon and Chickasaw plum; grape-vines and a large variety of berry-bushes grow wild and in abundance.

Climate.—The climate of Maryland in the south-east is influenced by ocean and bay—perhaps also by the sandy soil—while in the west it is influenced by the mountains. The prevailing winds are westerly; but generally north-west in winter in the west section and south-west in summer in the south section. In the south the normal winter is mild, the normal summer rather hot; in the west the normal winter is cold, the normal summer cool. The normal average annual temperature for the entire state is between 53° and 54° F., ranging from 48° at Grantsville in the north-west to 53° at Darlington in the north-east, and to 57° at Princess Anne in the south-east. The normal temperature for the state during July (the warmest month) is 75·2° F., and during January (the coldest month) 32·14° F. Although the west section is generally much the cooler in summer, yet both of the greatest extremes recorded since 1891 were at points not far apart in Western Maryland: 109° F. at Boettcherville and − 26° F. at Sunnyside. The normal annual precipitation for the state is about 43 in. It is greatest, about 53 in., on the east slope of Catoctin Mountain, owing to the elevations which obstruct the moisture-bearing winds, and is above the average along the middle of the shores of the Chesapeake. It is least, from 25 to 35 in., in the Greater Appalachian Valley, in the south on the West Shore, and along the Atlantic border. During spring and summer the precipitation throughout the state is about 2 in. more than during autumn and winter.

Soils and Agriculture.—The great variety of soils is one of the more marked features of Maryland. On the East Shore to the north is a marly loam overlying a yellowish-red clay sub-soil, to the south is a soil quite stiff with light coloured clay, while here and there, especially in the middle and south, are considerable areas both of light sandy soils and tidal marsh loams. On the West Shore the soils range from a light sandy loam in the lower levels south from Baltimore to rather heavy loams overlying a yellowish clay on the rolling uplands and on the terraces along the Potomac and Patuxent. Crossing the state along the lower edge of the Fall Line is a belt heavy with clay, but so impervious to water as to be of little value for agricultural purposes. The soils of the Piedmont Plateau east of Parr's Ridge are, like the underlying rocks, exceptionally variable in composition, texture and colour. For the most part they are considerably heavier with clay than are those of the Coastal Plain, and better adapted to general agricultural purposes. Light loams, however, are found both in the north-east and south-east. A soil of very close texture, the gabbro, is found, most largely in the north-east. Alluvial loams occupy the narrow river valleys; but the most common soil of the section is that formed from gneiss with a large per cent. of clay in the subsoil. West of Parr's Ridge in the Piedmont, the principal soils are those the character of which is determined either by decomposed red sandstone or by decomposed limestone. In the east portion of the mountainous region the soil so well adapted to peach culture contains much clay, together with particles of Cambrian sandstone. In Hagerstown Valley are rich red or yellow limestone-clay soils. The Allegheny ridges have only a thin stony soil; but good limestone, sandstone, shale and alluvial soils occur in the valleys and in some of the plateaus of the extreme west.

Of the total land surface of the state 82% was in 1900 included in farms and 68% of the farmland was improved. There were 46,012 farms, of which 15,833 contained less than 50 acres, 3940 contained 260 acres or more, and 79 contained 1,000 acres or more—the average size being 112·4 acres. In 1890, 69% of the farms were worked by the owners or their managers, in 1900 only 66·4%; but share tenants outnumber cash tenants by almost three to one. Of the total number of farms about seven times as many are operated by white as by negro farmers, though the number of farms operated by white share tenants outnumber those operated by negro share tenants by only about five to one. Of all the inhabitants of the state, at least ten years old, who in 1900 were engaged in gainful occupations, 20·8% were farmers. The leading agricultural pursuits are the growing of Indian corn and wheat and the raising of livestock, yet it is in the production of fruits, vegetables and tobacco, that Maryland ranks highest as an agricultural state, and in no other state except South Carolina is so large a per cent. of the value of the crop expended for fertilizers. In 1907, according to the *Year Book* of the U.S. Department of Agriculture, the Indian corn crop was 22,196,000 bushels, valued at $11,986,000; the wheat crop was 14,763,000 bushels, valued at $14,172,000; the oat crop was 825,000 bushels, valued at $404,000; and the crop of rye was 315,000 bushels, valued at $236,000. Of the livestock, hogs were the most numerous in 1900, cattle next, sheep third, and horses fourth. The hay and forage crop of 1899 (exclusive of corn-stalks) grew on 374,848 acres. Until after the middle of the 18th century tobacco was the staple crop of Maryland, and the total yield did not reach its maximum until 1860 when the crop amounted to 51,000 hhds.; from this it decreased to 14,000 hhds., or 12,356,838 ℔ in 1889; in 1899 it rose again to 24,589,480 ℔, in 1907 the crop was only 16,962,000 ℔, less than that of nine other states. In market-garden products, including small fruits, Maryland ranked in 1899 sixth among the states of the Union, the crop being valued at $4,766,760, an increase of 350·9% over that of 1889. In the yield both of strawberries and of tomatoes it ranked first; the yield of raspberries and blackberries is also large. In its crop of green-peas Maryland was exceeded (1899) by New York only; in sweet Indian corn it ranked fifth; in kale, second; in spinach, third; in cabbages, ninth. The number of peach-trees, especially in the west part of the state, where the quality is of the best, is rapidly increasing, and in the yield of peaches and nectarines the state ranked thirteenth in 1899; in the yield of pears it ranked fifth; in apples seventeenth.

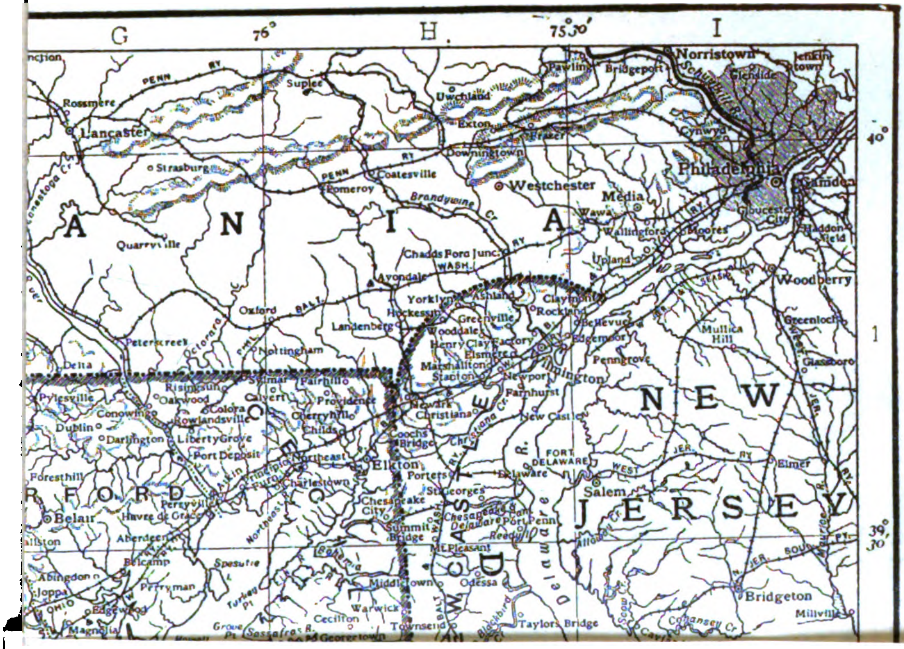
The Indian-corn, wheat and livestock sections of the state, are in the Piedmont Plateau, the Hagerstown Valley and the central portion of the East Shore. Garrett county in the extreme north-west, however, raises the largest number of sheep. Most of the tobacco is grown in the south counties of the West Shore. The great centre for vegetables and small fruits is in the counties bordering on the north-west shore of the Chesapeake, and in Howard, Frederick and Washington counties, directly west, Anne Arundel county producing the second largest quantity of strawberries of all the counties in the Union in 1899. Peaches and pears grow in large quantities in Kent and neighbouring counties on the East Shore and in Washington and Frederick counties; apples grow in abundance in all parts of the Piedmont Plateau.

The woodland area of the state in 1900 was 4400 sq. m., about 44% (estimated in 1907 to be 3450 sq. m., about 35%) of the total land area, but with the exception of considerable oak and chestnut, some maple and other hard woods in west Maryland, about all of the merchantable timber has been cut. The lumber industry, nevertheless, has steadily increased in importance, the value of the product in 1860 amounting to only $605,864, that in 1890 to $1,600,472, and that in 1900 to $2,650,082, of which sum $2,495,169 was the value of products under the factory system; in 1905 the value of the factory product was $2,750,339.

Fisheries.—In 1897 the value of the fishery product of Maryland was exceeded only by that of Massachusetts, but by 1901, although it had increased somewhat during the four years, it was exceeded by the product of New Jersey, of Virginia and of New York. Oysters constitute more than 80% of the total value, the product in 1901 amounting to 5,685,561 bushels, and being valued at $3,031,518. The supply on natural beds has been diminishing, but the planting of private beds promises a large increase. Crabs are next in value and are caught chiefly along the East Shore and in Anne Arundel and Calvert counties on the West Shore. Shad, to the number of 3,111,181 and valued at $120,602, were caught during 1901. In Somerset and Worcester counties clams are a source of considerable value. The terrapin catch decreased in value from $22,333 in 1891 to $1,139 in 1901. The total value of the fish product of 1901 was $3,767,461. The state laws for the protection of fish and shell-fish were long carelessly enforced because of the fishermen's strong feeling against them, but this sentiment has slowly changed and enforcement has become more vigorous.

Minerals and Manufactures.—The coal deposits, which form a part of the well-known Cumberland field, furnish by far the most important mineral product of the state; more than 98% of this, in 1901, was mined in Allegany county from a bed about 20 m. long and 5 m. wide and the remainder in Garrett county, whose deposits, though undeveloped, are of great value. The coal is of two varieties: bituminous and semi-bituminous. The bituminous is of excellent quality for the manufacture of coke and gas, but up to 1902 had been mined only in small quantities. Most of the product has been of the semi-bituminous variety and of the best quality in the country for the generation of steam. Nearly all the high grade blacksmithing coal mined in the United States comes from Maryland. The deposits were discovered early in the 19th century (probably first in 1804 near the present Frostburg), but were not exploited until railway transport became available in 1842, and the output was not large until after the close of the Civil War; in 1865 it was 1,025,208 short tons, from which it steadily increased to 5,532,628 short tons in 1907. From 1722 until the War of Independence the iron-ore product of North and West Maryland was greater than that of any of the other colonies, but since then ores of superior quality have been discovered in other states and the output in Maryland, taken chiefly from the west border of the Coastal Plain in Anne Arundel and Prince George's counties, has become comparatively of little importance—24,367 long tons in 1902 and only 8269 tons in 1905. Gold, silver and copper ores, have been found in the state, and attempts have been made to mine them, without much success. The Maryland building stone, of which there is an abundance of good quality, consists chiefly of granites, limestones, slate, marble and sandstones, the greater part of which is quarried in the east section of the Piedmont Plateau especially in Cecil county, though some limestones, including those from which hydraulic cement is manufactured, and some sandstones are obtained from the western part of the Piedmont Plateau and the east section of the Appalachian region; the value of stone quarried in the state in 1907 was $1,439,355, of which $1,183,753 was the value of granite, $142,825 that of limestone, $98,918 that of marble, and $13,859 that of sandstone. Brick, potter's and tile clays are obtained most largely along the west border of the Coastal Plain, and fire-clay from the coal region of West Maryland; in 1907 the value of clay products was $1,886,362. Materials for porcelain, including flint, feldspar and kaolin, abound in the east portion of the Piedmont, the kaolin chiefly in Cecil county, and material for mineral paint in Anne Arundel and Prince George's counties, as well as farther north-west.

Between 1850 and 1900, while the population increased 103·8%, the average number of wage-earners employed in manufacturing establishments increased 258·5%, constituting 5·2% of the total population in 1850 and 9·1% in 1900. In 1900 the total value of manufactured goods was $242,552,990, an increase of 41·1% over that of 1890. Of the total given for 1900, $211,076,143 was the value of products under the factory system; and in 1905 the value of factory products was $243,375,996, being 15·3% more than in 1900. The products of greatest value in 1905 were: custom-made men's clothing; fruits and vegetables and oysters, canned and preserved; iron and steel; foundry and machine-shop products, including stoves and furnaces; flour and grist mill products; tinware, coppersmithing and sheet iron working; fertilizers; slaughtering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Coatesville
Pomeroy
Westchester
Media
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Brandywine Cr.
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Rockland
Hockessin
Greenville
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Oxford
BALT.
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Woodale
Henry Clay Factory
Edgemoor
Mullica Hill
Greenloch
Glassboro
Peterscreek
Octorara Cr.
Nottingham
Elsmere
Marshallton
Stanton
Newport
Wilmington
Penngrove
Delta
Pylesville
Risingsun
Oakwood
Calvert
Fairhill
Providence
Cherryhill
Colora
Rowlandsville
Conowingo
Dublin
Darlington
LibertyGrove
Port Deposit
Childs
Farnhurst
Christiana
Newark
New Castle
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Elkton
Northeast
Charlestown
Principio Furnace
Aikin
Perryville
Foresthill
R F O R D
C E C
Porters
St. Georges
FORT DELAWARE
Delaware
WEST JER. RY
Elmer
Salem
J E R S E Y
Belair
Havre de Grace
Chesapeake City
Summit Bridge
Chesapeake & Delaware Canal
Port Penn
Reedy I.
Delaware
Alloway Cr.
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Belcamp
Bohemia
Mt. Pleasant
Odessa
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SOU. JER. RY.
Maurice R.
Millville
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Turkey Pt.
Middletown
Warwick
Magnolia
Cecilton
Townsend
Grove Pt.
Sassafras R.
Georgetown
Blackbird Cr.
Taylors Bridge
Scow Cr.
Cohansey Cr.
PENN. RY.
WASH. RY.
BALT. & OHIO

and meat-packing; cars and repairs by steam railways; shirts; cotton goods; malt liquors; and cigars and cigarettes. In the value of fertilizers manufactured, and in that of oysters canned and preserved, Maryland was first among the states in 1900 and second in 1905; in 1900 and in 1905 it was fourth among the states in the value of men's clothing. Baltimore is still the great manufacturing centre, but of the state's total product the percentage in value of that manufactured there decreased from 82·5 in 1890 to 66·5 in 1900, and to 62·3 (of the factory product) in 1905. The largest secondary centres are Cumberland, Hagerstown and Frederick the total value of whose factory products in 1905 was less than $10,000,000.

Communications.—Tide-water Maryland is afforded rather unusual facilities of water transportation by the Chesapeake Bay, with its deep channel, numerous deep inlets and navigable tributaries, together with the Chesapeake and Delaware Canal, which crosses the state of Delaware and connects its waters with those of the Delaware river and bay. As early as 1783 steps were taken to extend these facilities to the navigable waters of the Ohio, chiefly by improving the navigation of the Potomac above Georgetown. By 1820 this project was merged into a movement for a Chesapeake and Ohio canal along the same line. Ground was broken in 1828 and in 1850 the canal was opened to navigation from Georgetown to Cumberland, a distance of 186 m. In 1878 and again in 1889 it was wrecked by a freshet, and since then has been of little service.[1] However, on the same day that ground was broken for this canal, ground was also broken for the Baltimore & Ohio railway, of which 15 m. was built in 1828–1830 and which was one of the first steam railway lines in operation in the United States. Since then railway building has progressed steadily. In Maryland (and including the District of Columbia) there were 259 m. of railway in 1850, 386 m. in 1860, 671 m. in 1870, and 1040 m. in 1880; in 1890, in Maryland alone, the mileage was 1270·04 m., and in 1909 it was 1394·19 m. The more important railway lines are the Baltimore & Ohio, the Philadelphia, Baltimore & Washington (controlled by the Pennsylvania and a consolidation of the Philadelphia, Wilmington & Baltimore, and the Baltimore & Potomac), the Western Maryland, the West Virginia Central & Pittsburg (leased by the Western Maryland), the Northern Central, the Maryland electric railways (including what was formerly the Baltimore & Annapolis Short Line), and the Washington, Baltimore & Annapolis electric railway. Baltimore is the chief railway centre and its harbour is one of the most important in the country.

Inhabitants.—The population of Maryland in 1880 was 934,943; in 1890, 1,042,390, an increase of 11·5%; in 1900, 1,188,044 (14%); in 1910, 1,295,346 (increase 9%). Of the total population in 1900 there were 952,424 whites, 235,064 negroes, 544 Chinese, 9 Japanese and 3 Indians, the increase in the white population from 1890 to 1900 being 15·2%, while that of the negroes was only 9%. In 1900 there were 1,094,110 native born to 93,934 foreign-born, and of the foreign-born 44,990 were natives of Germany and 68,600 were residents of the city of Baltimore. The urban population, *i.e.* total population of cities of 4000 or more inhabitants, in 1900, was 572,795, or 48·2% of the total and an increase of 16·6% over that of 1890; while the rural population, *i.e.* population outside of incorporated places, was 539,685, an increase of about 8% over that of 1890. There are about 59 religious sects, of which the members of the Roman Catholic Church, which was prominent in the early history of Maryland, are far the most numerous, having in 1906 166,941 members out of 473,257 communicants of all denominations; in the same year there were 137,156 Methodists, 34,965 Protestant Episcopalians, 32,246 Lutherans, 30,928 Baptists, 17,895 Presbyterians and 13,442 members of the Reformed Church in the United States. The chief cities are Baltimore, pop. (1910) 558,485, Cumberland 21,839, Hagerstown 16,507, Frederick 10,411 and Annapolis 8609.

Government.—The state constitution of 1867, the one now in force, has been frequently amended, all that is required for its amendment being a three-fifths vote of all of the members elected to each of the two houses of the General Assembly, followed by a majority vote of the state electorate, and it is further provided that once in twenty years, beginning with 1887, the wish of the people in regard to calling a convention for altering the constitution shall be ascertained by a poll. Any constitution or constitutional amendment proposed by such constitutional convention comes into effect only if approved by a majority of the votes cast in a popular election. Since 1870 suffrage has been the right of all male citizens (including negroes) twenty-one years of age or over who shall have lived within the state for one year and within the county or the legislative district of the city of Baltimore in which they may offer to vote for six months immediately preceding an election; persons convicted of larceny or other infamous crime and not since pardoned by the governor, as well as lunatics or those who have been convicted of bribery at a previous election are excepted. In 1908 the General Assembly passed a law providing for annual direct primary elections (outside of Baltimore; and making the Baltimore special primary law applicable to state as well as city officials), but, as regards state officers, making only a slight improvement upon previous conditions inasmuch as the county or district is the unit and the vote of county or district merely " instructs " delegates to the party's state nominating convention, representation in which is not strictly in proportion to population, the rural counties having an advantage over Baltimore; no nomination petition is required. In the same year a separate law was passed providing for primary elections for the choice of United States senators; but here also the method is not that of nomination by a plurality throughout the state, but by the vote of counties and legislative districts, so that this measure, like the other primary law, is not sufficiently direct to give Baltimore a vote proportional to its population.

The chief executive authority is vested in a governor elected by popular vote for a term of four years. Since becoming a state Maryland has had no lieutenant-governor except under the constitution of 1864; and the office of governor is to be filled in case of a vacancy by such person as the General Assembly may elect.[3] Any citizen of Maryland may be elected to the office who is thirty years of age or over, who has been for ten years a citizen of the state, who has lived in the state for five years immediately preceding election, and who is at the time of his election a qualified voter therein. Until 1838 the governor had a rather large appointing power, but since that date most of the more important offices have been filled by popular election. He, however, still appoints, subject to the confirmation of the senate, the secretary of state, the superintendent of public education, the commissioner of the land office, the adjutant-general, justices of the peace, notaries public, the members of numerous administrative boards, and other administrative officers. He is himself one of the board of education, of the board of public works, and of the board for the management of the house of correction. No veto power whatever was given to the governor until 1867, when, in the present constitution, it was provided that no bill vetoed by him should become a law unless passed over his veto by a three-fifths vote of the members elected to each house, and an amendment of 1890 (ratified by the people in 1891) further provides that any item of a money bill may likewise be separately vetoed. The governor's salary is fixed by the constitution at $4500 a year. Other executive officers are a treasurer, elected by joint ballot of the General Assembly for a term of two years, a comptroller elected by popular vote for a similar term, and an attorney-general elected by popular vote for four years.

The legislature, or General Assembly, meets biennially in even-numbered years, at Annapolis, and consists of a Senate and a House of Delegates. Senators are elected, one from each of the twenty-three counties and one from each of the four legislative districts of the city of Baltimore, for a term of four years, the terms of one-half expiring every two years. Delegates are elected for a term of two years, from each county and from each legislative district of Baltimore, according to population, as follows: for a population of 18,000 or less, two delegates; 18,000 to 28,000, three; 28,000 to 40,000, four; 40,000 to 55,000, five; 55,000 and upwards, six. Each legislative district of Baltimore is entitled to the number of delegates to which the largest county shall or may be entitled under the foregoing apportionment, and the General Assembly may from time to time alter the boundaries of Baltimore city districts in order to equalize their population. This system of apportionment gives to the rural counties a considerable political advantage over the city of Baltimore, which, with 42·8% of the total population according to the census of 1900, has only 4 out of 27 members of the Senate and only 24 out of 101 members of the House of Delegates. Since far back in the colonial era, no minister, preacher, or priest has been eligible to a seat in either house. A senator must be twenty-five years of age or over, and both senators and delegates must have lived within the state at least three years and in their county or legislative district at least one year immediately preceding their election.

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[1] Maryland and Delaware together began the construction of the Chesapeake and Delaware canal (13⅝ m. long) across the north part of the state of Delaware, between the Delaware river and Chesapeake Bay; this canal received Federal aid in 1828, was completed in 1829, and in 1907 was chosen as the most practicable route for a proposed ship waterway between the Chesapeake and the Delaware.

[2] The population at previous censuses was as follows: 319,728 in 1790; 341,548 in 1800; 380,546 in 1810; 407,350 in 1820; 447,040 in 1830; 470,019 in 1840; 583,034 in 1850; 687,049 in 1860; and 780,894 in 1870.

[3] The General Assembly regularly elected the governor during the period 1776–1838.

The constitution provides that no bill or joint resolution shall pass either house except by an affirmative vote of a majority of all the members elected to that house and requires that on the final vote the yeas and nays be recorded.

Justice, &c.—The administration of justice is entrusted to a court of appeals, circuit courts, special courts for the city of Baltimore, orphans' courts, and justices of the peace. Exclusive of the city of Baltimore, the state is divided into seven judicial circuits, in each of which are elected for a term of fifteen years one chief judge and two associate judges, who at the time of their election must be members of the Maryland bar, between the ages of thirty and seventy, and must have been residents of the state for at least five years. The seven chief judges so elected, together with one elected from the city of Baltimore, constitute the court of appeals, the governor with the advice and consent of the senate designating one of the eight as chief judge of that court. The court has appellate jurisdiction only. The three judges elected in each circuit constitute the circuit court of each of the several counties in such circuit. The courts have both original and appellate jurisdiction and are required to hold at least two sessions to which jurors shall be summoned every year in each county of its circuit, and if only two such terms are held, there must be two other and intermediate terms to which jurors shall not be summoned. Three other judges are elected for four-year terms, in each county and in the city of Baltimore to constitute an orphans' court. The number of justices of the peace for each county is fixed by local law; they are appointed by the governor, subject to the confirmation of the Senate, for a term of two years.

In the colonial era Maryland had an interesting list of governmental subdivisions—the manor, the hundred, the parish, the county, and the city—but the two last are about all that remain and even these are in considerable measure subject to the special local acts of the General Assembly. In general, each county has from three to seven commissioners—the number is fixed by county laws—elected on a general ticket of each county for a term of from two to six years, entrusted with the charge and control of property owned by the county, empowered to appoint constables, judges of elections, collectors of taxes, trustees of the poor, and road supervisors, to levy taxes, to revise taxable valuations of real property, and open or close public roads.

In Maryland a wife holds her property as if single except that she can convey real estate only by a joint deed with her husband (this requirement being for the purpose of effecting a release of the husband's " dower interest "), neither husband nor wife is liable for the separate debts of the other, and on the death of either the rights of the survivor in the estate of the other are about equal. Wife-beating is made punishable by whipping in gaol, not exceeding forty lashes. Prior to 1841 a divorce was granted by the legislature only, from then until 1851 it could be granted by either the legislature or the equity courts, since 1851 by the courts only. The grounds for a divorce *a mensa et thoro*, which may be granted for ever or for a limited time only, are cruelty, excessively vicious conduct, or desertion; for a divorce *a vinculo matrimonii* the chief grounds are impotence at the time of marriage, adultery or deliberate abandonment for three years. There is no homestead exemption law and exemptions from levy for the satisfaction of debts extend only to $100 worth of property, besides wearing apparel and books and tools used by the debtor in his profession or trade, and to all money payable in the nature of insurance. Employers of workmen in a clay or coal mine, stone quarry, or on a steam or street railway are liable for damage in case of an injury to any of their workmen where such injury is caused by the negligence of the employer or of any servant or employee of the employer. The chief of the bureau of labour statistics is directed in case of danger of a strike or lockout to seek to mediate between the parties and if unsuccessful in that, then to endeavour to secure their consent to the formation of a board of arbitration.

The state penal and charitable institutions include a penitentiary at Baltimore; a house of correction at Jessups, two houses of refuge at Baltimore; a house of reformation in Prince George's county; St Mary's industrial school for boys at Baltimore; an industrial home for negro girls at Melvale; an asylum and training school for the feeble-minded at Owings Mills; an infirmary at Cumberland; the Maryland hospital for the insane at Catonsville; the Springfield state hospital for the insane; the Maryland school for the deaf and dumb at Frederick city; and the Maryland school for the blind at Baltimore. Each of these is under the management of a board appointed by the governor subject to the confirmation of the senate. Besides these there are a large number of state-aided charitable institutions. In 1900 there was created a board of state aid and charities, composed of seven members appointed by the governor for a term of two years, not more than four to be reappointed. There is also a state lunacy commission of four members, who are appointed for terms of four years, one annually, by the governor.

Education.—The basis of the present common school system was laid in 1865, after which a marked development was accompanied by some important changes in the system and its administration, and the percentage of total illiteracy (*i.e.* inability to write among those ten years old and over) decreased from 19·3 in 1800 to 11·1 in 1900, while illiteracy among the native whites decreased during the same period from 7·8 to 4·1 and among negroes from 59·6 to 35·2. At the head of the system is a state board and a state superintendent, and under these in each county is a county board which appoints a superintendent for the county and a board of trustees for each school district none of which is to be more than four miles square. The state board is composed of the governor as its president, the state superintendent as its secretary, six other members appointed by the governor for a term of six years, and, as *ex-officio* members without the right to vote, the principals of the state and other normal schools. Prior to 1900 the principal of the state normal was *ex-officio* state superintendent, but since then the superintendent has been appointed by the governor for a term of four years. Each county board is also appointed by the governor for a term of six years. In both the state and the county boards at least one-third of the members appointed by the governor are not to be of the dominant political party and only one-third of the members are to be appointed every two years. The state board enacts by-laws for the administration of the system; its decision of controversies arising under the school law is final; it may suspend or remove a county superintendent for inefficiency or incompetency; it issues life state certificates, but applicants must have had seven years of experience in teaching, five in Maryland, and must hold a first-class certificate or a college or normal school diploma; and it pensions teachers who have taught successfully for twenty-five years in any of the public or normal schools of the state, who have reached the age of sixty, and who have become physically or mentally incapable of teaching longer, the pension amounting to $200 a year. The legislature of 1908 passed a law under which the minimum pay for a teacher holding a first-class certificate should be $350 a year after three years' teaching, $400 after five years' teaching and $450 after eight years' teaching. By a law of 1904 all teachers who taught an average of 15 pupils were to receive at least $300. School books are purchased out of the proceeds of the school tax, but parents may purchase if they prefer. In 1908 the average school year was nine and seven-tenths months—ten in the cities and nine and four-tenths in the counties; the aim is ten months throughout, and a law of 1904 provides that if a school is taught less than nine months a portion of the funds set apart for it shall be withheld. A compulsory education law of 1902—to operate, however, only in the city of Baltimore and in Allegany county—requires the attendance for the whole school year of children between the ages of eight and twelve and also of those between the ages of twelve and sixteen who are not employed at home or elsewhere. A separate school for negro children is to be maintained in every election district in which the population warrants it. The system is maintained by a state tax of 16 cents on each $100 of taxable property.

The higher state educational institutions are two normal schools and one agricultural college. One of the normal schools was opened in Baltimore in 1866, the other at Frostburg in 1904. Both are under the management of the state Board of Education, which appoints the principals and teachers and prescribes the course of study. There is besides, in Washington College at Chestertown, a normal department supported by the state and under the supervision of the state Board of Education. The Maryland Agricultural College, to which an experiment station has been added, was opened in 1859; it is at College Park in Prince George's county, and is largely under state management. Maryland supports no state university, but Johns Hopkins University, one of the leading institutions of its kind in the country, receives $25,000 a year from the state; the medical department of the university of Maryland receives an annual appropriation of about $2500, and St John's College, the academic department of the university of Maryland, receives from the state $13,000 annually and gives for each county in the state one free scholarship and one scholarship covering all expenses. Among the principal institutions in the state are the university of Maryland, an outgrowth of the medical college of Maryland (1807) in Baltimore, with a law school (reorganized in 1869), a dental school (1882), a school of pharmacy (1904), and, since 1907, a department of arts and science in St John's College (non-sect., opened in 1789) at Annapolis; Washington College, with a normal department (non-sect., opened in 1782) at Chestertown; Mount St Mary's College (Roman Catholic, 1808) at Emmitsburg; New Windsor College (Presbyterian, 1843) at New Windsor; St Charles College (Roman Catholic, opened in 1848) and Rock Hill College (Roman Catholic, 1857) near Ellicott City; Loyola College (Roman Catholic, 1852) at Baltimore; Western Maryland College (Methodist Protestant, 1867) at Westminster; Johns Hopkins University (non-sect., 1876) at Baltimore; Morgan College (coloured, Methodist, 1876) at Baltimore; Goucher College (Methodist, founded 1884, opened 1888) at Baltimore; several professional schools mostly in Baltimore (*q.v.*); the Peabody Institute at Baltimore; and the United States Naval Academy at Annapolis.

Revenue.—The state's revenue is derived from a general direct property tax, a licence tax, corporation taxes, a collateral inheritance tax, fines, forfeitures and fees; and the penitentiary yields an annual net revenue of about $40,000. There is no provision for a general periodic assessment, but a state tax commissioner appointed by the governor, treasurer and comptroller assesses the corporations, and the county commissioners (in the counties) and the appeal tax court (in the city of Baltimore) revise valuations of real property every two years. From 1820 to 1836 Maryland, in its enthusiasm over internal improvements, incurred an indebtedness of more than $16,000,000. To meet the interest, such heavy taxes were levied that anti-tax associations were formed to resist the collection, and in 1842 the state failed to pay what was due; but the accumulated interest had been funded by 1848 and was paid soon afterwards, the expenses of the government were curtailed by the constitution of 1851, and after the Civil War the amount of indebtedness steadily decreased until in 1902 the funded debt was $6,909,326 and the net debt only $2,797,269·13, while on the 1st of October 1908 the net debt was $366,643·91. As a result of incurring the large debt, a clause in the constitution prohibits the legislature from contracting a debt without providing by the imposition of taxes for the payment of the interest annually and the principal within fifteen years, except to meet a temporary deficiency not exceeding $50,000. The first bank of the state was established in 1790, and by 1817 there was one in each of twelve counties and several in Baltimore; in 1818–1820 and in 1837–1839 there were several serious bank failures, but there have been no serious failures since. A constitutional provision makes each stockholder in a state bank liable to the amount of his share or shares for all the bank's debts and liabilities. A savings bank is taxed on its deposits, and a state bank is taxed on its capital-stock.

History.—The history of Maryland begins in 1632 with the procedure of Charles I. to grant a charter conveying almost unlimited territorial and governmental rights therein to George Calvert, first Lord Baltimore (1580?–1632), and styling him its absolute lord and proprietor. George Calvert died before the charter had passed the great seal, but about two months later in the same year it was issued to his eldest son, Cecilius. In November 1633 two vessels, the "Ark" and the "Dove," carrying at least two hundred colonists under Leonard Calvert (*c.* 1582–1647), a brother of the proprietor, as governor, sailed from Gravesend and arrived in Maryland late in March of the following year. Friendly relations were at the outset established with the Indians, and the province never had much trouble with that race; but with William Claiborne (1589?–1676?), the arch-enemy of the province as long as he lived, it was otherwise. He had opposed the grant of the Maryland charter, had established a trading post on Kent Island in Chesapeake Bay in 1631, and when commanded to submit to the new government he and his followers offered armed resistance. A little later, during his temporary absence in England, his followers on the island were reduced to submission; but in 1644, while the Civil War in England was in progress, he was back in the province assisting Richard Ingle, a pirate who claimed to be acting in the interest of parliament, in raising an insurrection which deprived Governor Calvert of his office for about a year and a half. Finally, the lord proprietor was deprived of his government from 1654 to 1658 in obedience to instructions from parliament which were originally intended to affect only Virginia, but were so modified, through the influence of Claiborne and some Puritan exiles from Virginia who had settled in Maryland, as to apply also to "the plantations within Chesapeake Bay." Then the long continued unrest both in the mother country and in the province seems to have encouraged Josias Fendall, the proprietor's own appointee as governor, to strike a blow against the proprietary government and attempt to set up a commonwealth in its place; but this revolt was easily suppressed and order was generally preserved in the province from the English Restoration of 1660 to the English Revolution of 1688.

Meanwhile an interesting internal development had been in progress. The proprietor was a Roman Catholic and probably it was his intention that Maryland should be an asylum for persecuted Roman Catholics, but it is even more clear that he was desirous of having Protestant colonists also. To this end he promised religious toleration from the beginning and directed his officers accordingly; this led to the famous toleration act passed by the assembly in 1649, which, however, extended its protection only to sects of Trinitarian Christianity. Again, although the charter reserved to the proprietor the right of calling an assembly of the freemen or their delegates at such times and in such form and manner as he should choose, he surrendered in 1638 his claim to the sole right of initiating legislation. By 1650 the assembly had been divided into two houses, in one of which sat only the representatives of the freemen without whose consent no bill could become a law, and annual sessions as well as triennial elections were coming to be the usual order. When suffrage had thus come to be a thing really worth possessing, the proprietor, in 1670, sought to check the opposition by disfranchising all freemen who did not have a freehold of fifty acres or a visible estate of forty pounds sterling. But this step was followed by more and more impassioned complaints against him, such as: that he was interfering with elections, that he was summoning only a part of the delegates elected, that he was seeking to overawe those summoned, that he was abusing his veto power, and that he was keeping the government in the hands of Roman Catholics, who were mostly members of his own family. About this time also the north and east boundaries of the province were beginning to suffer from the aggressions of William Penn. The territory now forming the state of Delaware was within the boundaries defined by the Maryland charter, but in 1682 it was transferred by the duke of York to William Penn and in 1685 Lord Baltimore's claim to it was denied by an order in council, on the ground that it had been inhabited by Christians before the Maryland charter was granted. In the next place, although it was clear from the words of the charter that the parallel of 40° N. was intended for its north boundary, and although Penn's charter prescribed that Pennsylvania should extend on the south to the "beginning of the fortieth degree of Northern Latitude," a controversy arose with regard to the boundary between the two provinces, and there was a long period of litigation; in 1763–1767 Charles Mason and Jeremiah Dixon, two English mathematicians, established the line named from them (see MASON AND DIXON LINE), which runs along the parallel 39° 43′ 26″·3 N. and later became famous as the dividing line between the free states and the slave states. While the proprietor was absent defending his claims against Penn the English Revolution of 1688 was started. Owing to the death of a messenger there was long delay in proclaiming the new monarchs in Maryland; this delay, together with a rumor of a Popish plot to slaughter the Protestants, enabled the opposition to overthrow the proprietary government, and then the crown, in the interest of its trade policy, set up a royal government in its place, in 1692, without, however, divesting the proprietor of his territorial rights. Under the royal government the Church of England was established, the people acquired a strong control of their branch of the legislature and they were governed more by statute law and less by executive ordinance. The proprietor having become a Protestant, the proprietary government was restored in 1715. Roman Catholics were disfranchised immediately afterward. In 1730 Germans began to settle in considerable numbers in the west-central part of the colony, where they greatly promoted its industrial development but at the same time added much strength to the opposition. The first great dispute between proprietor and people after the restoration of 1715 was with regard to the extension of the English statutes to Maryland, the popular branch of the legislature vigorously contending that all such statutes except those expressly excluded extended to the province, and the lord proprietor contending that only those in which the dominions were expressly mentioned were in force there. Many other disputes speedily followed and when the final struggle between the English and French for possession in America came, although appropriations were made at its beginning to protect her own west frontier from the attacks of the enemy, a dead-lock between the two branches of the assembly prevented Maryland from responding to repeated appeals from the mother country for aid in the latter part of that struggle. This failure was used as an argument in favour of imposing the famous Stamp Act. Nevertheless, popular clamour against parliament on account of that measure was even greater than it had been against the proprietor. The stamp distributor was driven out, and the arguments of Daniel Dulany (1721–1797), the ablest lawyer in the province, against the act were quoted by speakers in parliament for its repeal.

In the years immediately preceding the Declaration of Independence Maryland pursued much the same course as did other leading colonies in the struggle—a vessel with tea on board was even burned to the water's edge—and yet when it came to the decisive act of declaring independence there was hesitation. As the contest against the proprietor had been nearly won, the majority of the best citizens desired the continuance of the old government and it was not until the Maryland delegates in the Continental Congress were found almost alone in holding back that their instructions not to vote for independence were rescinded. The new constitution drawn and adopted in 1776 to take the place of the charter was of an aristocratic rather than a democratic nature. Under it the property qualification for suffrage was a freehold of 50 acres or £30 current money, the property qualifications for delegates £500, for senators £1000, and for governor £5000. Four delegates were chosen from each county and two each from Baltimore and Annapolis, the same as under the proprietary government, population not being taken into account. Senators were chosen by a college of fifteen electors elected in the same manner as the delegates, and the governor by a joint ballot of the two houses of assembly. In 1802 negroes were disfranchised, and in 1810 property qualifications for suffrage and office were abolished. The system of representation that, with the rapid growth of population in the north-east sections, especially in the city of Baltimore, placed the government in the hands of a decreasing minority also began to be attacked about this time; but the fear of that minority which represented the tobacco-raising and slave-holding counties of south Maryland, with respect to the attitude of the majority toward slavery prevented any changes until 1837, when the opposition awakened by the enthusiasm over internal improvements effected the adoption of amendments which provided for the election of the governor and senators by a direct vote of the people, a slight increase in the representation of the city of Baltimore and the larger counties, and a slight decrease in that of the smaller counties. Scarcely had these amendments been carried when the serious financial straits brought on by debt incurred through the state's promotion of internal improvements gave rise to the demand for a reduction of governmental expenses and a limitation of the power of the General Assembly to contract debts. The result was the new constitution of 1851, which fully established representation in the counties on the basis of population and further increased that of Baltimore. The constitution of 1851 was however chiefly a patchwork of compromises. So, when during the Civil War Maryland was largely under Federal control and the demand arose for the abolition of slavery by the state, another constitutional convention was called, in 1864, which framed a constitution providing that those who had given aid to the Rebellion should be disfranchised and that only those qualified for suffrage in accordance with the new document could vote on its adoption. This was too revolutionary to stand long and in 1867 it was superseded by the present constitution. In national affairs Maryland early took a stand of perhaps far-reaching consequences in refusing to sign the Articles of Confederation (which required the assent of all the states before coming into effect), after all the other states had done so (in 1779), until those states claiming territory between the Alleghany Mountains and the Mississippi and north of the Ohio—Virginia, New York, Massachusetts and Connecticut—should have surrendered such claims. As those states finally yielded, the Union was strengthened by reason of a greater equality and consequently less jealousy among the original states, and the United States came into possession of the first territory in which all the states had a common interest and out of which new states were to be created. In the War of 1812 Frederick, Havre de Grace, and Frenchtown were burned by the British; but particularly noteworthy were the unsuccessful movements of the enemy by land and by sea against Baltimore, in which General Robert Ross (*c.* 1766–1814), the British commander of the land force, was killed before anything had been accomplished and the failure of the fleet to take Fort McHenry after a siege of a day and a night inspired the song *The Star-spangled Banner*, composed by Francis Scott Key who had gone under a flag of truce to secure from General Ross the release of a friend held as a prisoner by the British and during the attack was detained on his vessel within the British lines. In 1861 Maryland as a whole was opposed to secession but also opposed to coercing the seceded states. During the war that followed the west section was generally loyal to the north while the south section favoured the Confederacy and furnished many soldiers for its army; but most of the state was kept under Federal control, the writ of habeas corpus being suspended. The only battle of much importance fought on Maryland soil during the war was that of Sharpsburg or Antietam on the 16th and 17th of September 1862. As between political parties the state has usually been quite equally divided. From 1820 to 1860, however, the Whigs were in general a trifle the stronger; and from 1866 to 1895 the Democrats were triumphant; in 1895 a Republican governor was elected; in 1896 Maryland gave McKinley 32,232 votes more than it gave Bryan; and in 1904 seven Democratic electors and one Republican were chosen; and in 1908 five Democratic and three Republican.

The proprietors of Maryland were: Cecilius Calvert, second Lord Baltimore (1605[?]–1675) from 1632 to 1675; Charles Calvert, third Lord Baltimore (1629–1715) from 1675 to 1715; Benedict Leonard Calvert, fourth Lord Baltimore (1684?–1715) 1715; Charles Calvert, fifth Lord Baltimore (1699–1751) from 1715 to 1751; Frederick Calvert, sixth and last Lord Baltimore (1731–1771) from 1751 to 1771; Henry Harford, from 1771 to 1776.

Governors of Maryland.

Proprietary.

Leonard Calvert	1633–1645
Richard Ingle (usurper)	1645
Edward Hill (chosen by the council)	1646
Leonard Calvert	1646–1647
Thomas Greene	1647–1649
William Stone	1649–1652
Richard Bennett Edmund Curtis William Claiborne (commissioners of parliament)	1652
William Stone	1652–1654
William Fuller and others (appointed by the commissioners of parliament)	1654–1658
Josias Fendall	1658–1660
Philip Calvert	1660–1661
Charles Calvert	1661–1675
Charles Calvert, third Lord Baltimore	1675–1676
Cecilius Calvert (titular) and Jesse Wharton (real)	1676
Thomas Notley	1676–1679
Charles Calvert, third Lord Baltimore	1679–1684
Benedict Leonard Calvert (titular) and council (real)	1684–1688
William Joseph (president of the council)	1688–1689
Protestant Associators under John Coode	1689–1692

Royal.

Sir Lionel Copley	1692–1693
Sir Edmund Andros	1693–1694
Francis Nicholson	1694–1699
Nathaniel Blackistone	1699–1702
Thomas Tench (president of the council)	1702–1704
John Seymour	1704–1709
Edward Lloyd (president of the council)	1709–1714
John Hart	1714–1715
John Hart	1715–1720
Charles Calvert	1720–1727
Benedict Leonard Calvert	1727–1731
Samuel Ogle	1731–1732
Charles Calvert, fifth Lord Baltimore	1732–1733
Samuel Ogle	1733–1742
Thomas Bladen	1742–1747
Samuel Ogle	1747–1752
Benjamin Tasker (president of the council)	1752–1753
Horatio Sharpe	1753–1769
Robert Eden	1769–1774
Robert Eden (nominal) and Convention and Council of Safety (real)	1774–1776

STATE

Thomas Johnson	1777–1779
Thomas Sim Lee	1779–1782
William Paca	1782–1785
William Smallwood	1785–1788
John Eager Howard	1788–1791
George Plater[1]	1791–1792

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[1] Died in office.

James Brice (acting)		1792
Thomas Sim Lee		1792–1794
John H. Stone		1794–1797
John Henry	Democratic Republican	1797–1798
Benjamin Ogle	Federalist	1798–1801
John Francis Mercer	Democratic Republican	1801–1803
Robert Bowie	" "	1803–1806
Robert Wright[1]	" "	1806–1808
James Butcher (acting)		1808–1809
Edward Lloyd	Whig	1809–1811
Robert Bowie	Democratic Republican	1811–1812
Levin Winder	Federalist	1812–1815
Charles Ridgely	"	1815–1818
Charles Goldsborough	"	1818–1819
Samuel Sprigg	Democratic Republican	1819–1822
Samuel Stevens, jun.	" "	1822–1825
Joseph Kent	" "	1825–1828
Daniel Martin	Anti-Jackson	1828–1829
Thomas King Carroll	Jackson Democrat	1829–1830
Daniel Martin	Anti-Jackson	1830–1831
George Howard (acting)	Whig	1831–1832
George Howard	"	1832–1833
James Thomas	"	1833–1835
Thomas W. Veazey	"	1835–1838
William Grason	Democrat	1838–1841
Francis Thomas	"	1841–1844
Thomas G. Pratt	Whig	1844–1847
Philip Francis Thomas	Democrat	1847–1850
Enoch Louis Lowe	"	1850–1853
Thomas Watkins Ligon	"	1853–1857
Thomas Holliday Hicks	American or Know-Nothing	1857–1861
Augustus W. Bradford	Unionist	1861–1865
Thomas Swann	"	1865–1868
Oden Bowie	Democrat	1868–1872
William Pinkney Whyte[2]	"	1872–1874
James Black Groome	"	1874–1876
John Lee Carroll	"	1876–1880
William T. Hamilton	"	1880–1884
Robert M. McLane	"	1884–1885
Henry Lloyd	"	1885–1888
Elihu E. Jackson	"	1888–1892
Frank Brown	"	1892–1896
Lloyd Lowndes	Republican	1896–1900
John Walter Smith	Democrat	1900–1904
Edwin Warfield	"	1904–1908
Austin L. Crothers	"	1908–

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(N. D. M.)

MARYPORT, a market town and seaport in the Cockermouth parliamentary division of Cumberland, England, 25 m. W.S.W. of Carlisle, on the Maryport & Carlisle railway. Pop. of urban district (1901), 11,897. It is irregularly built on the shore of the Irish Sea and on the cliffs above, at the mouth of the river Ellen. Until 1750 there were only a few huts here, the spot being called Ellenfoot, but at this time the harbour was built by Humphrey Senhouse. In 1892 Maryport became an independent port with Workington, Whitehaven and Millom subordinate to it. Coal and pig-iron are exported from the mining district inland, and shipbuilding is carried on. There are also rope and sail works, iron-foundries, saw-mills, breweries and tanneries. On the hill north of the town there is a Roman fort which guarded the coast, and many remains of this period have been discovered. The fort was called Uxellodunum.

MARZABOTTO, a village of Emilia, Italy, in the province of Bologna, 17 m. S.S.W. of Bologna by rail. Pop. (1901), 617 (village); 5272 (commune). It lies in the valley of the Reno, 443 ft. above sea-level. In and below the grounds of the Villa Aria, close to it, are the remains of an Etruscan town of the 5th century B.C., protected on the west by the mountains, on the east and south by the river, which by a change of course has destroyed about half of it. The acropolis was just below the villa: here remains of temples were found. The town lay below the modern high-road and was laid out on a rectangular plan divided by main streets into eight quarters, and these in turn into blocks or *insulae*. Cemeteries were found on the east and north of the site. The name of the place is unknown: it was partially inhabited later by the Gauls, but was not occupied by the Romans.

The discoveries of 1888–1889 (with references to previous works), are described by E. Brizio in *Monumenti dei Lincei* (1891), i. 249 sqq.

(T. As.)

MASACCIO (1402–1429), Italian painter. Tommaso Guidi, son of a notary, Ser Giovanni di Simone Guidi, of the family of the Scheggia, who had property in Castel S. Giovanni di Val d'Arno, was born in 1402 (according to Milanesi, on the 21st of December 1401), and acquired the nickname of Masaccio, which may be translated "Lubberly Tom," in consequence of his slovenly dressing and deportment. From childhood he showed a great inclination for the arts of design, and he is said to have studied under his contemporary Masolino da Panicale. In 1421, or perhaps 1423, he was enrolled in the gild of the speziali (druggists) in Florence, in 1424 in the gild of painters. His first attempts in painting were made in Florence, and then in Pisa. Next he went to Rome, still no doubt very young; although the statement that he returned from Rome to Florence, in 1420, when only eighteen or nineteen, seems incredible, considering the works he undertook in the papal city. These included a series of frescoes still extant in a chapel of the church of S. Clemente, a Crucifixion, and scenes from the life of St Catherine and of St Clement, or perhaps some other saint. Though much inferior to his later productions, these paintings are, for naturalism and propriety of representation, in advance of their time. Some critics, however, consider that the design only, if even that, was furnished by Masaccio, and the execution left to an inferior hand; this appears highly improbable, as Masaccio, at his early age, can scarcely have held the position of a master laying out work for subordinates; indeed Vasari says that Lubberly Tom was held in small esteem at all times of his brief life. In the Crucifixion subject the group of the Marys is remarkable; the picture most generally admired is that of Catherine, in the presence of Maxentius, arguing against and converting eight learned doctors. After returning to Florence, Masaccio was chiefly occupied in painting in the church of the Carmine, and especially in that "Brancacci Chapel" which he has rendered famous almost beyond rivalry in the annals of painting.

The chapel had been built early in the 15th century by Felice Michele di Piuvichese Brancacci, a noble Florentine. Masaccio's work in it began probably in 1423, and continued at intervals until he finally quitted Florence in 1428. There is a whole library-shelf of discussion as to what particular things were done by Masaccio and what by Masolino, and long afterwards by Filippino Lippi, in the Brancacci Chapel, and also as to certain other paintings by Masaccio in the Carmine. He began with a trial piece, a majestic figure of St Paul, not in the chapel; this has perished. A monochrome of the Procession for the Consecration of the Chapel, regarded as a wonderful example, for that early period, of perspective and of grouping, has also disappeared; it contains portraits of Brunelleschi, Donatello and many others. In the cloister of the Carmine was discovered in recent years a portion of a fresco by Masaccio representing a procession; but this, being in colours and not in monochrome, does not appear to be the Brancacci procession. As regards the works in the Brancacci chapel itself, the prevalent opinion now is that Masolino, who used to be credited with a considerable portion of them, did either nothing, or at most the solitary compartment which represents St Peter restoring Tabitha to life, and the same saint healing a cripple. The share which Filippino Lippi bore in the work admits of little doubt; to him are due various items on which the fame of Masaccio used principally to be based—as for instance the figure of St Paul addressing Peter in prison, which Raphael partly appropriated; and hence it may be observed that an eloquent and often-quoted outpouring of Sir Joshua Reynolds in praise of Masaccio ought in great part to be transferred to Filippino. What Masaccio really painted in the chapel appears with tolerable certainty to be as follows, and is ample enough to sustain the high reputation he has always enjoyed:—(1) The "Temptation of Adam and Eve"; (2) "Peter and the Tribute-Money"; (3) The "Expulsion from Eden"; (4) "Peter Preaching"; (5) "Peter Baptizing"; (6) "Peter Almsgiving"; (7) "Peter and John curing the Sick"; (8) "Peter restoring to Life the Son of King Theophilus of Antioch" was begun by Masaccio, including the separate incident of "Peter Enthroned," but a large proportion is by Filippino; (9) the double subject already allotted to Masolino may perhaps be by Masaccio, and in that case it must have been one of the first in order of execution. A few words may be given to these pictures individually. (1) The "Temptation" shows a degree of appreciation of nude form, corresponding to the feeling of the antique, such as was at that date unexampled in painting. (2) The "Tribute-Money," a full, harmonious and expressive composition, contains a head reputed to be the portrait of Masaccio himself—one of the apostles, with full locks, a solid resolute countenance and a pointed beard. (3) The "Expulsion" was so much admired by Raphael that, with comparatively slight modifications, he adopted it as his own in one of the subjects of the Logge of the Vatican. (5) "Peter Baptizing" contains some nude figures of strong naturalistic design; that of the young man, prepared for the baptismal ceremony, who stands half-shivering in the raw air, has always been a popular favourite and an object of artistic study. (8) The restoration of the young man to life has been open to much discussion as to what precise subject was in view, but the most probable opinion is that the legend of King Theophilus was intended.

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[1] Resigned on the 6th of May 1808.

[2] Resigned in 1874 to become (March 4, 1875) U.S. senator from Maryland.

In 1427 Masaccio was living in Florence with his mother, then for the second time a widow, and with his younger brother Giovanni, a painter of no distinction; he possessed nothing but debts. In 1428 he was working, as we have seen, in the Brancacci chapel. Before the end of that year he disappeared from Florence, going, as it would appear, to Rome, to evade the importunities of creditors. Immediately afterwards, in 1429, when his age was twenty-seven or twenty-eight, he was reported dead. Poisoning by jealous rivals in art was rumoured, but of this nothing is known. The statement that several years afterwards, in 1443, he was buried in the Florentine Church of the Carmine, without any monument, seems to be improbable, and to depend upon a confused account of the dates, which have now, after long causing much bewilderment, been satisfactorily cleared up from extant documents.

It has been said that Masaccio introduced into painting the plastic boldness of Donatello, and carried out the linear perspective of Paolo Uccello and Brunelleschi (who had given him practical instruction), and he was also the first painter who made some considerable advance in atmospheric perspective. He was the first to make the architectural framework of his pictures correspond in a reasonable way to the proportions of the figures. In the Brancacci chapel he painted with extraordinary swiftness. The contours of the feet and articulations in his pictures are imperfect; and his most prominent device for giving roundness to the figures (a point in which he made a great advance upon his predecessors) was a somewhat mannered way of putting the high lights upon the edges. His draperies were broad and easy, and his landscape details natural, and superior to his age. In fact, he led the way in representing the objects of nature correctly, with action, liveliness and relief. Soon after his death, his work was recognized at its right value, and led to notable advances; and all the greatest artists of Italy, through studying the Brancacci chapel, became his champions and disciples.

Of the works attributed to Masaccio in public or private galleries hardly any are authentic. The one in the Florentine Academy, the "Virgin and Child in the Lap of St Anna," is an exception. The so-called portrait of Masaccio in the Uffizi Gallery is more probably Filippino Lippi; and Filippino, or Botticelli, may be the real author of the head, at first termed a Masaccio, in the National Gallery, London.

An early work on Masaccio was that of T. Patch, *Life with Engravings* (Florence, 1770–1772). See Layard, *The Brancacci Chapel*, &c. (1868); H. Eckstein, *Life of Masaccio, Giotto*, &c. (1882); Charles Yriarte, *Tommaso dei Guidi* (1894). (W. M. R.)

MASAI, an Eastern Equatorial African people of Negro-Hamitic stock, speaking a Nilotic language. The Hamitic element, which is not great, has probably been derived from the Galla. The Masai were probably isolated in the high mountains or plateaus which lie between the Nile and the Karamojo country There they originally had their home, and there to-day the Latuka, who show affinities with them, still live. Famine or inter-tribal wars drove the Masai in the direction of Mount Elgon and Lake Rudolf. After a long settlement there they split into two groups, the Masai proper and the Wa-Kuafi or agricultural Masai, and this at no very remote date, as the two tribes speak practically the same language. The more powerful Masai were purely nomadic and pastoral, their wealth consisting in enormous herds. The Wa-Kuafi, losing their cattle to their stronger kinsmen, split up again into the Burkeneji, the Gwas Ngishu, and the Nyarusi (Enjamusi) and settled as agriculturists. Meantime the Masai became masters of the greater part of inner East Africa from Ugogo and the Unyamwezi countries on the south and west to Mount Kenya and Galla-land on the north, and eastward to the hundred-mile strip of more or less settled Bantu country on the coast of the Indian Ocean.

The Masai physical type is slender, but among the finest in Africa. A tall, well-made people, the men are often well over six feet, with slim wiry figures, chocolate-coloured, with eyes often slightly oblique like the Mongolians, but the nose especially being often almost Caucasian in type, with well formed bridge and finely cut nostrils. Almost all the men and women knock out the two lower incisor teeth. For this custom they give the curious explanation that lockjaw was once very common in Masai-land, and that it was found to be easy to feed the sufferer through the gap thus made. All the hair on the body of both sexes is pulled out with iron tweezers; a Masai with a moustache or beard is unknown. The hair of the head is shaved in women and married men; but the hair of a youth at puberty is allowed to grow till it is long enough to have thin strips of leather plaited into it. In this way the hair, after a coating of red clay and mutton fat, is made into pigtails, the largest of which hangs down the back, another over the forehead, and one on each side. The warriors smear their whole bodies with the clay and fat, mixed in equal proportion.

No tattooing or scarring is performed on the men, but Sir Harry Johnston noticed women with parallel lines burnt into the skin round the eyes. In both sexes the lobes of the ears are distended into great loops, through holes in which large disks of wood are thrust. Bead necklaces, bead and wood armlets are worn by men, and before marriage the Masai girl has thick iron wire wound round her legs so tightly as to check the calf development. The women wear dressed hides or calico; the old men wear a skin or cloth cape. The warriors wind red calico round their waists, a circle of ostrich feathers round their face (or a cap of lion or colobus skin) and fringes of long white fur round the knee. Masai houses are of two kinds. The agricultural tribes build round huts with walls of reeds or sticks, and conical, grass-thatched roofs. The true Masai nomads, however, have houses unlike those of any other neighbouring negro tribe. Long, low (not more than 6 ft. high), flat-roofed, they are built on a framework of sticks with strong partitions dividing the structure into separate compartments, each a dwelling, with low, oblong door. Mud and cow-dung are plastered on to the brushwood used in the roofing. Beds are made of brushwood neatly stacked and covered with hides. The fireplace is a circle of stones. The only furniture, besides cooking-pots, consists of long gourds used as milkcans, half-gourds as cups, and small three-legged stools cut out of a single block of wood and used by the elder men to sit on. The Masai are not hunters of big game except lions, but they eat the eland and kudu. The domestic animals are cattle, sheep, goats, donkeys and dogs. Only women and the married men smoke. The dead are ordinarily not buried, but the bodies are carried a short distance from the village and left on the ground to be devoured by hyenas, jackals and vultures. Important chiefs are buried, however, and a year later the eldest son or successor recovers the skull, which is treasured as a charm. The medicine men of Masai are often the chiefs, and the supreme chief is almost always a medicine man.

The Masai believe in a nature-god as a supreme being—Ngai ("sky")—and his aid is invoked in cases of drought by a ceremonial chant of the children, standing in a circle after sunset, each with a bunch of grass in its hand. They have creation-myths involving four gods, the black, white, grey and red deities. They believe there is no future for women or common people, but that such distinction is reserved for chiefs. Pythons and a species of snake are revered as the reincarnated forms of their more celebrated ancestors. A kind of worship is paid to the hyena in some districts: the whole tribe going into mourning if the beast crosses their path. The Masai also have a vague tree-worship, and grass is a sacred symbol. When making peace a tuft is held in the right hand, and when the warriors start out on a raid their sweethearts throw grass after them or lay it in the forks of trees. But the oddest of their superstitious customs is the importance attached to spitting. To spit upon a person or thing is regarded as a sign of reverence and goodwill, as among other Nilotic tribes. Newly born children are spat on by every one who sees them. Johnston states that every Masai before extending his hand to him spat on it first. They spit when they meet and when they part, and bargains are sealed in this way. Joseph Thomson writes, "being regarded as a wizard of the first water, the Masai flocked to me . . . and the more copiously I spat on them the greater was their delight." The Masai has no love for work, and practises no industries. The women attend to his personal needs; and trades such as smelting and forging are left to enslaved tribes such as the Dorobo (Wandorobo). These manufacture spears with long blades and butts and the peculiar swords or *simés* like long slender leaves, very narrow towards the hilt and broad at the point. Most of the Masai live in the British East Africa Protectorate.

See A. C. Hollis, *The Masai, their Language and Folklore* (1905); M. Merker, *Die Nasai* (1904); Sir H. H. Johnston, *Kilimanjaro Expedition* (1886) and *Uganda Protectorate* (1902); Joseph Thomson, *Through Masai-land* (1885); O. Baumann, *Durch Massai-land zur Nilquelle* (1894); F. Kallenberg, *Auf dem Kriegspfad gegen die Massai* (1892).

MASANIELLO, an abbreviation of Tommaso Aniello (1622–1647), an Amalfi fisherman, who became leader of the revolt against Spanish rule in Naples in 1647. Misgovernment and fiscal oppression having aroused much discontent throughout the two Sicilies, a revolt broke out at Palermo in May 1647, and the people of Naples followed the example of the Sicilians. The immediate occasion of the latter rising was a new tax on fruit, the ordinary food of the poor, and the chief instigator of the movement was Masaniello, who took command of the malcontents. The outbreak began on the 7th of July 1647 with a riot at the city gates between the fruit-vendors of the environs and the customs officers; the latter were forced to flee, and the customs office was burnt. The rioters then poured into Naples and forced their way into the palace of the viceroy, the hated Count d'Arcos, who had to take refuge first in a neighbouring convent, then in Castel Sant' Elmo, and finally in Castelnuovo. Masaniello attempted to discipline the mob and restrain its vandalic instincts, and to some extent he succeeded; attired in his fisherman's garb, he gave audiences and administered justice from a wooden scaffolding outside his house. Several rioters, including the duke of Maddaloni, an opponent of the viceroy, and his brother Giuseppe Caraffa, who had come to Naples to make trouble, were condemned to death by him and executed. The mob, which every day obtained more arms and was becoming more intractable, terrorized the city, drove off the troops summoned from outside, and elected Masaniello "captain-general"; the revolt was even spreading to the provinces. Finally, the viceroy, whose negotiations with Masaniello had been frequently interrupted by fresh tumults, ended by granting all the concessions demanded of him. On the 13th of July, through the mediation of Cardinal Filomarino, archbishop of Naples, a convention was signed between D'Arcos and Masaniello as "leader of the most faithful people of Naples," by which the rebels were pardoned, the more oppressive taxes removed, and the citizens granted certain rights, including that of remaining in arms until the treaty should have been ratified by the king of Spain. The astute D'Arcos then invited Masaniello to the palace, confirmed his title of "captain-general of the Neapolitan people," gave him a gold chain of office, and offered him a pension. Masaniello refused the pension and laid down his dignities, saying that he wished to return to his old life as a fisherman; but he was entertained by the viceroy and, partly owing to the strain and excitement of the past days, partly because he was made dizzy by his astonishing change of fortune, or perhaps, as it was believed, because he was poisoned, he lost his head and behaved like a frenzied maniac. The people continued to obey him for some days, until, abandoned by his best friends, who went over to the Spanish party, he was murdered while haranguing a mob on the market-place on the 16th of July 1647; his head was cut off and brought by a band of roughs to the viceroy and the body buried outside the city. But the next day the populace, angered by the alteration of the measures for weighing bread, repented of its insane fury; the body of Masaniello was dug up and given a splendid funeral, at which the viceroy himself was represented.

Masaniello's insurrection appealed to the imagination of poets and composers, and formed the subject of several operas, of which the most famous is Auber's *La Muette de Portici* (1828).

See Saavedra, *Insurreccion de Napoli en 1647* (2 vols., Madrid, 1849); A. von Reumont, *Die Caraffa von Maddaloni* (2 vols., Berlin, 1849); Capasso, *La Casa e famiglia di Masaniello* (Naples, 1893); V. Spinazzola, *Masaniello e la sua famiglia, secondo un codice bolognese del sec. xvi.* (in the review *Flegrea*, 1900); A. G. Meissner, *Masaniello* (in German); E. Bourg, *Masaniello* (in French); F. Palermo, *Documenti diversi sulle novità accadute in Napoli l'anno 1647* (in the *Archivio storico italiano*, 1st series, vol. ix.). See also Naples.

MASAYA, the capital of the department of Masaya, Nicaragua, 13 m. W.N.W. of Lake Nicaragua and the city of Granada, on the eastern shore of Lake Masaya, and on the Granada-Managua railway. Pop. (1905), about 20,000. The city is built in the midst of a very fertile lowland region, which yields large quantities of tobacco. The majority of the inhabitants are Indians or half-castes. Lake Masaya occupies an extinct crater; the isolated volcano of Masaya (3000 ft.) on the opposite side of the lake was active at the time of the conquest of Nicaragua in 1522, and the conquerors, thinking the lava they saw was gold, had themselves lowered into the crater at the risk of their lives. The volcano was in eruption in 1670, 1782, 1857 and 1902.

MASCAGNI, PIETRO (1863–), Italian operatic composer, was born at Leghorn, the son of a baker, and educated for the law; but he neglected his legal studies for music, taking secret lessons at the Instituto Luigi Cherubini. There a symphony by him was performed in 1879, and various other compositions attracted attention, so that money was provided by a wealthy amateur for him to study at the Milan Conservatoire. But Mascagni chafed at the teaching, and soon left Milan to become conductor to a touring operatic company. After a somewhat chequered period he suddenly leapt into fame by the production at Rome in 1890 of his one-act opera *Cavalleria Rusticana*, containing a tuneful "intermezzo," which became wildly popular. Mascagni was the musical hero of the hour, and *Cavalleria Rusticana* was performed everywhere. But his later work failed to repeat this success. *L'Amico Frits* (1891), *I Rantzau* (1892), *Guglielmo Ratcliff* (1895), *Silvano* (1895), *Zanetto* (1896), *Iris* (1898), *Le Maschere* (1901), and *Amica* (1905), were coldly or adversely received; and though *Cavalleria Rusticana*, with its catchy melodies, still held the stage, this succession of failures involved a steady decline in the composer's reputation. From 1895 to 1903 Mascagni was director of the Pesaro Conservatoire, but in the latter year, having left his post in order to tour through the United States, he was dismissed from the appointment.

MASCARA, chief town of an arrondissement in the department of Oran, Algeria, 60 m. S.E. of Oran. It lies 1800 ft. above the sea, on the southern slope of a range forming part of the Little Atlas Mountains, and occupies two small hills separated by the Wad Tudman, which is crossed by three stone bridges. The walls, upwards of two miles in circuit, and strengthened by bastions and towers, give the place a somewhat imposing appearance. Mascara is a town of the French colonial type, few vestiges of the Moorish period remaining. Among the public buildings are two mosques, in one of which Abd-el-Kader preached the *jihad*. The town also contains the usual establishments attaching to the seat of a sub-prefect and the centre of a military subdivision. The principal industry is the making of wine, the white wines of Mascara being held in high repute. There is also a considerable trade in grains and oil. A branch railway eight miles long connects Mascara with the line from the seaport of Arzeu to Ain Sefra. Access is also gained by this line to Oran, Algiers, &c. Pop. (1906) of the town, 18,989; of the commune, which includes several villages, 22,934; of the arrondissement, comprising eleven communes, 190,154.

Mascara (*i.e.* "mother of soldiers") was the capital of a Turkish beylik during the Spanish occupation of Oran from the 16th to the close of the 18th century; but for the most of that period it occupied a site about two miles distant from the present position. On the removal of the bey to Oran its importance rapidly declined; and it was an insignificant place when in 1832 Abd-el-Kader, who was born in the neighbourhood, chose it as the seat of his power. It was laid in ruins by the French under Marshal Clausel and the duke of Orleans in 1835, the amir retreating south. Being reoccupied by Abd-el-Kader in 1838, Mascara was again captured in 1841 by Marshal Bugeaud and General Lamoricière.

MASCARENE ISLANDS (occasionally MASCARENHAS), the collective title of a group in the Indian Ocean east of Madagascar, viz. Mauritius, Réunion and Rodriguez (*q.v.*). The collective title is derived from the Portuguese navigator Mascarenhas, by whom Réunion, at first called Mascarenhas, was discovered.

MASCARON, JULES (1634–1703), French preacher, was the son of a barrister at Aix. Born at Marseilles in 1634, he early entered the French Oratory, and obtained great reputation as a preacher. Paris confirmed the judgment of the provinces; in 1666 he was asked to preach before the court, and became a great favourite with Louis XIV., who said that his eloquence was one of the few things that never grew old. In 1671 he was appointed bishop of Tulle; eight years later he was transferred to the larger diocese of Agen. He still continued, however, to preach regularly at court, being especially in request for funeral orations. A panegyric on Turenne, delivered in 1675, is considered his masterpiece. His style is strongly tinged with *préciosité*; and his chief surviving interest is as a glaring example of the evils from which Bossuet delivered the French pulpit. During his later years he devoted himself entirely to his pastoral duties at Agen, where he died in 1703.

Six of his most famous sermons were edited, with a biographical sketch of their author, by the Oratorian Borde in 1704.

MASCHERONI, LORENZO (1750–1800), Italian geometer, was professor of mathematics at the university of Pavia, and published a variety of mathematical works, the best known of which is his *Geometria del compasso* (Pavia, 1797), a collection of geometrical constructions in which the use of the circle alone is postulated. Many of the solutions are most ingenious, and some of the constructions of considerable practical importance.

There is a French translation by A. M. Carette (Paris, 1798), who also wrote a biography of Mascheroni. See Poggendorff, *Biog. Lit. Handwörterbuch*.

MASCOT (Fr. slang: perhaps from Port. *mascotto*, "witchcraft"), the term for any person, animal, or thing supposed to bring luck. The word was first popularized by Edmond Audran through his comic opera *La Mascotte* (1880), but it had been common in France long before among gamblers. It has been traced back to a dialectic use in Provence and Gascony, where it meant something which brought luck to a household. The suggestion that it is from *masqué* (masked or concealed), the provincial French for a child born with a caul, in allusion to the lucky destiny of such children, is improbable.

MASDEU, JUAN FRANCISCO (1744–1817), Spanish historian, was born at Palermo on the 4th of October 1744. He joined the Company of Jesus on the 19th of December 1759, and became professor in the Jesuit seminaries at Ferrara and Ascoli. He visited Spain in 1799, was exiled, and returned in 1815, dying at Valencia on the 11th of April 1817. His *Storia critica di Spagna e della cultura spagnuola in ogni genere* (2 vols., 1781–1784) was finally expanded into the *Historia critica de España y de la cultura española* (1783–1805), which, though it consists of twenty volumes, was left unfinished; had it been continued on the same scale, the work would have consisted of fifty volumes. Masdeu wrote in a critical spirit and with a regard for accuracy rare in his time; but he is more concerned with small details than with the philosophy of history. Still, his narrative is lucid, and later researches have not yet rendered his work obsolete.

MASERU, the capital of Basutoland, British South Africa. It is pleasantly situated on the left bank of the Caledon river, 90 m. by rail E. by S. of Bloemfontein, and 40 m. N.E. of Wepener. It is in the centre of a fertile grain-growing district. Pop. (1904), 862, of whom 99 were Europeans. The principal buildings are Government House, the church of the Paris Evangelical Missionary Society, the hospital, and the railway station. (See BASUTOLAND.)

MASHAM, ABIGAIL, LADY (d. 1734), favourite of Anne, queen of England, was the daughter of Francis Hill, a London merchant, her mother being an aunt of Sarah Jennings, duchess of Marlborough. The family being reduced to poor circumstances through Hill's speculations, Lady Churchill (as she then was), lady of the bedchamber to the Princess Anne, befriended her cousin Abigail, whom she took into her own household at St Albans, and for whom after the accession of the princess to the throne she procured an appointment in the queen's household about the year 1704. It was not long before Abigail Hill began to supplant her powerful and imperious kinswoman in the favour of Queen Anne. Whether she was guilty of the deliberate ingratitude charged against her by the duchess of Marlborough is uncertain. It is not unlikely that, in the first instance at all events, Abigail's influence over the queen was not so much due to subtle scheming on her part as to the pleasing contrast between her gentle and genial character and the dictatorial temper of the duchess, which after many years of undisputed sway had at last become intolerable to Anne. The first intimation of her protégé's growing favour with the queen came to the duchess in the summer of 1707, when she learned that Abigail Hill had been privately married to a gentleman of the queen's household named Samuel Masham, and that the queen herself had been present at the marriage. Inquiry then elicited the information that Abigail had for some time enjoyed considerable intimacy with her royal mistress, no hint of which had previously reached the duchess. Abigail was said to be a cousin of Robert Harley, earl of Oxford, and after the latter's dismissal from office in February 1708 she assisted him in maintaining confidential relations with the queen. The completeness of her ascendancy was seen in 1710 when the queen compelled Marlborough, much against his will, to give an important command to Colonel John Hill, Abigail's brother; and when Sunderland, Godolphin, and the other Whig ministers were dismissed from office, largely owing to her influence, to make way for Oxford and Bolingbroke. In the following year the duchess of Marlborough was also dismissed from her appointment at court, Mrs Masham taking her place as keeper of the privy purse. In 1711 the ministers, intent on bringing about the disgrace of Marlborough and arranging the Peace of Utrecht, found it necessary to secure their position in the House of Lords by creating twelve new peers; one of these was Samuel Masham, the favourite's husband, though Anne showed some reluctance to raise her bedchamber woman to a position in which she might show herself less ready to give her personal services to the queen. Lady Masham soon quarrelled with Oxford, and set herself to foster by all the means in her power the queen's growing personal distaste for her minister. Oxford's vacillation between the Jacobites and the adherents of the Hanoverian succession to the Crown probably strengthened the opposition of Lady Masham, who now warmly favoured the Jacobite party led by Bolingbroke and Atterbury. Altercations took place in the queen's presence between Lady Masham and the minister; and finally, on the 27th of July 1714, Anne dismissed Oxford from his office of lord high treasurer, and three days later gave the staff to the duke of Shrewsbury. Anne died on the 1st of August, and Lady Masham then retired into private life. She died on the 6th of December 1734.

Lady Masham was by no means the vulgar, ill-educated person she was represented to have been by her defeated rival, the duchess of Marlborough; her extant letters, showing not a little refinement of literary style, prove the reverse. Swift, with whom both she and her husband were intimate, describes Lady Masham as "a person of a plain sound understanding, of great truth and sincerity, without the least mixture of falsehood or disguise." The barony of Masham became extinct when Lady Masham's son, Samuel, the 2nd baron, died in June 1776.

AUTHORITIES.—Gilbert Burnet, *History of My Own Time*, vol. vi. (2nd ed., 6 vols., Oxford, 1833); F. W. Wyon, *History of Great Britain during the Reign of Queen Anne* (2 vols., London, 1876); Earl Stanhope, *History of England, comprising the Reign of Queen Anne until the Peace of Utrecht* (London, 1870), and *History of England from the Peace of Utrecht*, vol. i. (7 vols., London, 1836–1854); Justin McCarthy, *The Reign of Queen Anne* (2 vols., London, 1902); *An Account of the Conduct of the Dowager Duchess of Marlborough from first coming to Court to 1710*, edited by Nathaniel Hooke, with an anonymous reply entitled *A Review of a Late Treatise* (London, 1842); *Private Correspondence of Sarah, Duchess of Marlborough* (2 vols., London, 1838); *Letters of Sarah, Duchess of Marlborough* (London, 1875); Mrs Arthur Colville, *Duchess Sarah* (London, 1904). Numerous references to Lady Masham will also be found scattered through Swift's *Works* (2nd ed., 19 vols., Edinburgh, 1824).

(R. J. M.)

MASHAM, SAMUEL CUNLIFFE LISTER, 1st Baron (1815–1906), English inventor, born at Calverley Hall, near Bradford, on the 1st of January 1815, was the fourth son of Ellis Cunliffe (1774–1853), who successively took the names of Lister and Lister-Kay, and was the first member of parliament elected for Bradford after the Reform Act of 1832. It was at first proposed that he should take orders, but he preferred a business career and became a clerk at Liverpool. In 1838 he and his elder brother John started as worsted spinners and manufacturers in a new mill which their father built for them at Manningham, and about five years later he turned his attention to the problem of mechanical wool-combing, which, in spite of the efforts of E. Cartwright and numerous other inventors, still awaited a satisfactory solution. Two years of hard work spent in modifying and improving existing devices enabled him to produce a machine which worked well, and subsequently he consolidated his position by buying up rival patents, as well as by taking out additional ones of his own. His combing machines came into such demand that though they were made for only £200 apiece he was able to sell them for £1200, and the saving they effected in the cost of production not only brought about a reduction in the price of clothing, but in consequence of the increase in the sales created the necessity for new supplies of wool, and thus contributed to the development of Australian sheep-farming. In 1855 he was sent a sample of silk waste (the refuse left in reeling silk from the cocoons) and asked whether he could find a way of utilizing the fibre it contained. The task occupied his time for many years and brought him to the verge of bankruptcy, but at last he succeeded in perfecting silk-combing appliances which enabled him to make yarn that in one year sold for 23s. a pound, though produced from raw material costing only 6d. or 1s. a pound. Another important and lucrative invention in connexion with silk manufacture was his velvet loom for piled fabrics; and this, with the silk comb worked at his Manningham mill, yielded him an annual income of £200,000 for many years. But the business was seriously affected by the prohibitory duties imposed by America, and this was one reason why he was an early and determined critic of the British policy of free imports. In 1891 he was made a peer; he took his title from the little Yorkshire town of Masham, close to which is Swinton Park, purchased by him in 1888. In 1886 an Albert medal was awarded him for his inventions, which were mostly related to the textile industries, though he occasionally diverged to other subjects, such as an air-brake for railways. He was fond of outdoor sports, especially coursing and shooting, and was a keen patron of the fine arts. He died at Swinton Park on the 2nd of February 1906, and was succeeded in the title by his son.

MASHONA, a Bantu-negro people, inhabitants of Mashonaland, Southern Rhodesia. The name Mashona has been derived from the contemptuous term *Amaskuina* applied by the Matabele to the aborigines owing to the habit of the latter of taking refuge in the rocky hills with which the country abounds. Before the Matabele invasion about 1840 most of Southern Rhodesia was occupied by the Makalanga, the Makorikori and the Banyai, all closely related. Most of them became subject to the Matabele, but although they suffered severely from their attacks, the Mashona preserved a certain national unity. In 1890 the Mashona came under British protection (see RHODESIA). They are in general a peaceful, mild-mannered people, industrious and successful farmers, skilful potters, and weavers of bark cloth.

The crafts, however, in which they excel are the smelting and forging of iron and wood-carving. They are also great hunters; and they are very fond of music, the most usual instrument being the "piano" with iron keys. Bows and arrows, assegais and axes are the native weapons, but all who can get them now use guns. Up to their conquest by the Matabele the Mashona worked the gold diggings which are scattered over their country; indeed as late as 1870 certain Mashona were still extracting gold from quartz (*Geog. Jour.* April 1906).

For the possible connexion of these people with the builders of the ruins at Zimbabwe and elsewhere, see RHODESIA: *Archaeology*; and ZIMBABWE.

MASK (Fr. *masque*, apparently from med. Lat. *mascus*, *masca*, spectre, through Ital. *maschera*, Span. *mascara*), a covering for the face, taking various forms, used either as a protective screen or as a disguise. In the latter sense masks are mostly associated with the artificial faces worn by actors in dramatic representations, or assumed for exciting terror (*e.g.* in savage rites). The spelling "masque," representing the same word, is now in English used more specially for certain varieties of drama in which masks were originally worn (see DRAMA); so also "masquerade," particularly in the sense of a masked ball or an entertainment where the personages are disguised. Both "mask" and "masquerade" have naturally passed into figurative and technical meanings, the former especially for various senses of face and head (head of a fox, grotesque faces in sculpture), or as equivalent to "cloak" or "screen" (as in fortification or other military uses, fencing, &c.). And in the case of "death-masks" the term is employed for the portrait-casts, generally of plaster or metallic foil, taken from the face of a dead person (also similarly from the living), an ancient practice of considerable interest in art. An interesting collection made by Laurence Hutton (see his *Portraits in Plaster*, 1894), is at Princeton University in the United States. (For the historical mystery of the "man in the iron mask," see IRON MASK.)

The ancient Greek and Roman masks worn by their actors—hollow figures of heads—had the double object of identifying the performers with the characters assumed, and of increasing the power of the voice by means of metallic mouthpieces. They were derived like the drama from the rural religious festivities, the wearing of mock faces or beards being a primitive custom, connected no doubt with many early types of folk-lore and religion. The use of the dramatic mask was evolved in the later theatre through the mimes and the Italian popular comedy into pantomime; and the masquerade similarly came from Italy, where the *domino* was introduced from Venice. The *domino* (originally apparently an ecclesiastical garment) was a loose cloak with a small half-mask worn at masquerades and costume-balls by persons not otherwise dressed in character; and the word is applied also to the person wearing it.

See generally Altmann, *Die Masken der Schauspieler* (1875; new ed., 1896); and Dale, *Masks, Labrets and Certain Aboriginal Customs* (1885); also DRAMA.

MASKELYNE, NEVIL (1732–1811), English astronomer-royal, was born in London on the 6th of October 1732. The solar eclipse of 1748 made a deep impression upon him; and having graduated as seventh wrangler from Trinity College, Cambridge, in 1754, he determined to devote himself wholly to astronomy. He became intimate with James Bradley in 1755, and in 1761 was deputed by the Royal Society to make observations of the transit of Venus at St Helena. During the voyage he experimented upon the determination of longitude by lunar distances, and ultimately effected the introduction of the method into navigation (*q.v.*). In 1765 he succeeded Nathaniel Bliss as astronomer-royal. Having energetically discharged the duties of his office during forty-six years, he died on the 9th of February 1811.

Maskelyne's first contribution to astronomical literature was "A Proposal for Discovering the Annual Parallax of Sirius," published in 1760 (*Phil. Trans.* li. 889). Subsequent volumes of the same series contained his observations of the transits of Venus (1761 and 1769), on the tides at St Helena (1762), and on various astronomical phenomena at St Helena (1764) and at Barbados (1764). In 1763 he published the *British Mariner's Guide*, which includes the suggestion that in order to facilitate the finding of longitude at sea lunar distances should be calculated beforehand for each year and published in a form accessible to navigators. This important proposal, the germ of the *Nautical Almanac*, was approved of by the government, and under the care of Maskelyne the *Nautical Almanac* for 1767 was published in 1766. He continued during the remainder of his life the superintendence of this invaluable annual. He further induced the government to print his observations annually, thereby securing the prompt dissemination of a large mass of data inestimable from their continuity and accuracy. Maskelyne had but one assistant, yet the work of the observatory was perfectly organized and methodically executed. He introduced several practical improvements, such as the measurement of time to tenths of a second; and he prevailed upon the government to replace Bird's mural quadrant by a repeating circle 6 ft. in diameter. The new instrument was constructed by E. Troughton; but Maskelyne did not live to see it completed. In 1772 he suggested to the Royal Society the famous Schehallion experiment for the determination of the earth's density and carried out his plan in 1774 (*Phil. Trans.* l. 495), the apparent difference of latitude between two stations on opposite sides of the mountain being compared with the real difference of latitude obtained by triangulation. From Maskelyne's observations Charles Hutton deduced a density for the earth 4·5 times that of water (ib. lxviii. 782). Maskelyne also took a great interest in various geodetical operations, notably the measurement of the length of a degree of latitude in Maryland and Pennsylvania (ibid. lviii. 323), executed by Mason and Dixon in 1766–1768, and later the determination of the relative longitude of Greenwich and Paris (ib. lxxvii. 151). On the French side the work was conducted by Count Cassini, Legendre, and Méchain; on the English side by General Roy. This triangulation was the beginning of the great trigonometrical survey which has since been extended all over the country. His observations appeared in four large folio volumes (1776–1811). Some of them were reprinted in S. Vince's *Astronomy* (vol. iii.). (A. M. C.)

MASOLINO DA PANICALE (1383–*c.* 1445), Florentine painter, was said to have been born at Panicale di Valdelsa, near Florence. It is more probable, however, that he was born in Florence itself, his father, Cristoforo Fini, who was an "imbiancatore," or whitewasher, having been domiciled in the Florentine quarter of S. Croce. There is reason to believe that Tommaso, nicknamed Masolino, was a pupil of the painter Starnina, and was principally influenced in style by Antonio Veneziano; he may probably enough have become in the sequel the master of Masaccio. He was born in 1383; he died later than 1429, perhaps as late as 1440 or even 1447. Towards 1423 he entered the service of Filippo Scolari, the Florentine-born *obergespann* of Temeswar in Hungary, and stayed some time in that country, returning towards 1427 to Italy. The only works which can with certainty be assigned to him are a series of wall paintings executed towards 1428, commissioned by Cardinal Branda Castiglione, in the church of Castiglione d'Olona, not far from Milan, and another series in the adjoining baptistery. The first set is signed as painted by "Masolinus de Florentia." It was recovered in 1843 from a coating of whitewash, considerably damaged; its subject matter is taken from the lives of the Virgin and of SS Lawrence and Stephen. The series in the baptistery relates to the life and death of John the Baptist. The reputation of Masolino had previously rested almost entirely upon the considerable share which he was supposed to have had in the celebrated frescoes of the Brancacci Chapel, in the Church of the Carmine in Florence; he was regarded as the precursor of Masaccio, and by many years the predecessor of Filippino Lippi, in the execution of a large proportion of these works. But from a comparison of the Castiglione with the Brancacci frescoes, and from other data, it is very doubtful whether Masolino had any hand at all in the latter series. Possibly he painted in the Brancacci Chapel certain specified subjects which are now either destroyed or worked over. Several paintings assigned to Masolino on the authority of Vasari are now ascribed to Masaccio. (W. M. R.)

MASON, FRANCIS (1799–1874), American missionary, was born in York, England, on the 2nd of April 1799. His grandfather, Francis Mason, was the founder of the Baptist Society in York, and his father, a shoemaker by trade, was a Baptist lay preacher there. After working with his father as a shoemaker for several years, he emigrated in 1818 to the United States, and in Massachusetts was licensed to preach as a Baptist in 1827. In 1830 he was sent by the American Baptist Missionary Convention to labour among the Karens in Burma. Besides conducting a training college for native preachers and teachers at Tavoy, he translated the Bible into the two principal dialects of the Karens, the Sgaw and the Pwo (his translation being published in 1853), and Matthew, Genesis, and the Psalms into the Bghai dialect. He also published *A Pali Grammar on the Basis of Kachchayano, with Chrestomathy and Vocabulary* (1868). In 1852 he published a book of great value on the fauna and flora of British Burma, of which an improved edition appeared in 1860 under the title *Burmah, its People and Natural Productions*, and a third edition (2 vols.) revised and enlarged by W. Theobald in 1882–1883. He died at Rangoon on the 3rd of March 1874.

See his autobiography, *The Story of a Working Man's Life, with Sketches of Travel in Europe, Asia, Africa and America* (New York, 1870).

MASON, GEORGE (1725–1792), American statesman, was born in Stafford county (the part which is now Fairfax county), Virginia, in 1725. His family was of Royalist descent and emigrated to America after the execution of Charles I. His colonial ancestors held official positions in the civil and military service of Virginia. Mason was a near neighbour and a lifelong friend of George Washington, though in later years they disagreed in politics. His large estates and high social standing, together with his personal ability, gave Mason great influence among the Virginia planters, and he became identified with many enterprises, such as the organization of the Ohio Company and the founding of Alexandria (1749). He was a member of the Virginia House of Burgesses in 1759–1760. In 1769 he drew up for Washington a series of non-importation resolutions, which were adopted by the Virginia legislature. In July 1774 he wrote for a convention in Fairfax county a series of resolutions known as the Fairfax Resolves, in which he advocated a congress of the colonies and suggested non-intercourse with Great Britain, a policy subsequently adopted by Virginia and later by the Continental Congress. He was a member of the Virginia Committee of Safety from August to December 1775, and of the Virginia Convention in 1775 and 1776; and in 1776 he drew up the Virginia Constitution and the famous Bill of Rights, a radically democratic document which had great influence on American political institutions. In 1780 he outlined the plan which was subsequently adopted by Virginia for ceding to the Federal government her claim to the "back lands," *i.e.* to territory north and north-west of the Ohio river. From 1776 to 1788 he represented Fairfax county in the Virginia Assembly. He was a member of the Virginia House of Delegates in 1776–1780 and again in 1787–1788, and in 1787 was a member of the convention that framed the Federal Constitution, and as one of its ablest debaters took an active part in the work. Particularly notable was his opposition to the compromises in regard to slavery and the slave-trade. Indeed, like most of the prominent Virginians of the time, Mason was strongly in favour of the gradual abolition of slavery. He objected to the large and indefinite powers given by the completed Constitution to

Congress, so he joined with Patrick Henry in opposing its ratification in the Virginia Convention (1788). Failing in this he suggested amendments, the substance of several of which was afterwards embodied in the present Bill of Rights. Declining an appointment as a United States Senator from Virginia, he retired to his home, Gunston Hall (built by him about 1758 and named after the family home in Staffordshire, England), where he died on the 7th of October 1792. With James Madison and Thomas Jefferson, Mason carried through the Virginia legislature measures disestablishing the Episcopal Church and protecting all forms of worship. In politics he was a radical republican, who believed that local government should be kept strong and central government weak; his democratic theories had much influence in Virginia and other southern and western states.

See Kate Mason Rowland, *Life and Writings of George Mason* (2 vols., New York, 1892).

MASON, GEORGE HEMMING (1818–1872), English painter, was born at Wetley Abbey, the eldest son of a Staffordshire county gentleman. He was educated at King Edward's School, Birmingham, and studied for the medical profession for five years under Dr Watt of that city. But all his thoughts being given to art, he abandoned medicine in 1844 and travelled for a time on the Continent, finally settling in Rome, where he remained for some years and sought to make a living as an artist. During this period he underwent many privations which permanently affected his health; but he continued to labour assiduously, making studies of the picturesque scenery that surrounded him, and with hardly any instruction except that received from Nature and from the Italian pictures he gradually acquired the painter's skill. At least two important works are referable to this period: "Ploughing in the Campagna," shown in the Royal Academy of 1857, and "In the Salt Marshes, Campagna," exhibited in the following year. After Mason's return from the continent, in 1858, when he settled at Wetley Abbey, he continued for a while to paint Italian subjects from studies made during his stay abroad, and then his art began to touch in a wonderfully tender and poetic way the peasant life of England, especially of his native Staffordshire, and the homely landscape in the midst of which that life was set. The first picture of this class was "Wind on the Wold," and it was followed—along with much else of admirable quality —by the painter's three greatest works: The "Evening Hymn" (1868), a band of Staffordshire mill-girls returning from their work; "Girls dancing by the Sea" (1869); and the "Harvest Moon" (1872). He left Staffordshire in 1865 and went to live at Hammersmith; and he was elected an associate of the Royal Academy in 1869. By that time he had fully established his position as an artist of unusual power and individuality. Mason died on the 22nd of October 1872. In his work he laboured under the double disadvantage of feeble and uncertain health, and a want of thorough art-training, so that his pictures were never produced easily, or without strenuous and long-continued effort. His art is great in virtue of the solemn pathos which pervades it, of the dignity and beauty in rustic life which it reveals, of its keen perception of noble form and graceful motion, and of rich effects of colour and subdued light. In *motif* and treatment it has something in common with the art of Millet and Jules Breton, as with that of Frederick Walker among Englishmen; though he had neither the occasional uncouth robustness of Millet nor the firm actuality of Jules Breton. His pictures "Wind on the Wold" and "The Cast Shoe" are in the National Gallery of British Art.

MASON, JAMES MURRAY (1798–1871), American political leader, was born in Fairfax county, Virginia, on the 3rd of November 1798, the grandson of George Mason (1725–1792). Educated at the university of Pennsylvania and the college of William and Mary, he was admitted to the bar in 1820. He was a member of the Virginia House of Delegates in 1826–1827 and 1828–1831, of the state Constitutional Convention of 1829, of the National House of Representatives (1837–1839), of the United States Senate from 1847 until July 1861 (when, with other Southern senators he was formally expelled—he had previously withdrawn), and of the Virginia Secession Convention in April 1861. Entering politics as a Jacksonian Democrat, Mason was throughout his career a consistent strict constructionist, opposing protective tariffs, internal improvements by the national government, and all attempts to restrict or control the spread of slavery, which he sincerely believed to be essential to the social and political welfare of the South. He was the author of the Fugitive Slave Act of 1850, and in 1860 was chairman of the Senate committee which investigated the John Brown raid. After Lincoln's election as President he was one of the strongest advocates of secession in Virginia. He was appointed in August 1861 commissioner of the Confederate States to Great Britain. The British ship "Trent," upon which he and John Slidell, the commissioner to France, sailed, was intercepted (Nov. 8, 1861) by a United States ship-of-war (the "San Jacinto," Captain Charles Wilkes), and the two commissioners were seized and carried as prisoners to Boston. Great Britain immediately demanded their release, and war for a time seemed imminent; but owing mainly to the tactful diplomacy of the prince consort, Lincoln acknowledged that the seizure of Mason and Slidell was a violation of the rights of Great Britain as a neutral, and on the 1st of January 1862 released the commissioners. The incident has become known in history as the "Trent Affair." Mason at once proceeded to London, where, however, he was unable to secure official recognition, and his commission to Great Britain was withdrawn late in 1863. He remained in Europe, spending most of his time at Paris and holding blank commissions which he was authorized to fill in at his discretion in case the presence of a Confederate commissioner should seem desirable at any particular European court. These commissions, however, he did not use. After the war he lived for several years in Canada, but returned in 1869 to Virginia, and on the 28th of April 1871 died at Alexandria.

See *The Public Life and Diplomatic Correspondence of James M. Mason, with some Personal History* (Roanoke, Va., 1903), by his daughter, Virginia Mason; Sir Theodore Martin, *Life of the Prince Consort.*

MASON, SIR JOHN (1503–1566), English diplomatist, was born of humble parentage at Abingdon in 1503, and was educated at Oxford, where he became Fellow of All Souls in 1521. He was ordained before 1531. Most of his early years were spent on the Continent, where he witnessed the meeting between Henry VIII. and Francis I. at Calais in 1532, and where he was employed in collecting information for the English government, gaining in this work the reputation of a capable diplomatist. By his never-failing caution, moderation and pliancy, Mason succeeded in keeping himself in favour with four successive sovereigns of the Tudor monarchy. In 1537 he became secretary to the English ambassador at Madrid, Sir Thomas Wyat; but when the latter was put on his trial for treason in 1541 Mason was unmolested, and soon afterwards was appointed clerk of the privy council, and procured for himself sundry other posts and privileges. Mason was knighted and made dean of Winchester by Edward VI. He was one of the commissioners to negotiate the treaty by which Boulogne was restored to France in 1550, and in the same year he became English ambassador in Paris, where he helped to arrange the bethrothal of Edward VI. to the princess Elizabeth of France. He returned to England at the end of 1551, became clerk of parliament, received extensive grants of land, and in 1552 was made chancellor of Oxford University. He was elected member of parliament in the same year. On the death of Edward VI., he at first joined the party of Northumberland and the Lady Jane Grey; but quickly perceiving his mistake he took an active part in procuring the proclamation of Mary as queen. Mason now received fresh tokens of royal favour, being confirmed in all his secular, though not in his ecclesiastical, offices; and in 1553 he was appointed English ambassador at the court of the emperor Charles V., of whose abdication at Brussels in October 1555 he wrote a vivid account. He took a prominent share in the administrative business of the government in the first years of Elizabeth's reign, and largely influenced her foreign policy until his death, which occurred on the 20th of April 1566. Sir John Mason married Elizabeth, daughter of Sir Thomas Isley of Sundridge, Kent, and widow of Richard Hill. He had no children, and his heir was Anthony Wyckes, whom he had adopted, and who assumed the name of Mason and left a large family.

See J. A. Froude, *History of England* (12 vols., London, 1856–1870); Charles Wriothesley, *Chronicle of England during the Reigns of the Tudors*, edited by W. D. Hamilton (Camden Soc., 2 vols., London, 1875); P. F. Tytler, *England under the Reigns of Edward VI. and Mary* (2 vols., London, 1839); John Strype, *Ecclesiastical Memorials* (3 vols., Oxford, 1824) and *Memorials of Thomas Cranmer* (3 vols., Oxford, 1848); *Acts of the Privy Council of England* (new series), edited by J. R. Dasent, vols. i.–vii.

MASON, JOHN (1586–1635), founder of New Hampshire, U.S.A., was born in King's Lynn, Norfolk, England. In 1610 he commanded a small naval force sent by James I. to assist in subduing the Hebrides Islands. From 1615 to 1621 he was governor of the English colony on the north side of Conception Bay in Newfoundland; he explored the island, made the first English map of it (published in 1625), and wrote a descriptive tract entitled *A Briefe Discourse of the Newfoundland* (Edinburgh, 1620) to promote the colonization of the island by Scotsmen. Here he was brought into official relations with Sir Ferdinando Gorges, then a commissioner to regulate the Newfoundland fisheries. In March 1622 Mason obtained from the Council for New England, of which Gorges was the most influential member, a grant of the territory (which he named Mariana) between the Naumkeag or Salem river and the Merrimac, and in the following August he and Gorges together received a grant of the region between the Merrimac and Kennebec rivers, and extending 60 m. inland. From 1625 to 1629 Mason was engaged as treasurer and paymaster of the English army in the wars which England was waging against Spain and France. Towards the close of 1629 Mason and Gorges agreed upon a division of the territory held jointly by them, and on the 7th of November 1629 Mason received from the Council a separate grant of the tract between the Merrimac and the Piscataqua, which he now named New Hampshire. Thinking that the Piscataqua river had its source in Lake Champlain, Mason with Gorges and a few other associates secured, on the 17th of November 1629, a grant of a region which was named Laconia (apparently from the number of lakes it was supposed to contain), and was described as bordering on Lake Champlain, extending 10 m. east and south from it and far to the west and north-west, together with 1000 acres to be located along some convenient harbour, presumably near the mouth of the Piscataqua. In November 1631 Mason and his associates obtained, under the name of the Pescataway Grant, a tract on both sides of the Piscataqua river, extending 30 m. inland and including also the Isles of Shoals. Mason became a member of the Council for New England in June 1632, and its vice-president in the following November; and in 1635, when the members decided to divide their territory among themselves and surrender their charter, he was allotted as his share all the region between the Naumkeag and Piscataqua rivers extending 60 m. inland, the southern half of the Isles of Shoals, and a ten-thousand acre tract, called Masonia, on the west side of the Kennebec river. In October 1635 he was appointed vice-admiral of New England, but he died early in December, before crossing the Atlantic. He was buried in Westminster Abbey. Forty-four years after his death New Hampshire was made a royal province.

See *Captain John Mason, the Founder of New Hampshire* (Boston, 1887; published by the Prince Society), which contains a memoir by C. W. Tuttle and historical papers relating to Mason's career, edited by J. W. Dean.

MASON, JOHN YOUNG (1799–1859), American political leader and diplomatist, was born in Greenesville county, Virginia, on the 18th of April 1799. Graduating at the university of North Carolina in 1816, he studied law in the famous Litchfield (Connecticut) law school, and in 1819 was admitted to practice in Southampton county, Virginia. He served in the Virginia house of delegates in 1823–1827, in the state constitutional convention of 1829–1830, and from 1831 to 1837 in the National House of Representatives, being chairman of the committee on foreign affairs in 1835–1836. He was secretary of the navy in President Tyler's cabinet (1844–1845), and was attorney-general (1845–1846) and secretary of the navy (1846–1849), succeeding George Bancroft, under President Polk. He was president of the Virginia constitutional convention of 1851, and from 1853 until his death at Paris on the 3rd of October 1859, was United States minister to France. In this capacity he attracted attention by wearing at the court of Napoleon III. a simple diplomatic uniform (for this he was rebuked by Secretary of State W. L. Marcy, who had ordered American ministers to wear a plain civilian costume), and by joining with James Buchanan and Pierre Soulé, ministers to Great Britain and Spain respectively, in drawing up (Oct. 1854) the famous Ostend Manifesto. Hawthorne called him a "fat-brained, good-hearted, sensible old man"; and in politics he was a typical Virginian of the old school, a state's rights Democrat, upholding slavery and hating abolitionism.

MASON, SIR JOSIAH (1795–1881), English pen-manufacturer, was born in Kidderminster on the 23rd of February 1795, the son of a carpet-weaver. He began life as a street hawker of cakes, fruits and vegetables. After trying his hand in his native town at shoemaking, baking, carpentering, blacksmithing, house-painting and carpet-weaving, he moved in 1814 to Birmingham. Here he found employment in the gilt-toy trade. In 1824 he set up on his own account as a manufacturer of split-rings by machinery, to which he subsequently added the making of steel pens. Owing to the circumstance of his pens being supplied through James Perry, the London stationer whose name they bore, he was less well known than Joseph Gillott and other makers, although he was really the largest producer in England. In 1874 the business was converted into a limited liability company. Besides his steel-pen trade Mason carried on for many years the business of electro-plating, copper-smelting, and india-rubber ring making, in conjunction with George R. Elkington. Mason was almost entirely self-educated, having taught himself to write when a shoemaker's apprentice, and in later life he felt his deficiencies keenly. It was this which led him in 1860 to establish his great orphanage at Erdington, near Birmingham. Upon it he expended about £300,000, and for this munificent endowment he was knighted in 1872. He had previously given a dispensary to his native town and an almshouse to Erdington. In 1880 Mason College, since incorporated in the university of Birmingham, was opened, the total value of the endowment being about £250,000. Mason died on the 16th of June 1881.

See J. T. Bunce, *Josiah Mason* (1882).

MASON, LOWELL (1792–1872), American musician, was born at Medfield, Massachusetts. For some years he led a business life, but was always studying music; and in 1827, as the result of his work in forming the collection of church music published in 1821 at Boston by the Handel and Haydn Society, he moved to Boston and there first became president of the society and then founder of the Boston Academy of Music (1832). He published some successful educational books, and was a pioneer of musical instruction in the public schools, adopted in 1838. He received the degree of doctor of music from New York University in 1855. He died at Orange, New Jersey, on the 11th of August 1872.

His son William Mason (1829–1908), an accomplished pianist and composer, published an interesting volume of reminiscences, *Memoirs of a Musical Life*, in 1901.

MASON, WILLIAM (1725–1797), English poet, son of William Mason, vicar of Holy Trinity, Hull, was born on the 12th of February 1725, was educated at St John's College, Cambridge, and took holy orders. In 1744 he wrote *Musaeus*, a lament for Pope in imitation of *Lycidas*, and in 1749 through the influence of Thomas Gray he was elected a fellow of Pembroke College. He became a devoted friend and admirer of Gray, who addressed him as "Skroddles," and corrected the worst solecisms in his verses. In 1748 he published *Isis*, a poem directed against the supposed Jacobitism of the university of Oxford, which provoked Thomas Warton's *Triumph of Isis*. Mason conceived the ambition of reconciling modern drama with ancient forms by strict observance of the unities and the restoration of the chorus. These ideas were exemplified in *Elfrida* (1752) and *Caractacus* (1759), two frigid performances no doubt intended to be read rather than acted, but produced with some alterations at Covent Garden in 1772 and 1776 respectively. Horace Walpole described *Caractacus* as "laboured, uninteresting, and no more resembling the manners of Britons than of Japanese"; while Gray declared he had read the manuscript "not with pleasure only, but with emotion." In 1754 Mason was presented to the rectory of Aston, near Rotherham, Yorkshire, and in 1757 through the influence of the duke of Devonshire he became one of the king's chaplains. He also received the prebend of Holme in York Minster (1756), was made canon residentiary in 1762, and in 1763 became precentor and prebendary of Driffield. He married in 1764 Mary Sherman, who died three years later. When Gray died in 1771 he made Mason his literary executor. In the preparation of the *Life and Letters of Gray*, which appeared in 1774, he had much help from Horace Walpole, with whom he corresponded regularly until 1784 when Mason opposed Fox's India Bill, and offended Walpole by thrusting on him political advice unasked. Twelve years of silence followed, but in the year before his death the correspondence was renewed on friendly terms. Mason died at Aston on the 7th of April 1797.

His correspondence with Gray and Walpole shows him to have been a man of cultivated tastes. He was something of an antiquarian, a good musician, and an amateur of painting. He is said to have invented an instrument called the celestina, a modified pianoforte. Gray rewarded his faithful admiration with good-humoured kindness. He warned him against confounding Mona with the Isle of Man, or the Goths with the Celts, corrected his grammar, pointed out his plagiarisms, and laughed gently at his superficial learning. His powers show to better advantage in the unacknowledged satirical poems which he produced under the pseudonym of Malcolm Macgregor. In editing Gray's letters he took considerable liberties with his originals, and did not print all that related to himself.

Mason's other works included *Odes* (1756); *The English Garden*, a didactic poem in blank verse, the four books of which appeared in 1772, 1777, 1779 and 1782; *An Heroic Epistle to Sir William Chambers* (1774); an *Ode to Mr Pinchbeck* (1776) and an *Epistle to Dr Shebbeare* (1777)—all these by "Malcolm Macgregor"; *Essay, Historical and Critical, of Church Music* (1795), and a lyrical drama, *Sappho* (1797).

His poems were collected in 1764 and 1774, and an edition of his *Works* appeared in 1811. His poems with a *Life* are included in Alexander Chalmers's *English Poets*. His correspondence with Walpole was edited by J. Mitford in 1851; and his correspondence with Gray by the same editor in 1853. See also the standard editions of the letters of Gray and of Walpole. There is a very pleasant picture of Mason's character in Southey's *Doctor* (ch. cxxvi.).

MASON AND DIXON LINE, in America, the boundary line (lat. 39° 43′ 26·3″ N.) between Maryland and Pennsylvania, U.S.A.; popularly the line separating "free" states and "slave" states before the Civil War. The line derives its name from Charles Mason (1730–1787) and Jeremiah Dixon, two English astronomers, whose survey of it to a point about 244 m. west of the Delaware between 1763 and 1767[1] marked the close of the protracted boundary dispute (arising upon the grant of Pennsylvania to William Penn in 1681) between the Baltimores and Penns, proprietors respectively of Maryland and Pennsylvania. The dispute arose from the designation, in the grant to Penn, of the southern boundary of Pennsylvania mainly as the parallel marking the "beginning of the fortieth degree of Northerne Latitude," after the northern boundary of Maryland had been defined as a line "which lieth under the fortieth degree of north latitude from the equinoctial." The eastern part of the line as far as Sideling Hill in the western part of the present Washington county, was originally marked with milestones brought from England, every fifth of which bore on one side the arms of Baltimore and on the opposite side those of Penn; but the difficulties in transporting them to the westward were so great that many of them were not set up. Owing to the removal of the stone marking the north-east corner of Maryland, this point was again determined and marked in 1849–1850 by Lieut.-Colonel J. D. Graham of the U.S. topographical engineers; and as the western part of the boundary was not marked by stones, and local disputes arose, the line was again surveyed between 1901 and 1903 under the direction of a commission appointed by Pennsylvania and Maryland.

The use of the term "Mason and Dixon Line" to designate the boundary between the free and the slave states (and in general between the North and the South) dates from the debates in Congress over the Missouri Compromise in 1819–1820. As so used it may be defined as not only the Mason and Dixon Line proper, but also the line formed by the Ohio River from its intersection with the Pennsylvania boundary to its mouth, thence the eastern, northern and western boundaries of Missouri, and thence westward the parallel 36° 30′—the line established by the Missouri Compromise to separate free and slave territory in the "Louisiana Purchase," except as regards Missouri. It is to be noted, however, that the Missouri Compromise did not affect the territory later acquired from Mexico.

MASON CITY, a city and the county-seat of Cerro Gordo county, Iowa, U.S.A., on Lime Creek, in the northern part of the state. Pop. (1905, state census), 8357 (929 foreign-born); (1910) 11,230. It is served by the Chicago Milwaukee & St Paul, the Chicago & North-Western, the Chicago Great Western, the Iowa Central and the St Paul & Des Moines railways, and also by the Mason City & Clear Lake (electric) railway, which connects Mason City with Clear Lake, a pleasure resort, 10 m. west of the city. At Mason City is Memorial University (co-educational; founded in 1900 by the National Encampment of the Sons of Veterans, and opened in 1902), dedicated to the Grand Army of the Republic, the special aim of which is to teach American history. The city is situated in a good agricultural region, and there are valuable stone quarries in the vicinity. The manufactures include lime, Portland cement, brick and tile. Mason City was settled in 1853, laid out in 1855, incorporated as a town in 1870 and chartered as a city in 1881.

MASONRY,[2] the art of building in stone. The earliest remains (apart from the primitive work in rude stone—see STONE MONUMENTS; ARCHAEOLOGY, &c.) are those of the ancient temples of India and Egypt. Many of these early works were constructed of stones of huge size, and it still remains a mystery how the ancients were able to quarry and raise to a considerable height above the ground blocks seven or eight hundred tons in weight. Many of the early buildings of the middle ages were entirely constructed of masses of concrete, often faced with a species of rough cast. The early masonry seems to have been for the most part worked with the axe and not with the chisel. A very excellent example of the contrast between the earlier and later Norman masonry may be seen in the choir of Canterbury Cathedral. In those times the groining was frequently filled in with a light tufa stone, said by some to have been brought from Italy, but more probably from the Rhine. The Normans imported a great quantity of stone from Caen, it being easily worked, and particularly fit for carving. The freestones of England were also much used; and in the first Pointed period, Purbeck and Bethersden marbles were employed for column shafts, &c. The methods of working and setting stone were much the same as at present, except that owing to difficulties of conveyance the stones were used in much smaller sizes. As time went on the art of masonry advanced till in England, in point of execution, it at length rivalled that of any country.

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[1] These surveyors also surveyed and marked the boundary between Maryland and Delaware.

[2] The English word "mason" is from the French, which appears in the two forms, *machun* and *masson* (from the last comes the modern Fr. form *maçon*, which means indifferently a bricklayer or mason. In O. H. Ger. the word is *mezzo*, which survives in the German for a stone-mason, *Steinmetz*. The med. Lat. form, *machio*, was connected with *machina*—obviously a guess. The Low Lat., *machcria* or *maceria* (see Du Cange, *Glossarium*, *s.v. macio*), a wall, has been suggested as showing some connexion. Some popular Lat. form as *macio* or *mattio* is probably the origin. No Teut. word, according to the *New English Dictionary*, except that which appears in "mattock," seems to have any bearing on the ultimate origin.

Tools.—The mason's tools may be grouped under five heads—hammers and mallets, saws, chisels, setting-out and setting tools, and hoisting appliances.

Hammers and Mallets.

There are several different kinds of iron hammers used by the stone worker; the mash hammer has a short handle and heavy head for use with chisels; the iron hammer, used in carving, in shape resembles a carpenter's mallet but is smaller; the waller's hammer is used for roughly shaping stones in rubble work; the spalling hammer for roughly dressing stones in the quarry; the scabbling-hammer, for the same purpose, has one end pointed for use on hard stone; the pick has a long head pointed at both ends, weighs from 14 to 20 lb, and is used for rough dressing and splitting; the axe has a double wedge-shaped head and is used to bring stones to a fairly level face preparatory to their being worked smooth; the patent axe, or patent hammer, is formed with a number of plates with sharpened edges bolted together to form a head; the mallet of hard wood is used for the finishing chisel work and carving; and the dummy is of similar shape but smaller.

Saws.

A hand saw similar to that used by the carpenter is used for cutting small soft stones. Larger blocks are cut with the two-handed saw worked by two men. For the largest blocks the frame saw is used, and is slung by a rope and pulleys fitted with balance weights to relieve the operator of its weight. The blade is of plain steel, the cutting action being supplied by sand with water as a lubricant constantly applied.

Chisels.

There are perhaps even more varieties of chisels than of hammers. The point and the punch have very small cutting edges, a quarter of an inch or less in width. The former is used on the harder and the latter on the softer varieties of stone after the rough hammer dressing. The pitching tool has a wide thick edge and is used in rough dressing. Jumpers are shafts of steel having a widened edge, and are used for boring holes in hard stone. Chisels are made with edges from a quarter-inch to one and a half inches wide; those that exceed this width are termed boasters. The claw chisel has a number of teeth from one-eighth to three-eighths wide, and is used on the surface of hard stones after the point has been used. The drag is a semi-circular steel plate, the straight edge having teeth cut on it. It is used to level down the surfaces of soft stones. Cockscombs are used for the same purpose on mouldings and are shaped to various curves. Wedges of various sizes are used in splitting stones and are inserted either in holes made with the jumper or in chases cut with the stone-pick.

Setting-out and Setting Tools.

The implements for setting out the work are similar to those used by the bricklayer and other tradesmen, comprising the rule, square, set square, the bevel capable of being set to any required angle, compasses, spirit level, plumb-rule and bob and mortar trowels. Gauges and moulds are required in sinking moulds to the proper section.

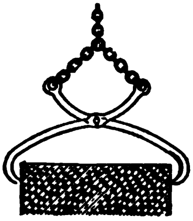


FIG. 1.

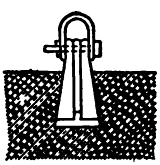


FIG. 2.

Hoisting Appliances.

The *nippers* (fig. 1), or *scissors*, as they are sometimes termed, have two hooked arms fitting into notches in the opposite sides of the block to be lifted. These arms are riveted together in the same way as a pair of scissors, the upper ends having rings attached for the insertion of a rope or chain which when pulled tight in the operation of lifting causes the hooked ends to grip the stone. *Lewises* (fig. 2.) are wedge-shaped pieces of steel which are fitted into a dovetailed mortise in the stone to be hoisted. They are also used for setting blocks too large to be set by hand, and are made in several forms. These are the usual methods of securing the stone to the hoisting rope or chain, the hoisting being effected by a pulley and fall, by a crane, or by other means.

Scaffolding.—For rubble walls single scaffolds, resting partly on the walls, similar to those used for brickwork (*q.v.*), are employed; for ashlar and other gauged stonework (see below) self-supporting scaffolds are used with a second set of standards and ledgers erected close to the wall, the whole standing entirely independent. The reason for the use of this double scaffold is that otherwise holes for the putlogs to rest in would have to be left in the wall, and obviously in an ashlar stone wall it would be impossible properly to make these good on the removal of the scaffold (see further SCAFFOLD).

Seasoning Stone.—Stone freshly quarried is full of sap, and thus admits of being easily worked. On being exposed to the air the sap dries out, and the stone becomes much harder in consequence. For this reason, and because carriage charges are lessened by the smaller bulk of the worked stone as compared with the rough block, the stone for a building is often specified to be quarry-worked. Vitruvius recommended that stone should be quarried in summer when driest, and that it should be seasoned by being allowed to lie two years before being used, so as to allow the natural sap to evaporate. In the erection of St Paul's Cathedral, Sir Christopher Wren required that the stone after being quarried should be exposed for three years on the sea-beach before its introduction into the building.

The regular and determined form of bricks makes it to a large extent a matter of practice to enable a man to become a good bricklayer, but beyond these a continual exercise of judgment is required of the workman in stone, who has for the most part to deal with masses of all forms and of all sizes.

Setting Stones.—All beds and joints should be truly worked and perfectly level. If the surface be convex it will give rise to wide unsightly joints; if concave the weight thrown on the stone will rest on the edges and probably cause them to "flush" or break off and disfigure the work. Large stones are placed in position with the aid of hoisting appliances and should be tried in position before being finally set. Great care should be taken to avoid fracturing or chipping the stone in the process of handling, as it is impossible to make good such damage. All stratified stones—and this includes by far the largest proportion of building stones—when set in a level position should be laid on their natural bed, *i.e.* with their laminae horizontal. The greatest strength of a stone is obtained when the laminae lie at right angles to the pressure placed upon it. In the case of arches these layers should be parallel with the centre line of the voussoirs and at right angles to the face of the arch. For cornices (except the corner-stones) and work of a like nature, the stone is set with the laminae on edge and perpendicular to the face of the work. With many stones it is easy to determine the bed by moistening with water, when the laminae will become apparent. Some stones, however, it is impossible to read in this way, and it is therefore advisable to have them marked in the quarry. A horizontal line in a quarry does not in all cases give the proper bed of the stone, for since the deposits were made ages ago natural upheavals have possibly occurred to alter the "lie" of the material.

For the shafts of columns especially it is necessary to have the layers horizontally placed, and a stone should be selected from a quarry with a bed of the required depth. An example of the omission of this precaution is visible in the arcading of the Royal Courts of Justice, London, where the small shafts of the front arcade in red sandstone have been turned with the laminae in a vertical position, with the result that nearly every shaft is flaking away or is cracked.

Use of Mortar.—See BRICKWORK. Of whatever quality the stone may be of which a wall is built, it should consist as much of stone and as little of mortar as possible. Only fine mortar is admissible if we are to obtain as thin joints as possible. The joints should be well raked out and pointed in Portland cement mortar. This applies only to some sandstones, as marbles and many limestones are stained by the use of Portland cement. For these a special cement must be employed, composed of plaster of Paris, lime, and marble or stone-dust.

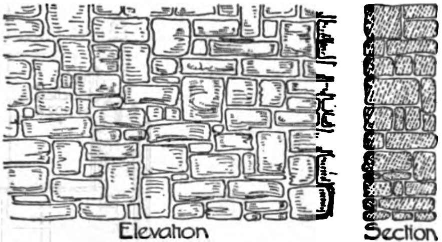
Bonding.—Bond (see BRICKWORK) is of not less importance in stone walling than in brickwork. In ashlar-work the work is bonded uniformly, the joints being kept perpendicularly one over the other; but in rubble-work, instead of making the joints recur one over the other in alternate courses they should be carefully made to lock, so as to give the strength of two or three courses or layers between a joint in one course and the joint that next occurs vertically above it in another course. In the through or transverse bonding of a wall a good proportion of header stones running about two-thirds of the distance through the width of the wall should be provided to bind the whole structure together. The use of through stones, *i.e.* stones running through the whole thickness of the wall from front to back, is not to be recommended. Such stones are liable to fracture and convey damp to the internal face.

Slip Joints.—As with brickwork so in masonry great care must be exercised to prevent the different parts of a building settling unequally. When two portions of a building differing considerably in height come together, it is usual to employ a slip or housed joint instead of bonding the walls into each other. This arrangement allows the heavier work to settle to a greater extent than the low portion without causing any defect in the stones.

Footings.—The footings of stone walls should consist of large stones of even thickness proportionate to their length; if possible they should be the full breadth in one piece. Each course should be well bedded and levelled.

Walling.—There are broadly speaking two classes of stone walling: rubble and ashlar. Rubble walls are built of stones more or less irregular in shape and size and coarsely jointed. Ashlar walls are constructed of carefully worked blocks of regular dimensions and set with fine joints.

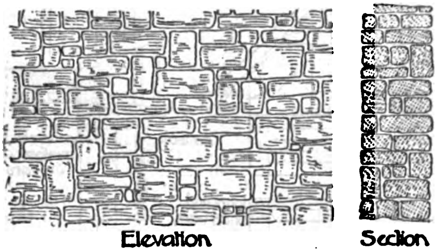
Random Rubble (fig. 3) is the roughest form of stonework. It is built with irregular pieces of stone usually less than 9 in. thick, loosely packed without much regard to courses, the interstices between the large stones being occupied by small ones, the remaining crevices filled up with mortar. Bond stones or headers should be used frequently in every course. This form of walling is much used in stone districts for boundary walls and is often set dry without mortar. For this work the mason uses no tool but the trowel to lay on the mortar, the scabbling hammer to break off the most repulsive irregularities from the stone, and the plumb-rule to keep his work perpendicular.



RANDOM RUBBLE WALLING

FIG. 3.

Coursed Rubble (fig. 4) is levelled up in courses 12 or 18 in. deep, the depth varying in different courses according to the sizes of the stones. The stones are dressed by the workman before he begins building, to obtain a fairly level bed and perpendicular face.



COURSED RUBBLE

FIG. 4.

Irregularly Coursed Squared Rubble is a development of uncoursed random rubble, the stones in this case being squared with the hammer and roughly faced up with the axe. The courses jump abruptly from one level to another as the sizes of the blocks demand; the interstices are filled in with small pieces of stone called "snecks."

For *Coursed Squared Rubble* the stone is faced in a similar manner and set in courses, the depth of each course being made up of one or more stones.

In *Regular Coursed Rubble* all the stones in one course are of the same height.

Block-in-course is the name applied to a form of stone walling that has some of the characteristics of ashlar but the execution of which is much rougher. The courses are usually less than 12 in. high. It is much used by engineers for waterside and railway work where a good appearance is desired.

The *Angles* or *Quoins* of rubble-work are always carefully and precisely worked and serve as a gauge for the rest of the walling. Frequently the quoins and jambs are executed in ashlar, which gives a neat and finished appearance and adds strength to the work.

The name *Ashlar* is given, without regard to the finish of the face of the stone, to walling composed of stones carefully dressed, from 12 to 18 in. deep, the mortar joints being about an eighth of an inch or less in thickness. No stone except the hardest should exceed in length three times its depth when required to resist a heavy load and its breadth should be from one and a half to three times its depth. The hardest stone may have a length equal to four or perhaps five times its depth and a width three times its depth. The face of ashlar-work may be plain and level, or have rebated, chamfered, or moulded joints.

The great cost of this form of stonework renders the employment of a backing of an inferior nature very general. This backing varies according to the district in which the building operations are being carried on, being rubble stonework in stone districts and brick or concrete elsewhere, the whole being thoroughly tied together both transversely and longitudinally with bondstones. In England a stone much used for backing ashlar and Kentish rag rubble-work is a soft sandstone called "hassock." In the districts where it is quarried it is much cheaper than brickwork. (For brickbacking see BRICKWORK.) Ashlar facing usually varies from 4 to 9 in. in thickness. The work must not be all of one thickness, but should vary in order that effective bond with the backing may be obtained. If the work is in courses of uneven depth the narrow courses are made of the greater thickness and the deep courses are narrow. It is sometimes necessary to secure the stone facing back with iron ties, but this should be avoided wherever possible, as they are liable to rust and split the stonework. When it is necessary to use them they should be covered with some protective coating. The use of a backing to a stone wall, besides lessening the cost, gives a more equable temperature inside the building and prevents the transmission of wet by capillary attraction to the interior, which would take place if single stones were used for the entire thickness.

Backing to Stonework.

All work of this description must be executed in Portland cement mortar of good strength, to avoid as much as possible the unequal settlement of the deep courses of stone facing and the narrower courses of the brick or rough stone backing. If the backing is of brick it should never be less than 9 in. thick, and whether of stone or brick it should be levelled up in courses of the same thickness as the ashlar.

There are many different sorts of walling, or modes of structure, arising from the nature of the materials available in various localities. That is perhaps of most frequent occurrence in which either squared, broken, or round flints are used. This, when executed with care, has a distinctly decorative appearance. To give stability to the structure, lacing courses of tiles, bricks or dressed stones are introduced, and brick or stone piers are built at intervals, thus forming a flint panelled wall. The quoins, too, in this type of wall are formed in dressed stone or brick work.

Walling.

Uncoursed rubble built with irregular blocks of ragstone, an unstratified rock quarried in Kent, is in great favour for facing the external walls of churches and similar works (fig. 5).

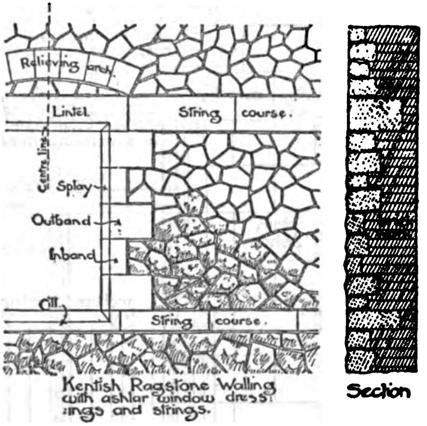


FIG. 5.

Pointing.—As with brickwork this is generally done when the work is completed and before the scaffolding is removed. Suitable weather should be chosen, for if the weather be either frosty or too hot the pointing will suffer. The joints are raked out to a depth of half an inch or more, well wetted, and then refilled with a fine mortar composed specially to resist the action of the weather. This is finished flat or compressed with a special tool to a shaped joint, the usual forms of which are shown in fig. 6.

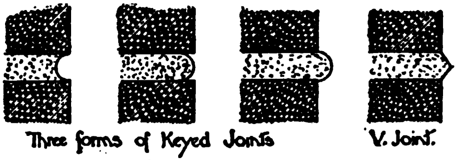


FIG. 6.

Stonewash.—To give a uniform appearance to the stonework and preserve the finished face until a hardened skin has formed, it is usual to coat the surface of exposed masonry with a protective compound of ordinary limewhite with a little size mixed in it, or a special mixture of stone-dust, lime, salt, whiting and size with a little ochre to tone it down. After six months or more the work is cleaned down with water and stiff bristle or wire brushes. Sometimes muriatic acid much diluted with water is used.

Technical Terms.—Of the following technical terms, many will be found embodied in the drawing of a gable wall (fig. 7), which shows the manner and position in which many different members are used.

Apex Stone.—The topmost stone of a gable forming a finial for the two sloping sides; it is sometimes termed a "saddle" (fig. 7).

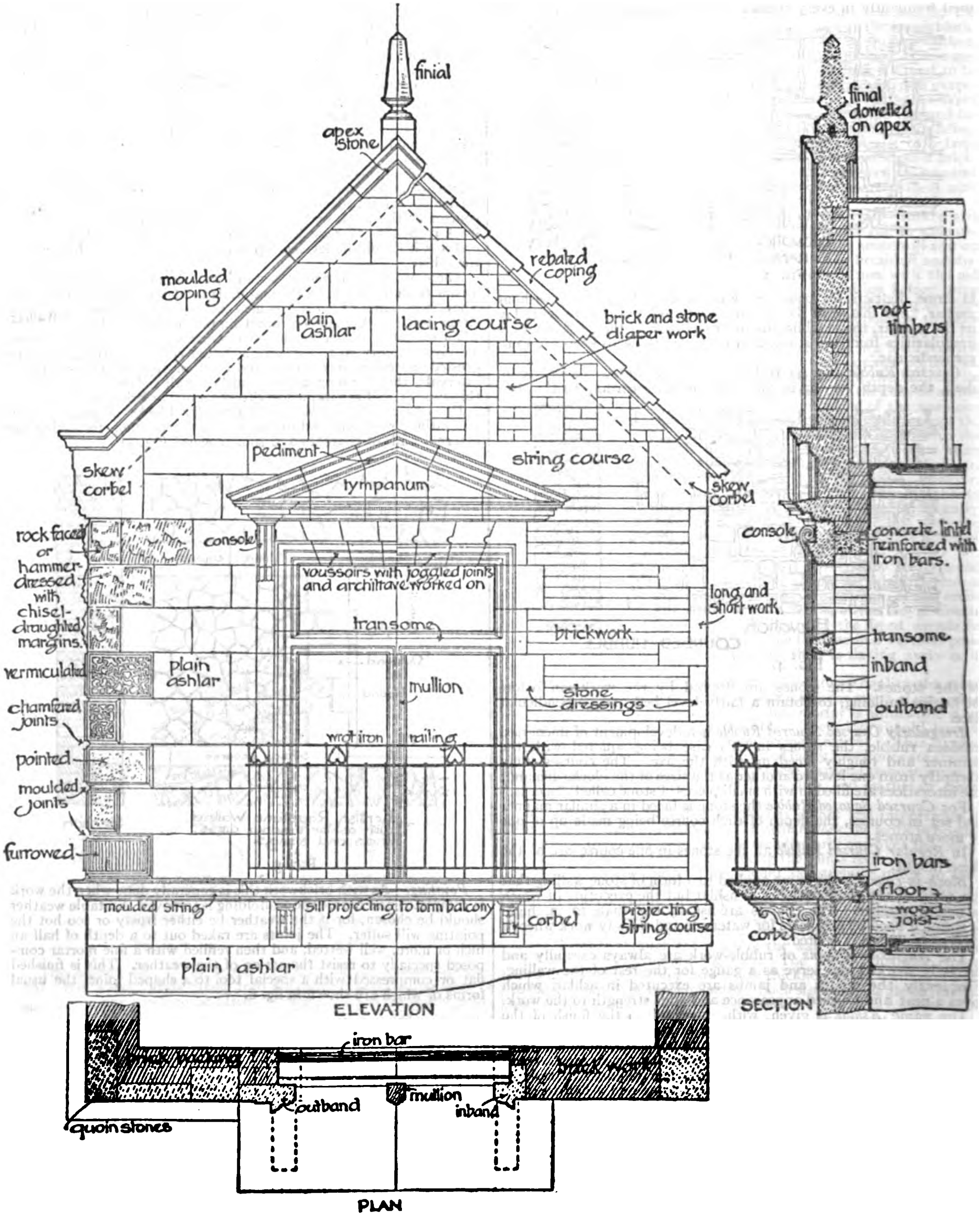


Fig. 7.

Blocking Course, a heavy course of stone above a cornice to form a parapet and weigh down the back of the cornice (fig. 8).

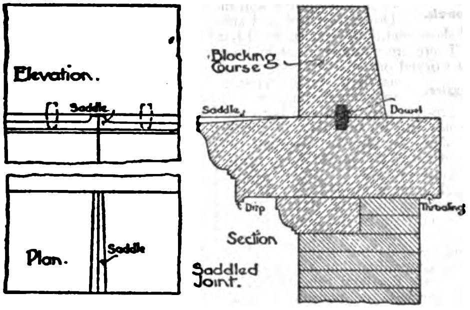


FIG. 8.

Bed.—The *bed* surface upon which a stone is set or bedded should be worked truly level in every part. Many workmen to form a neat thin joint with a minimum amount of labour hollow the bed and thus when the stone is set all weight is thrown upon the edges with the frequent result that these are crushed.

Coping.—The *coping* or *capping* stones are placed on the top of walls not covered by a roof, spanning their entire width and throwing off the rain and snow, thus keeping the interior of the wall dry. The fewer the number of joints the better the security, and for this reason it is well to form copings with as long stones as possible. To throw water off clear, and prevent it from running down the face of the wall, the coping should project an inch or two on each side and have a throat worked on the under-side of the projections (fig. 7).

Cornice, a projecting course of moulded stone crowning a structure, forming a cap or finish and serving to throw any wet clear of the walls. A deep drip should always be worked in the upper members of a cornice to prevent the rain trickling down and disfiguring the face of the moulding and the wall below (fig. 8).

Corbel, a stone built into a wall and projecting to form a cantilever, supporting a load beyond the face of the wall. It is frequently richly ornamented by carving (fig. 7).

Skew Corbel, a stone placed at the base of the sloping side of a gable wall to resist any sliding tendency of the sloping coping. Stones placed for a similar purpose at intervals along the sloping side, tailing into the wall, are termed "kneelers" and have the section of the coping worked upon them (fig. 7)

Corbel Table, a line of small corbels placed at short distances apart supporting a parapet or arcade. This forms an ornamental feature which was much employed in early Gothic times. It probably originates from the machicolations of ancient fortresses.

Dressings, the finished stones of window and door jambs and quoins. For example, a "brick building with stone dressings" would have brick walls with stone door and window jambs, heads and sills, and perhaps also stone quoins (fig. 7).

Diaper, a square pattern formed on the face of the stonework by means of stones of different colours and varieties or by patterns carved on the surface (fig. 7).

Finial, a finishing ornament applied usually to a gable end (fig. 7).

Gablet, small gable-shaped carved panels frequently used in Gothic stonework for apex stones, and in spires, &c.

Gargoyle, a detail, not often met with in modern work, which consists of a waterspout projecting so as to throw the rain-water from the gutters clear of the walls. In early work it was often carved into grotesque shapes of animal and other forms.

Galleting.—The joints of rubble are sometimes enriched by having small pebbles or chips of flint pressed into the mortar whilst green. The joints are then said to be "galleted."

Jamb.—Window and door jambs should always be of dressed stone, both on account of the extra strength thus gained and in order to give a finish to the work. The stones are laid alternately as stretchers and headers; the former are called outbands, the latter inbands (fig. 7).

Label Moulding, a projecting course of stone running round an arch. When not very large it is sometimes cut on the voussoirs, but is usually made a separate course of stone. Often, and especially in the case of door openings, a small sinking is worked on the top surface of the moulding to form a gutter which leads to the sides any water that trickles down the face of the wall.

Lacing Stone.—This is placed as a voussoir in brick arches of wide span, and serves to bond or lace several courses together (see BRICKWORK).

Lacing Course, a course of dressed stone, bricks or tiles, run at intervals in a wall of rubble or flint masonry to impart strength and tie the whole together (fig. 7).

Long and Short Work, a typical Saxon method of arranging quoin stones, flat slabs and long narrow vertical stones being placed alternately. Earls Barton church in Northamptonshire is an example of their use in old work. In modern work long and short work, sometimes termed "block and start," is little used (fig. 7).

Parapet, a fence wall at the top of a wall at the eaves of the roof. The gutter lies behind, and waterways are formed through the parapet wall for the escape of the rain-water.

Plinth, a projecting base to a wall serving to give an appearance of stability to the work.

Quoin, the angle at the junction of two walls. Quoins are often executed in dressed stone (Fig 7).

Rag-bolt, the end of an iron bolt when required to be let into stone is roughed or ragged. A dovetailed mortise is prepared in the stone and the ragged end of the bolt placed in this, and the mortise filled in with molten lead or sand and sulphur (fig 9).

Sill, the stone which forms a finish to the wall at the bottom of an opening. Sills should always be weathered, slightly in the case of door sills, more sharply for windows, and throated on the under side to throw off the wet. The weathering is not carried through the whole length of the sill, but a stool is left on at each end to form a square end for building in (fig. 7).

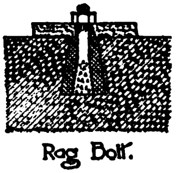


FIG. 9.

String Courses, horizontal bands of stone, either projecting beyond or flush with the face of the wall and often moulded or carved. They are frequently continuations of the sills or head lines of windows (figs. 5 and 7).

Scontion.—In a thick wall the dressed stones forming the inside angles of the jamb of a window or door opening are termed scontions.

Spalls, small pieces chipped off whilst working a stone.

Templates, slabs of hard stone set in a wall to take the ends of a beam or girder so as to distribute the load over a larger area of the wall.

Tympanum, the triangular filling of masonry in a pediment between the cornices, or between the horizontal head of a window or door and the under-side of the relieving arch above it. It is often panelled or enriched with carved ornament (fig. 7).

Throat, a groove worked on the under-side of projecting external members to intercept rain-water and cause it to drop off the member clear of the work beneath (fig. 8).

Weathering.—The surface of an exposed stone is weathered when it is worked to a slope so as to throw off the water. Cornices, copings, sills and string courses should all be so weathered.

Voussoirs, the wedge-shaped blocks of which an arch is built up.

Methods of finishing Face of Stones.—The *self face* or *quarry face* is the natural surface formed when the stone is detached from the mass in the quarry or when a stone is split.

Saw-face, the surface formed by sawing.

Hammer-dressed, Rock-faced, or Pitch-faced.—This face is used for ashlar-work, usually with a chisel-draughted margin around each block. It gives a very massive and solid appearance to the lower storeys of masonry buildings, and is formed with little labour, and is therefore the cheapest face to adopt for ashlar-work (fig. 7).

Broached and Pointed Work.—This face is also generally used with a chisel-draughted margin. The stone as left from the scabbling hammer at the quarry has its rocky face worked down to an approximate level by the point. In broached work the grooves made by the tool are continuous, often running obliquely across the face of the block. In pointed work the lines are not continuous; the surface is rough or fine pointed according as the point is used over every inch or half-inch of the stone. The point is used more upon hard stones than soft ones (fig. 7).

Tooth-chiselled Work.—The cheapest method of dressing soft stones is by the toothed chisel which gives a surface very much like the pointed work of hard stones.

Droved Work.—This surface is obtained with a chisel about two and a half inches wide, no attempt being made to keep the cuts in continuous lines.

Tooled Work is somewhat similar to droved work and is done with a flat chisel, the edge of which is about four inches wide, care being taken to make the cuts in continuous lines across the width of the stone.

Combed or Dragged Work.—For soft stones the steel comb or drag is often employed to remove all irregularities from the face and thus form a fine surface. These tools are specially useful for moulded work, as they are formed to fit a variety of curves.

Rubbed Work.—For this finish the surface of the stone is previously brought with the chisel to a level and approximately smooth face, and then the surface is rubbed until it is quite smooth with a piece of grit stone aided by fine sand and water as a lubricant. Marbles are polished by being rubbed with gritstone, then with pumice, and lastly with emery powder.

Besides these, the most usual methods of finishing the faces of stonework, there are several kinds of surface formed with hammers or axes of various descriptions. These types of hammers are more used on the continent of Europe and in America perhaps than in England, but they deserve notice here.

The *toothed axe* has its edges divided into teeth, fine or coarse according to the work to be done. It is used to reduce the face of limestones and sandstones to a condition ready for the chisel. The *bush hammer* has a heavy square-shaped double-faced head, upon which are cut projecting pyramidal points. It is used to form a surface full of little holes, and with it the face of sand and limestones may be brought to a somewhat ornamental finish. The *patent hammer* is used on granite and other hard rocks, which have been first dressed to a medium surface with the point. The fineness of the result is determined by the number of blades in the hammer, and the work is said to be " six," " eight " or " ten-cut " work according to the number of blades inserted or bolted in the hammer head. The *crandall* has an iron handle slotted at one end with a hole ¾ in. wide and 3 in. long. In this slot are fixed by a key ten or eleven double-headed points of ¼ in. square steel about 9 in long It is used for finishing sandstone and soft stones after the surface has been levelled down with the axe or chisel. It gives a fine pebbly sparkling appearance.

There are several methods of finishing stone which involve a great deal of labour and are therefore expensive to work, but which result in imparting a very stiff and unnatural appearance to the masonry.

Vermiculated Work.—This is formed by carving a number of curling worm-like lines over the face of the block, sinking in between the worms to a depth of a fourth of an inch. The surface of the strings is worked smooth, and the sinkings are pock-marked with a pointed tool (fig. 7).

Furrowed Work.—In this face the stone is cut with a chisel into a number of small parallel grooves or furrows (fig. 7).

Reticulated Face is a finish somewhat similar to vermiculated work, but the divisions are more nearly squares.

Face Joints of Ashlar.—The face joints of ashlar stonework are often sunk or rebated to form what are termed rusticated joints; sometimes the angles of each block are moulded or chamfered to give relief to the surface or to show a massive effect (fig. 7).

Joints in Stonework.—The joints between one block of stone and another are formed in many ways by cramps, dowels and joggles of various descriptions.

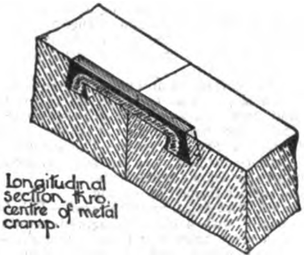


FIG. 10.

Cramps.

The stones of copings, cornices and works of a similar nature, are often tied together with metal cramps to check any tendency for the stones to separate under the force of the wind (figs. 10 and 11). Cramps are made of iron (plain or galvanized), copper or gun-metal, of varying sections and lengths to suit the work. A typical cramp would be about 9 in. long, 1 or 1½ in. wide, and from ¼ to ½ in. thick, and turned down about 1½ in. at each end. A dovetailed mortise is formed at a suitable point in each of the stones to be joined and connected by a chase. The cramp is placed in this channel with its turned-down ends in the mortises, and it is then fixed with molten lead, sulphur and sand, or Portland cement. Lead shrinks on cooling, and if used at all should be well caulked when cold. Double dovetailed slate cramps bedded in Portland cement are occasionally used (fig. 11).

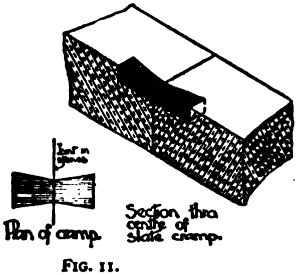


FIG. 11.

Dowels.

Dowels are used for connecting stones where the use of cramps would be impracticable, as in the joints of window mullions, the shafts of small columns, and in similar works (figs. 7, 8 and 20). Dowels for bed and side joints may be used. They are of slate, metal, or sometimes of hard wood.

Joggles.

There are many ways of making a joggle joint The joggle may be worked on one of the stones so as to fit into a groove in the adjoining stone, or grooves may be cut in both the stones and an independent joggle of slate, pebbles, or Portland cement fitted, the joggle being really a kind of dowel. The pebble joggle joint is formed with the aid of pebbles as small dowels fitted into mortises in the jointing faces of two stones and set with Portland cement; but joggles of slate have generally taken the place of pebbles. Portland cement joggles are formed by pouring cement grout into a vertical or oblique mortise formed by cutting a groove in each of the joining surfaces of the stones. What is known as a he-and-she joggle, worked on the edges of the stones themselves, is shown in fig 13.

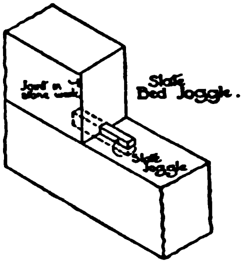


FIG. 12.

Plugs or dowels of lead are formed by pouring molten lead through a channel into dovetailed mortises in each stone (figs. 14 and 15). When cold the metal is caulked to compress it tightly into the holes.

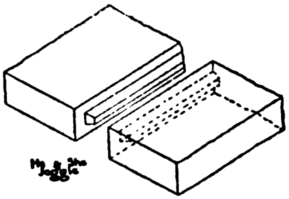


FIG. 13.

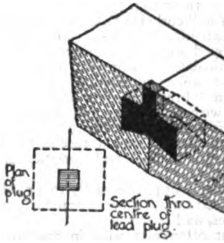


FIG. 14.

The saddle joint is used for cornices, and is formed when a portion of the stone next the joint is left raised so as to guide rain-water away from the joint (fig. 8).

Two forms of rebated joints for stone copings and roofs are common. In one form (shown in fig. 7) the stones forming the coping are thicker at their lower and rebated edge than at the top plain edge, giving a stepped surface. The other form has a level surface and the stone is of the same thickness throughout and worked to a rebate on top and bottom edges. In laying stone roofs the joints are usually lapped over with an upper slab of stone.

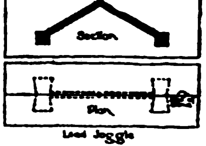


FIG. 15.

Joints in Spires.—Four forms of jointing for the battering stonework of spires are shown in fig 16. A is a plain horizontal joint. B is a similar joint formed at right angles to the face of the work. This is the most economical form of joint, the stone being cut with its sides square with each other; but if the mortar in the joint decay moisture is allowed to penetrate. With these forms dowelling is frequently necessary for greater stability. The joints C and D are more elaborate and much more expensive on account of the extra labour involved in working and fitting.

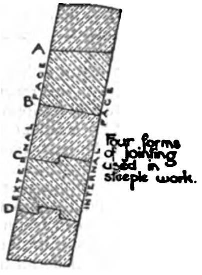


FIG. 16.

Where a concentrated weight is carried by piers or columns the bed joints are in many cases formed without the use of mortar, a thin sheet of milled lead being placed between the blocks of stone to fill up any slight inequalities.

Moulded Work.—The working of mouldings in stone is an important part of the mason's craft, and forms a costly item in the erection of a stone structure. Much skill and care is required to retain the arrises sharp and the curved members of accurate and proportionate outline. As in the case of wood mouldings, machinery now plays an important part in the preparation of stone moulded work. The process of working a stone by hand labour is as follows: The profile of the moulding is marked on to a zinc template on opposite ends of the stone to be worked; a short portion, an inch or two in length termed a "draught," is at each end worked to the required section. The remaining portion is then proceeded with, the craftsman continually checking the accuracy of his work with a straight-edge and zinc templates. A stone to be moulded by machinery is fixed to a moving table placed under a shaped tool which is fixed in an immovable portion of the machine, and is so adjusted as to cut or chip off a small layer of stone. Each time the stone passes under the cutter it is automatically moved a trifle nearer, and thus it gradually reduces the stone until the required shape is attained.

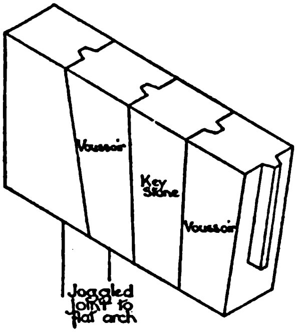


FIG. 17.

Iron in Stonework.—The use of iron dowels or cramps in stonework, unless entirely and permanently protected from oxidation is attended by the gravest risks; for upon the expansion of the iron by rusting the stone may split, and perhaps bring about a more or less serious failure in that portion of the building. A case in point is that of the church of St Mary-le-Strand, London, where the ashlar facing was secured to the backing with iron cramps; these were inefficiently protected from damp, with the result that many of the blocks have been split in consequence of rusting. John Smeaton in his Eddystone Lighthouse used dowels of Purbeck marble.

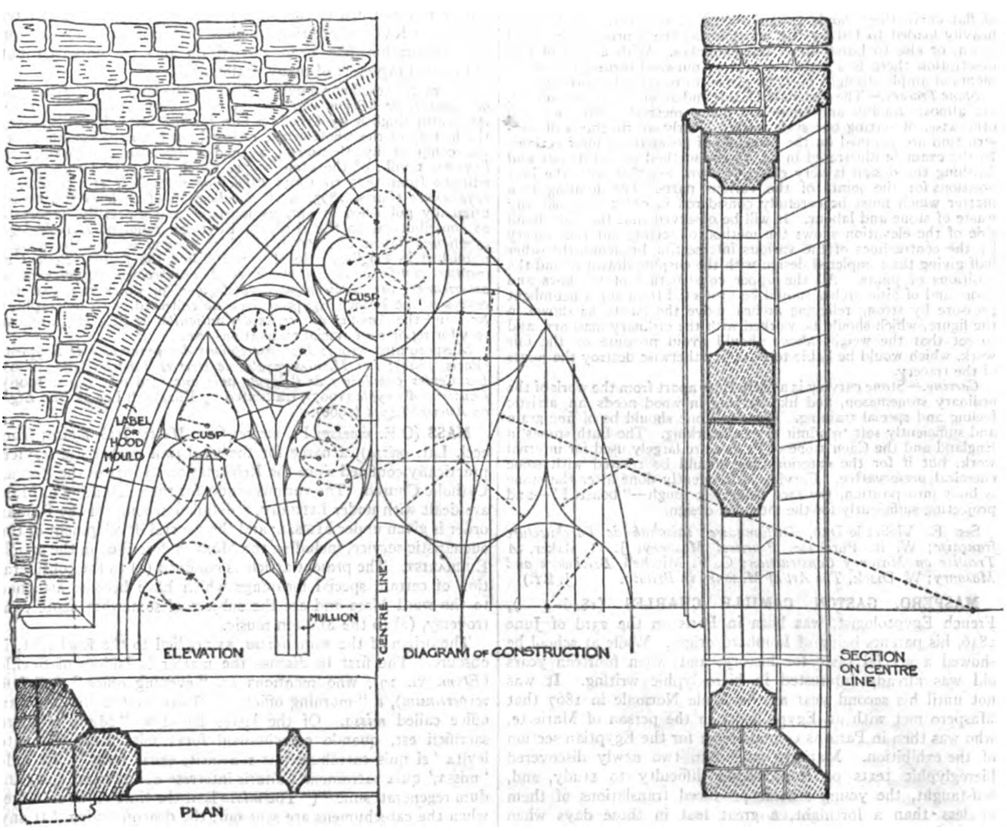


FIG. 18.

Stone Arches.—Stone arches are very frequently used both in stone and brick buildings. (For general definitions and terms see Brickwork.) They may be built in a great variety of styles, either flat, segmental, circular, elliptical or pointed. Each block or voussoir should be cut to fit exactly in its appointed place, the joints being made as fine as possible. The joints should radiate from the centre from which the soffit or intrados is struck, or in the case of an elliptical arch they should be at right angles to a tangent drawn to the intrados at that point. The extrados or back of the arch is usually concentric with the intrados, but is sometimes made thicker in one portion than in another; thus the arch may be deeper at the crown than at the sides, or at the sides than in the centre. In some cases two or more voussoirs are of one stone, having a false joint cut in the centre; this is economical, and in some cases adds to the stability of the arch. Generally the arch is divided into an uneven number of voussoirs so as to give a keystone, the voussoirs being laid from each side of the keystone and fitting exactly in the centre of the arch. The keystone is not a necessity, arches being frequently formed with an even number of voussoirs, some architects hold that the danger of the voussoirs cracking is thereby lessened. Where lintels are used in a stone wall over openings of small span it is usual to build a relieving arch above to take the superincumbent weight of masonry; or the same purpose may be effected in walls of ashlar by a flat relieving or "save" arch, formed in the next course of three stones above the lintel, the tapering keystone resting between the two side stones which are tailed well into the wall.

In very many cases it is desired to form square heads to openings of greater span than it is convenient to obtain lintels for in one piece, and some form of flat arch must therefore be adopted. The voussoirs are connected by joggles worked on their joints, as in fig. 17. The weight of the superimposed wall is taken by a lintel with relieving arch above at the back of the arch.

Arches built to an elliptical form when used for large spans (if of flat curve they should bridge over 8 ft. or 10 ft.) are liable if heavily loaded to fail by the voussoirs at the centre being forced down, or else to burst up at the haunches. With arches of this description there is a large amount of outward thrust, and abutments of ample strength must be placed to receive the springers.

Stone Tracery.—The designs of Gothic and other tracery stonework are almost infinite, and there are many methods, ingenious and otherwise, of setting out such work. Nearly all diagrams of construction are planned on the principle of geometrical intersections. In the example illustrated in fig. 18 the method of setting out and finishing the design is very clearly shown, together with the best positions for the joints of the various parts. The jointing is a matter which must be carefully considered in order to avoid any waste of stone and labour. It will be observed that the right-hand side of the elevation shows the method of setting out the tracery by the centre lines of the various intersecting branches, the other half giving the completed design with the cusping drawn in and the positions of joints. All the upper construction of windows and doors and of aisle arches should be protected from superincumbent pressure by strong relieving arches above the labels, as shown in the figure, which should be worked with the ordinary masonry, and so set that the weight above should avoid pressure on the fair work, which would be liable to flush or otherwise destroy the joints of the tracery.

Carving.—Stone carving is a craft quite apart from the work of the ordinary stonemason, and like carving in wood needs an artistic feeling and special training. Carving-stone should be of fine grain and sufficiently soft to admit of easy working. The Bath stones in England and the Caen stone of France are largely used for internal work, but if for the exterior they should be treated with some chemical preservative. Carving is frequently done after the stone is built into position, the face being left rough—"boasted"—and projecting sufficiently for the intended design.

See E. Viollet-le-Duc, *Dictionnaire raisonné de l'architecture française*; W. R. Purchase, *Practical Masonry*, J. O. Baker, *A Treatise on Masonry Construction*; C. F. Mitchell, *Brickwork and Masonry*; W. Diack, *The Art of Masonry in Britain.* (J. Bt.)

MASPERO, GASTON CAMILLE CHARLES (1846–), French Egyptologist, was born in Paris on the 23rd of June 1846, his parents being of Lombard origin. While at school he showed a special taste for history, and when fourteen years old was already interested in hieroglyphic writing. It was not until his second year at the École Normale in 1867 that Maspero met with an Egyptologist in the person of Mariette, who was then in Paris as commissioner for the Egyptian section of the exhibition. Mariette gave him two newly discovered hieroglyphic texts of considerable difficulty to study, and, self-taught, the young scholar produced translations of them in less than a fortnight, a great feat in those days when Egyptology was still almost in its infancy. The publication of these in the same year established his reputation. A short time was spent in assisting a gentleman in Peru, who was seeking to prove an Aryan affinity for the dialects spoken by the Indians of that country, to publish his researches; but in 1868 Maspero was back in France at more profitable work. In 1869 he became a teacher (*répétiteur*) of Egyptian language and archaeology at the École des Hautes Études; in 1874 he was appointed to the chair of Champollion at the Collège de France.

In November 1880 Professor Maspero went to Egypt as head of an archaeological mission despatched thither by the French government, which ultimately developed into the well-equipped Institut Français de l'Archéologie Oriental. This was but a few months before the death of Mariette, whom Maspero then succeeded as director-general of excavations and of the antiquities of Egypt. He held this post till June 1886; in these five years he had organized the mission, and his labours for the Bulak museum and for archaeology had been early rewarded by the discovery of the great cache of royal mummies at Deir el-Bahri in July 1881. Maspero now resumed his professorial duties in Paris until 1899, when he returned to Egypt in his old capacity as director-general of the department of antiquities. He found the collections in the Cairo Museum enormously increased, and he superintended their removal from Gizeh to the new quarters at Kasr en-Nil in 1902. The vast catalogue of the collections made rapid progress under Maspero's direction. Twenty-four volumes or sections were already published in 1909. The repairs and clearances at the temple of Karnak, begun in his previous tenure of office, led to the most remarkable discoveries in later years (see Karnak), during which a vast amount of excavation and exploration has been carried on also by unofficial but authorized explorers of many nationalities.

Among his best-known publications are the large *Histoire ancienne des peuples de l'Orient classique* (3 vols., Paris, 1895–1897, translated into English by Mrs McClure for the S.P.C.K.), displaying the history of the whole of the nearer East from the beginnings to the conquest by Alexander; a smaller *Histoire des peuples de l'Orient*, 1 vol., of the same scope, which has passed through six editions from 1875 to 1904; *Études de mythologie et d'archéologie égyptiennes* (Paris, 1893, &c.), a collection of reviews and essays originally published in various journals, and especially important as contributions to the study of Egyptian religion; *L'Archéologie égyptienne* (latest ed., 1907), of which several editions have been published in English. He also established the journal *Recueil de travaux relatifs à la philologie et à l'archéologie égyptiennes et assyriennes*; the *Bibliothèque égyptologique*, in which the scattered essays of the French Egyptologists are collected, with biographies, &c.; and the *Annales du service des antiquités de l'Égypte*, a repository for reports on official excavations, &c.

Maspero also wrote: *Les Inscriptions des pyramides de Saqqarah* (Paris, 1894); *Les Momies royales de Deir el-Bahari* (Paris, 1889); *Les Contes populaires de l'Égypte ancienne* (3rd ed., Paris, 1906); *Causeries d'Égypte* (1907), translated by Elizabeth Lee as *New Light on Ancient Egypt* (1908).

MASS (O.E. *maesse*; Fr. *messe*; Ger. *Messe*; Ital. *messa*; from eccl. Lat. *missa*), a name for the Christian eucharistic service, practically confined since the Reformation to that of the Roman Catholic Church. The various orders for the celebration of Mass are dealt with under Liturgy, a detailed account of the Roman order is given under Missal; and the general development of the eucharistic service, including the Mass, is described in the article Eucharist. The present article is confined (1) to the consideration of certain special meanings which have become attached to the word Mass and are the subject of somewhat acute controversy, (2) to the Mass in music.

The origin of the word *missa*, as applied to the Eucharist, is obscure. The first to discuss the matter is Isidore of Seville (*Etym.* vi. 19), who mentions an "evening office" (*officium vespertinum*), a "morning office" (*officium matutinum*), and an office called *missa*. Of the latter he says: "Missa tempore sacrificii est, quando catechumeni foras mittuntur, clamante levita 'si quis catechumenus remansit, exeat foras.' Et inde 'missa,' quia sacramentis altaris interesse non possunt, qui nondum regenerati sunt" ("The *missa* is at the time of the sacrifice, when the catechumens are sent out, the deacon crying, 'If any catechumen remain, let him go forth.'" Hence *missa*, because those who are as yet unregenerate—*i.e.* unbaptized—may not be present at the sacraments of the altar). This derivation of the word Mass, which would connect it with the special formula of dismissal still preserved in the Roman liturgy—*Ite, missa est*—once generally accepted, is now disputed. It is pointed out that the word *missa* long continued to be applied to any church service, and more particularly to the lections (see Du Cange for numerous examples), and it is held that such services received their name of *missal* from the solemn form of dismissal with which it was customary to conclude them; thus, in the 4th century *Pilgrimage of Etheria* (*Silvia*) the word *missa* is used indiscriminately of the Eucharist, other services, and the ceremony of dismissal. F. Kattenbusch (Herzog-Hauck, *Realencyklop.* s. "Messe") ingeniously, but with little evidence, suggests that the word may have had a double origin and meaning: (1) in the sense of *dimissio*, "dismissal"; (2) in that of *commissio*, "commission," "official duty," *i.e.* the exact Latin equivalent of the Greek λειτουργία (see Liturgy), and hence the conflicting use of the term. It is, however, far more probable that it was a general term that gradually became crystallized as applying to that service in which the dismissal represented a more solemn function. In the narrower sense of "Mass" it is first found in St Ambrose (*Ep.* 20, 4, ed. Ballerini): "Missam facere coepi. Dum offero. . ." which evidently identifies the *missa* with the sacrifice. It continued, however, to be used loosely, though its tendency to become proper only to the principal Christian service is clear from a passage in the 12th homily of Caesarius, bishop of Arles (d. 542): "If you will diligently attend, you will recognize that *missae* are not celebrated when the divine readings are recited in the church, but when gifts are offered and the Body and Blood of the Lord are consecrated." The complete service (*missa ad integrum*), the bishop goes on to say, cannot be had at home by reading and prayer, but only in the house of God, where, besides the Eucharist, "the divine word is preached and the blessing is given to the people."

Whatever its origin, the word Mass had by the time of the Reformation been long applied only to the Eucharist; and, though in itself a perfectly colourless term, and used as such during the earlier stages of the 16th century controversies concerning the Eucharist, it soon became identified with that sacrificial aspect of the sacrament of the altar which it was the chief object of the Reformers to overthrow. In England, so late as the first Prayer-book of Edward VI., it remained one of the official designations of the Eucharist, which is there described as "The Supper of the Lorde and holy Communion, commonly called the Masse." This, however, like the service itself, represented a compromise which the more extreme reformers would not tolerate, and in the second Prayer-book, together with such language in the canon as might imply the doctrine of transubstantiation and of the sacrifice, the word Mass also disappears. That this abolition of the word Mass, as implying the offering of Christ's Body and Blood by the priest for the living and the dead was deliberate is clear from the language of those who were chiefly responsible for the change. Bishops Ridley and Latimer, the two most conspicuous champions of "the new religion," denounced "the Mass" with unmeasured violence; Latimer said of "Mistress Missa" that "the devil hath brought her in again"; Ridley said: "I do not take the Mass as it is at this day for the communion of the Church, but for a popish device," &c. (*Works*, ed. Parker Soc., pp. 121, 120), and again: "In the stead of the Lord's holy table they give the people, with much solemn disguising, a thing which they call their mass; but in deed and in truth it is a very masking and mockery of the true Supper of the Lord, or rather I may call it a crafty juggling, whereby these false thieves and jugglers have bewitched the minds of the simple people . . . unto pernicious idolatory" (ib. p. 409). This language is reflected in the 31st of the Articles of Religion of the Church of England: "Wherefore the sacrifices of Masses, in which it was commonly said that the Priest did offer Christ for the quick and the dead, to have remission of pain and guilt, were blasphemous fables and dangerous deceits." Clearly the word Mass had ceased to be a colourless term generally applicable to the eucharistic service; it was, in fact, not only proscribed officially, but in the common language of English people it passed entirely out of use except in the sense in which it is defined in Johnson's Dictionary, *i.e.* that of the "Service of the Romish Church at the celebration of the Eucharist." In connexion with the Catholic reaction in the Church of England, which had its origin in the "Oxford Movement" of the 19th century, efforts have been made by some of the clergy to reintroduce the term "Mass" for the Holy Communion in the English Church.

See Du Cange, *Glossarium*, *s.v.* "Missa"; F. Kattenbusch in Herzog-Hauck, *Realencyklopädie* (ed. 1903), *s.v.* "Messe, dogmengeschichtlich", for the facts as to the use of the word "Mass" at the time of the Reformation see the article by J. H. Round in the *Nineteenth Century* for May 1897. (W. A. P.)

Mass, in Music: 1. *Polyphonic Masses.*—The composition of musical settings of the Mass plays a part in the history of music which is of special importance up to and including the 16th century. As an art-form the musical Mass is governed to a peculiar degree by the structure of its text. It so happens that the supremely important parts of the Mass are those which have the smallest number of words, namely the *Kyrie*, important as being the opening prayer; the *Sanctus* and *Benedictus*, embodying the central acts and ideas of the service; and the *Agnus Dei*, the prayer with which it concludes. The 16th-century methods were specially fitted for highly developed music when words were few and embodied ideas of such important emotional significance or finality that they could be constantly repeated without losing force. Now the texts of the *Gloria* and *Credo* were more voluminous than any others which 16th-century composers attempted to handle in a continuous scheme. The practical limits of the church service made it impossible to break them up by setting each clause to a separate movement, a method by which 16th-century music composers contrived to set psalms and other long texts to compositions lasting an hour or longer. Accordingly, Palestrina and his great contemporaries and predecessors treated the *Gloria* and *Credo* in a style midway in polyphonic organization and rhythmic breadth between that of the elaborate motet (adopted in the *Sanctus*) and the homophonic reciting style of the Litany. The various ways in which this special style could be modified by the scale of the work, and contrasted with the broader and more elaborate parts, gave the Mass (even in its merely technical aspects) a range which made it to the 16th-century composer what the symphony is to the great instrumental classics. Moreover, as being inseparably associated with the highest act of worship, it inspired composers in direct proportion to their piety and depth of mind. Of course there were many false methods of attacking the art-problem, and many other relationships, true and false, between the complexity of the settings of the various parts of the Mass and of motets. The story of the action of the council of Trent on the subject of corruption of church music is told elsewhere (see Music and Palestrina); and it has been recently paralleled by a decree of Pope Pius X., which has restored the 16th-century polyphonic Mass to a permanent place in the Roman Catholic Church music.

2. *Instrumental Masses in the Neapolitan Form.*—The next definite stage in the musical history of the Mass was attained by the Neapolitan composers who were first to reach musical coherence after the monodic revolution at the beginning of the 17th century. The fruit of their efforts came to maturity in the Masses of Mozart and Haydn. By this time the resources of music were such that the long and varied text of the *Gloria* and *Credo* inevitably either overbalanced the scheme or met with an obviously perfunctory treatment. It is almost impossible, without asceticism of a radically inartistic kind, to treat with the resources of instrumental music and free harmony such passages as that from the *Crucifixus* to the *Resurrexit*, without an emotional contrast which inevitably throws any natural treatment of the *Sanctus* into the background, and makes the *Agnus Dei* an inadequate conclusion to the musical scheme. So unfavourable were the conditions of 18th-century music for the formation of a good ecclesiastical style that only a very small proportion of Mozart's and Haydn's Mass music may be said to represent their ideas of religious music at all. The best features of their Masses are those that combine faithfulness to the Neapolitan forms with a contrapuntal richness such as no Neapo-

litan composer ever achieved. Thus Mozart's most perfect as well as most ecclesiastical example is his extremely terse Mass in F, written at the age of seventeen, which is scored simply for four-part chorus and solo voices accompanied by the organ with a largely independent bass and by two violins mostly in independent real parts. This scheme, with the addition of a pair of trumpets and drums and, occasionally, oboes, forms the normal orchestra of 18th-century Masses developed or degenerated from this model. Trombones often played with the three lower voices, a practice of high antiquity surviving from a time when there were soprano trombones or *cornetti* (*Zincken*, a sort of treble *serpent*) to play with the sopranos.

3. *Symphonic Masses.*—The enormous dramatic development in the symphonic music of Beethoven made the problem of the Mass with orchestral accompaniment almost insoluble. This makes it all the more remarkable that Beethoven's second and only important Mass (in D, *Op.* 123) is not only the most dramatic ever penned but is, perhaps, the last classical Mass that is thoughtfully based upon the liturgy, and is not a mere musical setting of what happens to be a liturgic text. It was intended for the installation of Beethoven's friend, the archduke Rudolph, as archbishop of Olmütz; and, though not ready until two years after that occasion, it shows the most careful consideration of the meaning of a church service, no doubt of altogether exceptional length and pomp, but by no means impossible for its unique occasion. Immense as was Beethoven's dramatic force, it was equalled by his power of sublime repose; and he was accordingly able once more to put the supreme moment of the music where the service requires it to be, viz. in the *Sanctus* and *Benedictus*. In the *Agnus Dei* the circumstances of the time gave him something special to say which has never so imperatively demanded utterance since. Europe had been shattered by the Napoleonic wars. Beethoven read the final prayer of the Mass as a "prayer for inward and outward peace," and, giving it that title, organized it on the basis of a contrast between terrible martial sounds and the triumph of peaceful themes, in a scheme none the less spiritual and sublime because those who first heard it had derived their notions of the horror of war from living in Vienna during its bombardment. Critics who have lived in London during the relief of Mafeking have blamed Beethoven for his realism.

Schubert's Masses show rather the influence of Beethoven's not very impressive first Mass, which they easily surpass in interest, though they rather pathetically show an ignorance of the meaning of the Latin words. The last two Masses are later than Beethoven's Mass in D and contain many remarkable passages. It is evident from them that a dramatic treatment of the *Agnus Dei* was "in the air"; all the more so, since Schubert does not imitate Beethoven's realism.

4. *Lutheran Masses.*—Music with Latin words is not excluded from the Lutheran Church, and the *Kyrie* and *Gloria* are frequently sung in succession and entitled a Mass. Thus the *Four Short Masses* of Bach are called short, not because they are on a small scale, which is far from being the case, but because they consist only of the *Kyrie* and *Gloria*. Bach's method is to treat each clause of his text as a separate movement, alternating choruses with groups of arias; a method which was independently adopted by Mozart in those larger masses in which he transcends the Neapolitan type, such as the great unfinished Mass in C minor. This method, in the case of an entire Mass, results in a length far too great for a Roman Catholic service; and Bach's B minor Mass, which is such a setting of the entire text, must be regarded as a kind of oratorio. It thus has obviously nothing to do with the Roman liturgy; but as an independent setting of the text it is one of the most sublime and profoundly religious works in all art; and its singular perfection as a design is nowhere more evident than in its numerous adaptations of earlier works.

The most interesting of all these adaptations is the setting of the words: "Et expecto resurrectionem mortuorum et vitam venturi saeculi.—Amen." Obviously the greatest difficulty in any elaborate instrumental setting of the *Credo* is the inevitable anti-climax after the *Resurrexit*. Bach contrives to give this anti-climax a definite artistic value, all the more from the fact that his *Crucifixus* and *Resurrexit*, and the contrast between them, are among the most sublime and directly impressive things in all music. To the end of his *Resurrexit* chorus he appends an orchestral *ritornello*, summing up the material of the chorus in the most formal possible way, and thereby utterly destroying all sense of finality as a member of a large group, while at the same time not in the least impairing the force and contrast of the whole—that contrast having ineffaceably asserted itself at the moment when it occurred. After this the aria "Et in spiritum sanctum," in which the next dogmatic clauses are enshrined like relics in a casket, furnishes a beautiful decorative design on which the listener can repose his mind, and then comes the voluminous ecclesiastical fugue, *Confiteor unum baptisma*, leading, as through the door and world-wide spaces of the Catholic Church, to that veil which is not all darkness to the eye of faith. At the words "Et expecto resurrectionem mortuorum" the music plunges suddenly into a slow series of some of the most sublime and mysterious modulations ever written, until it breaks out as suddenly into a *vivace e allegro* of broad but terse design, which comes to its climax very rapidly and ends as abruptly as possible, the last chord being carefully written as a short note without a pause. This gives the utmost possible effect of finality to the whole *Credo*, and contrasts admirably with the coldly formal instrumental end of the *Resurrexit* three movements further back. Now, such subtleties seem as if they must be unconscious on the part of the composer; yet here Bach is so far aware of his reasons that his *vivace e allegro* is an arrangement of the second chorus of a church cantata, *Gott man lobet dich in der Stille*; and in the cantata the chorus has introductory and final symphonies and a middle section with a *da capo!*

5. *The Requiem.*—The *Missa pro defunctis* or *Requiem Mass* has a far less definite musical history than the ordinary Mass; and such special musical forms as it has produced have little in common with each other. The text of the *Dies Irae* so imperatively demands either a very dramatic elaboration or none at all, that even in the 16th century it could not possibly be set to continuous music on the lines of the *Gloria* and *Credo*. Fortunately, however, the Gregorian *canto fermo* associated with it is of exceptional beauty and symmetry; and the great 16th century masters either, like Palestrina, left it to be sung as plain-chant, or obviated all occasion for dramatic expression by setting it in versicles (like their settings of the *Magnificat* and other canticles) for two groups of voices alternatively, or for the choir in alternation with the plain chant of the priests.

With modern orchestral conditions the text seems positively to demand an unecclesiastical, not to say sensational, style, and probably the only instrumental Requiem Masses which can be said to be great church music are the sublime unfinished work of Mozart (the antecedents of which would be a very interesting subject) and the two beautiful works by Cherubini. These latter, however, tend to be funereal rather than uplifting. The only other artistic solution of the problem is to follow Berlioz, Verdi and Dvořák in the complete renunciation of all ecclesiastical style.

Brahms's *Deutsches requiem* has nothing to do with the Mass for the dead, being simply a large choral work on a text compiled from the Bible by the composer. (D. F. T.)

MASSA, a town of Tuscany, Italy, the joint capital with Carrara of the province of Massa and Carrara, and sharing with it the episcopal see, 20 m. S.E. of Spezia by rail, 246 ft. above sea-level. Pop. (1901), 10,559 (town); 26,118 (commune). The Palazzo Ducale (now the prefecture) was erected in 1701, and was a summer residence of Napoleon's sister, Elisa Baciocchi, princess of Lucca, who caused the ancient cathedral opposite to be destroyed. The hills round the town yield marble, and there is a narrow-gauge railway to the Marina d'Avenza, where the marble is shipped.

MASSACHUSETTS (an Indian name, originally applied to a tribe of Indians), one of the original thirteen states of the American Union, bounded on the N. by Vermont and New Hampshire, on the E. by the Atlantic, on the S. by Rhode Island

and Connecticut, and on the W. by New York. It lies approximately between 41° 15′ and 42° 50′ N. lat. and 69° 55′ and 73° 30′ W. long. The bulk of its area—which is about 8266 sq. m. (of which 227 are water)—forms a parallelogram of 130 m. E. and W., 46 m. N. and S., the additional area lying in a projection at the S.E. and a lesser one at the N.E., which give the mainland a breadth of 90 m. where it borders upon the ocean, while the general irregularity of the coast-line gives a sea frontage of about 250 m.

Physical Features.—The east and south-east portions are in general undulating or level, the central hilly and broken, and the west rugged and mountainous. (For geological details see UNITED STATES: *Geology, ad fin.*) The Hoosac Hills (1200–1600 ft. high), separating the valleys of the Housatonic and Connecticut, are a range of the Berkshires, a part of the Appalachian system, and a continuation of the Green Mountains of Vermont, and with the Taconic range on the west side of the Housatonic Valley—of which the highest peaks are Greylock, or "Saddleback" (3535 ft.), and Mt Williams (3040 ft.)—in the extreme north-west corner of the state, form the only considerable elevated land.[1] Bordering on the lowlands of the Connecticut, Mt Tom (1214 ft.) and a few other hills (Mt Holyoke, 954 ft.; Mt Toby, 1275) form conspicuous landmarks. East of this valley the country continues more or less hilly and rocky, but the elevations eastward become increasingly slight and of little consequence. Mt Lincoln (1246 ft.) and especially Mt Wachusett (2108 ft.), to the east in a level country, are very exceptional. The Blue Hills in Milton are the nearest elevations to the coast, and are conspicuous to navigators approaching Boston. The south-east corner of the state is a sandy lowland, generally level with a slightly elevated ridge (Manomet) south of Plymouth, and well watered by ponds.

With the exception of this corner, Massachusetts is a part of the slanting upland that includes all of southern New England. This upland is an uplifted peneplain of subaerial denudation,[2] now so far advanced in a "second" cycle of weathering and so thoroughly dissected that to an untrained eye it appears to be only a country of hills confusedly arranged. The general contour of the upland, marked by a remarkably even sky-line, is evident at almost every locality in the state. In the nature and position of the upland rocks—mainly crystalline schists and gneisses, excessively complicated and disordered in mass, and also internally deformed—there is found abundant proof that the peneplain is a degraded mountain region. The upland is interrupted by the rivers, and on the coast by great lowlands, and is everywhere marked by hills somewhat surmounting the generally even skyline. Monadnock (in New Hampshire, near N.E. Massachusetts), the Blue Hills near Boston, Greylock, in the north-west, and Wachusett in the centre, are the most commanding remnant-summits (known generically as "Monadnocks") of the original mountain system. But in the derivant valley peneplains developed in the present cycle of denudation, and there are residual summits also; in the Connecticut Valley trap ridges, of which Mt Tom and Mt Holyoke are the best examples; at Mt Holyoke, lava necks; occasionally in the lowlands, ridges of resistant sandstone, like Deerfield Mountain near Northampton; in the Berkshire Valley, summits of resistant schists, like Greylock, the highest summit in the state. The larger streams have cut their channels to very moderate gradients, but the smaller ones are steeper. The Housatonic and Millers (and the Connecticut also, but not in its course within Massachusetts alone) afford beautiful examples of the dependence of valley breadth upon the strike of soft or harder rocks across the stream. The Connecticut lowland is cut from 5 to 18 m. wide in soft sandstones and shales. The glacial era has left abundant evidences in the topography of the state. The ice covered even the Monadnocks. Till drumlins, notably abundant on the lowland about Boston and the highland near Spencer; morainic hills, extending, *e.g.* all along Cape Cod; eskers, kames and river terraces afford the plainest evidences of the extent of the glacial sheet. The Berkshire country—Berkshire, Hampden, Hampshire and Franklin counties—is among the most beautiful regions of the United States. It is a rolling highland dominated by long, wooded hill-ridges, remarkably even-topped in general elevation, intersected and broken by deep valleys. Scores of charming lakes lie in the hollows. The district is often called the Lake Region of America, partly from the comparableness of its scenic beauties with the English Lake Country (Matthew Arnold, however, wrote: "The country is pleasing but not to be compared with Westmoreland. It is wider and opener, and neither hills nor lakes are so effective."), and partly from the parallelism of iterary associations. It has become since 1850, and especially n much more recent years, a favoured resort of summer residents. Owing to topography, and also to the manner in which Massachusetts was settled, the western counties were long connected commercially more closely with New York than with Massachusetts, and this territory was long in dispute between these two states.

The Connecticut is the most considerable stream, and is navigable by small craft. Its valley, much the richest portion of the state agriculturally, is celebrated for the quiet variety and beauty of its scenery. The Housatonic, in portions placid, in others wild and rapid, winding along the deflecting barrier of the Hoosac Hills, is the most beautiful river of the state, despite the mercantile use of its water-power. The Merrimac, the second stream of the state in volume, runs in a charming valley through the extreme north-east corner, and affords immensely valuable water-power at Lowell, Lawrence and Haverhill.

South of Cohasset the shore is sandy, with a few isolated rocky ledges and boulders. About Boston, and to the north of it, the shore is rocky and picturesque. Cape Cod, like a human arm doubled at the elbow, 40 m. from shoulder to elbow and 30 from elbow to hand, is nowhere more than a few miles broad. It is a sandy ridge, dotted with summer resorts and cottages. Cape Ann has a rugged interior and a ragged, rocky coast. It, too, is a summer recreation ground, with much beautiful scenery. Boston Harbor (originally known as Massachusetts Bay, a name which now has a much broader signification) is the finest roadstead on the coast. The extreme hook of the Cape Cod Peninsula forms Provincetown Harbor, which is an excellent and capacious port of refuge for vessels approaching Boston. Salem Harbor is the most considerable other haven on Massachusetts Bay; on Buzzard's Bay New Bedford has a good harbour, and on the Atlantic coast are the excellent harbours of Gloucester and Marblehead, both frequented by summer residents. Gloucester has the largest fishery interests of any place in the country, and is one of the chief fishing ports of the world. Buzzard's Bay is also a popular yachting ground, and all about its shores are towns of summer residence. Wood's Hole is a station of the United States Bureau of Fisheries, and a marine biological laboratory is there.

The principal islands lie off the south coast. The largest is Martha's Vineyard, about 20 m. long, with an extreme breadth of about 9½ m. It has in Vineyard Haven (Holmes's Hole) a spacious harbour, much frequented by wind-bound vessels seeking a passage round Cape Cod. The island is covered with stunted trees. Its population was formerly dependent wholly upon the sea, but its climate has made it a popular summer resort, Oak Bluffs being one of the chief resorts of the Atlantic coast. Farther east, Nantucket, a smaller island of triangular shape, is likewise the home of a seafaring folk who still retain in some degree primitive habits, though summer visitors are more and more affecting its life.

Flora and Fauna.—Massachusetts lies entirely in the humid area of the Transition life-zone, with the exception of the extreme north-western corner of the state, which lies in the Boreal zone. Thus the original native trees and plants were those common to New England and northern New York. The presence of a dense population has driven out some, and brought in others, including some noxious weeds. The larger wild animals have disappeared, excepting an occasional black bear or deer. Of the smaller fur-bearing animals, the beaver was long ago exterminated, the otter is seen very rarely, and the mink only in the most isolated districts; but foxes, skunks, weasels, musk-rats, rabbits, and grey and red squirrels are not uncommon. Copperhead snakes and rattlesnakes are occasionally seen, and there are several species of harmless serpents. Of game birds the most characteristic is the partridge (ruffed grouse), exclusively a woodland bird; the Wilson's snipe and the woodcock are not uncommon in favourable localities, and several species of ducks are found especially in the bays and marshes near the coast during the seasons of migration. A stray eagle is sometimes seen. Very interesting to ornithologists are the few heath hens, the eastern representative of the prairie hen (pinnated grouse), which are found on the island of Martha's Vineyard, and are the sole survivors in the eastern states of one of the finest of American game birds, now practically exterminated even on the western plains. There are many insectivorous birds; among the song birds are the hermit thrush, the wood thrush, the Wilson's thrush, the brown thrasher, the bobolink, the catbird, the oven bird, the house wren, the song sparrow, the fox sparrow, the vesper sparrow, the white-throated sparrow (Peabody bird), the goldfinch and the robin. Brook trout are found, especially in the streams in the western part of the state, and bass, pickerel, perch and smaller fish occur in the rivers and other inland waters. Fish are so abundant on the coast that the cod is sometimes used as an emblem of the state; thus a figure of one hangs in the representatives' chamber at the State House. The artificial propagation and preservation of salmon and other edible fresh-water fish have been carried on successfully under the supervision of a state commission. The commonwealth has expended large sums since 1890 in a vain attempt to exterminate the gipsy moth (*Ocneria*, or more exactly *Porthetria, dispar*), accidentally allowed to escape in 1869 by a French naturalist.

Climate.—The climate is trying, showing great extremes of temperature (20° F. below zero to 100° above) and marked local variations. The south-eastern coast and islands are mildest. The mean average temperature of Boston is 48° F. In the interior it is slightly lower. The mean summer temperature generally over the state is about 70° F. Changes are often sudden, and the passage from winter to summer is through a rapid spring. The ocean tempers the climate considerably on the seaboard. Boston Harbor has been frozen over in the past, but steamtugs plying constantly now prevent the occurrence of such obstruction. In the elevated region in the west the winters are decidedly severe, and the springs and summers often late and cold. Williamstown has a winter mean of about 23° F. The yearly precipitation is about 39 to 45 in., decreasing inland, and is evenly distributed throughout the year. Fogs are common on the coast, and east wind drizzles; the north-east winds being the weather bane of spring and late autumn. In the summer and the autumn the weather is commonly fine, and often most beautiful; and especially in the Berkshires a cool, pure and elastic atmosphere prevails, relatively dry, and altogether delightful.

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[1] At least seventy hills in the state, mainly in this quarter, have an levation of 1500 ft. (twenty-four above 2000 ft.).

[2] In some localities it is not easy to establish irrefutably and in etail the inter-arrangement of drainage and rock structure that roves it to be a subaerial peneplain instead of an uplifted submarine platform; but the general proof is very clear.

Agriculture.—The soil, except in some of the valleys, is not naturally fertile; and sandy wastes are common in the south-east parts. High cultivation, however, has produced valuable market-gardens about Boston and the larger towns; and industry has made tillage remunerative in most other parts. The gross value of agricultural products is not great compared with that of other industries, but they are of great importance in the economy of the state. The total value of farm property in 1900 was $182,646,704, including livestock valued at $15,798,464. Of the increase in the total value of farm property between 1850 and 1900 more than half was in the decade 1890–1900; this increase being due partly to the rising value of suburban realty, but also to a development of intensive farming that has been very marked since 1880. The total value of farm products in 1899 was $42,298,274 (expenditure for fertilizers $1,320,600); crops representing 54·7 and animal products 45·3% of this total. The leading crops and their percentages of the total crop value were hay and forage (39·1%), vegetables (23·9%), fruits and nuts (11·7%), forest products (8·4%), and flowers and plants (7·1%). Of the animal products 67·3% were dairy products, and 20·8% poultry and eggs. Cereals[1] have been for many years declining, although Indian corn is a valuable subsidiary to the dairy interest, which is the most thriving farm industry. The value of farms on which dairying was the chief source of income in 1900 was 46% of the total farm value of the state; the corresponding percentages for livestock, vegetables, hay and grain, flowers and plants, fruit and tobacco, being respectively 14·6, 10·2, 8·0, 4·2, 3·2, and 1·8%. The shrinkage of cereal crops has been mainly responsible for the idea that Massachusetts is agriculturally decadent. Parallel to this shrinkage was the decrease in ranging sheep (82·0% from 1850–1900; 34·2% from 1890–1900), and cattle, once numerous in the hill counties of the west, and in the Connecticut Valley; Boston, then ranking after London as the second wool market of the world, and being at one time the chief packing centre of the country. Dairy cows increased, however, from 1850 to 1900 by 41·9% (1890–1900, 7·3%). The amount of improved farmland decreased in the same period 39·4%, decreasing even more since 1880 than earlier, and amounting in 1900 to no more than 25·1% of the area of the state; but this decrease has been compensated by increased value of products, especially since the beginning of intensive agriculture. An unusual density of urban settlement, furnishing excellent home markets and transportation facilities, are the main props of this new interest. Worcester and Middlesex counties are agriculturally foremost. Tobacco, which has been cultivated since colonial times, especially since the Civil War, is grown exclusively in the Connecticut Valley or on its borders. In the swamps and bogs of the south-east coast cranberry culture is practised, this district producing in 1900 three-fifths of the entire yield of the United States. "Abandoned farms" (aggregating, in 1890, 3·4% of the total farm area, and 6·85% in Hampshire county) are common, especially in the west and south-east.

Mines and Mining.—Granite is the chief mineral, and granite quarrying is the principal mineral industry of the state. In 1900 the value of manufactures based primarily upon the products of mines and quarries was $196,930,979, or 19% of the state's total manufactured product. In 1906 Massachusetts led all states in the value of its granite output, but in 1907 and 1908 it was second to Vermont. The value of the product (including a small output of igneous rocks) was in 1903, $2,351,027; 1904, $2,554,748; 1905, $2,251,319; 1906, $3,327,416; 1907, $2,328,777; 1908, $2,027,463.

Granite boulders were used for construction in Massachusetts as early as 1650. Systematic quarrying of siliceous crystalline rocks in New England began at Quincy in about 1820. The Gloucester quarries, opened in 1824, were probably the next to be worked regularly. The principal granite quarries are in Milford, (Worcester county), Quincy and Milton (Norfolk county), Rockport (Essex county) and Becket (Berkshire county). Of the fourteen quarries of "Milford granite," twelve are in the township of that name, and two in Hopkinton township, Middlesex county. B. K. Emerson and J. H. Perry classify this granite as post-Cambrian. They describe it[2] as "a compact, massive rock, somewhat above medium grain, and of light colour. The light flesh colour of the feldspar, and the blue of the quartz give it in some places a slight pinkish tint, and it is now much used as a building-stone under the name of 'pink granite.'"

The Quincy granite district lies around the north-east end of the Blue Hill region, about 11 m. south of Boston. For monumental purposes this granite is classified as "medium," "dark," and "extra dark." Quincy granite takes a very high polish, owing to the absence of mica and to the coarser cleavage of its hornblende and augite. The lightest of the monumental stone quarried at Quincy is called gold-leaf; it is bluish-green gray, speckled with black and light yellow brown. Another variety has small, rather widely separated cherry-red dots.

The Rockport granite is found along or near the seashore, between Rockport and Bay View, and within about three-quarters of a mile of Cape Ann. The granite is of two kinds, known commercially as "grey granite" and "green granite." Both varieties are hard and take a very high polish.

The Becket granite (known as "Chester dark" and "Chester light") is a muscovite-biotite granite varying from medium grey to medium bluish grey colour, and fine in texture. It is used principally for monuments.

In 1907 Massachusetts ranked sixth among the states in the value of its trap rock product ($432,604), and eighth in sandstone ($243,328). The value of the marble produced in the same year was $212,438, the state ranking fifth in the value of the total product and fourth in building-marble. Other minerals are emery, limestone and quartz. The state ranked fifth in 1906 in the total value of stone quarried ($4,333,616), and eighth in 1908 ($2,955,195). The output of lime in 1908 was 107,813 tons, valued at $566,022. Second in value to the various stones were the clay products of the state, which were valued in 1906 at $2,172,733 (of which $1,415,864 was the value of common brick) and in 1908 at $1,647,362 (of which $950,921 was the value of common brick). There are many mineral springs in the state, more than half being in Essex and Middlesex counties. The total amount of mineral waters sold in 1908 was valued at $227,907. In that year the total value of the minerals and mining products of the state was $5,925,949. Gold has been found in small quantities in Middlesex, Norfolk and Plymouth counties.

Manufactures.—Though only four states of the Union are smaller, only three exceeded Massachusetts in 1905 in the value of manufactured products (six exceeding it in population); and this despite very scant native resources of raw materials and a very limited home market. Historical priority of development, exceptionally extensive and well utilized water-power, and good transportation facilities are largely responsible for the exceptional rank of Massachusetts as a manufacturing state. Vast water-power is developed on the Merrimac at Lawrence and Lowell, and on the Connecticut at South Hadley, and to a less extent at scores of other cities on many streams and artificial ponds; many of the machines that have revolutionized industrial conditions since the beginning of the factory system have been invented by Massachusetts men; and the state contains various technical schools of great importance. In 1900 the value of manufactures was $1,035,198,989, an increase from 1890 of 16·6%; that from 1880 to 1890 having been 40·7%. In textiles—cottons, worsteds, woollens and carpets—in boots and shoes, in rubber foot-wear, in fine writing paper, and in other minor products, it is the leading state of the country. The textile industries (the making of carpets and rugs, cotton goods, cotton smallwares, dyeing and finishing textiles, felt goods, felt hats, hosiery and knit goods, shoddy, silk and silk goods, woollen goods, and worsted goods), employed 32·5% of all manufacturing wage earners in 1905, and their product ($271,369,816) was 24·1% of the total, and of this nearly one-half ($129,171,449) was in cotton goods, being 28·9% of the total output of the country, as compared with 11% for South Carolina, the nearest competitor of Massachusetts. There is a steadily increasing product of fine grade fabrics. The output of worsted goods in 1905 ($51,973,944) was more than three-tenths that of the entire country, Rhode Island being second with $44,477,596; in Massachusetts the increase in the value of this product was 28·2% between 1900 and 1905. The value of woollen goods in 1905 ($44,653,940) was more than three-tenths of the entire product for the country; and it was 44·6% more than that of 1900. The value of boots and shoes and cut stock in 1905 was $173,612,660, being 23% greater than in 1900; the value of boots and shoes in 1905 ($144,291,426) was 45·1% of the country's output, that of New York, the second state, being only 10·7%. In this industry, as in the manufacture of cotton goods, Massachusetts has long been without serious rivalry; Brockton, Lynn,

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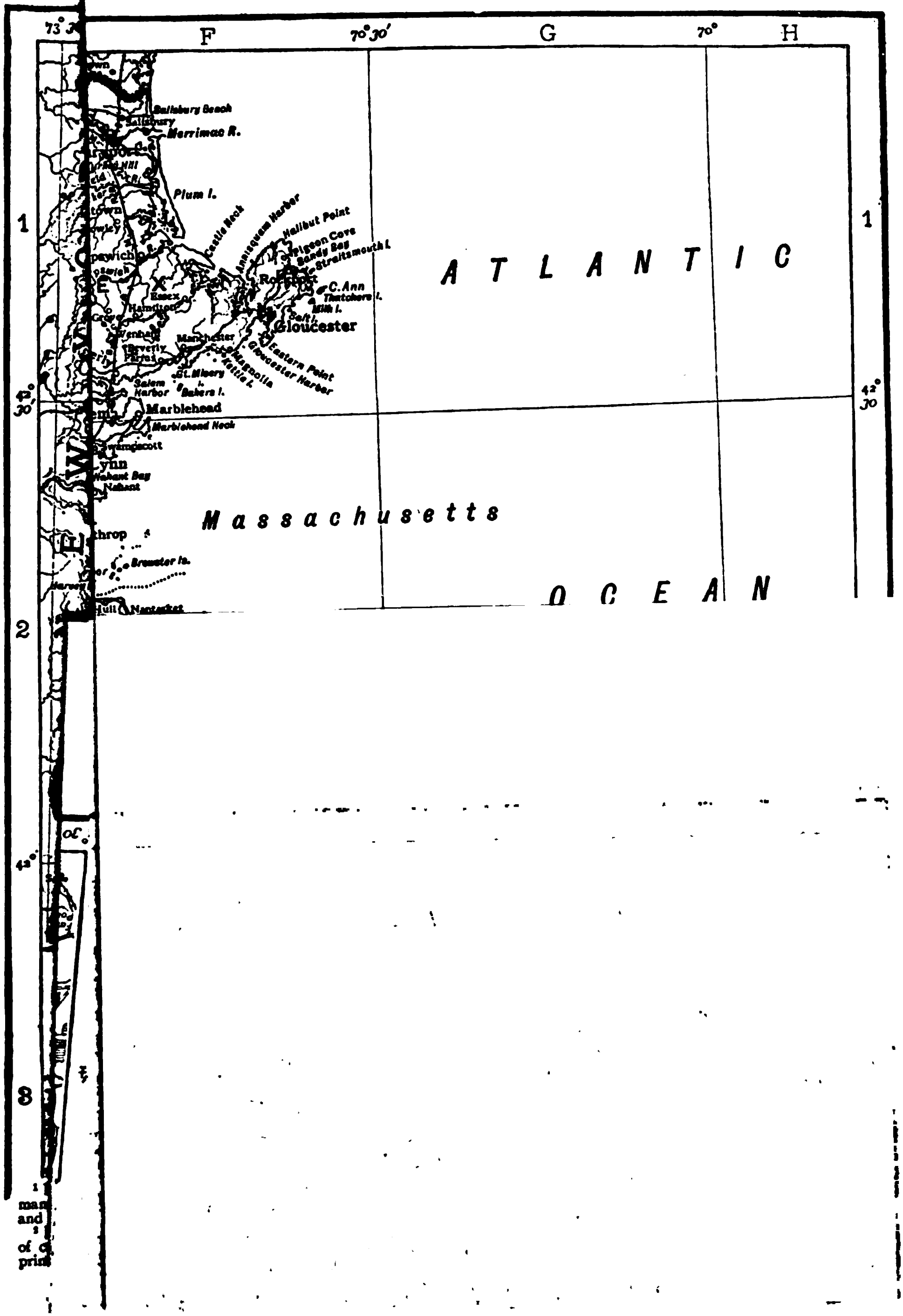
[1] The yield of cereals and of such other crops in 1907 as are recorded in the *Yearbook* of the United States Department of Agriculture was as follows: Indian corn, 1,584,000 bushels; oats, 245,000 bushels; barley, 64,000 bushels; buckwheat, 42,000 bushels; potatoes, 3,600,000 bushels; hay, 760,000 tons; tobacco, 7,167,500 lb. In the same year, according to the same authority, there were in the state 196,000 milch cows, 92,000 other neat cattle, 45,000 sheep and 70,000 swine.

[2] *The Green Schists and Associated Granites and Porphyries of Rhode Island*, Bulletin, U.S. Geological Survey, No. 311, 1907.



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Haverhill, Marlboro and Boston, in the order named, being the principal centres. The third industry in 1905 was that of foundry and machine-shop products ($58,508,793), of which Boston and Worcester are the principal centres. Lesser interests, in the order of importance, with the product value of each in 1905, were: rubber goods ($53,133,020), tanned, curried and finished leather ($33,352,999), in the manufacture of which Massachusetts ranked second among the states; paper and wood pulp[1] ($32,012,247), in the production of which the state ranked second among the states of the Union; slaughtering and meat packing ($30,253,838); printing and publishing ($33,900,748, of which $21,020,237 was the value of newspapers and periodicals); clothing ($21,724,056); electrical machinery, apparatus and supplies ($15,882,216); lumber ($12,636,329); iron and steel, steel works and rolling-mills products ($11,947,731; less than in 1900); cordage and twine ($11,173,521), in the manufacture of which Massachusetts was second only to New York; furniture ($11,092,581); malt liquors ($11,080,944); jewelry ($10,073,595), Massachusetts ranking second to Rhode Island; confectionery ($9,317,996), in which Massachusetts was third among the states.

Many of these industries have a history going back far into colonial times, some even dating from the first half of the 17th century. Textile products were really varied and of considerable importance before 1700. The policy of the British government towards such industries in the colonial period was in general repressive. The non-importation sentiment preceding the War of Independence fostered home manufactures considerably, and the Embargo and Non-Intercourse Acts before the war of 1812, as well as that war itself (despite the subsequent glut of British goods) had a much greater effect; for they mark the introduction of the factory system, which by 1830 was firmly established in the textile industry and was rapidly transforming other industries. Improvements were introduced much more slowly than in England, the cost of cotton machinery as late as 1826 being 50–60% greater in America. The first successful power loom in America was set up at Waltham in 1814. Carding, roving and spinning machines were constructed at Bridgewater in 1786. The first cotton mill had been established in Beverly in 1788, and the first real woollen factory at Byfield in 1794. Woolcard machinery destined to revolutionize the industry was devised by Amos Whittemore (1759–1828) in 1797; spinning jennies were in operation under water-power before 1815. Carpet-weaving was begun at Worcester in 1804. "Not a yard of fancy wool fabric had ever been woven by the power-loom in any country till done by William Crompton at the Middlesex Mills, Lowell, in 1840" (Samuel Lawrence).[2] The introduction of the remarkably complete machinery of the shoe industry was practically complete by 1865, this being the last of the great industries to come under the full dominance of machinery. At Pittsfield and at Dalton is centred the manufacture of fine writing papers, including that of paper used by the national government for bonds and paper money. Four-fifths of all loft-dried paper produced in the country from 1860–1897 was made within 15 m. of Springfield; Holyoke and South Hadley being the greatest producers. Vulcanized rubber is a Massachusetts invention. Most of the imitation jewelry of the United States is produced at Attleboro and North Attleboro, and in Providence, Rhode Island. In 1905 Boston produced 16·4% of all the manufactures of the state, and Lynn, the second city, which had been fifth in 1900, 4·9%. Some industries which have since become dead or of relatively slight magnitude were once of much greater significance, economically or socially: such as the rum-distilling connected with the colonial slave trade, and various interests concerned with shipbuilding and navigation. The packing of pork and beef formerly centred in Boston; but, while the volume of this business has not diminished, it has been greatly exceeded in the west. For many years Massachusetts controlled a vast lumber trade, drawing upon the forests of Maine, but the growth of the west changed the old channels of trade, and Boston carpenters came to make use of western timber. It was between 1840 and 1850 that the cotton manufactures of Massachusetts began to assume large proportions; and about the same time the manufacture of boots and shoes centred there. Medford ships began to be famous shortly after the beginning of the 19th century, and by 1845 that town employed one quarter of all the shipwrights in the state.

Fishing is an important industry. Drift whales were utilized in the earliest years of the colony, and shore boating for the baleen (or "right") whale—rich in bone and in blubber yielding common oil—was an industry already regulated by various towns before 1650; but the pursuit of the sperm whale did not begin until about 1713. The former industry had died out before the War of Independence; the latter is not yet quite extinct. Nantucket and New Bedford were the centres of the whaling trade, which, for the energy and skill required and the length (three to five years when sailing vessels were employed) of the ever-widening voyages which finally took the fishermen into every quarter of the globe, contributes the most romantic chapters in the history of American commerce. At one time it gave occupation to a thousand ships, but the introduction of petroleum gradually diminished this resource of the lesser ports. The Newfoundland Bank fisheries were of greater economic importance and are still very important. Gloucester is the chief centre of the trade. The value of fishery products in 1895 was $5,703,143, and in 1905 $7,025,249; and 15,694 persons were engaged in the fisheries. Though cod is much the most important fish (in 1905 fresh cod were valued at $991,679, and salted cod at $696,928), haddock (fresh, $1,051,910; salted, $17,194), mackerel (value in 1905, including horse mackerel, $970,876), herring (fresh, $266,699; salted, $114,997), pollock ($267,927), hake ($258,438), halibut ($218,232), and many other varieties are taken in great quantities. The shell fisheries are less important than those of Maine.

Commerce.—Already by 1660 New England products were an "important element in the commerce and industries of the mother country" (Weeden). Codfish was perhaps the truest basis of her commerce, which soon came to include the West Indies, Africa and southern Europe. Of fundamental importance was the trade with the French West Indies, licit and illicit, particularly after the Peace of Utrecht (1713). Provisions taken to Newfoundland, poor fish to the West Indies, molasses to New England, rum to Africa and good cod to France and Spain, were the commonest ventures of foreign trade. The English Navigation Acts were generally evaded, and were economically of little effect; politically they were of great importance in Massachusetts as a force that worked for independence. Privateering, piracy and slave-trading—which though of less extent than in Rhode Island became early of importance, and declined but little before the American War of Independence—give colour to the history of colonial trade.

Trade with China and India from Salem was begun in 1785 (first voyage from New York, 1784), and was first controlled there, and afterwards in Boston till the trade was lost to New York. The Boston trade to the Canadian north-west coast was begun in 1788. The first regular steamship line from Boston to other American Atlantic ports was established in 1824. In commercial relations the chief port of Massachusetts attained its greatest importance about 1840, when it was selected as the American terminus of the first steamship line (Cunard) connecting Great Britain with the United States; but Boston lost the commercial prestige then won by the failure of the state to promote railway communication with the west, so as to equal the development effected by other cities. The decline of commerce, however, had already begun, manufacturing supplanting it in importance; and this decline was rapid by 1850. From 1840 to 1860 Massachusetts-built ships competed successfully in the carrying trade of the world. Before 1840 a ship of 500 tons was a large ship, but after the discovery of gold in California the size of vessels increased rapidly and their lines were more and more adapted to speed. The limit of size was reached in an immense clipper of 4555 tons, and the greatest speed was attained in a passage from San Francisco to Boston in seventy-five days, and from San Francisco to Cork in ninety-three days. The development of steam navigation for the carrying of large cargoes has driven this fleet from the sea. Only a small part of the exports and imports of Massachusetts is now carried in American bottoms.[3] The first grain elevator built in Boston, and one of the first in the world, was erected in 1843, when Massachusetts sent Indian corn to Ireland. When the Civil War and steam navigation put an end to the supremacy of Massachusetts wooden sailing ships, much of the capital which had been employed in navigation was turned into developing railway facilities and coasting steamship lines. In 1872 the great fire in Boston made large drains upon the capital of the state, and several years of depression followed. But in 1907 Boston was the second port of the United States in the magnitude of its foreign commerce. In that year the value of imports at the Boston-Charlestown customs district was $123,411,168, and the value of exports was $104,610,908; for 1909 the corresponding figures were $127,025,654 and $72,936,869. Other ports of entry in the state in 1909 were Newburyport, Gloucester, Salem, Marblehead, Plymouth, Barnstable, Nantucket, Edgartown, New Bedford and Fall River. A protective tariff was imposed in early colonial times and protection was generally approved in the state until toward the close of the 19th century, when a strong demand became apparent for reciprocity with Canada and for tariff reductions on the raw materials (notably hides) of Massachusetts manufactures.

At the end of 1908 the length of railway lines within the state was 2,109·33 miles. The Hoosac Tunnel, 5¾ m. long, pierces the Hoosac Mountain in the north-west corner of the state, affording a communication with western lines. It cost about $20,000,000, the state lending its credit, and was built between 1855 and 1874. The inter-urban electric railways are of very great importance in the state; in 1908 the total mileage of street and inter-urban electric railways was 2841·59 m. (2233·85 m. being first main track). The Cape Cod canal, 12 m. long, from Sandwich on Barnstable Bay to Buzzard's Bay, was begun in June 1909, with a view to shortening the distance by water from Boston to New York and eliminating the danger of the voyage round Cape Cod.

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[1] In 1905 Massachusetts produced 60·7% of the writing paper manufactured in the country. Besides writing paper, book paper and building paper are made in the state, but very little newspaper.

[2] It must be noted, however, that the first successful construction of cards, drawing and roving, and of spindles, on the Arkwright principle was by S. Slater at Pawtucket, Rhode Island in 1790.

[3] The tax valuation on ships engaged in foreign trade was lowered between 1884 and 1900 from $2,801,405 to $147,768.

Population.—The population of the state in 1910 was 3,366,416, the increases in successive decades after 1790 being respectively 11·6, 11·6, 10·9, 16·6, 20·9, 34·8, 23·8, 18·4, 22·4, 25·6, 25·3 and 20%.[1] With the exception of Rhode Island, it is the most densely populated state in the Union, the average number to the square mile in 1900 being 349 (in 1910, 418·8), and the urban population, *i.e.* the population of places having above 8000 or more inhabitants, being 69·9% in 1890 and in 1900 76·0% of the total population (in places above 2500, 91·5%; in places above 25,000, 58·3%). The female population is greater (and has been since 1765, at least) than the male, the percentage being in 1900 greater than in any other state of the Union (51·3%; District of Columbia, owing to clerks in government service 52·6%). In 1900 less than 1·3% of the population was coloured; 30·2% were foreign-born (this element having almost continuously risen from 16·49% in 1855), and 62·3% of all inhabitants and 46·5% of those native-born had one or both parents of foreign birth. Ireland contributed the largest proportion of the foreign-born (29·5%), although since 1875 the proportion of Irish in the total population has considerably fallen. After the Irish the leading foreign elements are Canadian English (18·7%), Canadian French (15·8%) and English (9·7%), these four constituting three-fourths of the foreign population. Since 1885 the natives of southern Italy have greatly increased in number. Of the increase in total population from 1856–1895 only a third could be attributed to the excess of births over deaths; two-thirds being due to immigration from other states or from abroad. Boston is the second immigrant port of the country. A large part of the trans-atlantic immigrants pass speedily to permanent homes in the west, but by far the greater part of the Canadian influx remains.

According to the census of 1910 there were 32 incorporated cities[2] in Massachusetts, of which 6 had between 12,000 and 20,000 inhabitants; 3 between 20,000 and 25,000 (Gloucester, Medford and North Adams); 11 between 25,000 and 50,000 (Malden, Haverhill, Salem, Newton, Fitchburg, Taunton, Everett, Quincy, Pittsfield, Waltham, Chicopee); 7 between 50,000 and 100,000 (New Bedford, Lynn, Springfield, Lawrence, Somerville, Holyoke, Brockton); and 5 more than 100,000 (Boston, 670,585; Worcester, 145,986; Fall River, 119,295; Lowell, 106,294; Cambridge, 104,839).

Taking quinquennial periods from 1856–1905 the birth-rates were 29·5, 25·3, 26·0, 27·6, 24·2, 25·0, 25·8, 27·6, 27·0 and 24·2 per 1,000; and the death-rates 17·7, 20·7, 18·2, 20·8, 18·8, 19·8, 19·4, 19·8, 18·0 and 16·4.[3] Pneumonia and consumption, approximately of equal fatality (15 to 18 per 10,000 each), exceed more than twofold the diseases of next lower fatality, cancer and cholera infantum.

Of males (1,097,581) engaged in 1900 in gainful occupations 47·1% were engaged in manufacturing and mechanical pursuits (77·9 in every 100 in 1870 and 73 in 1900), 27·1 in trade and transportation, 14·2 in domestic and personal service, 7·4 in agricultural pursuits and 4·2 in professional service. The corresponding percentages for females (1,169,467) were 46·4 in manufacturing (in 1890, 52%), 32·3 in domestic and personal service, 13·6 in trade and transportation, 7·1 in professional service and 0·6 in agriculture. Formerly farmers' daughters of native stock were much employed in factories; but since operatives of foreign birth or parentage have in great part taken their places, they have sought other occupations, largely in the manufacture of small wares in the cities, and particularly in departments of trade where skilled labour is essential. Household service is seldom now done, as it formerly was, by women of native stock. The federal census of 1900 showed that of every 100 persons employed for gain only 37·5% were of native descent (that is, had a native-born father). Natives heavily predominated in agriculture and the professions, slightly in trade, and held barely more than half of all governmental positions; but in transportation, personal service, manufactures, labour and domestic service, the predominance of the foreign element warranted the assertion of the state Bureau of Statistics of Labour that "the strong industrial condition of Massachusetts has been secured and is held not by the labour of what is called the 'native stock,' but by that of the immigrants." After the original and exclusively English immigration from 1620 to 1640 there was nothing like regular foreign immigration until the 19th century; and it was a favourite assertion of Dr Palfrey that the blood of the fishing folk on Cape Cod was more purely English through two centuries than that of the inhabitants of any English county.

With foreign immigration the strength of the Roman Catholic Church has greatly increased: in 1906 of every 1000 of estimated population 355 were members of the Roman Catholic Church (a proportion exceeded only in New Mexico and in Rhode Island: 310 was the number per 1000 in Louisiana), and only 148 were communicants of Protestant bodies; in 1906 there were 1,080,706 Roman Catholics (out of a total of 1,562,621 communicants of all denominations), 119,196 Congregationalists, 80,894 Baptists, 65,498 Methodists and 51,636 Protestant Episcopalians.

Reference has been made to "abandoned farms" in Massachusetts. The desertion of farms was an inevitable result of the opening of the great cereal regions of the west, but it is by no means characteristic of Massachusetts alone. The Berkshire district affords an excellent example of the interrelations of topography, soil and population. Many hill towns once thriving have long since become abandoned, desolate and comparatively inaccessible; though with the development of the summer resident's interests many will probably eventually regain prosperity. Almost half of the highland towns reached their maximum population before the opening of the 19th century, although Berkshire was scarcely settled till after 1760, and three-fourths of them before 1850. On the other hand three-fourths of the lowland towns reached their maximum since that date, and half of them since 1880. The lowland population increased six and a half times in the century, the upland diminished by an eighth. Socially and educationally the upland has furnished an interesting example of decadence. Since 1865 (at least) various parts of Cape Cod have shrunk greatly in population, agriculture and manufactures, and even in fishing interests; this reconstruction of industrial and social interests being, apparently, simply part of the general urban movement—a movement toward better opportunities. What prosperity or stability remains in various Cape Cod communities is largely due to foreign immigrants—especially British-Americans and Portuguese from the Azores; although the population remains, to a degree exceptional in northern states, of native stock.

Government.—Representative government goes back to 1634, and the bicameral legislature to 1644. The constitution of 1780, which still endures (the only remaining state constitution of the 18th century), was framed in the main by Samuel Adams, and as an embodiment of colonial experience and revolutionary principles, and as a model of constitution-making in the early years of independence, is of very great historical interest. It has been amended with considerable freedom (37 amendments up to 1907), but with more conservatism than has often prevailed in the constitutional reform of other states; so that the constitution of Massachusetts is not so completely in harmony with modern democratic sentiment as are the public opinion and statute law of the state. The commonwealth, for example, is still denominated "sovereign," and education is not declared a constitutional duty of the commonwealth. One unique feature is the duty of the supreme court to give legal advice, on request, to the governor and council. Another almost equally exceptional feature is the persistence of the colonial executive council, consisting of members chosen to represent divisions of the state, who assist the governor in his executive functions. Massachusetts is also one of the few states in which the legislature meets in annual session.[4] Townships were represented as such in this body (called the General Court) until 1856. Religious qualifications for suffrage and office-holding were somewhat relaxed, except in the case of

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[1] The population of the state was 378,787 in 1790; 422,845 in 1800; 472,040 in 1810; 523,287 in 1820; 610,408 in 1830; 737,699 in 1840; 994,514 in 1850; 1,231,066 in 1860; 1,457,351 in 1870; 1,783,085 in 1880; 2,238,943 in 1890; and 2,805,346 in 1900. In 1905, according to the state census, the population was 3,003,680, or about 7·7% more than in 1900.

[2] In 1910 the following townships each had populations of more than 15,000: Revere, Leominster, Westfield, Attleborough, Peabody, Hyde Park.

[3] The birth-rates every fifth (census) year up to 1895 varied for natives from 14·48 to 19·49; for foreigners from 45·87 to 66·68. The marriage rates in quinquennial periods up to 1905 were 19·6, 18·6, 21·0, 19·8, 15·6, 18·6, 18·6, 18·6, 17·4 and 17·4; the ratio of marriages to the marriageable population was for males (above 16 years) 61·5, for females (above 14) 46·0; the fecundity of marriages seemed to have increased, being about twice as high for foreigners as for natives. See *Annual Report* of the Board of Health (1896), by S. W. Abbott; and *Sixty-fourth Report of Births, Marriages and Deaths in Massachusetts* (1906).

[4] The number of representatives from 1832 to 1908 varied from 240 to 635, and the length of session from 58 to 206 days (since 1861 none of under 100 days), with an almost continual increase in both respects.

Roman Catholics, after 1691.[1] Real toleration in public opinion grew slowly through the 18th century, removing the religious tests of voters; and a constitutional amendment in 1821 explicitly forbade such tests in the case of office-holders. Property qualifications for the suffrage and for office-holding—universal through colonial times—were abolished in the main in 1780. From 1821 to 1891 the payment of at least a poll-tax was a condition precedent to the exercise of the suffrage. An educational test (dating from 1857) is exacted for the privilege of voting, every voter being required to be able to read the constitution of the commonwealth in the English language, and to write his name. The property qualification of the governor was not abolished until 1892. In the presidential election of 1896, when an unprecedentedly large vote was cast, the number of voters registered was nearly 20 % of the population, and of these nearly 82 % actually voted. Massachusetts is one of the only two states in the Union in which elections for state officers are held annually. In 1888 an act was passed providing for the use in state elections of a blanket ballot, on which the names of all candidates for each office are arranged alphabetically under the heading of that office, and there is no arrangement in party columns. This was the first state law of the kind in the country. The same method of voting has been adopted in about two-thirds of the townships of the state. A limited suffrage was conferred upon women in 1879. Every female citizen having the qualifications of a male voter may vote in the city and town elections for members of the school committee.

A householder with a family may, by recording the proper declaration in a registry of deeds, hold exempt from attachment, levy on execution, and sale for the payment of debts thereafter contracted an estate of homestead, not exceeding $800 in value, in a farm or lot with buildings thereon which he lawfully possesses by lease or otherwise and occupies as his residence. The exemption does not extend, however, to the prohibition of sale for taxes, and in case the householder's buildings are on land which he has leased those buildings are not exempt from sale or levy for the ground rent. If the householder has a wife he can mortgage or convey his estate of homestead only with her consent, and if he dies leaving a widow or minor children the homestead exemption survives until the youngest child is twenty-one years of age, or until the death or marriage of the widow, provided the widow or a child continues to occupy it.

The scope of state activity has become somewhat remarkable. In addition to the usual state boards of education (1837), agriculture (1852), railroad commissioners (1869), health (1869), statistics of labour, fisheries and game, charity (1879), the dairy bureau (1891), of insanity (1898), prison, highways, insurance and banking commissions, there are also commissions on ballot-law, voting machines, civil service (1884), uniformity of legislation, gas and electric lighting corporations, conciliation and arbitration in labour disputes (1886), &c. There are efficient state boards of registration in pharmacy, dentistry and medicine. Foods and drugs have been inspected since 1882. In general it may be said that the excellence of administrative results is noteworthy. The work of the Bureau of Statistics of Labor, of the Bureau of Health, of the Board of Railroad Commissioners, and of the Board of Conciliation and Arbitration, and the progress of civil service, have been remarkable for value and efficiency. Almost all state employees are under civil service rules; the same is true of the city of Boston; and of the clerical, stenographic, prison, police, civil engineering, fire, labour-foreman, inspection and bridge tender services of all cities; and under a law (1894) by which cities and towns may on petition enlarge the application of their civil service rules. Various other public services, including even common labourers of the larger towns, are rapidly passing under civil service regulation. Veterans of the Civil War have privileges in the administration of the state service. In the settlement of labour disputes conciliatory methods were successful in the formative period, when the parties to disputes adopted customary attitudes of hostility and fought to the end unless they were reconciled by the Board to a final agreement or to an agreement to arbitrate.[2] In this earlier period (before 1900), thanks to the efforts of the board there was an increase in the frequency of appeal to arbitration, and settlements by compromise were often made. Afterwards the number of arbitrations by the board increased in number; from 1900 to 1908 (inclusive), of 568 controversies submitted to the board, 525 were settled by an award and 43 by an induced agreement. In the same period the mediation of the Board settled disputes affecting 5560 establishments; and in the latter half of this period labour disputes involving hostilities and of the magnitude contemplated by the statute governing the Board of Conciliation and Arbitration had almost disappeared. The laws relating to labour are full, but, as compared with those of other states, present few features calling for comment.[3] In 1899 eight hours were made to constitute a day's work for all labourers employed by or for any city or town adopting the act at an annual election. Acts have been passed extending the common-law liability of employers, prohibiting the manufacture and sale of sweat-shop clothing, and authorizing cities and towns to provide free lectures and to maintain public baths, gymnasia and playgrounds. Boston has been a leader in the establishment of municipal baths. The state controls and largely maintains two beaches magnificently equipped near the city. The Massachusetts railroad commission, though preceded in point of time by that of New Hampshire of 1844, was the real beginning of modern state commissions. Its powers do not extend to direct and mandatory regulation, being supervisory and advisory only, but it can make recommendations at its discretion, appealing if necessary to the General Court; and it has had great influence and excellent results. The Torrens system of land registration was adopted in 1898, and a court created for its administration. In the case of all quasi-public corporations rigid laws exist prohibiting the issue of stock or bonds unless the par value is first paid in; prohibiting the declaration of any stock or scrip dividend, and requiring that new stock shall be offered to stockholders at not less than its market value, to be determined by the proper state officials, any shares not so subscribed for to be sold by public auction. These laws are to prevent fictitious capitalization and "stock-watering." In the twenty years preceding 1880 60 % of all sentences for crime were found traceable to liquor. In 1881 a local option law was passed, by which the granting of licences for the sale of liquor was confined to cities and towns voting at the annual election to authorize their issue. In 1888 the number of licences to be granted in municipalities voting in favour of their issue was limited to one for each 1000 inhabitants, except in Boston, where one licence may be issued for every 500 inhabitants. The vote varies from year to year, and it is not unusual for a certain number of municipalities to change from "licence" to "no licence," and vice versa. The general result has been that centres of population, especially where the foreign element is large, usually vote for licence, while those in which native population predominates, as well as the smaller towns, usually vote for prohibition. Through a growing acquiescence in the operation of the local option law, the relative importance of the vote of the Prohibition Party has diminished. Since 1895 indeterminate sentences have been imposed on all convicts sentenced to the state prison otherwise than for life or as habitual criminals; *i.e.* maximum and minimum terms are established by law and on the expiration of the latter a revocable permit of liberty may be issued. Execution by electricity has been the death penalty since 1898. Stringent legislation controls prison labour.

The extension of state activity presents some surprising features in view of the strength of local self-sufficiency nurtured by the old system of township government. But this form of pure democracy was in various cases long since inevitably abandoned: by Boston reluctantly in 1822, and subsequently by many other townships or cities, as growing population made action in town meeting unbearably cumbersome. In modern times state activity has encroached on the cities. Especially has the commonwealth undertaken certain noteworthy enterprises as the agent of the several municipalities in the immediate vicinity of Boston, constituting what is known as the Metropolitan District; as, for example, in bringing water thither from the Nashua River at Clinton, 40 m. from Boston, and in the development of a magnificent park system of woods, fells, river-banks and seashore, unrivalled elsewhere in the country. The commonwealth joined the city of Boston in the construction of a subway beneath the most congested portion of the city for the passage of electric cars. For the better accommodation of the increasing commerce of the port of Boston, the commonwealth bought a considerable frontage upon the harbour lines and constructed a dock capable of receiving the largest vessels, and has supplemented the work of the United States government in deepening the approaches to the wharves. It has secured as public reservations the summit and sides of Greylock (3535 ft.) in the north-west corner of the state, and of Wachusett (2108 ft.) near the centre. Since 1885 a large expenditure has been incurred in the abolition of grade crossings of railways and highways,[1] and in 1894 the commonwealth began the construction and maintenance of state highways.[2]

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[1] However, every office-holder was, and every subject might be, required to take (though this was not a condition of the franchise) the oaths enjoined by parliament in the first year of the reign of William and Mary as a substitute for the oaths of Allegiance and Supremacy; and the same still applies to the signing of the Declaration.

[2] From 1887–1900, out of 290 cases settled, only 107 were formal arbitrations, 124 agreements were effected by the mediation of the Board, 100 were effected otherwise while proceedings were pending, and in 59 cases the Board interposed when the parties preferred hostilities.

[3] For a summary statement of state labour laws in the United States in 1903 see *Bulletin 54* of the United States Bureau of Labor, September 1904; and for a summary of labour laws in force at the end of 1907 see 22nd *Annual Report* (for 1907) of the U.S. Commissioner of Labor (Washington, 1908).

Since 1885, in Boston, and since 1894, in Fall River, the administration of the city police departments, including the granting of liquor licences, has been in the hands of state commissioners (one commissioner in Boston, a board in Fall River) appointed by the governor. But though in each case the result has been an improved administration, it has been generally conceded that only most exceptional circumstances can justify such interference with local self-government, and later attempts to extend the practice have failed. The referendum has been sparingly used in matters of local concern. Beginning in 1892 various townships and cities, numbering 18 in 1903, adopted municipal ownership and operation of lighting works. The gasworks have been notably more successful than the electric plants.

In Massachusetts, as in New England generally, the word "town" is used, officially and colloquially, to designate a township, and during the colonial era the New England town-meeting was a notable school for education in self-government. The members of the first group of settlers in these colonies were mostly small farmers, belonged to the same church, and dwelt in a village for protection from the Indians. They adapted to these conditions some of the methods for managing local affairs with which they had been familiar in England, and called the resultant institution a town. The territorial extent of each town was determined by its grant or grants from the general court, which the towns served as agents in the management of land. A settlement or "plantation" was sometimes incorporated first as a "district" and later as a town, the difference being that the latter had the right of corporate representation in the general court, while the former had no such right. The towns elected (until 1856) the deputies to the general court, and were the administrative units for the assessment and collection of taxes, maintaining churches and schools, organizing and training the militia, preserving the peace, caring for the poor, building and repairing roads and bridges, and recording deeds, births, deaths and marriages; and to discuss questions relating to these matters as well as other matters of peculiarly local concern, to determine the amount of taxes for town purposes, and to elect officers. All the citizens were expected to attend the annual town-meeting, and such male inhabitants as were not citizens were privileged to attend and to propose and discuss measures, although they had no right to vote. Generally several villages have grown up in the same "town," and some of the more populous "towns," usually those in which manufacturing has become more important than farming, have been incorporated as "cities"; thus either a town or a city may now include a farming country and various small villages. Although the tendency in Massachusetts is towards chartering as cities "towns" which have a population of 12,000 or more, the democratic institution of the town-meeting persists in many large municipalities which are still technically towns.[3] Most "towns" hold their annual meeting in March, but some hold them in February and others in April. In the larger "towns" the officers elected at this meeting may consist of five, seven or nine selectmen, a clerk, a treasurer, three or more assessors, three or more overseers of the poor, one or more collectors of taxes, one or more auditors, one or more surveyors of highways, a road commissioner, a sewer commissioner, a board of health, one or more constables, two or more field drivers, two or more fence viewers, and a tree warden; but in the smaller "towns" the number of selectmen may be limited to three, the selectmen may assess the taxes, be overseers of the poor, and act as a board of health, and the treasurer or constable may collect the taxes. The term of all these officers may be limited to one year, or the selectmen, clerk, assessors and overseers of the poor may be elected for a term of three years, in which case a part only of the selectmen, assessors and overseers of the poor are elected each year. The selectmen have the general management of a "town's" affairs during the interval between town-meetings. They may call special town-meetings; they appoint election officers and may appoint additional constables or public officers, and such minor officials as inspectors of milk, inspectors of buildings, gauger of measures, cullers of staves and hoops, fish warden and forester. A school committee consisting of any number of members divisible by three is chosen, one-third each year, at the annual town-meeting or at a special meeting which is held in the same month. Any "town" having a village or district within its limits that contains 1000 inhabitants or more may authorize that village or district to establish a separate organization for lighting its streets, building and maintaining sidewalks, and employing a watchman or policeman, the officers of such organization to include at least a prudential committee and a clerk. All laws relative to "towns" are applied to "cities" in so far as they are not inconsistent with general or special laws relative to the latter, and the powers of the selectmen are vested in the mayor and aldermen.

Education.—For cities of above 8000 inhabitants (for which alone comparative statistics are annually available), in 1902–1903 the ratio of average attendance to school enrolment, the average number of days' attendance of each pupil enrolled, and the value of school property per capita of pupils in average attendance were higher than in any other state; the average length of the school term was slightly exceeded in eight states; and the total cost of the schools per capita of pupils in average attendance ($39·05) was exceeded in six other states. In 1905–1906 the percentage of average attendance in the public schools to the number of children (between 5 and 15 years) in the state was 80; in Barnstable county it was 95, and in Plymouth 92; and the lowest rate of any county was 68, that of Bristol. In the same year the amount of the various school taxes and other contributions was $30·53 for each child in the average membership of the public schools, and the highest amount for each child in any county was $35·77 in Suffolk county, and in any township or city $68·01—in Lincoln. The school system is not one of marked state centralization—as contrasted, *e.g.* with New York. A state board of education has general control, its secretary acting as superintendent of the state system in conjunction with local superintendents and committees. Women are eligible for these positions, and among the teachers in the schools they are greatly in excess over men (more than 10 to 1), especially in lower grades. No recognition exists in the schools of race, colour or religion. The proportion of the child population that attends schools is equalled in but two or three states east of the Mississippi river. The services of Horace Mann (*q.v.*) as secretary of the state board (1837–1848) were productive of almost revolutionary benefits not only to Massachusetts but to the entire country. His reforms, which reached every part of the school system, were fortunately introduced just at the beginning of railway and city growth. Since 1850 truant and compulsory attendance laws (the first compulsory education law was passed in 1642) have been enforced in conjunction with laws against child labour. In 1900 the average period of schooling per inhabitant for the United States was 4·3 years, for Massachusetts 7 years. (The same year the ratio of wealth productivity was as 66 to 37.) Massachusetts stands "foremost in the Union in the universality of its provision for secondary education."[4] The laws practically offer such education free to every child of the commonwealth. Illiterate persons not less than ten years of age constituted in 1900 5·9 % of the population; and 0·8, 14·6, 10·7 % respectively of native whites, foreign-born whites and negroes. More patents are issued, relatively, to citizens of Massachusetts than to those of any other state except Connecticut. Post office statistics indicate a similarly high average of intelligence.

The public school system includes common, high and normal schools, and various evening, industrial and truant schools. Many townships and cities maintain free evening schools. In 1894 manual training was made a part of the curriculum in all municipalities having 20,000 inhabitants. There are also many private business colleges, academic schools and college-preparatory schools. The high schools enjoy an exceptional reputation. An unusual proportion of teachers in the public schools are graduates of the state normal schools, of which the first were founded in 1839 at Lexington and Barre, the former being the first normal school of the United

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[1] The usual allotment of the cost of this work is as follows: 65 % is paid by the railway company, 25 % by the commonwealth and 10 % by the municipality in which the crossing is located.

[2] The cost was apportioned between the commonwealth and the local government in the proportion of 3 to 1.

[3] Boston remained a township, governed by town-meetings, until 1822, when it had a population of some 47,000. The government of Brookline (pop. in 1905, 23,436) is an interesting example of the adaptation of the township system to urban conditions. The town is frequently referred to as a model residential suburb; its budgets are very large, its schools are excellent, and, among other things, it has established a township gymnasium. The town hall is not large enough for an assemblage of all the voters, but actually the attendance is usually limited to about 200, and since 1901 there has been in force a kind of referendum, under which any measure passed by a town-meeting attended by 700 or more voters may be referred, upon petition of 100 legal voters, to a regular vote at the polls. Much of the work of the town-meetings is done through special committees.

[4] E. G. Brown, in *Monographs on Education in the United States* prepared for the Paris Exposition of 1900 and edited by N. M. Butler.

States.[1] These two schools were removed subsequently to Framingham (1853) and Westfield (1844), where they are still active; while others flourish at Bridgewater (1840), Salem (1854), Worcester (1874), Fitchburg (1895), North Adams (1897), Hyannis (1897) and Lowell (1897), that at Framingham being open to women only. There is also a state normal art school at Boston (1873) for both sexes.

The commonwealth contributes to the support of textile schools in cities in which 450,000 spindles are in operation. Such schools exist (1909) in Lowell, Fall River and New Bedford. The commonwealth also maintains aboard a national ship a nautical training school (1891) for instruction in the science and practice of navigation. During the Spanish-American War of 1898 more than half of the graduates and cadets of the school enlisted in the United States service.

There are several hundred private schools, whose pupils constituted in 1905–1906 15·7 % of the total school-enrolment of the state. Of higher academies and college-preparatory schools there are scores. Among those for boys Phillips Academy, at Andover, the Groton school, and the Mount Hermon school are well-known examples. For girls the largest school is the Northfield Seminary at East Northfield. In Boston and in the towns in its environs are various famous schools, among them the boys' classical school in Boston, founded in 1635, one of the oldest secondary schools in the country. The leading educational institution of the state, as it is the oldest and most famous of the country, is Harvard University (founded 1636) at Cambridge. In the extreme north-west of the state, at Williamstown, is Williams College (1793), and in the Connecticut Valley is Amherst College (1821), both of these unsectarian. Boston University (Methodist Episcopal, 1867); Tufts College (1852), a few miles from Boston in Medford, originally a Universalist school; Clark University (1889, devoted wholly to graduate instruction until 1902, when Clark College was added), at Worcester, are important institutions. Two Roman Catholic schools are maintained—Boston College (1863) and the College of the Holy Cross (1843), at Worcester. Of various institutions for the education of women, Mount Holyoke (1837) at South Hadley, Smith College (1875) at Northampton, Wellesley College (1875) at Wellesley near Boston, Radcliffe College (1879) in connexion with Harvard at Cambridge and Simmons College (1899) at Boston, are of national repute. The last emphasizes scientific instruction in domestic economy.

For agricultural students the state supports a school at Amherst (1867), and Harvard University the Bussey Institution. In technological science special instruction is given—in addition to the scientific departments of the schools already mentioned—in the Worcester Polytechnic Institute (1865), and the Massachusetts Institute of Technology (opened in 1865). There are schools of theology at Cambridge (Protestant Episcopal), Newton (Baptist) and Waltham (New Church), as well as in connexion with Boston University (Methodist), Tufts College (Universalist) and Harvard (non-sectarian, and the affiliated Congregational Andover Theological Seminary at Cambridge). Law and medical schools are maintained in Boston and Harvard universities.

Public Institutions.—Massachusetts was in 1903, in proportion to the population, more richly provided with public collections of books than any other state: in that year she had nearly a seventh of all books in public, society and school libraries in the country, and a much larger supply of books per capita (2·56) than any other state. The rate for New York, the only state having a larger number of books in such libraries, being only 1·19. The Boston public library, exceeded in size in the United States by the library of Congress at Washington—and probably first, because of the large number of duplicates in the library of Congress—and the largest free municipal library in the world; the library of Harvard, extremely well chosen and valuable for research; the collections of the Massachusetts Historical Society (1791); the Boston Athenaeum (1807); the State Library (1826); the New England Historic Genealogical Society (1845); the Congregational Library; the American Academy of Arts and Sciences (1780); and the Boston Society of Natural History (1830), all in Boston, leave it easily unrivalled, unless by Washington, as the best research centre of the country. The collections of the American Antiquarian Society (1812) at Worcester are also notable. Massachusetts led, about 1850, in the founding of town and city libraries supported by public taxes, and by 1880 had established more of such institutions than existed in all other states combined. In 1900 out of 353 towns and cities only five, representing less than half of 1 %, were without free library facilities, and three of these five had association libraries charging only a small fee.

The state is very well supplied with charitable and reformatory institutions, in which noteworthy methods have been employed with success. The state institutions, each governed by a board of trustees, and all under the supervision of the state board of charity, include a state hospital at Tewksbury, for paupers (1866); a state farm at Bridgewater (1887) for paupers and petty criminals; the Lyman school for boys at Westboro, a reformatory for male criminals under fifteen years of age sentenced to imprisonment for terms less than life in connexion with which a very successful farm is maintained for the younger boys at Berlin; an industrial school for girls at Lancaster, also a reformatory school—a third reformatory school for boys was planned in 1909; a state sanatorium at Rutland for tuberculous patients (the first public hospital for such in the United States) and a hospital school at Canton for the care and instruction of crippled and deformed children. Three more hospitals for consumptives were planned in 1909. Under the supervision of the state board of insanity, and each under the government of a board of seven trustees (of whom two are women) are state hospitals for the insane at Worcester (1833), Taunton, Northampton, Danvers, Westboro and Medford, a state colony for the insane at Gardner, a state hospital for epileptics at Palmer, a state school for the feeble-minded at Waltham (governed by six trustees), a state school at Wrentham, state "hospital cottages for children" (1882) at Baldwinville (governed by five trustees), and the Foxboro state hospital for dipsomaniacs and insane. There are also semi-state institutions for the insane at Waverley, Barre, Wrentham and Baldwinville, and nineteen small private institutions, all under the supervision of the state board of insanity. Under the supervision of a board of prison commissioners, which appoints the superintendent and warden of each, are a reformatory prison for women at Sherborn (1877), a state reformatory for men at Concord (1884), a state prison at Boston (Charlestown), and a prison camp and hospital at Rutland (1905). There is a prison department at the state farm which receives misdemeanants. Other institutions receiving state aid, each governed by trustees appointed by the governor, are the Massachusetts general hospital at Boston, the Massachusetts charitable eye and ear infirmary at Boston, the Massachusetts homoeopathic hospital at Boston, the Perkins Institution and Massachusetts school for the blind at South Boston and the soldiers' home in Massachusetts at Boston. The Horace Mann school in Boston, a public day school for the deaf, the New England industrial school for deaf mutes at Beverly and the Clarke school for the deaf at Northampton are maintained in part by the state. Finally, many private charitable corporations (about 500 in 1905) report to the state board of charity, and town and city almshouses (205 in 1904) are subject to visitation. The Perkins Institution is memorable for its association with the fame of S. G. Howe (*q.v.*), whose reforms in charity methods were felt through all the charitable interests of the state. The net yearly cost of support and relief from 1884 to 1904 averaged $2,136,653, exclusive of vagrancy cases (average $31,714). The whole number of paupers, besides vagrants, in 1908 was 23·02 per 1000 of state population, and the cost of relief ($5,104,255) was $1·699 for each inhabitant of the state. The number of sane paupers declined steadily and markedly from 1863 to 1904.

Finance.—Massachusetts is a very rich state, and Boston a very wealthy city. The debt of the state (especially the contingent debt, secured by sinking funds) has been steadily rising since 1888, and especially since 1896, chiefly owing to the erection of important public buildings, the construction of state highways and metropolitan park roadways, the improvement of Boston harbour, the abolition of grade crossings on railways, and the expenses incurred for the Spanish-American War of 1898.

The net direct funded debt (also secured by accumulating sinking funds) in December 1908 was $17,669,372 (3·61 millions in 1893). The average interest on this and the contingent debt ($60,428,223 in December 1908) combined was only 3·35 %. The net debts of towns and cities rose in the years 1885–1908 from $63,306,213 to $163,558,325. The county debts in 1908 aggregated $6,076,867. The assessed valuation of realty in the state in 1908 was $2,799,062,707 and of personalty $1,775,073,438. No other state has given so vigorous a test of the ordinary American general-property tax, and the results have been as discouraging as elsewhere. The "dooming" process (*i.e.* estimation by assessors, without relief for over-valuation except for excess more than 50 % above the proper valuation) was introduced in 1868 as a method of securing returns of personalty. But the most rigorous application of the doomage law has only proved its complete futility as an effort to reach unascertained corporate and personal property.[2] Various special methods are used for the taxation of banks, insurance companies, railways, tramways, trust companies and corporations, some of them noteworthy. In the case of corporations realty and machinery are taxed generally by the local authorities, and stock values by the commonwealth. The Boston stock exchange is the second of the country in the extent of the securities in which it deals. The proportion of holders of U.S. bonds among the total population is higher than that in any other state.

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[1] This is an especially honourable distinction, for William T. Harris has said that "The history of education since the time of Horace Mann is very largely an account of the successive modifications introduced into elementary schools through the direct or indirect influence of the normal school."

[2] In 1869 the personalty valuation was 60 % that of realty; but it steadily fell thereafter, amounting in 1893 to 32 %. From 1874–

History.—It is possible that the coasts of Massachusetts were visited by the Northmen, and by the earliest navigators who followed Cabot, but this is only conjecture. In 1602 Bartholomew Gosnold landed at and named Cape Cod and coasted as far south as the present No-Man's Land, which he named Martin's or Martha's Vineyard, a name later transferred to a neighbouring larger island. Pring and Champlain at a later date coasted along what is now Massachusetts, but the map of Champlain is hardly recognizable. The first sufficient explorations for cartographical record were made by John Smith in 1614, and his map was long the basis—particularly in its nomenclature—of later maps. Permanency of occupation, however, dates from the voyage of the "Mayflower," which brought about a hundred men, women and children who had mostly belonged to an English sect of Separatists, originating in Yorkshire, but who had passed a period of exile for religion's sake in Holland. In the early winter of 1620 they made the coast of Cape Cod; they had intended to make their landing farther south, within the jurisdiction of the Virginia Company, which had granted them a patent; but stress of weather prevented their doing so. Finding themselves without warrant in a region beyond their patent, and threatened with the desertion of disaffected members of their company (probably all servants or men of the "lesser" sort) unless concessions were made to these, they drew up and signed before landing a democratic compact of government which is accounted the earliest written constitution in history.[1] After some exploration of the coast they made a permanent landing on the 21st of December 1620 (N.S.) at Plymouth, a harbour which had already been so named by John Smith in his maps of 1614 and 1616. During the first winter nearly one-half their number died from exposure, and the relations of the survivors with their partners of the London Company, who had insisted that for seven years the plantation should be managed as a joint stock company, were unsatisfactory. However, about thirty-five new colonists arrived in 1622 and ninety-six more in 1623. The abandonment of the communal system was begun in the latter year, and with the dissolution of the partnership with the adventurers of the London Company in 1627 Plymouth became a corporate colony with its chief authority vested in the whole body of freemen convened in the General Court. Upon the death of the first governor, John Carver, in the spring of 1621, the General Court chose William Bradford as his successor, and with him was chosen one assistant. The subsequent elections were annual, and within a few years the number of assistants was increased to seven. The General Court was the legislature and the electorate; the governor and assistants were the executive and the judiciary. The whole body of freemen composed the General Court until other towns than Plymouth had been organized, the first of which were Scituate in 1636 and Duxbury in 1637, and then the representative form of government was adopted and there was a gradual differentiation between Plymouth the town and Plymouth the colony. When it had become known that the colony was within the territory of the New England Council, John Pierce, in 1621, procured from that body a grant which made the colonists its tenants. A year later Pierce surrendered this and procured another, which in effect made him proprietor of the colony, but he was twice shipwrecked and was forced to assign to the adventurers his second patent. In 1629 Governor Bradford procured from the same council a definite grant of the tract which corresponds to the south-eastern portion of the present state. But all attempts to procure a royal charter for Plymouth Colony were unsuccessful, and in 1691 it was annexed to the Colony of Massachusetts Bay under what is termed the Provincial Charter.

King James having by patent in 1620 created a Council for New England to whom he made a large grant of territory, the council in 1628 made a sub-grant, confirmed by a royal charter that passed the seals on the 4th of March 1629, to the "Governor and Company of the Massachusetts Bay in Newe England." There had been various minor expeditions during the few years since Smith was on the coast before this company, in the Puritan interests, had sent over John Endecott with a party in 1628 to what is now Salem. In 1630 the government of the company, with questionable right (for the charter seems evidently to have contemplated the residence of the company in England), transferred itself to their territory, and under the leadership of John Winthrop laid the foundations anew of the Massachusetts colony, when they first settled Boston in the autumn of that year. Winthrop served repeatedly, though not continuously, as governor of the colony till his death in 1649, his rejection in 1636 being due to a party of theological revolt which chose Henry Vane (afterwards Sir Henry) to the office. This was an incident in a famous episode, important rather as a symptom than in itself, namely, the Antinomian controversy, "New England's earliest protest against formulas," in which Vane and Ann Hutchinson took the lead in criticizing the official orthodoxy of the colony.

The magistrates successfully asserted themselves to the discomfiture of their critics (Ann Hutchinson being banished), and this was characteristic of the colony's early history. The charter gave the company control over the admission of "freemen" (co-partners in the enterprise, and voters), "full and absolute power and authority to correct, punish and rule" subjects settling in the territory comprised in their grant, and power to "resist . . . by all fitting ways and means whatever" all persons attempting the "destruction, invasion, detriment or annoyance" of the plantation. Some writers deny the company's right under this instrument to rule as they proceeded to do; but at any rate what they did was to make the suffrage dependent on stringent religious tests, and to repress with determined zeal all theological "vagaries" and "whimsies." Criticism of church or magistrates was not tolerated. Laws were modelled closely on the Bible. The clergy were a ruling class. The government was frankly theocratic. Said Winthrop (1637): "We see not that any should have authority to set up any other exercises besides what authority hath already set up"; and a synod at Cambridge in 1637 catalogued eighty-two "opinions, some blasphemous, others erroneous and all unsafe," besides nine "unwholesome expressions," all of which were consigned "to the devil of hell from whence they came." Another synod at Cambridge in 1647 more formally established the principle of state control. The legislation against Baptists (about 1644–1678) and the persecution of the Quakers (especially 1656–1662) partook of the brutality of the time, including scourging, boring of tongues, cutting of ears and in rare cases capital punishment. It cannot be denied that men like Roger Williams and some of the persecuted Quakers, though undeniably contentious and aggressive in their conscientious dissent, showed a spirit which to-day seems sweeter in tolerance and humanity than that of the Puritans. And it seems necessary to emphasize these facts because until about 1870 it was almost unchallenged tradition to regard the men of Massachusetts Bay as seekers and champions of "religious liberty." They left England, indeed, for liberty to discard the "poperies" of the English Church, and once in Massachusetts they even discarded far more than those

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1882 the assessment of realty increased nearly twelve times as much as personalty. In the intervening period the assessed valuation of realty in Boston increased more than 100%, while that of personalty slightly diminished (the corresponding figures for the entire United States from 1860 to 1890 being 172% and 12%), yet the most competent business and expert opinions regarded the true value of personalty as at least equal to and most likely twice as great as that of realty.

[1] In this document, whose democracy is characteristic of differences between the Plymouth Colony and that of Massachusetts Bay, the signatories "solemnly and mutually . . . covenant and combine ourselves together into a civil body politic, for our better ordering and preservation and furtherance of the ends aforesaid; and by virtue hereof to enact, constitute and frame—[laws]—unto which we promise all due submission and obedience." This was signed 11/21 of November 1620 by 41 persons.

"poperies." But religious liberty in our modern sense they did not seek for themselves, nor accord to others; they abhorred it, they trampled on it, and their own lives they subjected to all the rigid restrictions to which they subjected others. They were narrow but strong; no better example can be imagined of what the French call "the defects of one's qualities." Their failures were small compared with those of their contemporaries in England and elsewhere in Europe, and public opinion did not long sustain violent persecution of opinion. More than once mobs freed Quaker prisoners. Also it is to be said that with the single exception of religious toleration the record of the state in devotion to human rights has been from the first a splendid one, whether in human principles of criminal law, or in the defence of the civil rights commonly declared in American constitutions. It was once generally assumed that the repression practised attained its end of securing harmony of opinion. The fact seems to be that intellectual speculation was as strong in America as in Puritan England; the assumption that the inhibition of its expression was good seems wholly gratuitous, and contrary to general convictions underlying modern freedom of speech. A safer opinion is probably that "the spiritual growth of Massachusetts withered under the shadow of dominant orthodoxy; the colony was only saved from mental atrophy by its vigorous political life" (J. A. Doyle). In literature the second half of the 17th century is a sterile waste of forbidding theology; and its life, judged by the present day, singularly sombre.

In addition to the few persons banished to Rhode Island, theological and political differences led many to emigrate thither. Others, discontented with Massachusetts autocracy and wishing, too, "to secure more room," went to Connecticut (*q.v.*) where they established a bulwark against the Dutch of New York.

A witchcraft scare (at its worst in 1691–1697, though the earliest Connecticut case was in 1646–1647 and the earliest in Boston in 1648) led to another tragedy of ignorance. In all thirty-two persons were executed (according to W. F. Poole, about a thousandth part of those executed for witchcraft in the British Isles in the 16th and 17th centuries). Salem was the scene of the greatest excitement in 1691–1692.

Exceptionally honourable to the early colonists was their devotion to education (see HARVARD UNIVERSITY and BOSTON). Massachusetts Bay had a large learned element; it is supposed that about 1640 there was an Oxford or Cambridge graduate to every 250 persons in the colony. The earliest printing in the British-American colonies was done at Cambridge in 1639; it was not until 1674 that the authorities of the colony permitted printing, except at Cambridge. Boston and Cambridge remain leading publishing centres to-day. The first regular newspaper of Boston, the *Boston Newsletter*, was the pioneer of the American newspaper press.

The early history was rendered unquiet at times by wars with the Indians, the chief of which were the Pequot War in 1637, and King Philip's War in 1675–76; and for better combining against these enemies, Massachusetts, with Connecticut, New Haven and New Plymouth, formed a confederacy in 1643, considered the prototype of the larger union of the colonies which conducted the War of American Independence (1775–83). The struggle with the Crown, which ended in independence, began at the foundation of the colony, with assumptions of power under the charter which the colonial government was always trying to maintain, and the crown was as assiduously endeavouring to counteract. After more than half a century of struggle, the crown finally annulled the charter of the colony in 1684, though not until 1686 was the old government actually supplanted on the arrival of Joseph Dudley, a native of the colony, as president of a provisional council; later, Sir Edmund Andros was sent over with a commission to unite New York and New England under his rule. The colonists had been for many years almost independent; they made their own laws, the Crown appointed natives as officials, and the colonial interpretation of the old charter had in general been allowed to stand. Massachusetts had excluded the English Book of Common Prayer, she had restricted the franchise, laid the death penalty on religious opinions, and passed various other laws repugnant to the Crown, notably to Charles II. and James II.; she had caused laws and writs to run in her own name, she had neglected to exact the oath of allegiance to the sovereign, though carefully exacting an oath of fidelity to her own government, she had protected the regicides, she had coined money with her own seal, she had blocked legal appeals to the English courts, she had not compelled the observance of the navigation acts. The revocation of the charter aroused the strongest fears of the colonists. Andros speedily met determined opposition by measures undertaken relative to taxation and land titles, by efforts to secure a church for Episcopal service, and an attempt to curb the town meetings. His government was supported by a small party (largely an Anglican Church party), but was intensely unpopular with the bulk of the people; and—it is a disputed question, whether before or after news arrived of the landing in England of William of Orange—in April 1689 the citizens of Boston rose in revolution, deposed Andros, imprisoned him and re-established their old colonial form of government. Then came a struggle, carried on in England by Increase Mather as agent (1688–1692) of the colony, to secure such a form of government under a new charter as would preserve as many as possible of their old liberties. Plymouth Colony, acting through its agent in London, endeavoured to secure a separate existence by royal charter, but accepted finally union with Massachusetts when association with New York became the probable alternative. The province of Maine was also united in the new provincial charter of 1691, and Sir William Phips came over with it, commissioned as the first royal governor. As has been mentioned already, the new charter softened religious tests for office and the suffrage, and accorded "liberty of conscience" except to Roman Catholics. The old religious exclusiveness had already been greatly lessened: the clergy were less powerful, heresy had thrived under repression, Anglican churchmen had come to the colony and were borne with perforce, devotion to trade and commerce had weakened theological tests in favour of ideals of mere good order and prosperity, and a spirit of toleration had grown.

Throughout the continuance of the government under the provincial charter, there was a constant struggle between a prerogative party, headed by the royal governor, and a popular party who cherished recollections of their practical independence under the colonial charter, and who were nursing the sentiments which finally took the form of resistance in 1775. The intercharter period, 1686–1691, is of great importance in this connexion. The popular majority kept up the feeling of hostility to the royal authority in recurrent combats in the legislative assembly over the salary to be voted to the governor; though these antagonisms were from time to time forgotten in the wars with the French and Indians. During the earl of Bellomont's administration, New York was again united with Massachusetts under the same executive (1697–1701). The scenes of the recurrent wars were mostly distant from Massachusetts proper, either in Maine or on Canadian or Acadian territory, although some savage inroads of the Indians were now and then made on the exposed frontier towns, as, for instance, upon Deerfield in 1704 and upon Haverhill in 1708. Phips, who had succeeded in an attack on Port Royal, had ignominiously failed when he led the Massachusetts fleet against Quebec in 1690; and the later expedition of 1711 was no less a failure. The most noteworthy administration was that of William Shirley (1741–1749 and 1753–1756), who at one time was the commanding officer of the British forces in North America. He made a brilliant success of the expedition against Louisburg in 1745, William Pepperell, a Maine officer, being in immediate command. Shirley with Massachusetts troops also took part in the Oswego expedition of 1755; and Massachusetts proposed, and lent the chief assistance in the expedition of Nova Scotia in 1755 which ended in the removal of the Acadians. Her officers and troops also played an important part in the Crown Point and second Louisburg expedition (1758).

The first decided protests against the exercise of sovereign power by the crown, the first general moral and political revolt that marked the approach of the American War of Independence, took place in Massachusetts; so that the most striking events in the general history of the colonies as a whole from 1760 to 1775 are an intimate part of her annals. The beginning of the active opposition to the crown may be placed in the resistance, led by James Otis, to the issuing of writs (after 1752, Otis's famous argument against them being made in 1760–1761) to compel citizens to assist the revenue officers; followed later by the outburst of feeling at the imposition of the Stamp Act (1765), when Massachusetts took the lead in confronting the royal power. The governors put in office at this time by the crown were not of conciliatory temperaments, and the measures instituted in parliament (see UNITED STATES) served to increase bitterness of feeling. Royal troops sent to Boston (several regiments, 1768) irritated the populace, who were highly excited at the time, until in an outbreak on the 5th of March 1770 a file of garrison troops shot down in self-defence a few citizens in a crowd which assailed them. This is known as the "Boston Massacre." The merchants combined to prevent the importation of goods which by law would yield the crown a revenue; and the patriots—as the anti-prerogative party called themselves—under the lead of Samuel Adams, instituted regular communication between the different towns, and afterwards, following the initiative of Virginia, with the other colonies, through "committees of correspondence"; a method of the utmost advantage thereafter in forcing on the revolution by intensifying and unifying the resistance of the colony, and by inducing the co-operation of other colonies. In 1773 (Dec. 16) a party of citizens, disguised as Indians and instigated by popular meetings, boarded some tea-ships in the harbour of Boston, and to prevent the landing of their taxable cargoes threw them into the sea; this incident is known in history as the "Boston tea-party." Parliament in retaliation closed the port of Boston (1774), a proceeding which only aroused more bitter feeling in the country towns and enlisted the sympathy of the other colonies. The governorship was now given to General Thomas Gage, who commanded the troops which had been sent to Boston. Everything foreboded an outbreak. Most of the families of the highest social position were averse to extreme measures; a large number were not won over and became expatriated loyalists. The popular agitators, headed by Samuel Adams—with whom John Hancock, an opulent merchant and one of the few of the richer people who deserted the crown, leagued himself—forced on the movement, which became war in April 1775, when Gage sent an expedition to Concord and Lexington to destroy military stores accumulated by the patriots and to capture Adams and Hancock, temporarily staying at Lexington. This detachment, commanded by Lord Percy, was assaulted, and returned with heavy loss. The country towns now poured their militia into Cambridge, opposite Boston; troops came from neighbouring colonies, and Artemas Ward, a Massachusetts general, was placed in command of the irregular force, which with superior numbers at once shut the royal army up in Boston. An attempt of the provincials to seize and hold a commanding hill in Charlestown brought on the battle of Bunker Hill (June 17, 1775), in which the provincials were driven from the ground, although they lost much less heavily than the royal troops. Washington, chosen by the Continental Congress to command the army, arrived in Cambridge in July 1775, and stretching his lines around Boston, forced its evacuation in March 1776. The state was not again the scene of any conflict during the war. Generals Henry Knox and Benjamin Lincoln were the most distinguished officers contributed by the state to the revolutionary army. Out of an assessment at one time upon the states of $5,000,000 for the expenses of the war, Massachusetts was charged with $820,000, the next highest being $800,000 for Virginia. Of the 231,791 troops sent by all the colonies into the field, reckoning by annual terms, Massachusetts sent 67,907, the next highest being 31,939 from Connecticut, Virginia furnishing only 26,678; and her proportion of sailors was very much greater still. In every campaign in every colony save in 1779–80 her soldiery were in absolute, and still more in relative, number greater than those of any other colony.

After the outbreak of the war a somewhat indefinite, heterogeneous provisional government was in power till a constitution was adopted in 1780, when John Hancock became the first governor. Governor James Bowdoin in 1786–1787 put down with clemency an almost bloodless insurrection in the western counties (there was strong disaffection, however, as far east as Middlesex), known as the Shays Rebellion, significant of the rife ideas of popular power, the economic distress, and the unsettled political conditions of the years of the Confederation. Daniel Shays (1747–1825), the leader, was a brave Revolutionary captain of no special personal importance. The state debt was large, taxation was heavy, and industry was unsettled; worthless paper money was in circulation, yet some men demanded more; debtors were made desperate by prosecution; the state government seemed weak, the Federal government contemptibly so; the local courts would not, or from intimidation feared to, punish the turbulent; and demagogues encouraged ideas of popular power. A convention of delegates representing the malcontents of numerous towns in Worcester county met at Worcester on the 15th of August 1786 to consider grievances, and a week later a similar convention assembled at Hatfield, Hampshire county. Encouraged by these and other conventions in order to obstruct the collection of debts and taxes, a mob prevented a session of the Court of Common Pleas and General Sessions of the Peace at Northampton on the 29th of August, and in September other mobs prevented the same court from sitting in Worcester, Middlesex and Berkshire counties. About 1000 insurgents under Shays assembled at Springfield on the 26th of September to prevent the sitting there of the Supreme Court, from which they feared indictments. To protect the court and the national arsenal at Springfield, for which the Federal government was powerless to provide a guard, Major-General William Shepard (1737–1817) ordered out the militia, called for volunteers, and supplied them with arms from the arsenal, and the court sat for three days. The Federal government now attempted to enlist recruits, ostensibly to protect the western frontier from the Indians, but actually for the suppression of the insurrection; but the plan failed from lack of funds, and the insurgents continued to interrupt the procedure of the courts. In January 1787, however, Governor Bowdoin raised an army of 4400 men and placed it under the command of Major-General Benjamin Lincoln (1733–1810). While Lincoln was at Worcester Shays planned to capture the arsenal at Springfield, but on the 25th of January Shepard's men fired upon Shays's followers, killing four and putting the rest to flight. Lincoln pursued them to Petersham, Worcester county, where on the 4th of February he routed them and took 150 prisoners. Subsequently the insurgents gathered in small bands in Berkshire county; but here, a league having been formed to assist the government, 84 insurgents were captured at West Stockbridge, and the insurrection practically terminated in an action at Sheffield on the 27th of February, in which the insurgents lost 2 killed and 30 wounded and the militia 2 killed and 1 wounded. Two of the insurgent leaders, Daniel Shays and Eli Parsons, escaped to Vermont soon after the rout at Petersham. Fourteen other insurgents who were tried by the Supreme Court in the spring of 1787 were found guilty of treason and sentenced to death. They were, however, held rather as hostages for the good behaviour of worse offenders who had escaped, and were pardoned in September. In February 1788 Shays and Parsons petitioned for pardon, and this was granted by the legislature in the following June. The outcome of the uprising was an encouraging test of loyalty to the commonwealth; and the insurrection is regarded as having been very potent in preparing public opinion throughout the country for the adoption of a stronger national government. The Federal Constitution was ratified by Massachusetts by only a small majority on the 6th of February 1788, after its rejection had been at one time imminent; but Massachusetts became a strong Federalist state. Indeed, the general interest of her history in the quarter-century after the adoption of the Constitution lies mainly in her connexion with the fortunes of that great political party. Her leading politicians were out of sympathy with the conduct of national affairs (in the conduct of foreign relations, the distribution of political patronage, naval policy, the question of public debt) from 1804—when Jefferson's party showed its complete supremacy—onward; and particularly after the passage of the Embargo Act of 1807, which caused great losses to Massachusetts commerce, and, so far from being accepted by her leaders as a proper diplomatic weapon, seemed to them designed in the interests of the Democratic party. The Federalist preference for England over France was strong in Massachusetts, and her sentiment was against the war with England of 1812–15. New England's discontent culminated in the Hartford Convention (Dec. 1814), in which Massachusetts men predominated. The state, however, bore her full part in the war, and much of its naval success was due to her sailors.

During the interval till the outbreak of the Civil War in 1861, Massachusetts held a distinguished place in national life and politics. As a state she may justly be said to have been foremost in the struggle against slavery.[1] She opposed the policy that led to the Mexican War in 1846, although a regiment was raised in Massachusetts by the personal exertions of Caleb Cushing. The leaders of the ultra non-political abolitionists (who opposed the formation of the Liberty party) were mainly Massachusetts men, notably W. L. Garrison and Wendell Phillips. The Federalist domination had been succeeded by Whig rule in the state; but after the death of the great Whig, Daniel Webster, in 1852, all parties disintegrated, re-aligning themselves gradually in an aggressive anti-slavery party and the temporizing Democratic party. First, for many years the Free-Soilers gained strength; then in 1855 in an extraordinary party upheaval the Know-Nothings quite broke up Democratic, Free-Soil and Whig organizations; the Free-Soilers however captured the Know-Nothing organization and directed it to their own ends; and by their junction with the anti-slavery Whigs there was formed the Republican party. To this the original Free-Soilers contributed as leaders Charles Sumner and C. F. Adams; the Know-Nothings, Henry Wilson and N. P. Banks; and later, the War Democrats, B. F. Butler—all men of mark in the history of the state. Charles Sumner, the most eminent exponent of the new party, was the state's senator in Congress (1851–1874). The feelings which grew up, and the movements that were fostered till they rendered the Civil War inevitable, received something of the same impulse from Massachusetts which she had given a century before to the feelings and movements forerunning the War of American Independence. When the war broke out it was her troops who first received hostile fire in Baltimore, and turning their mechanical training to account opened the obstructed railroad to Washington. In the war thus begun she built, equipped and manned many vessels for the Federal navy, and furnished from 1861 to 1865 26,163 (or, including final credits, probably more than 30,000) men for the navy. During the war all but twelve small townships raised troops in excess of every call, the excess throughout the state amounting in all to more than 15,000 men; while the total recruits to the Federal army (including re-enlistments) numbered, according to the adjutant-general of the state, 159,165 men, of which less than 7000 were raised by draft.[2] The state, as such, and the townships spent $42,605,517.19 in the war; and private contributions of citizens are reckoned in addition at about $9,000,000, exclusive of the aid to families of soldiers, paid then and later by the state.

Since the close of the war Massachusetts has remained generally steadfast in adherence to the principles of the Republican party, and has continued to develop its resources. Navigation, which was formerly the distinctive feature of its business prosperity, has under the pressure of laws and circumstances given place to manufactures, and the development of carrying facilities on the land rather than on the sea.

In the Spanish-American War of 1898 Massachusetts furnished 11,780 soldiers and sailors, though her quota was but 7388; supplementing from her own treasury the pay accorded them by the national government.

No statement of the influence which Massachusetts has exerted upon the American people, through intellectual activity, and even through vagary, is complete without an enumeration of the names which, to Americans at least, are the signs of this influence and activity. In science the state can boast of John Winthrop, the most eminent of colonial scientists; Benjamin Thompson (Count Rumford); Nathaniel Bowditch, the translator of Laplace; Benjamin Peirce and Morse the electrician; not to include an adopted citizen in Louis Agassiz. In history, Winthrop and Bradford laid the foundations of her story in the very beginning; but the best example of the colonial period is Thomas Hutchinson, and in later days Bancroft, Sparks, Palfrey, Prescott, Motley and Parkman. In poetry, a pioneer of the modern spirit in American verse was Richard Henry Dana; and later came Bryant, Longfellow, Whittier, Lowell and Holmes. In philosophy and the science of living, Jonathan Edwards, Franklin, Channing, Emerson and Theodore Parker. In education, Horace Mann; in philanthropy, S. G. Howe. In oratory, James Otis, Fisher Ames, Josiah Quincy, junr., Webster, Choate, Everett, Sumner, Winthrop and Wendell Phillips; and, in addition, in statesmanship, Samuel Adams, John Adams and John Quincy Adams. In fiction, Hawthorne and Mrs Stowe. In law, Story, Parsons and Shaw. In scholarship, Ticknor, William M. Hunt, Horatio Greenough, W. W. Story and Thomas Ball. The "transcendental movement," which sprang out of German affiliations and produced as one of its results the well-known community of Brook Farm (1841–1847), under the leadership of Dr George Ripley, was a Massachusetts growth, and in passing away it left, instead of traces of an organization, a sentiment and an aspiration for higher thinking which gave Emerson his following. When Massachusetts was called upon to select for Statuary Hall in the capitol at Washington two figures from the long line of her worthies, she chose as her fittest representatives John Winthrop, the type of Puritanism and state-builder, and Samuel Adams (though here the choice was difficult between Samuel Adams and John Adams) as her greatest leader in the heroic period of the War of Independence.

Governors of Plymouth Colony
(Chosen annually by the people).

John Carver	1620–1621
William Bradford	1621–1633
Edward Winslow	1633–1634
Thomas Prence (or Prince)	1634–1635
William Bradford	1635–1636
Edward Winslow	1636–1637
William Bradford	1637–1638
Thomas Prence (or Prince)	1638–1639
William Bradford	1639–1644
Edward Winslow	1644–1645
William Bradford	1645–1657
Thomas Prence (or Prince)	1657–1673
Josiah Winslow	1673–1680
Thomas Hinckley	1680–1686
Sir Edmund Andros	1686–1689
Thomas Hinckley	1689–1692

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[1] Slavery had existed as a social fact from the earliest years, and legally after 1641; but it was never profitable, and was virtually abolished long before the War of American Independence; still it was never abolished explicitly by Massachusetts, though the slave trade was prohibited in 1788, and though a number of negroes were declared free after the adoption of the constitution of 1780 on the strength of the sweeping declaration of human rights in that instrument.

[2] According to the final report of the U.S. Adjutant-General in 1885, the enlistments were 146,730 men, of whom 13,942 died in war. These figures are probably less accurate than those of the state.

Governors of Massachusetts

(Under the First Charter—chosen annually).

John Endecott[1]	1629–1630
John Winthrop	1630–1634
Thomas Dudley	1634–1635
John Haynes	1635–1636
Henry Vane	1636–1637
John Winthrop	1637–1640
Thomas Dudley	1640–1641
Richard Bellingham	1641–1642
John Winthrop	1642–1644
John Endecott	1644–1645
Thomas Dudley	1645–1646
John Winthrop	1646–1649
John Endecott	1649–1650
Thomas Dudley	1650–1651
John Endecott	1651–1654
Richard Bellingham	1654–1655
John Endecott	1655–1665
Richard Bellingham	1665–1672
John Leverett (acting, 1672–1673)	1672–1679
Simon Bradstreet	1679–1686

Sir Edmund Andros	1686–1689
Simon Bradstreet	1689–1692

Under Second Charter—appointed by the Crown.[2]

Sir William Phips	1692–1694
William Stoughton (acting)	1694–1699
Richard Coote, earl of Bellomont	1699–1700
William Stoughton (acting)	1700–1701
Joseph Dudley	1702–1715
William Tailer (acting)	1715–1716
Samuel Shute	1716–1722
William Dummer (acting)	1722–1728
William Burnet	1728–1729
William Dummer (acting)	1729–1730
William Tailer (acting)	1730
Jonathan Belcher	1730–1741
William Shirley	1741–1749
Spencer Phips (acting)	1749–1753
William Shirley	1753–1756
Spencer Phips (acting)	1756–1757
Thomas Pownal	1757–1760
Thomas Hutchinson (acting)	1760
Sir Francis Bernard, Bart.	1760–1769
Thomas Hutchinson (acting)	1769–1771
Thomas Hutchinson	1771–1774
Thomas Gage[3]	1774–1775

Under the Constitution.

John Hancock		1780–1785
James Bowdoin		1785–1787
John Hancock		1787–1793
Samuel Adams (acting)		1793–1794
Samuel Adams		1794–1797
Increase Sumner	Federalist	1797–1799
Moses Gill (lieut.-governor; acting)	"	1799–1800
Caleb Strong	"	1800–1807
Jas. Sullivan	Democratic-Republican	1807–1808
Levi Lincoln (acting)	"	1808–1809
Christopher Gore	Federalist	1809–1810
Elbridge Gerry	Democratic-Republican	1810–1812
Caleb Strong	Federalist	1812–1816
John Brooks	"	1816–1823
William Eustis	Democratic-Republican	1823–1825
Levi Lincoln	"	1825–1834
John Davis	Whig	1834–1835
Edward Everett	"	1836–1840
Marcus Morton	Democrat	1840–1841
John Davis	Whig	1841–1843
Marcus Morton	Democrat	1843–1844
George N. Briggs	Whig	1844–1851
George S. Boutwell	Free-Soil Democrat	1851–1853
John H. Clifford	Whig	1853–1854
Emory Washburn	"	1854–1855
Henry J. Gardner	Know-Nothing	1855–1858
Nathaniel P. Banks	Republican	1858–1861
John A. Andrew	Republican	1861–1866
Alexander H. Bullock	"	1866–1869
William Claflin	"	1869–1872
William B. Washburn	"	1872–1874
Thomas Talbot (acting)	"	1874–1875
William Gaston	Democrat	1875–1876
Alexander H. Rice	Republican	1876–1879
Thomas Talbot	"	1879–1880
John Davis Long	"	1880–1883
Benjamin F. Butler	Democrat	1883–1884
George D. Robinson	Republican	1884–1887
Oliver Ames	"	1887–1890
John Q. A. Brackett	"	1890–1891
William E. Russell	Democrat	1891–1894
Frederic T. Greenhalge	Republican	1894–1896
Roger Wolcott	"	1896–1897
Roger Wolcott	"	1897–1900
W. Murray Crane	"	1900–1903
John L. Bates	"	1903–1905
William L. Douglas	Democrat	1905–1906
Curtis L. Guild	Republican	1906–1909
Eben S. Draper	"	1909–1911
Eugene N. Foss	Democrat	1911–

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In many cases the most valuable material on various periods is indicated under the biographies (or autobiographies in some cases) of the public men named in the above article, to which add Timothy Pickering, George Cabot, Joseph Warren, Elbridge Gerry, Benjamin F. Butler, G. S. Boutwell and George F. Hoar. Many townships have published their local records, and many township and county histories contain valuable matter of general interest (*e.g.* as showing in detail township action before the War of Independence), though generally weighted heavily with genealogy and matters of merely local interest. In American works of fiction, particularly of New England authors, the reader will find a wealth of description of Massachusetts and New England life, past and present. as in the writings of William D. Howells, Sarah O. Jewett, Mary E. Wilkins-Freeman; Harriet B. Stowe and others.

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[1] Endecott, by commission dated the 30th of April 1629, was made "governor of London's plantation in the Massachusetts Bay." Matthew Cradock, first governor of the Company, from the 4th of March 1629 to the 20th of October 1629, was succeeded on the latter date by John Winthrop, who, on reaching Salem on the 12th of June 1630 with the charter, superseded Endecott.

[2] During three periods, 1701–1702, in February 1715, and from April to August 1757 the affairs of the colony were administered by the Executive Council.

[3] General Gage was military governor, Hutchinson remaining nominally civil governor.

MASSACRE, a wholesale indiscriminate killing of persons, and also, in a transferred sense, of animals. The word is adopted from the French; but its origin is obscure. The meaning and the old form *macecle* seem to point to it being a corruption of the Lat. *macellum*, butcher's shop or shambles, hence meat market; this is probably from the root *mac*–, seen in *μάχεσθαι*, to fight, *μάχαιρα*, sword, and Lat. *mactare*, to sacrifice. Another derivation connects with the Old Low Ger. *matsken*, to cut in pieces; cf. mod. Ger. *metzeln*, to massacre.

MASSAGE. The word *massage* has of late years come into general use to signify the method of treating disease or other physical conditions by manipulating the muscles and joints. According to Littré the word is derived from the Arabic *mass*, and has the specific meaning of "pressing the muscular parts of the body with the hands, and exercising traction on the joints in order to give suppleness and stimulate vitality." It was probably adopted from the Arabian physicians by the French, who have played a leading part in reviving this method of treatment, which has been practised from time immemorial, and by the most primitive people, but has from time to time fallen into disuse among Western nations. In the *Odyssey* the women are described as rubbing and kneading the heroes on their return from battle. In India, under the name "shampoo" (*tshāmpuā*), the same process has formed part of the native system of medicine from the most remote times; professional massers were employed there by Alexander the Great in 327 B.C. In China the method is also of great antiquity, and practised by a professional class; the Swedish gymnastic system instituted by Pehr Henrik Ling is derived from the book of Cong-Fou, the bonze of Tao-Sse. Hippocrates describes and enjoins the use of manipulation, especially in cases of stiff joints, and he was followed by other Greek physicians. Oribasius gives an account of the application of friction with the bare hands, which exactly corresponds with the modern practice of massage. It is worthy of note that the treatment, after being held in high esteem by the leading Greek physicians, fell into disrepute with the profession, apparently on account of its association with vicious abuses. The same drawback has made itself felt in the present day, and can only be met by the most scrupulous care in the choice of agents and the manner of their employment. Among the Greeks, Romans, Egyptians, and later the Turks, massage came to be part of the ordinary procedure of the bath without any special therapeutic intention, and the usage has survived until to-day; but that mode of application was no doubt a refinement of civilized life. Medical rubbing is older and more elementary than bathing, as we see from its employment by savages. Probably it was evolved independently among different races from the natural instinct—shared by the lower animals—which teaches to rub, press or lick any part of the body in which uneasiness is felt, and is therefore the oldest of all therapeutic means.

According to Weiss, the therapeutic use of massage was revived in Europe by Hieronymus Fabricius ab Aquapendente (1537–1619), who applied it to stiff joints and similar conditions. Paracelsus in his *De medicina Aegyptiorum* (1591), gives a description of methodical massage as practised by the Egyptians quite on modern lines. Thereafter it appears to have been adopted here and there by individual practitioners, and various references are made to it, especially by French writers. The word "massage" occurs in an essay written by Pierre Adolphe Piorry (1794–1879) for a large encyclopaedia which appeared in 1818, but it was probably used before. The practice was gradually advocated by an increasing number of medical men. In Great Britain it was called "medical rubbing," and at Edinburgh Beveridge had a staff of eight trained male rubbers. A book published by Estradère in 1863 attracted much attention, but the man who contributed most to the modern popularity of massage was Metzger of Amsterdam, who began to use it tentatively in 1853, and then proceeded to study and apply it methodically. He published an essay on the subject in 1868. The modern refinements of the treatment are chiefly due to him. At the same time, its application by Dr Silas Weir Mitchell to hysterical and other nervous conditions, in conjunction with the "rest cure," has done much to make it known.

Massage, as now practised, includes several processes, some of which are passive and others active. The former are carried out by an operator, and consist of rubbing and kneading the skin and deeper tissues with the hands, and exercising the joints by bending the patient's limbs. The active movements consist of a special form of gymnastics, designed to exercise particular muscles or groups of muscles. In what is called "Swedish massage" the operator moves the limbs while the patient resists, thus bringing the opposing muscles into play. Some writers insist on confining the word "massage" to the rubbing processes, and use the general term "manipulation" to cover all the movements mentioned; but this is a verbal subtlety of no importance. It is evident that alike among the Greeks, the Orientals, and savage races, the two processes have always been applied as part of the same treatment, and the definition quoted above from Littré goes to show that the word "massage" is properly applied to both.

Rubbing has been subdivided into several processes, namely (1) stroking, (2) kneading, (3) rubbing, and (4) tapping, and some practitioners attach great importance to the application of a particular process in a particular way. As a rule, oils and other lubricants are not used. But, however it may be applied, the treatment acts essentially by increasing circulation and improving nutrition. It has been shown by Lauder Brunton that more blood actually flows through the tissues during and after rubbing. The number of red corpuscles, and, to some extent, their haemoglobin value, are also said to be increased (Mitchell). At the same time the movement of the lymph stream is accelerated. In order to assist the flow of blood and lymph, stroking is applied centripetally, that is to say, upwards along the limbs and the lower part of the body, downwards from the head. The effects of the increased physiological activity set up are numerous. Functional ability is restored to exhausted muscles by the removal of fatigue products and the induction of a fresh blood supply; congestion is relieved; collections of serous fluid are dispersed; secretion and excretion are stimulated; local and general nutrition are improved. These effects indicate the conditions in which massage may be usefully applied. Such are various forms of paralysis and muscular wasting, chronic and subacute affections of the joints, muscular rheumatism, sciatica and other neuralgias, local congestions, sprains, contractions, insomnia and some forms of headache, in which downward stroking from the head relieves cerebral congestion. It has also been used in anaemia, hysteria and "neurasthenia," disorders of the female organs, melancholia and other forms of insanity, morphinism, obesity, constipation, inflammatory and other affections of the eye, including even cataract. General massage is sometimes applied, as a form of passive exercise, to indolent persons whose tissues are overloaded with the products of incomplete metabolism.

As with other methods of treatment, there has been a tendency on the part of some practitioners to exalt it into a cure-all, and of others to ignore it altogether. Of its therapeutic value, when judiciously used, there is no doubt, but it is for the physician or surgeon to say when and how it should be applied. Affections to which it is not applicable are fevers, pregnancy, collections of pus, acute inflammation of the joints, inflamed veins, fragile arteries, wounds of the skin and, generally speaking, those conditions in which it is not desirable to increase the circulation, or in which the patient cannot bear handling. In such conditions it may have a very injurious and even dangerous effect, and therefore should not be used in a haphazard manner without competent advice.

The revival of massage in Europe and America has called into existence a considerable number of professional operators, both male and female, who may be regarded as forming a branch of the nursing profession. Some of these are trained in hospitals or other institutions, some by private practitioners and some not at all. Similarly some are attached to organized societies or institutions while others pursue their calling independently. Several things are required for a good operator. One is physical strength. Deep massage is very laborious work, and cannot be carried on for an hour, or even half an hour, without unusual muscular power. Feeble persons cannot practise it effectively at all. The duration of a sitting may vary from five or ten minutes to an hour. For general massage at least half an hour is required. A masser should have strength enough to do the work without too obvious exhaustion, which gives the patient an unpleasant impression. A second requirement is tactile and muscular sensibility. A person not endowed with a fine sense of touch and resistance is liable to exert too great or too little pressure; the one hurts the patient, the other is ineffective. Then skill and knowledge, which can only be acquired by a course of instruction, are necessary. Finally, some guarantee of cleanliness and character is almost indispensable. Independent massers may possess all these qualifications in a higher degree than those connected with an institution, but they may also be totally devoid of them, whereas connexion with a recognized hospital or society is a guarantee for a certain standard of efficiency. In London there are several such institutions, which train and send out both male and female massers. The fee is 5s. an hour, or from two to four guineas a week. On the European continent, where trained massers are much employed by some practitioners, the fee is considerably lower; in the United States it is higher. For reasons mentioned above, it is most desirable that patients should be attended by operators of their own sex. If this is not insisted upon, a valuable therapeutic means will be in danger of falling into disrepute both with the medical profession and the general public. (A. Sl.)

MASSAGETAE, an ancient warlike people described by Herodotus (i. 203–216; iv. 22, 172) as dwelling beyond the Araxes (*i.e.* the Oxus) in what is now Balkh and Bokhara. It was against their queen Tomyris that Cyrus undertook the expedition in which according to one story he met his end. In their usages some tribes were nomads like the people of Scythia (*q.v.*), others with their community of wives and habit of killing and eating their parents recalled the Issedones (*q.v.*); while the dwellers in the islands of the river were fish-eating savages. Probably the name denoted no ethnic unity, but included all the barbarous north-eastern neighbours of the Persians. Herodotus says they only used gold and copper (or bronze), not silver or iron. Their lavish use of gold has caused certain massive ornaments from southern Siberia, now in the Hermitage at St Petersburg, to be referred to the Massagetae. (E. H. M.)

MASSA MARITTIMA, a town and episcopal see of the province of Grosseto, Tuscany, Italy, 24 m. N.N.W. of Grosseto direct and 16 m. by rail N.E. of Follonica (which is 28 m. N.W. of Grosseto on the main coast railway), 1444 ft. above sea-level. Pop. (1901), (town) 9219; (commune) 17,519. It has a cathedral of the 13th century containing a Romanesque font (1267 with a cover of 1447) and a Gothic reliquary (1324) of the saint Cerbone, to whom the cathedral is dedicated. The battlemented municipal palace of the 13th century is picturesque. There are mineral springs, mines of iron, mercury, lignite and copper, with foundries, ironworks and olive-oil mills. At Follonica on the coast, but in this commune, are the furnaces in which are smelted the iron ore of Elba.

MASSAWA, or Massowah, a fortified town on the African coast of the Red Sea, chief port of the Italian colony of Eritrea, in 15° 36′ N. and 39° 28′ E. Pop. about 10,000. The town stands at the north end of the bay of Massawa and is built partly on a coral island of the same name—where was the original settlement—and partly on the islets of Tautlub and Sheik Said, and the neighbouring mainland. Massawa Island is from 20 to 25 ft. above the sea, its length does not exceed ¾ m. and its breadth is about ¼ m. The harbour is formed by the channel between the island and the mainland. It affords good anchorage in from 5 to 9 fathoms. The town possesses several good public buildings, chiefly built of coral, as are the houses of the principal European and Arab merchants. Landward the town is guarded by forts erected by the Italians since 1885. Water was formerly scarce; but in 1872 an ancient aqueduct from Mokullu (5 m. distant westward) was restored and continued by an embankment to the town. A railway connects Massawa with Asmara, the capital of the colony. Besides the Abyssinians, who speak a Tigré dialect corrupted with Arabic, the inhabitants comprise Italian officials and traders, Greeks, Indians, Arabs from Yemen and Hadramut, Gallas and Somalis. Massawa is the natural port for northern Abyssinia but commerce is undeveloped owing to the lack of rapid means of communication. The trade done consists mainly in exporting hides, butter, Abyssinian coffee and civet, and importing European and Indian cotton goods and silks. It increased in value from about £65,000 per annum in 1865 (the last year of Turkish control) to from £240,000 to £280,000 between 1879 and 1881, when under the administration of Egypt. Under the Italians trade greatly developed. The returns for the five years 1901–1905 showed an average annual value of £1,800,000, about two-thirds being imports.

The island of Massawa has probably been inhabited from a very early date. It appears to have formed part of the Abyssinian dominions for many centuries. It was at Massawa (Matzua, as it is called by the Portuguese chroniclers) that Christopher da Gama and his comrades landed in July 1541 on their way to aid the Abyssinians against the Moslem invaders. Captured by the Turks in 1557, the island remained a Turkish possession over two hundred years. A military colony of Bosnians settled at Arkiko (a port on the bay 4 m. south of Massawa Island) was appointed not only to defend it in case of attack from the mainland, but to keep it supplied with water in return for $1400 per month from the town's customs. For some time at the close of the 18th century Massawa was held by the sherif of Mecca, and it afterwards passed to Mehemet Ali of Egypt. The Turks were reinstated about 1850, but in 1865 they handed the island back to Egypt for an annual tribute of 2½ million piastres. In February 1885 Massawa was occupied by an Italian force, the Egyptian garrison stationed there being withdrawn in the November following (see EGYPT; ITALY; ABYSSINIA). The port was the capital of the Italian colony until 1900 when the seat of administration was removed to Asmara (see ERITREA).

For a description of the town in 1769 see the *Travels* of James Bruce. At that time the governor, though appointed by the Turks, paid one half of the customs receipts to the negus of Abyssinia in return for the protection of that monarch.

MASSÉNA, ANDRÉ, or ANDREA, duke of Rivoli, prince of Essling (1756–1817), the greatest of Napoleon's marshals, son of a small wine merchant, it is said of Jewish origin, was born at Nice on the 6th of May 1756. His parents were very poor, and he began life as a cabin boy, but he did not care much for the sea, and in 1775 he enlisted in the Royal-Italien regiment. He quickly rose to be under-officer-adjutant; but, finding his birth would prevent his ever getting a commission, he left the army in 1789, retired to his native city, and married. At the sound of war, however, and the word republic, his desire to see service increased, and he once more left Italy, and joined the 3rd battalion of the volunteers of the Var in 1791. In those days when men elected their officers, and many of the old commissioned officers had emigrated, promotion to a man with a knowledge of his drill was rapid, and by February 1792 Masséna was a lieutenant-colonel. His regiment was one of those in the army which occupied Nice, and in the advance to the Apennines which followed, his knowledge of the country, of the language, and of the people was so useful that in December 1793 he was already a general of division. In command of the advanced guard he won the battle of Saorgio in August 1794, capturing ninety guns, and after many successes he at last, on the 23rd of November 1795, with the right wing of the army of Italy, had the greatest share in the victory of Loano, won by Schérer over the Austrians and Sardinians. In Bonaparte's great campaign of 1796–97 Masséna was his most trusted general of division; in each battle he won fresh laurels, up to the crowning victory of Rivoli, from which he afterwards took his title. It was during this campaign that Bonaparte gave him the title of *enfant gâté de la victoire*, which he was to justify till he met the English in 1810. In 1798 he commanded the army of Rome for a short time, but was displaced by the intrigues of his subordinate Berthier. Masséna's next important service was in command of the army in Switzerland, which united the army in Germany under Moreau, and that in Italy under Joubert. There he proved himself a great captain, as he had already proved himself a great lieutenant; the archduke Charles and Suvarov had each been successful in Germany and in Italy, and now turned upon Masséna in Switzerland. That general held his ground well against the archduke, and then suddenly, leaving Soult to face the Austrians, he transported his army to Zürich, where, on the 26th of September 1799, he entirely defeated Korsakov, taking 200 guns and 5000 prisoners. This campaign and battle placed his reputation on a level with that of his compatriot Bonaparte, and he might have made the revolution of Brumaire, but he was sincerely attached to the republic; and had no ambition beyond a desire to live well and to have plenty of money to spend. Bonaparte, now First Consul, sent him to Genoa to command the débris of the army of Italy, and he nobly defended Genoa from February to June to the very last extremity, giving time for Bonaparte to strike his great blow at Marengo. He now went to Paris, where he sat in the Corps Législatif in 1803, and actually defended Moreau without drawing upon himself the ill-will of Napoleon, who well knew his honesty and lack of ambition.

In 1804 he was made one of the first marshals of France of the new régime, and in 1805 was decorated with the Grand Eagle of the Legion of Honour. In that year Napoleon needed an able general to keep in check the archduke Charles in Italy, while he advanced through Germany with the grand army. Masséna was chosen; he kept the archduke occupied till he received news of the surrender of Ulm, and then on the 30th of October defeated him in the battle of Caldiero After the peace of Pressburg had been signed, Masséna was ordered to take possession of the kingdom of Naples, and to place Joseph Bonaparte on the throne. This task done, Napoleon summoned Masséna to Poland, where he as usual distinguished himself, and where he for the time gave up his republican principles. In 1808 he was made duke of Rivoli. In 1808 he was accidentally wounded by his old enemy Berthier when both were in attendance on the emperor at a shooting party, and he lost the sight of one eye. In the campaign in 1809 he covered himself with glory at Landshut and at Eckmühl, and finally at the battle of Aspern-Essling his magnificent leadership made what would without him have been an appalling disaster into a mere reverse of which the enemy could make no use. On the field of Wagram Masséna, though too ill to ride, directed from his carriage the movements of the right wing. For his great services he was created prince of Essling, and given the princely castle of Thouars. He was then ordered to Spain to "drive the English into the sea." (For the campaigns of 1810 and 1811, the advance to and the retreat from Torres Vedras see PENINSULAR WAR.) Masséna himself, with some justice, ascribed his failure to the frequent disobedience of his subordinates Ney, Reynier and Junot, and public opinion attributed this disobedience to the presence with the army of Masséna's mistress, and to the resentment thereat felt by the wives of the three generals. Still, unsuccessful as he was, Masséna displayed the determination of the defence of Genoa and the fertility in expedients of the campaign of Zürich, and kept his army for five weary months close up to Wellington's impregnable position before retiring. His retreat through a devastated country was terrible, but his force of character kept his men together, and Ney having shown the worst side of his character now showed the best in the frequent and brilliant rearguard actions, until a new act of insubordination at last made the old marshal dismiss Ney from his command. Soon Masséna was once again ready to try his fortune, and he nearly defeated Wellington at Fuentes d'Oñoro, though much hampered by Bessières. But his recall soon followed this and he returned home to find his prestige gone. The old marshal felt he had a right to complain of Ney and of Napoleon himself, and, it is said, opened communications with Fouché and the remnant of the republican party. Whether this be true or not, Napoleon gave his greatest marshal no more employment in the field, but made him merely a territorial commandant at Marseilles. This command he still held at the restoration, when Louis XVIII. confirmed him in it, and with true Bourbon stupidity gave him letters of naturalization, as if the great leader of the French armies had not ceased to be an Italian. When Napoleon returned from Elba, Masséna, probably by the advice of Fouché, kept Marseilles quiet to await events, the greatest service he could do the royalists, but afterwards imputed to him as a fault. After the second restoration Masséna was summoned to sit on the court-martial which tried Marshal Ney, but, though he had been on bad terms with that general, and attributed his own disgrace to him, the old soldier would not be his comrade's judge. This refusal was used by the royalists to attack the marshal, against whom they raked up every offence they could think of. This annoyance shortened his life, and on the 4th of April 1817 the old hero died. He was buried in Père-la-Chaise, with only the word "Masséna" upon his tombstone.

In private life indolent, greedy, rapacious, ill-educated and morose, in war Masséna was, like Napoleon, the incarnation of battle. Only his indolence and his consequent lack of far-ranging imagination prevented him being as great in strategy as in tactics. His genius needed the presence of the enemy to stimulate it, but once it sprang to life Masséna became an ideal leader, absolutely brave, resourceful, unrelenting and indefatigable. He was as great a master of the strategy of forces in immediate contact—of gathering up as it were the threads of the fugue into a "stretto." For the planning of a whole perfect campaign he had neither knowledge nor inclination, and he falls short therefore of the highest rank amongst great generals; but his place amongst the greatest of soldiers is beyond challenge.

See Thiébault's *Éloge funèbre*, and Koch's *Mémoires de Masséna* (4 vols., 1849), a valuable work, carefully compiled. In more modern times E. Gachot has produced several important works dealing with Masséna's campaigns.

MASSENBACH, CHRISTIAN KARL AUGUST LUDWIG VON (1758–1827), Prussian soldier, was born at Schmalkalden on the 16th of April 1758, and educated at Heilbronn and Stuttgart, devoting himself chiefly to mathematics. He became an officer of the Württemberg army in 1778, and left this for the service of Frederick the Great in 1782. The pay of his rank was small, and his appointment on the quartermaster-general's staff made it necessary to keep two horses, so that he had to write mathematical school-books in his spare time to eke out his resources. He was far however from neglecting the science and art of war, for thus early he had begun to make his name as a theorist as well as a mathematician. After serving as instructor in mathematics to the young prince Louis, he took part with credit in the expedition into Holland, and was given the order *Pour le mérite*. On returning to Prussia he became mathematical instructor at the school of military engineering, leaving this post in 1792 to take part as a general staff officer in the war against France. He was awarded a prebend at Minden for his services as a topographical engineer on the day of Valmy, and after serving through the campaigns of 1793 and 1794 he published a number of memoirs on the military history of these years. He was chiefly occupied however with framing schemes for the reorganization of the then neglected general staff of the Prussian army, and many of his proposals were accepted. Bronsart von Schellendorf in his *Duties of the General Staff* says of Massenbach's work in this connexion, "the organization which he proposed and in the main carried out survived even the catastrophes of 1806–1807, and exists even at the present moment in its original outline." This must be accounted as high praise when it is remembered how much of the responsibility for these very disasters must be laid to Massenbach's account. The permanent gain to the service due to his exertions was far more than formal, for it is to him that the general staff owes its tradition of thorough and patient individual effort. But the actual doctrine taught by Massenbach, who was now a colonel, may be summarized as the doctrine of positions carried to a ludicrous excess; the claims put forward for the general staff, that it was to prepare cut-and-dried plans of operations in peace which were to be imposed on the troop leaders in war, were derided by the responsible generals; and the memoirs on proposed plans of campaign to suit certain political combinations were worked out in quite unnecessary detail. It was noteworthy that none of the proposed plans of campaign considered France as an enemy.

In 1805 came threats of the war with Napoleon which Massenbach had strongly opposed. He was made quartermaster-general (chief of staff) to Prince Hohenlohe, over whom he soon obtained a fatal ascendancy. War was averted for a moment by the result of the battle of Austerlitz, but it broke out in earnest in October 1806. Massenbach's influence clouded all the Prussian operations. The battles of Jena and Auerstädt were lost, and the capitulation of Prince Hohenlohe's army was negotiated. Even suggestions of disloyalty were not wanting; an attempt to try him by court-martial was only frustrated by Prince Hohenlohe's action in taking upon himself, as commander-in-chief, the whole responsibility for Massenbach's actions. He then retired to his estate in the Posen province, and occupied himself in writing pamphlets, memoirs, &c. When his estates passed into the grand duchy of Warsaw, he chose to remain a Prussian subject, and on the outbreak of the war of liberation he asked in vain for a post on the Prussian staff. After the fall of Napoleon he took part in Württemberg politics, was expelled from Stuttgart and Heidelberg, and soon afterwards arrested at Frankfurt, delivered over to the Prussian authorities and condemned to fourteen years' fortress imprisonment for his alleged publication of state secrets in his memoirs. He was kept in prison till 1826, when Frederick William III., having recovered from an accident, pardoned those whom he considered to have wronged him most deeply. He died on the 21st of November 1827, at his estate of Bialokoscz, Posen.

The obituary in *Neuer Nekrolog der Deutschen*, pt. ii. (Ilmenau, 1827) is founded on a memoir (*Der Oberst C. v. Massenbach*) which was published at the beginning of his imprisonment.

MASSENET, JULES ÉMILE FRÉDÉRIC (1842–), French composer, was born at Montaud, on the 12th of May 1842. He studied at the Paris Conservatoire, where he obtained the Grand Prix de Rome in 1863 with the cantata *David Rizzio*. Massenet became one of the most prolific composers of his time. His operas include the following: *La Grande tante*, one act, opéra comique (1867); *Don César de Bazan*, three acts, opéra comique (1872); *Le Roi de Lahore*, five acts, opéra (1877); *Hérodiade*, five acts (Brussels, 1881); *Manon*, five acts, opéra comique (1884); *Le Cid*, four acts, opéra (1885); *Esclarmonde*, four acts, opéra comique (1889); *Le Mage*, five acts, opéra (1891); *Werther*, four acts (Vienna, 1892); *Thaïs*, three acts, opéra (1894); *Le Portrait de Manon*, one act, opéra comique (1894); *La Navarraise*, two acts (Covent Garden, 1894); *Sapho*, opéra comique (1897); *Cendrillon*, opéra comique (1900); *Grisélidis*, opéra comique (1901); *Le Jongleur de Notre Dame* (Mentone, 1902). Of these the most popular is *Manon*. Massenet's other works include *Marie Madeleine*, sacred drama (1873); *Eve*, a mystery (1875); *La Vierge*, sacred legend (1880); six orchestral suites entitled *Scènes hongroises*, *Scènes pittoresques*, *Scènes dramatiques*, *Scènes napolitaines*, *Scènes de féerie*, *Scènes alsaciennes*; music to the tragedy *Les Erynnies*, to *Théodora*, *Le Crocodile*, *L'Hetman*; a requiem, *Narcisse*; an idyll, *Biblis*; a *Scène antique*; several sets of songs, entitled *Poème d'avril*, *Poème d'amour*, *Poème d'hiver*, *Poème d'octobre*, *Poème pastoral*, *Poème du souvenir*; also a large number of detached songs. He was professor of composition at the Conservatoire from 1878 to 1896, among his pupils being Hillemacher, Marty, Bruneau, Vidal, Pierné, Leroux and Charpentier. Massenet undoubtedly possesses a style of his own. He is at his best in music descriptive of the tender passion, and many of the love scenes in his operas are very beautiful.

MASSEREENE, JOHN CLOTWORTHY, 1ST VISCOUNT (d. 1665), Anglo-Irish politician, was a son of Sir Hugh Clotworthy, sheriff of county Antrim. He was elected to the Irish parliament as member for county Antrim in 1634, and was a member both of the Short and of the Long Parliament in England. Clotworthy was a vehement opponent of the earl of Strafford, in whose impeachment he took an active share. He also took part in the prosecution of Archbishop Laud. Having unsuccessfully negotiated with Ormond for the surrender of Dublin to the Parliamentary forces in 1646, he was accused in the following year of having betrayed his cause, and also of embezzlement; in consequence of these charges he fled to the Continent, but returned to parliament in June 1648. On the 12th of December in that year he was arrested, and remained in prison for nearly three years. Having taken an active part in forwarding the Restoration, he was employed in Ireland in arranging the affairs of the soldiers and other adventurers who had settled in Ireland. Clotworthy in no way abated his old animosity against "papists" and high Anglicans, and he championed the cause of the Irish Presbyterians; but being personally agreeable to Charles II., his ecclesiastical views were overlooked, and on the 21st of November 1660 he was created Baron Loughneagh and Viscount Massereene in the Irish peerage, with remainder in default of male heirs to his son-in-law, Sir John Skeffington. Massereene died without male issue in September 1665, and the title devolved on Skeffington, whose great-grandson, the fifth viscount, was created earl of Massereene in 1756. The earldom became extinct on the death of the fourth earl without male issue in 1816, the viscounty and barony of Loughneagh descending to his daughter Harriet, whose husband, Thomas Foster, took the name of Skeffington, and inherited from his mother in 1824 the titles of Viscount Ferrard and Baron Oriel of Collon in the Irish peerage, and from his father in 1828 that of Baron Oriel of Ferrard in the peerage of the United Kingdom.

MASSEY, SIR EDWARD (*c.* 1619–*c.* 1674), English soldier in the Great Rebellion, was the son of John Massey of Coddington, Cheshire. Little is known of his early life, but it is said that he served in the Dutch army against the Spaniards. In 1639 he appears as a captain of pioneers in the army raised by Charles I. to fight against the Scots. At the outbreak of the Great Rebellion he was with the king at York, but he soon joined the Parliamentary army. As lieutenant-colonel under the earl of Stamford he became deputy governor of Gloucester, where he remained till towards the end of the first Civil War, becoming governor early in 1643. He conducted minor operations against numerous small bodies of Royalists, and conducted the defence of Gloucester against the king's main army in August 1643, with great steadiness and ability, receiving the thanks of parliament and a grant of £1000 for his services. In 1644 Massey continued to keep the field and to disperse the local Royalists, and on several occasions he measured swords with Prince Rupert. In May 1644 he was made general of the forces of the Western Association. In 1645 he took the offensive against Lord Goring and the western Royalists, advanced to the relief of Taunton, and in the autumn co-operated effectively with Sir Thomas Fairfax and the New Model army in the Langport campaign. After taking part in the desultory operations which closed the first war, he took his seat in the House of Commons as member for Gloucester. He then began to take an active part in politics on the Presbyterian side, and was one of the generals who was impeached by the army on the ground that they were attempting to revive the Civil War in the Presbyterian interests. Massey fled from England in June 1647, and though he resumed his seat in the house in 1648 he was again excluded by Pride's Purge, and after a short imprisonment escaped to Holland. Thence, taking the side of the king openly and definitely like many other Presbyterians, he accompanied Charles II. to Scotland. He fought against Cromwell at the bridge of Stirling and Inverkeithing, and commanded the advanced guard of the Royalist army in the invasion of England in 1651. It was hoped that Massey's influence would win over the towns of the Severn valley to the cause of the king, and the march of the army on Worcester was partly inspired by this expectation. However, he effected little, and after riding with the king for some distance from the field of Worcester, fell into the hands of his former comrades and was lodged in the Tower. He again managed to escape to Holland. While negotiating with the English Presbyterians for the restoration of Charles, he visited England twice, in 1654 and 1656. In 1660 he was active in preparing for Charles's return, and was rewarded by a knighthood and a grant of £3000. The rest of his life was spent in political, and occasionally in military and administrative business, and he is said to have died in Ireland in 1674 or 1675.

MASSEY, GERALD (1828–1907), English poet, was born near Tring, Hertfordshire, on the 29th of May 1828. His parents were in humble circumstances, and Massey was little more than a child when he was set to hard work in a silk factory, which he afterwards deserted for the equally laborious occupation of straw-plaiting. These early years were rendered gloomy by much distress and deprivation, against which the young man strove with increasing spirit and virility, educating himself in his spare time, and gradually cultivating his innate taste for literary work. He was attracted by the movement known as Christian Socialism, into which he threw himself with whole-hearted vigour, and so became associated with Maurice and Kingsley. His first public appearance as a writer was in connexion with a journal called the *Spirit of Freedom*, of which he became editor, and he was only twenty-two when he published his first volume of poems, *Voices of Freedom and Lyrics of Love*. These he followed in rapid succession by *The Ballad of Babe Christabel* (1854), *War Waits* (1855), *Havelock's March* (1860), and *A Tale of Eternity* (1869). Many years afterwards in 1889, he collected the best of the contents of these volumes, with additions, into a two-volume edition of his poems called *My Lyrical Life*. He also published works dealing with spiritualism, the study of Shakespeare's sonnets (1872 and 1890), and theological speculation. It is generally understood that he was the original of George Eliot's *Felix Holt*. Massey's poetry has a certain rough and vigorous element of sincerity and strength which easily accounts for its popularity at the time of its production. He treated the theme of Sir Richard Grenville before Tennyson thought of using it, with much force and vitality. Indeed, Tennyson's own praise of Massey's work is still its best eulogy, for the Laureate found in him "a poet of fine lyrical impulse, and of a rich half-Oriental imagination." The inspiration of his poetry is essentially British; he was a patriot to the core. It is, however, as an Egyptologist that Gerald Massey is best known in the world of letters. He first published *The Book of the Beginnings*, followed by *The Natural Genesis*; but by far his most important work is *Ancient Egypt: The Light of the World*, published shortly before his death. He died on the 29th of October 1907.

See an article by J. Churton Collins in the *Contemporary Review* (May 1904).

MASSICUS, MONS, a mountain ridge of ancient Italy, in the territory of the Aurunci, and on the border of Campania and Latium adjectum—attributed by most authors to the latter. It projects south-west from the volcanic system of Rocca Monfina (see SUESSA AURUNCA) as far as the sea, and separates the lower course of the Liris from the plain of Campania. It consists of limestone, with a superstratum of pliocenic and volcanic masses, and was once an island; its highest point is 2661 ft. above sea-level.

It was very famous for its wine in ancient times. There was just room along the coast for the road to pass through; the pass was guarded by the Auruncan town of Vescia (probably on the mountain side), which ceased to exist in 314 B.C. after the defeat of the Ausones, but left its name to the spot. Its successor, Sinuessa, on the coast, a station on the Via Appia, was constructed in 312 B.C., and a colony was founded there in 295 B.C. It is not infrequently mentioned by classical writers as a place in which travellers halted. Here Virgil joined Horace on the famous journey to Brundusium. Domitian considerably increased its importance by the construction of the Via Domitiana, which left the Via Appia here and ran to Cumae and Puteoli, and it was he, no doubt, who raised it to the position of *colonia Flavia*. The town was destroyed by the Saracens, but some ruins of it are still visible two miles north-west of the modern village of Mondragone. The mineral springs which still rise here were frequented in antiquity.

MASSIF, a French term, adopted in geology and physical geography for a mountainous mass or group of connected heights, whether isolated or forming part of a larger mountain system. A "massif" is more or less clearly marked off by valleys.

MASSILLON, JEAN BAPTISTE (1663–1742), French bishop and preacher, was born at Hyères on the 24th of June 1663, his father being a royal notary of that town. At the age of eighteen he joined the Congregation of the Oratory and taught for a time in the colleges of his order at Pézenas, and Montbrison and at the Seminary of Vienne. On the death of Henri de Villars, archbishop of Vienne, in 1693, he was commissioned to deliver a funeral oration, and this was the beginning of his fame. In obedience to Cardinal de Noailles, archbishop of Paris, he left the Cistercian abbey of Sept-Fonds, to which he had retired, and settled in Paris, where he was placed at the head of the famous seminary of Saint Magloire. He soon gained a wide reputation as a preacher and was selected to be the Advent preacher at the court of Versailles in 1699. He was made bishop of Clermont in 1717, and two years later was elected a member of the French Academy. The last years of his life were spent in the faithful discharge of his episcopal duties; his death took place at Clermont on the 18th of September 1742. Massillon enjoyed in the 18th century a reputation equal to that of Bossuet and of Bourdaloue, and has been much praised by Voltaire, D'Alembert and kindred spirits among the *Encyclopaedists*. His popularity was probably due to the fact that in his sermons he lays little stress on dogmatic questions, but treats generally of moral subjects, in which the secrets of the human heart and the processes of man's reason are described with poetical feeling. He has usually been contrasted with his predecessor Bourdaloue, the latter having the credit of vigorous denunciation, Massillon that of gentle persuasiveness. Besides the *Petit Carême*, a sermon which he delivered before the young king Louis XV. in 1718, his sermons on the Prodigal Son, on the small number of the elect, on death, for Christmas Day, and for the Fourth Sunday in Advent, may be perhaps cited as his masterpieces. His funeral oration on Louis XIV. is only noted now for the opening sentence: "Dieu seul est grand." But in truth Massillon is singularly free from inequality. His great literary power, his reputation for benevolence, and his known toleration and dislike of doctrinal disputes caused him to be much more favourably regarded than most churchmen by the *philosophes* of the 18th century.

The first edition of Massillon's complete works was published by his nephew, also an Oratorian (Paris, 1745–1748), and upon this, in the absence of MSS., succeeding reprints were based. The best modern edition is that of the Abbé Blampignon (Paris, 1865–1868, 4 vols.; new ed. 1886).

See Abbé Blampignon, *Massillon, d'après des documents inédits* (Paris, 1879); and *L'Épiscopat de Massillon d'après des documents inédits, suivi de sa correspondance* (Paris, 1884); F. Brunetière "L'Éloquence de Massillon" in *Études critiques* (Paris, 1882); Père Ingold, *L'Oratoire et le jansénisme au temps de Massillon* (Paris, 1880); and Louis Petit de Julleville's *Histoire de la langue et de la littérature française*, v. 372–385 (Paris, 1898).

MASSILLON, a city of Stark county, Ohio, U.S.A., on the Tuscarawas river and the Ohio canal, 8 m. W. of Canton, and about 50 m. S. by E. of Cleveland. Pop. (1900), 11,944 (1693 foreign-born); (1910), 13,879. It is served by the Pennsylvania (Pittsburg, Ft Wayne & Chicago Division), the Baltimore & Ohio and the Wheeling & Lake Erie railways. Massillon is built among hills in a part of the state noted for its large production of coal and wheat and abounding in white sandstone, iron ore and potter's clay. The city has various manufactures, including iron, engines, furnaces, reapers, threshers and bottles. The total value of the factory products in 1905 was $3,707,013, an increase of 34·8% over that of 1900. The first settlement was made in 1825; in 1826 the town was laid out and named in honour of Jean Baptiste Massillon; it was incorporated a village in 1853, and became a city in 1868.

MASSIMO, or MASSIMI, a Roman princely family of great antiquity, said to be descended from the ancient Maximi of republican Rome. The name is first mentioned in 1012 in the person of Leo de Maximis, and the family played a considerable part in the history of the city in the middle ages. The brothers Pietro and Francesco Massimi acquired fame by protecting and encouraging the German printer Ulrich Hahn, who came to Rome in 1467. In the 16th century the Massimi were the richest of the Roman nobles. A marquisate was conferred on them in 1544, and the lordship of Arsoli in 1574. To-day there are two branches of the Massimi, viz. the Principi Massimo, descended from Camillo Massimiliano (1770–1840), and the dukes of Rignano, descended from Francesco Massimo (1773–1844). One of the sons of the present Prince Camillo Carlo Alberto, Don Fabrizio, married Princess Beatrice, daughter of Don Carlos of Bourbon (duke of Madrid), the pretender to the Spanish throne. The Palazzo Massimo in Rome was built by Baldassare Peruzzi by order of Pietro Massimo, on the ruins of an earlier palace destroyed in the sack of Rome in 1527.

See F. Gregorovius, *Geschichte der Stadt Rom* (Stuttgart, 1880); A. von Reumont, *Geschichte der Stadt Rom* (Berlin, 1868); *Almanach de Gotha*; J. H. Douglas, *The Principal Noble Families of Rome* (Rome, 1905).

MASSINGER, PHILIP (1583–1640), English dramatist, son of Arthur Massinger or Messanger, was baptized at St Thomas's, Salisbury, on the 24th of November 1583. He apparently belonged to an old Salisbury family, for the name occurs in the city records as early as 1415. He is described in his matriculation entry at St Alban Hall, Oxford (1602), as the son of a gentleman. His father, who had also been educated at St Alban Hall, was a member of parliament, and was attached to the household of Henry Herbert, 2nd earl of Pembroke, who recommended him in 1587 for the office of examiner in the court of the marches. The 3rd earl of Pembroke, the William Herbert whose name has been connected with Shakespeare's sonnets, succeeded to the title in 1601. It has been suggested that he supported the poet at Oxford, but the significant omission of any reference to him in any of Massinger's prefaces points to the contrary. Massinger left Oxford without a degree in 1606. His father had died in 1603, and he was perhaps dependent on his own exertions. The lack of a degree and the want of patronage from Lord Pembroke may both be explained on the supposition that he had become a Roman Catholic. On leaving the university he went to London to make his living as a dramatist, but his name cannot be definitely affixed to any play until fifteen years later, when *The Virgin Martyr* (ent. at Stationers' Hall, Dec. 7, 1621) appeared as the work of Massinger and Dekker. During these years he worked in collaboration with other dramatists. A joint letter, from Nathaniel Field, Robert Daborne and Philip Massinger, to Philip Henslowe, begs for an immediate loan of five pounds to release them from their "unfortunate extremitie," the money to be taken from the balance due for the "play of Mr Fletcher's and ours." A second document shows that Massinger and Daborne owed Henslowe £3 on the 4th of July 1615. The earlier note probably dates from 1613, and from this time Massinger apparently worked regularly with John Fletcher, although in editions of Beaumont and Fletcher's works his co-operation is usually unrecognized. Sir Aston Cokayne, Massinger's constant friend and patron, refers in explicit terms to this collaboration in a sonnet addressed to Humphrey Moseley on the publication of his folio edition of Beaumont and Fletcher (*Small Poems of Divers Sorts*, 1658), and in an epitaph on the two poets he says:—

> "Plays they did write together, were great friends,
> And now one grave includes them in their ends."

After Philip Henslowe's death in 1616 Massinger and Fletcher began to write for the King's Men. Between 1623 and 1626 Massinger produced unaided for the Lady Elizabeth's Men then playing at the Cockpit three pieces, *The Parliament of Love*, *The Bondman* and *The Renegado*. With the exception of these plays and *The Great Duke of Florence*, produced in 1627 by the Queen's servants, Massinger continued to write regularly for the King's Men until his death. The tone of the dedications of his later plays affords evidence of his continued poverty. Thus in the preface to *The Maid of Honour* (1632) he wrote, addressing Sir Francis Foljambe and Sir Thomas Bland: "I had not to this time subsisted, but that I was supported by your frequent courtesies and favours." The prologue to *The Guardian* (licensed 1633) refers to two unsuccessful plays and two years of silence, when the author feared he had lost the popular favour. S. R. Gardiner, in an essay on "The Political Element in Massinger" (*Contemp. Review*, Aug. 1876), maintained that Massinger's dramas are before all else political, that the events of his day were as openly criticized in his plays as current politics are in the cartoons of *Punch*. It is probable that this break in his production was owing to his free handling of public matters. In 1631 Sir Henry Herbert, the master of the revels, refused to license an unnamed play by Massinger because of "dangerous matter as the deposing of Sebastian, King of Portugal," calculated presumably to endanger good relations between England and Spain. There is little doubt that this was the same piece as *Believe as You List*, in which time and place are changed, Antiochus being substituted for Sebastian, and Rome for Spain. In the prologue Massinger ironically apologizes for his ignorance of history, and professes that his accuracy is at fault if his picture comes near "a late and sad example." The obvious "late and sad example" of a wandering prince could be no other than Charles I.'s brother-in-law, the elector palatine. An allusion to the same subject may be traced in *The Maid of Honour*. In another play by Massinger, not extant, Charles I. is reported to have himself struck out a passage put into the mouth of Don Pedro, king of Spain, as "too insolent." The poet seems to have adhered closely to the politics of his patron, Philip Herbert, earl of Montgomery, and afterwards 4th earl of Pembroke, who had leanings to democracy and was a personal enemy of the duke of Buckingham. In *The Bondman*, dealing with the history of Timoleon, Buckingham is satirized as Gisco. The servility towards the Crown displayed in Beaumont and Fletcher's plays reflected the temper of the court of James I. The attitude of Massinger's heroes and heroines towards kings is very different. Camiola's remarks on the limitations of the royal prerogative (*Maid of Honour*, act IV. sc. v.) could hardly be acceptable at court.

Massinger died suddenly at his house near the Globe theatre, and was buried in the churchyard of St Saviour's, Southwark, on the 18th of March 1640. In the entry in the parish register he is described as a "stranger," which, however, implies nothing more than that he belonged to another parish.

The supposition that Massinger was a Roman Catholic rests upon three of his plays, *The Virgin Martyr* (licensed 1620), *The Renegado* (licensed 1624) and *The Maid of Honour* (*c.* 1621). The religious sentiment is certainly such as would obviously best appeal to an audience sympathetic to Roman Catholic doctrine. *The Virgin Martyr*, in which Dekker probably had a large share, is really a miracle play, dealing with the martyrdom of Dorothea in the time of Diocletian, and the supernatural element is freely used. Little stress can be laid on this performance as elucidating Massinger's views. It is not entirely his work, and the story is early Christian, not Roman Catholic. In *The Renegado*, however, the action is dominated by the beneficent influence of a Jesuit priest, Francisco, and the doctrine of baptismal regeneration is enforced. In *The Maid of Honour* a complicated situation is solved by the decision of the heroine, Camiola, to take the veil. For this she is held up "to all posterity a fair example for noble maids to imitate." Among all Massinger's heroines Camiola is distinguished by genuine purity and heroism.

His plays have generally an obvious moral intention. He sets himself to work out a series of ethical problems through a succession of ingenious and effective plots. In the art of construction he has, indeed, few rivals. But the virtue of his heroes and heroines is rather morbid than natural, and often singularly divorced from common-sense. His *dramatis personae* are in general types rather than living persons, and their actions do not appear to spring inevitably from their characters, but rather from the exigencies of the plot. The heroes are too good, and the villains too wicked to be quite convincing. Moreover their respective goodness and villainy are too often represented as extraneous to themselves. This defect of characterization shows that English drama had already begun to decline.

It seems doubtful whether Massinger was ever a popular playwright, for the best qualities of his plays would appeal rather to politicians and moralists than to the ordinary playgoer. He contributed, however, at least one great and popular character to the English stage. Sir Giles Overreach, in *A New Way to Pay Old Debts*, is a sort of commercial Richard III., a compound of the lion and the fox, and the part provides many opportunities for a great actor. He made another considerable contribution to the comedy of manners in *The City Madam*. In Massinger's own judgment *The Roman Actor* was "the most perfect birth of his Minerva." It is a study of the tyrant Domitian, and of the results of despotic rule on the despot himself and his court. Other favourable examples of his grave and restrained art are *The Duke of Milan*, *The Bondman* and *The Great Duke of Florence*.

Massinger was a student and follower of Shakespeare. The form of his verse, especially in the number of run-on lines, approximates in some respects to Shakespeare's later manner. He is rhetorical and picturesque, but rarely rises to extraordinary felicity. His verse is never mean, but it sometimes comes perilously near to prose, and in dealing with passionate situations it lacks fire and directness.

The plays attributed to Massinger alone are: *The Duke of Milan, a Tragedy* (*c.* 1618, pr. 1623 and 1638); *The Unnatural Combat, a Tragedy* (*c.* 1619, pr. 1639); *The Bondman, an Antient Storie* (licensed 1623, pr. 1624); *The Renegado, a Tragaecomedie* (lic. 1624, pr. 1630); *The Parliament of Love* (lic. 1624; ascribed, no doubt erroneously, in the Stationers' Register, 1660, to W. Rowley; first printed by Gifford from an imperfect MS. in 1805); *A New Way to Pay Old Debts, a Comoedie* (*c.* 1625, pr. 1632); *The Roman Actor. A Tragaedie* (lic. 1626, pr. 1629); *The Maid of Honour* (dating perhaps from 1621, pr. 1632); *The Picture, a Tragecomedie* (lic. 1629, pr. 1630); *The Great Duke of Florence, a Comicall Historie* (lic. 1627, pr. 1635); *The Emperor of the East, a Tragaecomoedie* (lic. and pr. 1631), founded on the story of Theodosius the Younger; *Believe as You List* (rejected by the censor in January, but licensed in May, 1631; pr. 1848–1849 for the Percy Society); *The City Madam, a Comedie* (lic. 1632, pr. 1658), which Mr Fleay (*Biog. Chron. of the Eng. Drama*, i. 226), however, considers to be a *rifaciamento* of an older play, probably by Jonson; *The Guardian* (lic. 1633, pr. 1655); and *The Bashful Lover* (lic. 1636, pr. 1655). *A Very Woman, or The Prince of Tarent*, licensed in 1634 as the work of Massinger alone, is generally referred to his collaboration with Fletcher. The "exquisite temperance and justice" of this piece are, according to Swinburne, foreign to Fletcher's genius, and afford a striking example of Massinger's artistic skill and moderation.

Twelve plays of Massinger are said to be lost, but the titles of some of these may be duplicates of those of existing plays. Five of these lost plays were MSS. used by John Warburton's cook for pie-covers. The numerous plays in which Massinger's co-operation with John Fletcher is generally assumed are dealt with under BEAUMONT and FLETCHER. But it may be here noted that Mr R. Boyle has constructed an ingenious case for the joint authorship by Fletcher and Massinger of the two "Shakespearian" plays, *Henry VIII.* and *Two Noble Kinsmen* (see the New Shakspere Society's *Transactions*, 1884 and 1882). Mr Boyle sees the touch of Massinger in the first two acts of the *Second Maiden's Tragedy* (Lansdowne MS., lic. 1611), a play with which the names of Fletcher and Tourneur are also associated by different critics. *The Fatall Dowry, a Tragedy* (*c.* 1619, pr. 1632), which was adapted without acknowledgment by Nicholas Rowe in his *Fair Penitent*, was written in conjunction with Nathaniel Field; and *The Virgin Martir, a Tragedie* (lic. 1620, pr. 1621), with Thomas Dekker.

Massinger's independent works were collected by Coxeter (4 vols., 1759, revised edition with introduction by Thomas Davies, 1779), by J. Monck Mason (4 vols., 1779), by William Gifford (4 vols., 1805, 1813), by Hartley Coleridge (1840), by Lieut.-Colonel Cunningham (1867), and selections by Mr Arthur Symons in the *Mermaid Series* (1887–1889). Gifford's remains the standard edition, and formed the basis of Cunningham's text. It contains "An Essay on the Dramatic Writings of Massinger" by Dr John Ferriar.

Massinger has been the object of a good deal of criticism. A metrical examination of the plays in which Massinger was concerned is given in *Englische Studien* (Halle, v. 74, vii. 66, viii. 39, ix. 209 and x. 383), by Mr R. Boyle, who also contributed the life of the poet in the *Dictionary of National Biography*. The sources of his plays are dealt with by E. Koeppel in *Quellen Studien zu den Dramen Chapman's, Massinger's und Ford's* (Strassburg, 1897). For detailed criticism, beside the introductions to the editions quoted, see A. W. Ward, *Hist. of Eng. Dram. Lit.* (1899), iii. 1–47, and F. G. Fleay, *Biog. Chron. of the Eng. Drama* (1891), under *Fletcher*; a general estimate of Massinger, dealing especially with his moral standpoint, is given in Sir Leslie Stephen's *Hours in a Library* (3rd series, 1879); Swinburne, in the *Fortnightly Review* (July 1889), while acknowledging the justice of Sir L. Stephen's main strictures, found much to say in praise of the poet.

MASSINISSA (*c.* 238–149 B.C.), king of Massylian or eastern Numidia. He was educated, like many of the Numidian chiefs, at Carthage, learnt Latin and Greek, and was an accomplished as well as a naturally clever man. Although his kingdom was nominally independent of Carthage, it really stood to it in a relation of vassalage; it was directly under Carthaginian influences, and was imbued to a very considerable extent with Carthaginian civilization. It was to this that Massinissa owed his fame and success; he was a barbarian at heart, but he had a varnish of culture, and to this he added the craft and cunning in which Carthaginian statesmen were supposed to excel. While yet a young man (212) he forced his neighbour Syphax, prince of western Numidia, who had recently entered into an alliance with Rome, to fly to the Moors in the extreme west of Africa. Soon afterwards he appeared in Spain, fighting for Carthage with a large force of Numidian cavalry against the Romans under the two Scipios. The defeat of the Carthaginian army in 206 led him to cast in his lot with Rome. Scipio Africanus is said to have cultivated his friendship. Massinissa now quitted Spain for a while for Africa, and was again engaged in a war with Syphax in which he was decidedly worsted. Scipio's arrival in Africa in 204 gave him another chance, and no sooner had he joined the Roman general than he crushed his old enemy Syphax, and captured his capital Cirta (Constantine). Here occurs the romantic story of Sophonisba, daughter of the Carthaginian Hasdrubal, who had been promised in marriage to Massinissa, but had subsequently become the wife of Syphax. Massinissa, according to the story, married Sophonisba immediately after his victory, but was required by Scipio to dismiss her as a Carthaginian, and consequently an enemy to Rome.

To save her from such humiliation he sent her poison, with which she destroyed herself. Massinissa was now accepted as a loyal ally of Rome, and was confirmed by Scipio in the possession of his kingdom. In the battle of Zama (202) (see Punic Wars), he commanded the cavalry on Scipio's right wing, and materially assisted the Roman victory. For his services he received the kingdom of Syphax, and thus under Roman protection he became master of the whole of Numidia, and his dominions completely enclosed the Carthaginian territories, now straitened and reduced at the close of the Second Punic War. It would seem that he had thoughts of annexing Carthage itself with the connivance of Rome. In a war which soon followed he was successful; the remonstrances of Carthage with Rome on the behaviour of her ally were answered by the appointment of Scipio as arbitrator; but, as though intentionally on the part of Rome, no definite settlement was arrived at, and thus the relations between Massinissa and the Carthaginians continued strained. Rome, it is certain, deliberately favoured her ally's unjust claims with the view of keeping Carthage weak, and Massinissa on his part was cunning enough to retain the friendship of the Roman people by helping them with liberal supplies in their wars against Perseus of Macedon and Antiochus. As soon as Carthage seemed to be recovering herself, and some of Massinissa's partisans were driven from the city into exile, his policy was to excite the fears of Rome, till at last in 149 war was declared—the Third Punic War, which ended in the final overthrow of Carthage. The king took some part in the negotiations which preceded the war, but died soon after its commencement in the ninetieth year of his age and the sixtieth of his reign.

Massinissa was an able ruler and a decided benefactor to Numidia. He converted a plundering tribe into a settled and civilized population, and out of robbers and marauders made efficient and disciplined soldiers. To his sons he bequeathed a well-stored treasury, a formidable army, and even a fleet. Cirta (*q.v.*), his capital, became a famous centre of Phoenician civilization. In fact Massinissa changed for the better the whole aspect of a great part of northern Africa. He had much of the Arab nature, was singularly temperate, and equal to any amount of fatigue. His fidelity to Rome was merely that of temporary expediency. He espoused now one side, and now the other, but on the whole supported Rome, so that orators and historians could speak of him as "a most faithful ally of the Roman people."

See Livy xxiv. 49, xxviii. 11, 35, 42, xxix. 27, xxx. 3, 12, 28, 37, xlii. 23, 29, xliii. 3; Polybius iii. 5, ix. 42, xiv. 1, xxxii. 2, xxxvii. 3; Appian, *Hisp.* 37, *Punica*, 11, 27, 105; Justin xxxiii. 1; A. H. J. Greenidge, *Hist. of Rome* (London, 1904).

MASSON, DAVID (1822–1907), Scottish man of letters, was born at Aberdeen on the 2nd of December 1822, and educated at the grammar school there and at Marischal College. Intending to enter the Church, he proceeded to Edinburgh University, where he studied theology under Dr Chalmers, whose friendship he enjoyed until the divine's death in 1847. However, abandoning his project of the ministry, he returned to his native city to undertake the editorship of the *Banner*, a weekly paper devoted to the advocacy of Free Kirk principles. After two years he resigned this post and went back to the capital, bent upon pursuing a purely literary career. There he wrote a great deal, contributing to *Fraser's Magazine*, *Dublin University Magazine* (in which appeared his essays on Chatterton) and other periodicals. In 1847 he went to London, where he found wider scope for his energy and knowledge. He was secretary (1851–1852) of the "Society of the Friends of Italy." In a famous interview with Mrs Browning at Florence he contested her admiration for Napoleon III. He had known De Quincey, whose biography he contributed in 1878 to the "English Men of Letters" series, and he was an enthusiastic friend and admirer of Carlyle. In 1852 he was appointed professor of English literature at University College, London, in succession to A. H. Clough, and from 1858 to 1865 he edited the newly established *Macmillan's Magazine*. In 1865 he was selected for the chair of rhetoric and English literature at Edinburgh, and during the early years of his professorship actively promoted the movement for the university education of women. In 1879 he became editor of the Register of the Scottish Privy Council, and in 1893 was appointed Historiographer Royal for Scotland. Two years later he resigned his professorship. His *magnum opus* in his *Life of Milton in Connexion with the History of His Own Time* in six volumes, the first of which appeared in 1858 and the last in 1880. He also edited the library edition of Milton's *Poetical Works* (3 vols., 1874), and De Quincey's *Collected Works* (14 vols., 1889–1890). Among his other publications are *Essays, Biographical and Critical* (1856, reprinted with additions, 3 vols., 1874), *British Novelists and their Styles* (1859), *Drummond of Hawthornden* (1873), *Chatterton* (1873) and *Edinburgh Sketches* (1892). He died on the 6th of October 1907. A bust of Masson was presented to the senate of the university of Edinburgh in 1897 Professor Masson had married Rosaline Orme. His son Orme Masson became professor of chemistry in the university of Melbourne, and his daughter Rosaline is known as a writer and novelist.

MASSON, LOUIS CLAUDE FREDÉRIC (1847–), French historian, was born at Paris on the 8th of March 1847 His father, Francis Masson, a solicitor, was killed on the 23rd of June 1848, when major in the *garde nationale*. Young Masson was educated at the college of Sainte Barbe, and at the lycée Louis-le-Grand, and then travelled in Germany and in England; from 1869 to 1880 he was librarian at the Foreign Office. At first he devoted himself to the history of diplomacy, and published between 1877 and 1884 several volumes connected with that subject. Later he published a number of more or less curious memoirs illustrating the history of the Revolution and of the empire. But he is best known for his books connected with Napoleon. In *Napoléon inconnu* (1895), Masson, together with M. Guido Biagi, brought out the unpublished writings (1786–1793) of the future emperor. These were notes, extracts from historical, philosophical and literary books, and personal reflections in which one can watch the growth of the ideas later carried out by the emperor with modifications necessitated by the force of circumstances and his own genius. But this was only one in a remarkable series: *Joséphine de Beauharnais, 1763–1796* (1898); *Joséphine, impératrice et reine* (1899); *Joséphine répudiée 1809–1814* (1901); *L'Impératrice Marie Louise* (1902); *Napoléon et les femmes* (1894); *Napoléon et sa famille* (9 vols., 1897–1907); *Napoléon et son fils* (1904); and *Autour de l'Île d'Elbe* (1908). These works abound in details and amusing anecdotes, which throw much light on the events and men of the time, laying stress on the personal, romantic and dramatic aspects of history. The author was made a member of the Académie française in 1903. From 1886 to 1889 he edited the review *Arts and Letters*, published in London and New York.

A bibliography of his works, including anonymous ones and those under an assumed name, has been published by G. Vicaire (*Manuel de l'amateur des livres du XIX^{e} siècle*, tome v., 1904). *Napoléon et les femmes* has been translated into English as *Napoleon and the Fair Sex* (1894).

MAST (1) (O. Eng. *maest*; a common Teutonic word, cognate with Lat. *malus*; from the medieval latinized form *mastus* comes Fr. *mât*), in nautical language, the name of the spar, or straight piece of timber, or combination of spars, on which are hung the yards and sails of a vessel of any size. It has been ingeniously supposed that man himself was the first mast. He discovered by standing up in his prehistoric "dugout," or canoe, that the wind blowing on him would carry his craft along. But the origin of the mast, like that of the ship, is lost in times anterior to all record. The earliest form of mast which prevailed till the close of the middle ages, and is still in use for small vessels, was and is a single spar made of some tough and elastic wood, the conifers supply the best timber for the purpose. In sketching the history of the development of the mast, we must distinguish between the increase in the number erected, and the improvements made in the mast itself. The earliest ships had only one, carrying a single sail. So little is known of the rigging of classical ships that nothing can be affirmed of them with absolute confidence. The Norse vessels carried one mast placed in the middle. The number gradually increased till it reached four or five. All were at first upright, but the mast which stood nearest the bow was by degrees lowered forward till it became the bow-sprit of modern times, and lost the name of mast. The next from the bows became the foremast—called in Mediterranean sea language *mizzana*, in French *misaine*. Then came the main-mast—in French *grand mât*; and then the mizen—in French, which follows the Mediterranean usage, the *artimon*, *i.e.* "next the rudder," *timon*. A small mast was sometimes erected in the very end of the ship, and called in English a "bonaventure mizen." It had a close resemblance to the jigger of yawl-rigged yachts. By the close of the 16th century it had become the established rule that a ship proper had three masts—fore, main and mizen. The third takes its name not as the other two do, from its place, but from the lateen sail originally hoisted on it (see Rigging), which was placed fore and aft in the middle (Italian, *mizzo*) of the ship, and did not lie across like the courses and topsails. With the development of very large sailing clippers in the middle of the 19th century a return was made to the practice of carrying more than three masts. Ships and barques are built with four or five. Some of the large schooners employed in the American coast trade have six or seven, and some steamers have had as many.

The mast was for long made out of a single spar. Thence the Mediterranean name of "palo" (spar) and the Spanish "arbol" (tree). The typical Mediterranean mast of "lateen" (Latin) vessels is short and bends forward. In other classes it is upright, or bends slightly backwards with what is called a "rake." The mast is grounded, or in technical language "stepped," on the kelson (or keelson), the solid timber or metal beam lying parallel with, and above the keel. As the 15th century advanced the growth of the ship made it difficult, or even impossible, to find spars large enough to make a mast. The practice of dividing it into lower, and upper or topmast, was introduced. At first the two were fastened firmly, and the topmast could not be lowered. In the 16th century the topmast became movable. No date can be given for the change, which was gradual, and was not simultaneously adopted. When the masting of sailing ships was fully developed, the division was into lower or standing mast, topmast, topgallant mast, and topgallant royal. The topgallant royal is a small spar which is often a continuation of the topgallant mast, and is fixed. Increase of size also made it impossible to construct each of these subdivisions out of single timbers. A distinction was made between "whole" or single-spar masts and "armed" and "made masts." The first were used for the lighter spars, for small vessels and the Mediterranean craft called "polacras." Armed masts were composed of two single timbers. Made masts were built of many pieces, bolted and "coaked," *i.e.* dovetailed and fitted together, fastened round by iron hoops, and between them by twelve or thirteen close turns of rope, firmly secured. "Made masts" are stronger than those made of a single tree and less liable to be sprung. The general principle of construction is that it is built round a central shaft, called in English the "spindle" or "upper tree," and in French the *mèche* or wick. The other pieces—"side trees," "keel pieces," "side fishes," "cant pieces" and "fillings" are "coaked," *i.e.* dovetailed and bolted on to and around the "spindle," which itself is made of two pieces, coaked and bolted. The whole is bound by iron bands, and between the bands, by rope firmly "woulded" or turned round, and nailed tight. The art of constructing made masts, like that of building wooden ships, is in process of dying out. In sailing men-of-war the mizen-mast often did not reach to the kelson, but was stepped on the orlop deck. Hollow metal cylinders are now used as masts. In the case of a masted screw steamer the masts abaft the engines could not be stepped on the kelson because they would interfere with the shaft of the screw. It is therefore necessary to step them on the lower deck, where they are supported by stanchions, or on a horseshoe covering the screw shaft. The size of masts naturally varies very much. In a 110-gun ship of 2164 tons the proportions of the mainmast were for the lower mast, length 117 ft., diameter 3 ft. 3 in.; topmast, 70 ft., and 20¾ in., topgallant mast, 35 ft., and 11¾ in., 222 ft. in all. At the other end of the scale, a cutter of 200 tons had a lower mast of 88 ft., of 22 in. diameter, and a topgallant mast (there was no topmast between them) of 44 ft., of 9¾ in. in diameter, 132 ft. in all; topgallant mast of 44 ft., and 9¾ in. in diameter. The masts of a warship were more lofty than those of a merchant ship of the same tonnage. At present masts are only used by warships for signalling and military purposes. In sailing merchant ships, the masts are more lofty than they were about a century ago. A merchant ship of 1300 tons, in 1830, had a mainmast 179 ft. in height; a vessel of the same size would have a mast of 198 ft. to-day.

A "jury mast" is a temporary mast put up by the crew when the spars have been carried away in a storm or in action, or have been cut away to relieve pressure in a storm. The word has been supposed without any foundation to be short for "injury" mast; it may be a mere fanciful sailor adaptation of "jury" in some connexion now lost. Skeat suggests that it is short for O. Fr. *ajourie*, Lat. *adjutare*, to aid. There is no reason to connect with *jour*, day.

See L. Jal, *Glossaire Nautique* (Paris, 1848); Sir Henry Manwayring, *The Seaman's Dictionary* (London, 1644); N. Hutchinson, *Treatise on Naval Architecture and Practical Seamanship* (Liverpool, 1777); David Steel, *Elements and Practice of Rigging, Seamanship and Naval Tactics* (London, 1800); William Burney's *Falconer's Dictionary* (London, 1830); Sir Gervais Nares's *Seamanship* (Portsmouth, 1882); and John Fincham, *On Masting Ships and Mast Making* (London, 1829). (D. H.)

Mast (2) (Anglo-Saxon *maest*, food, common to some Teutonic languages, and ultimately connected with "meat"), the fruit of the beech, oak, and other forest trees, used as food for swine.

MASTABA (Arab. for "bench"), in Egyptian architecture, the term given to the rectangular tombs in stone with raking sides and a flat roof. There were three chambers inside. In one the walls were sometimes richly decorated with paintings and had a low bench of stone in them on which incense was burnt. The second chamber was either closed, with holes pierced in the wall separating it from the first chamber, or entered through a narrow passage through which the fumes of the incense passed; this chamber contained the *serdab* or figure of the deceased. A vertical well-hole cut in the rock descended to a third chamber in which the mummy was laid.

MASTER (Lat. *magister*, related to *magis*, more, as the corresponding *minister* is to *minus*, less; the English form is due partly to the O. Eng. *maegister*, and partly to O. Fr. *maistre*, mod. *maître*; cf. Du. *meester*, Ger. *Meister*, Ital. *maestro*), one holding a position of authority, disposition or control over persons or things. The various applications of the word fall roughly into the following main divisions; as the title of the holder of a position of command or authority; as that of the holder of certain public or private offices, and hence a title of address; and as implying the relationship of a teacher to his pupils or of an employer to the persons he employs. As a title of the holder of an office, the use of the Lat. *magister* is very ancient. *Magister equitum*, master of the horse, goes back to the early history of the Roman Republic (see Dictator; and for the British office, Master of the Horse). In medieval times the title was of great frequency. In Du Cange (*Glossarium*) the article *magister* contains over 120 sub-headings. In the British royal household most of the offices bearing this title are now obsolete. Of the greater offices, that of master of the buckhounds was abolished by the Civil List Act 1901. The master of the household, master of the ceremonies, master of the king's music still survive. Since 1870 the office of master of the mint has been held by the chancellor of the exchequer, all the administrative and other duties being exercised by the deputy master.

At sea, a "master" is more properly styled "master mariner." In the merchant service he is the commander of a ship, and is by courtesy known as the captain. In the British navy he was the officer entrusted with the navigation under the captain. He had no royal commission, but a warrant from the Navy Board. Very often he had been a merchant captain. His duties are now performed by the staff commander or navigating lieutenant. The master-at-arms is the head of the internal police of a ship; the same title is borne by a senior gymnastic instructor in the army. In the United States navy, the master is a commissioned officer below the rank of lieutenant.

"Master" appears as the title of many legal functionaries (for the masters of the supreme court see Chancery; and King's Bench, Court of; for masters in lunacy see Insanity: § *Law*; see also Master of the Rolls, below). The "master of the faculties" is the chief officer of the archbishop of Canterbury in his court of faculties. His duties are concerned with the appointment of notaries and the granting of special licences of marriage. The duties are performed *ex officio* by the judge of the provincial courts of Canterbury and York, who is also dean of Arches; in accordance with § 7 of the Public Worship

Regulation Act 1874. The "master of the Temple" is the title of the priest-in-charge of the Temple Church in London. It was formerly the title of the grand master of the Knights Templars. The priest-in-charge of the Templars' Church was properly styled the *custos*, and this was preserved by the Knights Hospitallers when they were granted the property of the Templars at the dissolution of that order. The act of 1540 (32 Henry VIII.), which dissolved the order of the Hospitallers, wrongly styled the *custos* master of the Temple, and the mistake has been continued. The proper title of a bencher of the Inns of Court is "master of the Bench" (see Inns of Court). The title of "Master-General of the Ordnance" was revived in 1904 for the head of the Ordnance Department in the British military administration.

"Master" is the ordinary word for a teacher, very generally used in the compound "schoolmaster." The word also is used in a sense transferred from this to express the relation between the founder of a school of religion, philosophy, science, art, &c., and his disciples. It is partly in this sense and partly in that of one whose work serves as a model or type of superlative excellence that such terms as "old masters" are used. In medieval universities *magister* was particularly applied to one who had been granted a degree carrying with it the *licentia docendi*, the licence to teach. In English usage this survives in the faculty of arts. The degree is that of *artium magister*, master of arts, abbreviated M.A. In the other faculties the corresponding degree is doctor. Some British universities give a master's degree in surgery, *magister chirurgiae*, C.M. or M.Ch., and also in science, *magister scientiae*, M.Sc. The academic use of "master" as the title of the head of certain colleges at the universities of Oxford and Cambridge is to be referred to the frequent application of the term to the holder of a presiding office in an institution.

Master was the usual prefix of address to a man's name, though originally confined to people of some social standing. Probably under the influence of "mistress," it was corrupted in sound to "mister," and was abbreviated to "Mr." In the case of the puisne judges of the High Court "Mr Justice" is still used as the proper official form of written address. The Speaker of the House of Commons is also formally addressed as "Mr Speaker." In some Scottish peerages below the rank of earl, "master" is used in the courtesy title of the heir, *e.g.* the "Master of Ruthven."

MASTER AND SERVANT. These are scarcely to be considered as technical terms in English law. The relationship which they imply is created when one man hires the labour of another for a term. Thus it is not constituted by merely contracting with another for the performance of a definite work, or by sending an article to an artificer to be repaired, or engaging a builder to construct a house. Nor would the employment of a man for one definite act of personal service—*e.g.* the engagement of a messenger for a single occasion—generally make the one master and the other servant. It was held, however, in relation to the offence of embezzlement, that a drover employed on one occasion to drive cattle home from market was a servant within the statute. On the other hand, there are many decisions limiting the meaning of "servants" under wills giving legacies to the class of servants generally. Thus "a person who was not obliged to give his whole time to the master, but was yet in some sense a servant," was held not entitled to share in a legacy to the servants. These cases are, however, interpretations of wills where the intention obviously is to benefit domestic servants only. And so in other connexions questions may arise as to the exact nature of the relations between the parties—whether they are master and servant, or principal and agent, or landlord and tenant, or partners, &c.

The terms of the contract of service are for the most part such as the parties choose to make them, but in the absence of express stipulations terms will be implied by the law. Thus, "where no time is limited either expressly or by implication for the duration of a contract of hiring and service, the hiring is considered as a general hiring, and in point of law a hiring for a year." But "in the case of domestic and menial servants there is a well-known rule, founded solely on custom, that their contract of service may be determined at any time by giving a month's warning or paying a month's wages, but a domestic or other yearly servant, *wrongfully* quitting his master's service, forfeits all claim to wages for that part of the current year during which he has served, and cannot claim the sum to which his wages would have amounted had he kept his contract, merely deducting therefrom one month's wages. Domestic servants have a right by custom to leave their situations at any time on payment of a calendar month's wages in advance, just as a master may discharge them in a similar manner" (Manley Smith's *Law of Master and Servant*, chs. ii. and iii.). The following are sufficient grounds for discharging a servant: (1) wilful disobedience of any lawful order; (2) gross moral misconduct; (3) habitual negligence; (4) incompetence or permanent disability caused by illness. A master has a right of action against any person who deprives him of the services of his servant, by enticing him away, harbouring or detaining him after notice, confining or disabling him, or by seducing his female servant. Indeed, the ordinary and only available action for seduction in English law is in form of a claim by a parent for the loss of his daughter's services. The death of either master or servant in general puts an end to the contract. A servant wrongfully discharged may either treat the contract as rescinded and sue for services actually rendered, or he may bring a special action for damages for the breach. The common law liabilities of a master towards his servants have been further regulated by the Workmen's Compensation Acts (see Employer's Liability). A master is bound to provide food for a servant living under his roof, and wilful breach of duty in that respect is a misdemeanour under the Offences against the Person Act 1861.

A servant has no right to demand "a character" from an employer, and if a character be given it will be deemed a privileged communication, so that the master will not be liable thereon to the servant unless it be false and malicious. A master by knowingly giving a false character of a servant to an intending employer may render himself liable—should the servant for example rob or injure his new master.

Reference may be made to the articles on Labour Legislation for the cases in which special terms have been introduced into contracts of service by statute (*e.g.* Truck Acts).

MASTER OF THE HORSE, in England, an important official of the sovereign's household. The master of the horse is the third dignitary of the court, and is always a member of the ministry (before 1782 the office was of cabinet rank), a peer and a privy councillor. All matters connected with the horses and hounds of the sovereign, as well as the stables and coach-houses, the stud, mews and kennels, are within his jurisdiction. The practical management of the royal stables and stud devolves on the chief or crown equerry, formerly called the gentleman of the horse, who is never in personal attendance on the sovereign and whose appointment is permanent. The clerk marshal has the supervision of the accounts of the department before they are submitted to the Board of Green Cloth, and is in waiting on the sovereign on state occasions only. Exclusive of the crown equerry there are seven regular equerries, besides extra and honorary equerries, one of whom is always in attendance on the sovereign and rides at the side of the royal carriage. They are always officers of the army, and each of them is "on duty" for about the same time as the lords and grooms in waiting. There are also several pages of honour in the master of the horse's department, who must not be confounded with the pages of various kinds who are in the department of the lord chamberlain. They are youths aged from twelve to sixteen, selected by the sovereign in person, to attend on him at state ceremonies, when two of them, arrayed in an antique costume, assist the groom of the stole in carrying the royal train.

In France the master of the horse ("Grand Écuyer," or more usually "Monsieur le grand") was one of the seven great officers of the crown from 1617. As well as the superintendence of the royal stables, he had that of the retinue of the sovereign, also the charge of the funds set aside for the religious functions of the court, coronations, &c. On the death of a sovereign he had the right to all the horses and their equipment in the royal stables. Distinct from this officer and independent of him, was the first equerry (" Premier Écuyer "), who had charge of the horses which the sovereign used personally (" la petite écurie "), and who attended on him when he rode out. The office of master of the horse existed down to the reign of Louis XVI. Under Louis XVIII. and Charles X. the duties were discharged by the first equerry, but under Napoléon I. and Napoléon III. the office was revived with much of its old importance.

In Germany the master of the horse (Oberststallmeister) is a high court dignitary; but his office is merely titular, the superintendence of the king's stables being carried out by the Oberstallmeister, an official corresponding to the crown equerry in England.

MASTER OF THE ROLLS, the third member of the Supreme Court of Judicature in England, the lord chancellor, president of the chancery division, being the first, and the lord chief justice, president of the king's bench division, being the second. At first he was the principal clerk of the chancery, and as such had charge of the records of the court, especially of the register of original writs and of all patents and grants under the Great Seal. Until the end of the 15th century he was called either the clerk or the keeper of the rolls, and he is still formally designated as the master or keeper of the rolls. The earliest mention of him as master of the rolls is in an act of 1495; and in another act of the same year he is again described as clerk of the rolls, showing that his official designation still remained unsettled. About the same period, however, the chief clerks of the chancery came to be called masters in chancery, and the clerk, master or keeper of the rolls was always the first among them, whichever name they bore. In course of time, from causes which are not very easy to trace, his original functions as keeper of the records passed away from him and he gradually assumed a jurisdiction in the court of chancery second only to that of the lord chancellor himself. In the beginning he only heard causes in conjunction with the other masters in chancery, and his decrees were invalid until they had been approved and signed by the lord chancellor. Sitting in the Rolls chapel or in the court in Rolls yard, he heard causes without assistance, and his decrees held good until they were reversed on petition either to the lord chancellor or afterwards to the lords justices of appeal. Before any judge with the formal title of vice-chancellor was appointed the master of the rolls was often spoken of as vice-chancellor, and in theory acted as such, sitting only when the lord chancellor was not sitting and holding his court in the evening from six o'clock to ten. Only since 1827 has the master of the rolls sat in the morning hours. By the Public Record Office Act 1838 the custody of the records was restored to him, and he is chairman of the State Papers and Historical Manuscripts Commissions. Under the Judicature Act 1875, and the Appellate Jurisdiction Act 1876, he now always sits with the lords justices in the court of appeal (which usually sits in two divisions of three judges, the master of the rolls presiding over one division), whose decisions can be questioned only in the House of Lords. The master of the rolls was formerly eligible to a seat in the House of Commons—a privilege enjoyed by no other member of the judicial bench;[1] but he was deprived of it by the Supreme Court of Judicature Act 1873, which provides that all judges of the High Court of Justice and the court of appeal shall be incapable of being elected to or sitting in the House of Commons. The master of the rolls is always sworn of the privy council. His salary is £6000 a year.

See Lord Hardwicke, *Office of the Master of the Rolls*.

MASTIC, or MASTICH (Gr. *μαστίχη*, probably connected with *μασᾶσθαι*, to chew, since mastic is used in the East as a chewing gum), a resinous exudation obtained from the lentisk, *Pistacia lentiscus*, an evergreen shrub of the natural order Anacardiaceae. The lentisk or mastic plant is indigenous to the Mediterranean coast region from Syria to Spain, but grows also in Portugal, Morocco and the Canaries. Although experiments have proved that excellent mastic might be obtained in other islands in the archipelago, the production of the substance has been, since the time of Dioscorides, almost exclusively confined to the island of Chios. The mastic districts of that island are for the most part flat and stony, with little hills and few streams. The shrubs are about 6 ft. high. The resin is contained in the bark and not in the wood, and in order to obtain it numerous vertical incisions are made, during June, July and August, in the stem and chief branches. The resin speedily exudes and hardens into roundish or oval tears, which are collected, after about fifteen days, by women and children in little baskets lined with white paper or cotton wool. The ground around the trees is kept hard and clean, and flat pieces of stone are often laid beneath them to prevent any droppings of resin from becoming contaminated with dirt. The collection is repeated three or four times between June and September, a fine tree being found to yield about 8 or 10 lb of mastic during the season. Besides that obtained from the incisions, mastic of very fine quality spontaneously exudes from the small branches. The harvest is affected by showers of rain during the period of collection, and the trees are much injured by frost, which is, however, of rare occurrence in the districts where they grow. Mastic occurs in commerce in the form of roundish tears about the size of peas. They are transparent, with a glassy fracture, of a pale yellow or faint greenish tinge, which darkens slowly by age. During the 15th, 16th and 17th centuries mastic enjoyed a high reputation as a medicine, and formed an ingredient in a large number of medical compounds; but its use in medicine is now obsolete, and it is chiefly employed for making varnish.

Pistacia Khinjuk and *P. cabulica*, trees growing throughout Sindh, Baluchistan and Cabul, yield a kind of mastic which is met with in the Indian bazaars under the name of *Mustagirūmī*, *i.e.* Roman mastic. This when occurring in the European market is known as East Indian or Bombay mastic. In Algeria *P. Atlantica* yields a solid resin, which is collected and used by the Arabs as a masticatory. Cape mastic is the produce of *Euryops multifidus*, the resin bush, or *harpuis bosch* of the Boers—a plant of the composite order growing abundantly in the Clanwilliam district. Dammar resin is sometimes sold under the name of mastic. The West Indian mastic tree is the *Bursera gummifera* and the Peruvian mastic is *Schinus molle*; but neither of these furnishes commercial resins. The name mastic tree is also applied to a timber tree, *Sideroxylon mastichodendron*, nat. ord. Sapotaceae, which grows in the West Indies and on the coast of Florida.

MASTIGOPHORA, a group of Protozoa, moving and ingesting food by long flagella (Gr. *μάστιξ*, whip), usually few in number, and multiplying by fission, usually longitudinal, in the active condition. They were separated off from the rest of the old " Infusoria " by K. Düsing, and subdivided by O. Bütschli and E. R. Lankester into (1) Flagellata (*q.v.*), including Haemoflagellata (*q.v.*), (2) Dinoflagellata (*q.v.*) and Rhyncho = Cystoflagellata E. Haeckel (*q.v.*) = Rhynchoflagellata E. R. Lankester. The Mastigophora are frequently termed Flagellata or Flagellates.

MASTODON (Gr. *μαστὸς*, breast, *ὀδοὺς*, tooth), a name given by Cuvier to the Pliocene and Miocene forerunners of the elephants, on account of the nipple-like prominences on the molar teeth of some of the species (fig. 2), which are of a much simpler type than those of true elephants. Mastodons, like elephants, always have a pair of upper tusks, while the earlier ones likewise have a short pair in the lower jaw, which is prolonged into a snout-like symphysis for their support. These long-chinned mastodons are now regarded as forming a genus by themselves (*Tetrabelodon*), well-known examples of this group being *Tetrabelodon angustidens* from the Miocene and *T. longirostris* (fig. 1 C.) from the Lower Pliocene of the Continent. In the former the upper tusks are bent down so as to cross the tips of the short and chisel-like lower pair. These long-chinned mastodons must have had an extremely elongated muzzle, formed by the upper lip and nose above and the lower lip below, with which they were able to reach the ground, the neck being probably rather longer than in elephants. On the other hand, in the short-chinned mastodons, as represented by the Pleistocene North American *Mastodon americanus* and the Pliocene European *M. turicensis* (fig. 1), the chin had shrunk to the dimensions characteristic of elephants, with the loss of the lower incisors (or with temporary retention of rudimentary ones), while at the same time a true elephant-like trunk must have been developed by the shortening of the lower lip and the prolongation of the combined upper lip and nose.

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[1] Sir John Romilly, M.P. for Devonport, 1847 to 1852, was the last master of the rolls to sit in Parliament. He was appointed master of the rolls in 1851.

Mastodons are found in almost all parts of the world. In Asia they gave rise to the elephants, while they themselves originated in Africa from ungulates of more normal type. (See PROBOSCIDEA.)

The upper tusks of the early mastodons differ from those of elephants in retaining longitudinal bands of enamel. The molar teeth are six in number on each side, increasing in size from before backwards, and, as in the elephants, with a horizontal succession, the anterior teeth being lost before the full development of the posterior ones, which gradually move forward, taking the place of those that are destroyed by wear. This process is, however, less fully developed than in elephants, and as many as three teeth may be in place in each jaw at one time. There is, moreover, in many species a vertical succession, affecting either the third, or the third and second, or (in one American species, *Tetrabelodon productus*) the first, second and third of the six molar teeth. These three are therefore reckoned as milk-molars, and their successors as premolars, while the last three correspond to the true molars of other mammals. The mode of succession of the teeth in the mastodons exhibits so many stages of the process by which the dentition of elephants has been derived from that of more ordinary mammals. It also shows that the anterior molars of elephants do not correspond to the premolars of other ungulates, but to the milk-molars, the early loss of which in consequence of the peculiar process of horizontal forward-moving succession does not require their replacement by premolars. Specialized species like *Mastodon americanus* have completely lost the rudimentary premolars.

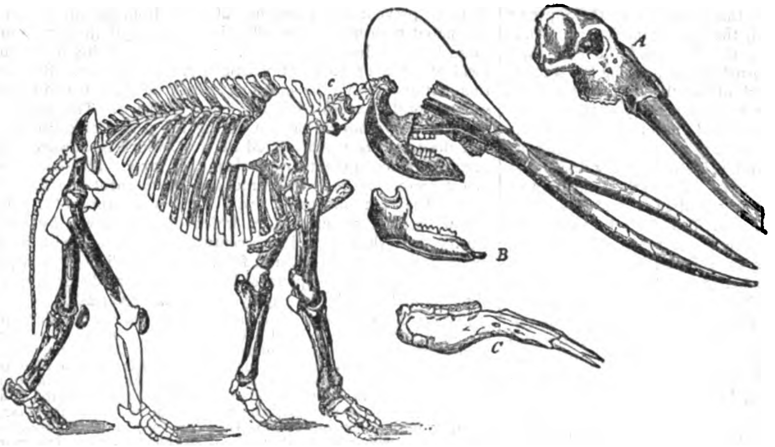
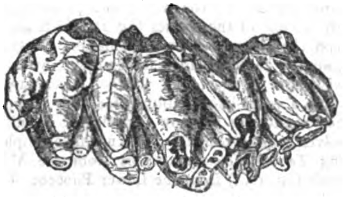


FIG. 1.—*Mastodon turicensis* (Pliocene).
A, B, Skull and Lower Jaw of *Mastodon americanus*. C, Lower Jaw of *Tetrabelodon longirostris*.



(From Owen.)

FIG. 2.—Upper Molar of *Mastodon arvernensis*, viewed from below.

Mastodons have fewer ridges on their molar teeth than elephants; the ridges are also less elevated, wider apart, with a thicker enamel covering, and scarcely any cement filling the space between them. Sometimes (as in *M. americanus*) the ridges are simple transverse wedge-shaped elevations, with straight or concave edges. In other species the summits of the ridges are divided into conical cusps, and may have accessory cusps clustering around them (as in *M. arvernensis*, fig. 2). When the summits of these are worn by mastication their surfaces present circles of dentine surrounded by a border of enamel, and as attrition proceeds different patterns are produced by the union of the bases of the cusps, a trefoil form being characteristic of some species.

Certain of the molar teeth of the middle of the series in both elephants and mastodons have the same number of principal ridges; those in front having fewer, and those behind a greater number. These teeth are distinguished as "intermediate" molars. In elephants there are only two, the last milk-molar and the first true molar (or the third and fourth of the whole series), which are alike in the number of ridges; whereas in mastodons there are three such teeth, the last milk-molar and the first and second molars (or the third, fourth and fifth of the whole series). In elephants the number of ridges on the intermediate molars always exceeds five, but in mastodons it is nearly always three or four, and the tooth in front has usually one fewer and that behind one more, so that the ridge-formula (*i.e.* a formula expressing the number of ridges on each of the six molar teeth) of most mastodons can be reduced either to 1, 2, 3, 3, 3, 4, or 2, 3, 4, 4, 4, 5. Three-ridged and four-ridged types occur both in *Mastodon* and *Tetrabelodon*. (R. L.*)

MAS'ŪDĪ (ABŪ-L ḤASAN 'ALĪ IBN ḤUSAIN IBN 'ALĪ UL-MAS'ŪDĪ] (d. *c.* 956), Arabian historian, was born at Bagdad towards the close of the 9th century. Much of his life was spent in travel. After he had been in Persia and Kerman, he visited Istakhr in 915, and went in the following year to Mūltān and Manṣūra, thence to Cambay, Saimur and Ceylon, to Madagascar and back to Oman. He seems about this time to have been as far as China. After a visit to the shores of the Caspian Sea he visited Tiberias in Palestine, examined the Christian church there, and described its relics. In 943 he was in Antioch, studying the ruins, and two years later in Damascus. The last ten years of his life he spent in Syria and Egypt. His great object in life had been to study with his own eyes the peculiarities of every land and to collect whatever was of interest for archaeology, history and manners. Himself a Mo'tazilite (see MAHOMMEDAN RELIGION: *Sects*), he was singularly free from bigotry, and took his information, when necessary, from Persians, Jews, Indians, and even the chronicle of a Christian bishop.

His most extensive work was the *Kitāb akhbār uz-Zamān* or *Annals*, in 30 volumes with a supplement, the *Kitāb ul-Ausaṭ*, a chronological sketch of general history. Of these the first part only of the former is extant in MS. in Vienna, while the latter seems to be in the Bodleian Library, also in MS. The substance of the two was united by him in the work by which he is now best known, the *Murūj udh-Dhahab wa Ma'ādin ul-Jawāhir* ("Meadows of Gold and Mines of Precious Stones"), an historical work which he completed in 947. In 956 he finished a second edition of this and made it double its former size, but no copy of this seems to be extant. The original edition has been published at Bulāq and Cairo, and with French translation by C. Barbier de Meynard and Pavet de Courteille (9 vols., Paris, 1861–1877). Another work of Mas'ūdī, written in the last year of his life, is the *Kitāb ut-Tanbīh wal Ishrāf* (the "Book of Indication and Revision"), in which he summarizes the work of his life and corrects and completes his former writings. It has been edited by M. J. de Goeje (Leiden, 1894), and a French translation has been made by Carra de Vaux (Paris, 1896); cf. also the memoir of S. de Sacy published in Meynard's edition of the *Murūj*.

An account of Mas'ūdī's works is to be found in de Sacy's memoir and in Goeje's preface to his edition of the *Tanbīh*, and of the works extant in C. Brockelmann's *Gesch. der Arabischen Litteratur*, i. 144–145 (Weimar, 1898). C. Field's *Tales of the Caliphs* (1909) is based on Mas'ūdī. (G. W. T.)

MASULIPATAM, or Bandar, a seaport of British India, administrative headquarters of the Kistna district of Madras, on one of the mouths of the river Kistna, 215 m. N. of Madras city. Pop. (1901), 39,507. Masulipatam was the earliest English settlement on the Coromandel coast, its importance being due to the fact that it was the *bandar* or port of Golconda. An agency was established there in 1611. During the wars of the Carnatic, the English were temporarily expelled the town, which was held by the French for some years. In 1759 the town and fort were carried by storm by Colonel Forde, an achievement followed by the acquisition of the Northern Circars (*q.v.*). In 1864 a great storm-wave swept over the entire town and is said to have destroyed 30,000 lives. Weavers form a large portion of the inhabitants, though their trade has greatly declined since the beginning of the 19th century. Their operations, besides weaving, include printing, bleaching washing and dressing. In former days the chintzes of Masulipatam had a great reputation abroad for the freshness and permanency of their dyes. Masulipatam is a station of the Church Missionary Society. The port is only a roadstead, where vessels anchor 5 m. out. A branch line from Bezwada on the Southern Mahratta railway was opened in 1908. The chief educational institution is the Noble College of the C.M.S.

MAT (O. Eng. *meatt*, from late Lat. *matta*, whence Ital. *matta*, Ger. and Dan. *matte*, Du. *mat*, &c.), an article of various sizes and shapes, according to the purpose for which it is intended, and made of plaited or woven materials, such as coir, hemp, coco-nut fibre, straw, rushes, &c., or of rope or coarse twine. The finer fabrics are known as "matting" (*q.v.*). Mats are mainly used for covering floors, or in horticulture as a protection against cold or exposure for plants and trees. When used near the entrance to a house for people to wipe their boots on "door mats" are usually made of coarse coco-nut fibre, or india-rubber, cork, or of thickly coiled wire. Bags, rolls or sacks made of matting are used to hold coffee, flax, rice and other produce, and the term is often used with reference to the specific quantities of such produce, *e.g.* so many "mats" of coffee, rice, &c.

To be distinguished from the above is the term "mat" in glass-painting or gilding, meaning dull, unpolished or unburnished. This is the same as Ger. *matt*, dead, dull, cf. *matt-blau*, Med. Lat. *mattus*, adapted from Persian *māt*, dazed, astonished, at a loss, helpless, and seen in "mate" in chess, from Pers. *shāh māt* the king is dead.

MATABELE ("vanishing" or "hidden" people, so called from their appearance in battle, hidden behind enormous oxhide shields), a people of Zulu origin who began national life under the chief Mosilikatze. Driven out of the Transvaal by the Boers in 1837, Mosilikatze crossed the Limpopo with a military host which had been recruited from every tribe conquered by him during his ten years' predominance in the Transvaal. In their new territories the Matabele absorbed into their ranks many members of the conquered Mashona tribes and established a military despotism. Their sole occupation was war, for which their laws and organization were designed to fit them. This system of constant warfare is, since the conquest of Matabeleland by the British in 1893, a thing of the past. The Matabele are now herdsmen and agriculturists. (See Rhodesia.)

MATACHINES (Span. *matachin*, clown, or masked dancer), bands of mummers or itinerant players in Mexico, especially popular around the Rio Grande, who wander from village to village during Lent, playing in rough-and-ready style a set drama based on the history of Montezuma. Dressed in fantastic Indian costumes and carrying rattles as their orchestra, the chief characters are *El Monarca* "the monarch" (Montezuma); *Malinche*, or *Malintzin*, the Indian mistress of Hernando Cortes; *El Toro*, "the bull," the malevolent "comic man" of the play, dressed in buffalo skin with the animal's horns on his head; *Aguelo*, the "grandfather," and *Aguela*, "grandmother." With the help of a chorus of dancers they portray the desertion of his people by Montezuma, the luring of him back by the wiles and smiles of Malinche, the final reunion of king and people, and the killing of El Toro, who is supposed to have made all the mischief.

MATADOR, a Spanish word meaning literally "killer," from *matar*, Lat. *mactare*, especially applied to the principal performer in a bull-fight, whose function it is to slay the bull (see Bull-fighting). The word is also used of certain important cards in such games as quadrille, ombre, &c., and more particularly of a special form of the game of dominoes.

MATAMOROS, a town and port of the state of Tamaulipas, Mexico, on the S. bank of the Rio Grande, 28 m. from its mouth, opposite Brownsville, Texas. Pop. (1900), 8347. Matamoros stands in an open plain, the commercial centre for a large district, but its import trade is prejudiced by the bar at the mouth of the Rio Grande, which permits the entrance of small vessels only. The exports include hides, wool and live stock. The importance of the town in the foreign trade of northern Mexico, however, has been largely diminished by the great railways. Formerly it was the centre of a large contraband trade with Brownsville, Texas. Matamoros was founded early in the 19th century, and was named in honour of the Mexican patriot Mariano Matamoros (*c.* 1770–1814). In the war between the United States and Mexico, Matamoros was easily taken by the Americans on the 18th of May 1846, following General Zachary Taylor's victories at Palo Alto and Resaca de la Palma. Matamoros was occupied by the Mexican imperialists under Mejia in 1864, and by the French in 1866.

MATANZAS, an important city of Cuba, capital of Matanzas Province, situated on a large deep bay on the N. coast, about 54 m. (by rail) E. of Havana. Pop. (1907), 36,009. There are railway outlets W., S. and E., and Matanzas is served by steamships to New York and by the coast steamers of the Herrera Line. The bay, unlike all the other better harbours of the island, has a broad mouth, 2 m. across, but there is good shelter against all winds except from the N.E. A coral reef lies across the entrance. Three rivers emptying into the bay—the San Juan, Canimar and Yumuri—have deposited much silt, necessitating the use of lighters in loading and unloading large ships. The city is finely placed at the head of the bay, on a low, sloping plain backed by wooded hills, over some of which the city itself has spread. The conical Pan de Matanzas (1277 ft.) is a striking land-mark for sailors. The San Juan and Yumuri rivers divide Matanzas into three districts. The Teatro Esteban, Casino Español and Government House are noteworthy among the buildings. The broad Paseo de Marti (Alameda de Versalles, Paseo de Santa Cristina) extends along the edge of the harbour, and is perhaps the handsomest parkway and boulevard in Cuba. At one end is a statue of Ferdinand VII., at the other a monument to 63 Cubans executed by the Spanish Government as traitors for bearing arms in the cause of independence. A splendid military road continues the Paseo to the Castillo de San Serverino (built in 1694–1695, reconstructed in 1773 and following years). There are two smaller forts, established in the 18th century. Near Matanzas are two of the most noted natural resorts of Cuba: the valley of the Yumuri, and the caves of Bellamar. Commanding the Yumuri Valley is the hill called Cumbre, on which is the Hermitage of Monteserrate (1870), with a famous shrine. Matanzas is the second port of the island in commerce. Sugar and molasses are the chief exports. The city is the chief outlet for the sugar product of the province, which, with the province of Santa Clara, produces two-thirds of the crop of the island. There are many large warehouses, rum distilleries, sugar-mills and railway machine-shops. Matanzas is frequently mentioned in the annals of the 16th and 17th centuries, when its bay was frequented by buccaneers; but the city was not laid out until 1693. In the next year it received an *ayuntamiento* (council). Its prosperity rapidly increased after the establishment of free commerce early in the 19th century. In 1815 it was made a department capital. The mulatto poet, Gabriel de la Concepción Valdés, known as Plácido (1809–1844), was born in Matanzas, and was executed there for participation in the supposed conspiracy of negroes in 1844, which is one of the most famous episodes in Cuban history. The hurricanes of 1844 and 1846 are the only other prominent local events. American commercial influence has always been particularly strong.

MATARÓ (anc. *Iluro*), a seaport of north-eastern Spain, in the province of Barcelona, on the Mediterranean Sea and the Barcelona-Perpignan railway. Pop. (1900), 19,704. The streets of the new town, lying next the sea, are wide and regularly built; those of the old town, farther up the hill, still preserve much of their ancient character. The parish church of Santa Maria has some good pictures and wood carvings. The wine of the neighbourhood, which resembles port, is shipped in large quantities from Barcelona; and the district furnishes fine roses and strawberries for the Barcelona market. The leading industries are manufactures of linen and cotton goods, especially canvas and tarpaulin, and of soap, paper, chemicals, starch, glass, leather, spirits and flour. The railway to Barcelona, opened in October 1848, was the first to be constructed in Spain. Outside the town is the much-frequented carbonated mineral spring of Argentona.

MATCH: 1. O. Eng. *gemaecca*, a cognate form of "make," meaning originally "fit" or "suitable"; a pair, or one of a pair of objects, persons or animals. As particularly applied to a husband and wife, and hence to a marriage, the word is especially used of two persons or things which correspond exactly to each other. The verb "to match" has also the meaning to "pit one against each other," and so is applied in sport to an arranged contest between individuals or sides.

2. O. Fr. *mesche*; apparently from a latinized form of Gr. *μύξα*, mucus from the nose, applied to the nozzle of a lamp; primarily the wick which conveys oil or molten wax to the flame of a lamp or candle (this use is now obsolete), the word being then applied to various objects having the property of carrying fire. With early firearms a match, consisting of a cord of hemp or similar material treated with nitre and other substances so that it continued to smoulder after it had been ignited, was used for firing the charge, being either held in the gunner's hand or attached to the cock of the musket or arquebus and brought down by the action of the trigger on the powder priming ("matchlock"); and more or less similar preparations, made to burn more or less rapidly as required ("quick-match" and "slow-match"), are employed as fuses in blasting and demolition work in military operations. The word "match" was further used of a splint of wood, tipped with sulphur so that it would readily ignite, but it now most commonly means a slip of wood or other combustible material, having its end covered with a composition which takes fire when rubbed either on any rough surface or on another specially prepared composition.

The first attempt to make matches in the modern sense may probably be ascribed to Godfrey Haukwitz, who, in 1680, acting under the direction of Robert Boyle, who at that time had just discovered how to prepare phosphorus, employed small pieces of that element, ignited by friction, to light splints of wood dipped in sulphur. This device, however, did not come into extensive use owing to its danger and inconvenience and to the cost of the phosphorus, and till the beginning of the 19th century flint and steel with tinder-box and sulphur-tipped splints of wood—"spunks" or matches—were the common means of obtaining fire for domestic and other purposes. The sparks struck off by the percussion of flint and steel were made to fall among the tinder, which consisted of carbonized fragments of cotton and linen; the entire mass of the tinder was set into a glow, developing sufficient heat to ignite the sulphur with which the matches were tipped, and thereby the splints themselves were set on fire. In 1805 one Chancel, assistant to Professor L. J. Thénard of Paris, introduced an apparatus consisting of a small bottle containing asbestos, saturated with strong sulphuric acid, with splints or matches coated with sulphur, and tipped with a mixture of chlorate of potash and sugar. The matches so prepared, when brought into contact with the sulphuric acid in the bottle, ignited, and thus, by chemical action, fire was produced. In 1823 a decided impetus was given to the artificial production of fire by the introduction of the Döbereiner lamp, so called after its inventor, J. W. Döbereiner of Jena. The first really practical friction matches were made in England in 1827, by John Walker, a druggist of Stockton-on-Tees. These were known as "Congreves" after Sir William Congreve, the inventor of the Congreve rocket, and consisted of wooden splints or sticks of cardboard coated with sulphur and tipped with a mixture of sulphide of antimony, chlorate of potash and gum. With each box which was retailed at a shilling, there was supplied a folded piece of glass paper, the folds of which were to be tightly pressed together, while the match was drawn through between them. The same idea occurred to Sir Isaac Holden independently two and a half years later. The so-called "Prometheans," patented by S. Jones of London in 1830, consisted of a short roll of paper with a small quantity of a mixture of chlorate of potash and sugar at one end, a thin glass globule of strong sulphuric acid being attached at the same point. When the sulphuric acid was liberated by pinching the glass globule, it acted on the mixed chlorate and sugar, producing fire. The phosphorus friction-match of the present day was first introduced on a commercial scale in 1833. It appears to have been made almost simultaneously in several distinct centres. The name most prominently connected with the early stages of the invention is that of J. Preschel of Vienna, who in 1833 had a factory in operation for making phosphorus matches, fusees, and amadou slips tipped with igniting composition. At the same time also matches were being made by F. Moldenhauer in Darmstadt; and for a long series of years Austria and the South-German states were the principal centres of the new industry.

But the use of ordinary white or yellow phosphorus as a principal ingredient in the igniting mixture of matches was found to be accompanied with very serious disadvantages. It is a deadly poison, and its free dissemination has led to many accidental deaths, and to numerous cases of wilful murder and suicide. Workers also who are exposed to phosphoric vapours are subject to a peculiarly distressing disease which attacks the jaw, and ultimately produces necrosis of the jaw-bone ("phossy jaw"), though with scrupulous attention to ventilation and cleanliness much of the risk of the disease may be avoided. The most serious objections to the use of phosphorus, however, were overcome by the discovery of the modified form of that body known as red or amorphous phosphorus. That substance was utilized for the manufacture of the well-known "safety matches" by J. E. Lundström, of Jönköping, Sweden, in 1852; its employment for this purpose had been patented eight years previously by another Swede, G. E. Pasch, who, however, regarded it as an oxide of phosphorus. Red phosphorus is in itself a perfectly innocuous substance, and no evil effects arise from freely working the compositions of which it forms an ingredient. The fact again that safety matches ignite only in exceptional circumstances on any other than the prepared surfaces which accompany the box—which surfaces and not the matches themselves contain the phosphorus required for ignition—makes them much less liable to cause accidental fires than other kinds.

The processes carried out in a match factory include preparing the splints, dipping them first in molten paraffin wax and then in the igniting composition, and filling the matches into boxes. All these operations are performed by complicated automatic machinery, in the development of which the Diamond Match Company of America has taken a leading part, with the minimum of manual intervention.

The chief element in the igniting mixture of ordinary or "strike anywhere" matches used to be common yellow phosphorus, combined with one or more other bodies which readily part with oxygen under the influence of heat. Chief among these latter substances is chlorate of potash, others being red lead, nitrate of lead, bichromate of potash and peroxide of manganese. But at the beginning of the 20th century many countries took steps to stop the use of yellow phosphorus owing to the danger to health attending its manipulation. In Sweden matches made with it have been prohibited for home consumption, but not for export, since 1901. In 1905 and 1906 two conferences, attended by representatives of most of the governments of Europe, were held at Berne to consider the question of prohibiting yellow phosphorus, but no general agreement was reached owing to the objections entertained by Sweden, Norway, Spain and Portugal, and also Japan. Germany, France, Italy, Denmark, Holland, Switzerland and Luxemburg, however, agreed to a convention whereby yellow phosphorus was prohibited as from 1912, and to this Great Britain expressed her adherence after the passing of the White Matches Prohibition Act 1908, which forbade the manufacture and importation of such matches from the 1st of January 1910; though to avoid hardship to retailers and others holding large stocks it permitted their sale for a year longer. Phosphorous sulphide (sesquisulphide of phosphorus) is one of the substances widely employed as a substitute for yellow phosphorus in matches which will strike anywhere without the need of a specially prepared surface.

Safety matches contain no phosphorus in the heads; according to one formula that has been published the mixture with which they are tipped consists of chlorate of potash, 32 parts; bichromate of potash, 12; red lead, 32; sulphide of antimony, 24; while the ingredients of a suitable rubbing surface are eight parts of amorphous phosphorus to nine of sulphide of antimony. There is no doubt, however, that there is considerable diversity in the composition of the mixtures actually employed.

"Vestas" are matches in which short pieces of thin "wax taper" are used in place of wooden splints. Fusees or vesuvians consist of large oval heads fixed on a round splint. These heads consist of a porous mixture of charcoal, saltpetre, cascarilla or other scented bark, glass and gum, tipped with common igniting composition. When lighted they form a glowing mass, without flame.

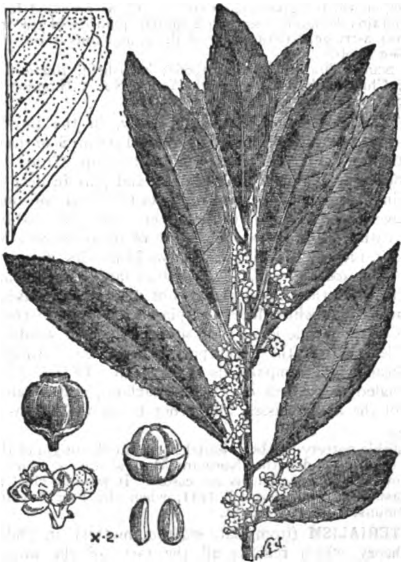
It is calculated that in the principal European countries from six to ten matches are used for each inhabitant daily, and the world's annual output must reach a total which requires twelve or thirteen figures for its expression. In the United States the manufacture is under the control of the Diamond Match Company, formed in 1881; which company also has an important share in the industry in Great Britain, where it has established large works. Similarly the manufacture of safety matches in Sweden is largely controlled by one big combination. In France matches are a government monopoly, and are both dear in price and inferior in quality, as compared with other countries where the industry is left to private enterprise. The French government formerly leased the manufacture to a company (*Société générale des allumettes chimiques*), but since 1890 it has been undertaken directly by the state.

MATE (a corruption of *make*, from O. Eng. *gemaca*, a "comrade"), a companion. In the language of the sea, the mate is the companion or assistant of the master, or of any officer at the head of a division of the crew. In the merchant service the mates are the officers who serve under the master, commonly called the captain, navigate the vessel under his direction, and replace him if he dies, or is disabled. In a war-ship mates serve under the gunner, boatswain, carpenter, &c. They are officers told off to attend to a particular part of the ship, as for example mate of the upper deck, whose duty is to see that it is kept clean, or mate of the hold, who is employed to serve out the water and other stores, and to keep the weights adjusted so as to preserve the trim—or balance—of the ship. (For "mate" in chess, see CHESS.)

MATÉ, or PARAGUAY TEA, the dried leaves of *Ilex paraguariensis*,[1] an evergreen shrub or small tree belonging to the same genus as the common holly, a plant to which it bears some resemblance in size and habit. The leaves are from 6 to 8 in. long, shortly stalked, with a somewhat acute tip and finely toothed at the margin. The small white flowers grow in forked clusters in the axils of the leaves; the sepals, petals and stamens are four in number, or occasionally five; and the berry is 4-seeded. The plant grows abundantly in Paraguay, and the south of Brazil, forming woods called *yerbales*. One of the principal centres of the maté industry is the Villa Real, a small town above Asuncion on the Paraguay river; another is the Villa de San Xavier, in the district between the rivers Uruguay and Parana.

Although maté appears to have been used from time immemorial by the Indians, the Jesuits were the first to attempt its cultivation. This was begun at their branch missions in Paraguay and the province of Rio Grande de San Pedro, where some plantations still exist, and yield the best tea that is made. From this circumstance the names Jesuits' tea, tea of the Missions, St Bartholomew's tea, &c., are sometimes applied to maté. Under cultivation the quality of the tea improves, but the plant remains a small shrub with numerous stems, instead of forming, as in the wild state, a tree with a rounded head. From cultivated plants the leaves are gathered every two or three years, that interval being necessary for restoration to vigorous growth. The collection of maté is, however, chiefly effected by Indians employed for that purpose by merchants, who pay a money consideration to government for the privilege.

When a yerbal or maté wood is found, the Indians, who usually travel in companies of about twenty-five in number, build wigwams and settle down to the work for about six months. Their first operation is to prepare an open space, called a *tatacua*, about 6 ft. square, in which the surface of the soil is beaten hard and smooth with mallets. The leafy branches of the maté are then cut down and placed on the tatacua, where they undergo a preliminary roasting from a fire kindled around it. An arch of poles, or of hurdles, is then erected above it, on which the maté is placed, a fire being lighted underneath. This part of the process demands some care, since by it the leaves have to be rendered brittle enough to be easily pulverized, and the aroma has to be developed, the necessary amount of heat being only learned by experience. After drying, the leaves are reduced to coarse powder in mortars formed of pits in the earth well rammed. Maté so prepared is called *caa guzu* or *yerva do polos*, and is chiefly used in Brazil. In Paraguay and the vicinity of Parana in the Argentine Republic, the leaves are deprived of the midrib before roasting; this is called *caa-mtri*. A very superior quality, or *caa-cuys*, is also prepared in Paraguay from the scarcely expanded buds. Another method of drying maté has been adopted, the leaves being heated in large cast-iron pans set in brickwork, in the same way that tea is dried in China; it is afterwards powdered by machinery.



Maté (*Ilex paraguariensis*).

Portion of plant. Flower, drupe and nuts Part of under-side of leaf showing minute glands, natural size

The different methods of preparation influence to a certain extent the value of the product, the maté prepared in Paraguay being considered the best, that of Oran and Paranagua very inferior. The leaves when dried are packed tightly in serons or oblong packages made of raw hides, which are then carefully sewed up. These shrink by exposure to the sun, and in a couple of days form compact parcels each containing about 200 lb of tea; in this form it keeps well. The tea is generally prepared for use in a small silver-mounted calabash, made of the fruit of *Crescentia cujete* (Cuca) or of *Lagenaria* (Cabaço), usually about the size of a large orange, the tapering end of the latter serving for a handle. In the top of the calabash, or *maté*,[2] a circular hole about the size of a florin is made, and through this opening the tea is sucked by means of a bombilla. This instrument consists of a small tube 6 or 7 in. long, formed either of metal or a reed, which has at one end a bulb made either of extremely fine basket-work or of metal perforated with minute holes, so as to prevent the particles of the tea-leaves from being drawn up into the mouth. Some sugar and a little hot water are first placed in the gourd, the yerva is then added, and finally the vessel is filled to the brim with boiling water, or milk previously heated by a spirit lamp.

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[1] *I. gigantea*, *I. ovalifolia*, *I. Humboldtiana*, and *I nigropunctata*, besides several varieties of these species, are also used for preparing maté.

[2] The word *caa* signified the plant in the native Indian language. The Spaniards gave it a similar name, *yerba*. *Maté* comes from the language of the Incas, and originally means a calabash. The Paraguay tea was called at first *yerva do maté*, and then, the *yerva* being dropped, the name *maté* came to signify the same thing.

A little burnt sugar or lemon juice is sometimes added instead of milk. The beverage is then handed round to the company, each person being furnished with a bombilla. The leaves will bear steeping about three times. The infusion, if not drunk soon after it is made, rapidly turns black. Persons who are fond of maté drink it before every meal, and consume about 1 oz. of the leaves per day. In the neighbourhood of Parana it is prepared and drunk like Chinese tea. Maté is generally considered disagreeable by those unaccustomed to it, having a somewhat bitter taste; moreover, it is the custom to drink it so hot as to be unpleasant. But in the south-eastern republics it is a much-prized article of luxury, and is the first thing offered to visitors. The *gaucho* of the plains will travel on horseback for weeks asking no better fare than dried beef washed down with copious draughts of maté, and for it he will forego any other luxury, such as sugar, rice or biscuit. Maté acts as a restorative after great fatigue in the same manner as tea. Since it does not lose its flavour so quickly as tea by exposure to the air and damp it is more valuable to travellers.

Since the beginning of the 17th century maté has been drunk by all classes in Paraguay, and it is now used throughout Brazil and the neighbouring countries.

The virtues of this substance are due to the occurrence in it of caffeine, of which a given quantity of maté, as prepared for drinking, contains definitely less than a similar quantity of tea or coffee. It is less astringent than either of these, and thus is, on all scores, less open to objection.

See Scully, *Brazil* (London, 1866); Mansfield, *Brasil* (London, 1856); Christy, *New Commercial Plants*, No. 3 (London, 1880); *Kew Bulletin* (1892), p. 132.

MATERA, a city of Basilicata, Italy, in the province of Potenza, from which it is 68 m. E. by road (13 m. S. of the station of Altamura), 1312 ft. above sea-level. Pop. (1901), 17,801. Part of it is built on a level plateau and part in deep valleys adjoining, the tops of the campaniles of the lower portions being on a level with the streets of the upper. The principal building is the cathedral of the archbishopric of Acerenza and Matera, formed in 1203 by the union of the two bishoprics, dating respectively from 300 and 398. The western façade of the cathedral is plain, while the utmost richness of decoration is lavished on the south front which faces the piazza. Almost in the centre of this south façade is an exquisitely sculptured window, from which letters from the Greek patriarch at Constantinople used to be read. The campanile is 175 ft. high. In the vicinity are the troglodyte caverns of Monte Scaglioso, still inhabited by some of the lower classes, and other caves with 13th-century frescoes.

Neolithic pottery has been found here, but the origin of the town is uncertain. Under the Normans Matera was a countship for William Bras de Fer and his successors. It was the chief town of the Basilicata from 1664 till 1811, when the French transferred the administration to Potenza.

MATERIALISM (from Lat. *materia*, matter), in philosophy, the theory which regards all the facts of the universe as explainable in terms of matter and motion, and in particular explains all psychical processes by physical and chemical changes in the nervous system. It is thus opposed both to natural realism and to idealism. For the natural realist stands upon the common-sense position that minds and material objects have equally effective existence; while the idealist explains matter by mind and denies that mind can be explained by matter. The various forms into which materialism may be classified correspond to the various causes which induce men to take up materialistic views. *Naïve materialism* is due to a cause which still, perhaps, has no small power, the natural difficulty which persons who have had no philosophic training experience in observing and appreciating the importance of the immaterial facts of consciousness. The pre-Socratics may be classed as naïve materialists in this sense; though, as at that early period the contrast between matter and spirit had not been fully realized and matter was credited with properties that belong to life, it is usual to apply the term hylozoism (*q.v.*) to the earliest stage of Greek metaphysical theory. It is not difficult to discern the influence of naïve materialism in contemporary thinking. We see it in Huxley, and still more in Haeckel, whose materialism (which he chooses to term "monism") is evidently conditioned by ignorance of the history and present position of speculation. *Cosmological materialism* is that form of the doctrine in which the dominant motive is the formation of a comprehensive world-scheme: the Stoics and Epicureans were cosmological materialists. In *anti-religious materialism* the motive is hostility to established dogmas which are connected, in the Christian system especially, with certain forms of spiritual doctrine. Such a motive weighed much with Hobbes and with the French materialists of the 18th century, such as La Mettrie and d'Holbach. The cause of *medical materialism* is the natural bias of physicians towards explaining the health and disease of mind by the health and disease of body. It has received its greatest support from the study of insanity, which is now fully recognized as conditioned by disease of the brain. To this school belong Drs Maudsley and Mercier. The highest form of the doctrine is *scientific materialism*, by which term is meant the doctrine so commonly adopted by the physicist, zoologist and biologist.

It may perhaps be fairly said that materialism is at present a necessary methodological postulate of natural-scientific inquiry. The business of the scientist is to explain everything by the physical causes which are comparatively well understood and to exclude the interference of spiritual causes. It was the great work of Descartes to exclude rigorously from science all explanations which were not scientifically verifiable; and the prevalence of materialism at certain epochs, as in the enlightenment of the 18th century and in the German philosophy of the middle 19th, were occasioned by special need to vindicate the scientific position, in the former case against the Church, in the latter case against the pseudo-science of the Hegelian dialectic. The chief definite periods of materialism are the pre-Socratic and the post-Aristotelian in Greece, the 18th century in France, and in Germany the 19th century from about 1850 to 1880. In England materialism has been endemic, so to speak, from Hobbes to the present time, and English materialism is more important perhaps than that of any other country. But, from the national distrust of system, it has not been elaborated into a consistent metaphysic, but is rather traceable as a tendency harmonizing with the spirit of natural science. Hobbes, Locke, Hume, Mill and Herbert Spencer are not systematic materialists, but show tendencies towards materialism.

See METAPHYSICS; and Lange's *History of Materialism*.

MATER MATUTA (connected with Lat. *mane*, *matutinus*, "morning"), an old Italian goddess of dawn. The idea of light being closely connected with childbirth, whereby the infant is brought into the light of the world, she came to be regarded as a double of Juno, and was identified by the Greeks with Eilithyia. Matuta had a temple in Rome in the Forum Boarium, where the festival of Matralia was celebrated on the 11th of June. Only married women were admitted, and none who had been married more than once were allowed to crown her image with garlands. Under hellenizing influences, she became a goddess of sea and harbours, the Ino-Leucothea of the Greeks. In this connexion it is noticeable that, as Ino tended her nephew Dionysus, so at the Matralia the participants prayed for the welfare of their nephews and nieces before that of their own children. The transformation was complete in 174 B.C., when Tiberius Sempronius Gracchus, after the conquest of Sardinia, placed in the temple of Matuta a map commemorative of the campaign, containing a plan of the island and the various engagements. The progress of navigation and the association of divinities of the sky with maritime affairs probably also assisted to bring about the change, although the memory of her earlier function as a goddess of childbirth survived till imperial times.

Ovid, *Fasti*, vi. 475; Livy xli. 28; Plutarch, *Quaestiones romanae*, 16, 17.

MATHEMATICS (Gr. *μαθηματική*, *sc.* *τέχνη* or *ἐπιστήμη*; from *μάθημα*, "learning" or "science"), the general term for the various applications of mathematical thought, the traditional field of which is number and quantity. It has been usual to define mathematics as "the science of discrete and continuous magnitude." Even Leibnitz,[1] who initiated a more modern point of view, follows the tradition in thus confining the scope of mathematics properly so called, while apparently conceiving it as a department of a yet wider science of reasoning. A short consideration of some leading topics of the science will exemplify both the plausibility and inadequacy of the above definition. Arithmetic, algebra, and the infinitesimal calculus, are sciences directly concerned with integral numbers, rational (or fractional) numbers, and real numbers generally, which include incommensurable numbers. It would seem that "the general theory of discrete and continuous quantity" is the exact description of the topics of these sciences. Furthermore, can we not complete the circle of the mathematical sciences by adding geometry? Now geometry deals with points, lines, planes and cubic contents. Of these all except points are quantities: lines involve lengths, planes involve areas, and cubic contents involve volumes. Also, as the Cartesian geometry shows, all the relations between points are expressible in terms of geometric quantities. Accordingly, at first sight it seems reasonable to define geometry in some such way as "the science of dimensional quantity." Thus every subdivision of mathematical science would appear to deal with quantity, and the definition of mathematics as "the science of quantity" would appear to be justified. We have now to consider the reasons for rejecting this definition as inadequate.

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[1] Cf. *La Logique de Leibnitz*, ch. vii., by L. Couturat (Paris, 1901).

Types of Critical Questions.—What are numbers? We can talk of five apples and ten pears. But what are "five" and "ten" apart from the apples and pears? Also in addition to the cardinal numbers there are the ordinal numbers: the fifth apple and the tenth pear claim thought. What is the relation of "the fifth" and "the tenth" to "five" and "ten"? "The first rose of summer" and "the last rose of summer" are parallel phrases, yet one explicitly introduces an ordinal number and the other does not. Again, "half a foot" and "half a pound" are easily defined. But in what sense is there "a half," which is the same for "half a foot" as "half a pound"? Furthermore, incommensurable numbers are defined as the limits arrived at as the result of certain procedures with rational numbers. But how do we know that there is anything to reach? We must know that $\sqrt{2}$ exists before we can prove that any procedure will reach it. An expedition to the North Pole has nothing to reach unless the earth rotates.

Also in geometry, what is a point? The straightness of a straight line and the planeness of a plane require consideration. Furthermore, "congruence" is a difficulty. For when a triangle "moves," the points do not move with it. So what is it that keeps unaltered in the moving triangle? Thus the whole method of measurement in geometry as described in the elementary textbooks and the older treatises is obscure to the last degree. Lastly, what are "dimensions"? All these topics require thorough discussion before we can rest content with the definition of mathematics as the general science of magnitude; and by the time they are discussed the definition has evaporated. An outline of the modern answers to questions such as the above will now be given. A critical defence of them would require a volume.[1]

Cardinal Numbers.—A one-one relation between the members of two classes α and β is any method of correlating all the members of α to all the members of β, so that any member of α has one and only one correlate in β, and any member of β has one and only one correlate in α. Two classes between which a one-one relation exists have the same cardinal number and are called cardinally similar; and the cardinal number of the class α is a certain class whose members are themselves classes—namely, it is the class composed of all those classes for which a one-one correlation with α exists. Thus the cardinal number of α is itself a class, and furthermore α is a member of it. For a one-one relation can be established between the members of α and α by the simple process of correlating each member of α with itself. Thus the cardinal number one is the class of unit classes, the cardinal number two is the class of doublets, and so on. Also a unit class is any class with the property that it possesses a member x such that, if y is any member of the class, then x and y are identical. A doublet is any class which possesses a member x such that the modified class formed by all the other members except x is a unit class. And so on for all the finite cardinals, which are thus defined successively. The cardinal number zero is the class of classes with no members; but there is only one such class, namely—the null class. Thus this cardinal number has only one member. The operations of addition and multiplication of two given cardinal numbers can be defined by taking two classes α and β, satisfying the conditions (1) that their cardinal numbers are respectively the given numbers, and (2) that they contain no member in common, and then by defining by reference to α and β two other suitable classes whose cardinal numbers are defined to be respectively the required sum and product of the cardinal numbers in question. We need not here consider the details of this process.

With these definitions it is now possible to *prove* the following six premisses applying to finite cardinal numbers, from which Peano[2] has shown that all arithmetic can be deduced:—

i. Cardinal numbers form a class.
ii. Zero is a cardinal number.
iii. If a is a cardinal number, $a+1$ is a cardinal number.
iv. If s is any class and zero is a member of it, also if when x is a cardinal number and a member of s, also $x+1$ is a member of s, then the whole class of cardinal numbers is contained in s.
v. If a and b are cardinal numbers, and $a+1=b+1$, then $a=b$.
vi. If a is a cardinal number, then $a+1 \neq 0$.

It may be noticed that (iv) is the familar principle of mathematical induction. Peano in an historical note refers its first explicit employment, although without a general enunciation, to Maurolycus in his work, *Arithmeticorum libri duo* (Venice, 1575).

But now the difficulty of confining mathematics to being the science of number and quantity is immediately apparent. For there is no self-contained science of cardinal numbers. The proof of the six premisses requires an elaborate investigation into the general properties of classes and relations which can be deduced by the strictest reasoning from our ultimate logical principles. Also it is purely arbitrary to erect the consequences of these six principles into a separate science. They are excellent principles of the highest value, but they are in no sense the necessary premisses which must be proved before any other propositions of cardinal numbers can be established. On the contrary, the premisses of arithmetic can be put in other forms, and, furthermore, an indefinite number of propositions of arithmetic can be proved directly from logical principles without mentioning them. Thus, while arithmetic may be defined as that branch of deductive reasoning concerning classes and relations which is concerned with the establishment of propositions concerning cardinal numbers, it must be added that the introduction of cardinal numbers makes no great break in this general science. It is no more than an interesting subdivision in a general theory.

Ordinal Numbers.—We must first understand what is meant by "order," that is, by "serial arrangement." An order of a set of things is to be sought in that relation holding between members of the set which constitutes that order. The set viewed as a class has many orders. Thus the telegraph posts along a certain road have a space-order very obvious to our senses; but they have also a time-order according to dates of erection, perhaps more important to the postal authorities who replace them after fixed intervals. A set of cardinal numbers have an order of magnitude, often called *the* order of the set because of its insistent obviousness to us; but, if they are the numbers drawn in a lottery, their time-order of occurrence in that drawing also ranges them in an order of some importance. Thus the order is defined by the "serial" relation. A relation (R) is serial[3] when (1) it implies diversity, so that, if x has the relation R to y, x is diverse from y; (2) it is transitive, so that if x has the relation R to y, and y to z, then x has the relation R to z; (3) it has the property of connexity, so that if x and y are things to which any things bear the relation R, or which bear the relation R to any things, then *either* x is identical with y, *or* x has the relation R to y, *or* y has the relation R to x. These conditions are necessary and sufficient to secure that our ordinary ideas of "preceding" and "succeeding" hold in respect to the relation R. The "field" of the relation R is the class of things ranged in order by it. Two relations R and R′ are said to be ordinally similar, if a one-one relation holds between the members of the two fields of R and R′, such that if x and y are any two members of the field of R, such that x has the relation R to y, and if x' and y' are the correlates in the field of R′ of x and y, then in all such cases x' has the relation R′ to y', and conversely, interchanging the dashes on the letters, *i.e.* R and R′, x and x', &c. It is evident that the ordinal similarity of two relations implies the cardinal similarity of their fields, but not conversely. Also, two relations need not be serial in order to be ordinally similar; but if one is serial, so is the other. The relation-number of a relation is the class whose members are all those relations which are ordinally similar to it. This class will include the original relation itself. The relation-number of a relation should be compared with the cardinal number of a class. When a relation is serial its relation-number is often called its serial type. The addition and multiplication of two relation-numbers is defined by taking two relations R and S, such that (1) their fields have no terms in common; (2) their relation-numbers are the two relation-numbers in question, and then by defining by reference to R and S two other suitable relations whose relation-numbers are defined to be respectively the sum and product of the relation-numbers in question. We need not consider the details of this process. Now if n be any finite cardinal number, it can be proved that the class of those serial relations, which have a field whose cardinal number is n, is a relation-number. This relation-number is the ordinal number corresponding to n; let it be symbolized by $\dot{n}$. Thus, corresponding to the cardinal numbers 2, 3, 4 . . . there are the ordinal numbers $\dot{2}$, $\dot{3}$, $\dot{4}$ . . . The definition of the ordinal number 1 requires some little ingenuity owing to the fact that no serial relation can have a field whose cardinal number is 1; but we must omit here the explanation of the process. The ordinal number $\dot{0}$ is the class whose sole member is the null relation—that is, the relation which never holds between any pair of entities. The definitions of the finite ordinals can be expressed without use of the corresponding cardinals, so there is no essential priority of cardinals to ordinals. Here also it can be seen that the science of the finite ordinals is a particular subdivision of the general theory of classes and relations. Thus the illusory nature of the traditional definition of mathematics is again illustrated.

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[1] Cf. *The Principles of Mathematics*, by Bertrand Russell (Cambridge, 1903).

[2] Cf. *Formulaire mathématique* (Turin, ed. of 1903); earlier formulations of the bases of arithmetic are given by him in the editions of 1898 and of 1901. The variations are only trivial.

[3] Cf. Russell, *loc. cit.*, pp. 199–256.

Cantor's Infinite Numbers.—Owing to the correspondence between the finite cardinals and the finite ordinals, the propositions of cardinal arithmetic and ordinal arithmetic correspond point by point. But the definition of the cardinal number of a class applies when the class is not finite, and it can be proved that there are different infinite cardinal numbers, and that there is a least infinite cardinal, now usually denoted by $\aleph_0$, where $\aleph$ is the Hebrew letter aleph. Similarly, a class of serial relations, called *well-ordered* serial relations, can be defined, such that their corresponding relation-numbers include the ordinary finite ordinals, but also include relation-numbers which have many properties like those of the finite ordinals, though the fields of the relations belonging to them are not finite. These relation-numbers are the infinite ordinal numbers. The arithmetic of the infinite cardinals does not correspond to that of the infinite ordinals. The theory of these extensions of the ideas of number is dealt with in the article NUMBER. It will suffice to mention here that Peano's fourth premiss of arithmetic does not hold for infinite cardinals or for infinite ordinals. Contrasting the above definitions of number, cardinal and ordinals, with the alternative theory that number is an ultimate idea incapable of definition, we notice that our procedure exacts a greater attention, combined with a smaller credulity; for every idea, assumed as ultimate, demands a separate act of faith.

The Data of Analysis.—Rational numbers and real numbers in general can now be defined according to the same general method If m and n are finite cardinal numbers, the rational number m/n is the relation which any finite cardinal number x bears to any finite cardinal number y when $n \times x = m \times y$. Thus the rational number one, which we will denote by 1_r, is not the cardinal number 1; for 1_r is the relation 1/1 as defined above, and is thus a relation holding between certain pairs of cardinals. Similarly, the other rational integers must be distinguished from the corresponding cardinals. The arithmetic of rational numbers is now established by means of appropriate definitions, which indicate the entities meant by the operations of addition and multiplication. But the desire to obtain general enunciations of theorems without exceptional cases has led mathematicians to employ entities of ever-ascending types of elaboration. These entities are not created by mathematicians, they are employed by them, and their definitions should point out the construction of the new entities in terms of those already on hand. The real numbers, which include irrational numbers, have now to be defined. Consider the serial arrangement of the rationals in their order of magnitude. A real number is a class (α, say) of rational numbers which satisfies the condition that it is the same as the class of those rationals each of which precedes at least one member of α. Thus, consider the class of rationals less than 2_r; any member of this class precedes some other members of the class—thus 1/2 precedes 4/3, 3/2 and so on; also the class of predecessors of predecessors of 2_r is itself the class of predecessors of 2_r. Accordingly this class is a real number; it will be called the real number 2_R. Note that the class of rationals less than or equal to 2_r is not a real number. For 2_r is not a predecessor of some member of the class. In the above example 2_R is an integral real number, which is distinct from a rational integer, and from a cardinal number. Similarly, any rational real number is distinct from the corresponding rational number. But now the irrational real numbers have all made their appearance. For example, the class of rationals whose squares are less than 2_r satisfies the definition of a real number; it is the real number $\sqrt{2}$. The arithmetic of real numbers follows from appropriate definitions of the operations of addition and multiplication. Except for the immediate purposes of an explanation, such as the above, it is unnecessary for mathematicians to have separate symbols, such as 2, 2_r and 2_R, or 2/3 and $(2/3)_R$. Real numbers with signs (+or−) are now defined. If a is a real number, $+a$ is defined to be the relation which any real number of the form $x+a$ bears to the real number x, and $-a$ is the relation which any real number x bears to the real number $x+a$. The addition and multiplication of these "signed" real numbers is suitably defined, and it is proved that the usual arithmetic of such numbers follows. Finally, we reach a complex number of the nth order. Such a number is a "one-many" relation which relates n signed real numbers (or n algebraic complex numbers when they are already defined by this procedure) to the n cardinal numbers 1, 2 . . . n respectively. If such a complex number is written (as usual) in the form $x_1e_1+x_2e_2+\dots+x_ne_n$, then this particular complex number relates x_1 to 1, x_2 to 2, . . . x_n to n. Also the "unit" e_1 (or e_r) considered as a number of the system is merely a shortened form for the complex number $(+1)\,e_1+0e_2+\dots+0e_n$. This last number exemplifies the fact that one signed real number, such as 0, may be correlated to many of the n cardinals, such as 2 . . . n in the example, but that each cardinal is only correlated with one signed number. Hence the relation has been called above "one-many." The sum of two complex numbers $x_1e_1+x_2e_2+\dots+x_ne_n$ and $y_1e_1+y_2e_2+\dots+y_ne_n$ is always defined to be the complex number $(x_1+y_1)e_1+(x_2+y_2)e_2+\dots+(x_n+y_n)e_n$. But an indefinite number of definitions of the product of two complex numbers yield interesting results. Each definition gives rise to a corresponding algebra of higher complex numbers. We will confine ourselves here to algebraic complex numbers—that is, to complex numbers of the second order taken in connexion with that definition of multiplication which leads to ordinary algebra. The product of two complex numbers of the second order—namely, $x_1e_1+x_2e_2$ and $y_1e_1+y_2e_2$, is in this case defined to mean the complex $(x_1y_1-x_2y_2)e_1+(x_1y_2+x_2y_1)e_2$. Thus $e_1\times e_1=e_1$, $e_2\times e_2=-e_1$, $e_1\times e_2=e_2\times e_1=e_2$. With this definition it is usual to omit the first symbol e_1, and to write i or $\sqrt{-1}$ instead of e_2. Accordingly, the typical form for such a complex number is $x+yi$, and then with this notation the above-mentioned definition of multiplication is invariably adopted. The importance of this algebra arises from the fact that in terms of such complex numbers with this definition of multiplication the utmost generality of expression, to the exclusion of exceptional cases, can be obtained for theorems which occur in analogous forms, but complicated with exceptional cases, in the algebras of real numbers and of signed real numbers. This is exactly the same reason as that which has led mathematicians to work with signed real numbers in preference to real numbers, and with real numbers in preference to rational numbers. The evolution of mathematical thought in the invention of the data of analysis has thus been completely traced in outline.

Definition of Mathematics.—It has now become apparent that the traditional field of mathematics in the province of discrete and continuous number can only be separated from the general abstract theory of classes and relations by a wavering and indeterminate line. Of course a discussion as to the mere application of a word easily degenerates into the most fruitless logomachy. It is open to any one to use any word in any sense. But on the assumption that "mathematics" is to denote a science well marked out by its subject matter and its methods from other topics of thought, and that at least it is to include all topics habitually assigned to it, there is now no option but to employ "mathematics" in the general sense[1] of the "science concerned with the logical deduction of consequences from the general premisses of all reasoning."

Geometry.—The typical mathematical proposition is: "If x, y, z . . . satisfy such and such conditions, then such and such other conditions hold with respect to them." By taking fixed conditions for the hypothesis of such a proposition a definite department of mathematics is marked out. For example, geometry is such a department. The "axioms" of geometry are the fixed conditions which occur in the hypotheses of the geometrical propositions. The special nature of the "axioms" which constitute geometry is considered in the article GEOMETRY (*Axioms*). It is sufficient to observe here that they are concerned with special types of classes of classes and of classes of relations, and that the connexion of geometry with number and magnitude is in no way an essential part of the foundation of the science. In fact, the whole theory of measurement in geometry arises at a comparatively late stage as the result of a variety of complicated considerations.

Classes and Relations.—The foregoing account of the nature of mathematics necessitates a strict deduction of the general properties of classes and relations from the ultimate logical premisses. In the course of this process, undertaken for the first time with the rigour of mathematicians, some contradictions have become apparent. That first discovered is known as Burali-Forti's contradiction,[1] and consists in the proof that there both is and is not a greatest infinite ordinal number. But these contradictions do not depend upon any theory of number, for Russell's contradiction[2] does not involve number in any form. This contradiction arises from considering the class possessing as members all classes which are not members of themselves. Call this class w; then to say that x is a w is equivalent to saying that x is not an x. Accordingly, to say that w is a w is equivalent to saying that w is not a w. An analogous contradiction can be found for relations. It follows that a careful scrutiny of the very idea of classes and relations is required. Note that classes are here required in extension, so that the class of human beings and the class of rational featherless bipeds are identical; similarly for relations, which are to be determined by the entities related. Now a class in respect to its components is many. In what sense then can it be one? This problem of "the one and the many" has been discussed continuously by the philosophers.[3] All the contradictions can be avoided, and yet the use of classes and relations can be preserved as required by mathematics, and indeed by common sense, by a theory which denies to a class—or relation—existence or being in any sense in which the entities composing it—or related by it—exist. Thus, to say that a pen is an entity and the class of pens is an entity is merely a play upon the word "entity"; the second sense of "entity" (if any) is indeed derived from the first, but has a more complex signification. Consider an incomplete proposition, incomplete in the sense that some entity which ought to be involved in it is represented by an undetermined x, which may stand for any entity. Call it a propositional function; and, if ϕx be a propositional function, the undetermined variable x is the argument. Two propositional functions ϕx and ψx are "extensionally identical" if any determination of x in ϕx which converts ϕx into a true proposition also converts ψx into a true proposition, and conversely for ψ and ϕ. Now consider a propositional function $F\chi$ in which the variable argument χ is itself a propositional function. If $F\chi$ is true when, and only when, χ is determined to be either ϕ or some other propositional function extensionally equivalent to ϕ, then the proposition $F\phi$ is of the form which is ordinarily recognized as being about the class determined by ϕx taken in extension—that is, the class of entities for which ϕx is a true proposition when x is determined to be any one of them. A similar theory holds for relations which arise from the consideration of propositional functions with two or more variable arguments. It is then possible to define by a parallel elaboration what is meant by classes of classes, classes of relations, relations between classes, and so on. Accordingly, the number of a class of relations can be defined, or of a class of classes, and so on. This theory[4] is in effect a theory of the *use* of classes and relations, and does not decide the philosophic question as to the sense (if any) in which a class in extension is one entity. It does indeed deny that it is an entity in the sense in which one of its members is an entity. Accordingly, it is a fallacy for any determination of x to consider "x is an x" or "x is not an x" as having the meaning of propositions. Note that for any determination of x, "x is an x" and "x is not an x," are neither of them fallacies but are both meaningless, according to this theory. Thus Russell's contradiction vanishes, and an examination of the other contradictions shows that they vanish also.

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[1] The first unqualified explicit statement of *part* of this definition seems to be by B. Peirce, "Mathematics is the science which draws necessary conclusions" (*Linear Associative Algebra*, § i. (1870), republished in the *Amer. Journ. of Math.*, vol. iv. (1881)). But it will be noticed that the second half of the definition in the text—"from the general premisses of all reasoning"—is left unexpressed. The full expression of the idea and its development into a philosophy of mathematics is due to Russell, *loc. cit.*

Applied Mathematics.—The selection of the topics of mathematical inquiry among the infinite variety open to it has been guided by the useful applications, and indeed the abstract theory has only recently been disentangled from the empirical elements connected with these applications. For example, the application of the theory of cardinal numbers to classes of physical entities involves in practice some process of counting. It is only recently that the *succession* of processes which is involved in any act of counting has been seen to be irrelevant to the idea of number. Indeed, it is only by experience that we can know that any definite process of counting will give the true cardinal number of some class of entities. It is perfectly possible to imagine a universe in which any act of counting by a being in it annihilated some members of the class counted during the time and only during the time of its continuance. A legend of the Council of Nicea[5] illustrates this point: "When the Bishops took their places on their thrones, they were 318; when they rose up to be called over, it appeared that they were 319; so that they never could make the number come right, and whenever they approached the last of the series, he immediately turned into the likeness of his next neighbour." Whatever be the historical worth of this story, it may safely be said that it cannot be disproved by deductive reasoning from the premisses of abstract logic. The most we can do is to assert that a universe in which such things are liable to happen on a large scale is unfitted for the practical application of the theory of cardinal numbers. The application of the theory of real numbers to physical quantities involves analogous considerations. In the first place, some physical process of addition is presupposed, involving some inductively inferred law of permanence during that process. Thus in the theory of masses we must know that two pounds of lead when put together will counterbalance in the scales two pounds of sugar, or a pound of lead and a pound of sugar. Furthermore, the sort of continuity of the series (in order of magnitude) of rational numbers is known to be different from that of the series of real numbers. Indeed, mathematicians now reserve "continuity" as the term for the latter kind of continuity; the mere property of having an infinite number of terms between any two terms is called "compactness." The compactness of the series of rational numbers is consistent with quasi-gaps in it—that is, with the possible absence of limits to classes in it. Thus the class of rational numbers whose squares are less than 2 has no upper limit among the rational numbers. But among the real numbers all classes have limits. Now, owing to the necessary inexactness of measurement, it is impossible to discriminate directly whether any kind of continuous physical quantity possesses the compactness of the series of rationals or the continuity of the series of real numbers. In calculations the latter hypothesis is made because of its mathematical simplicity. But, the assumption has certainly no a priori grounds in its favour, and it is not very easy to see how to base it upon experience. For example, if it should turn out that the mass of a body is to be estimated by counting the number of corpuscles (whatever they may be) which go to form it, then a body with an irrational measure of mass is intrinsically impossible. Similarly, the continuity of space apparently rests upon sheer assumption unsupported by any a priori or experimental grounds. Thus the current applications of mathematics to the analysis of phenomena can be justified by no a priori necessity.

In one sense there is no science of applied mathematics. When once the fixed conditions which any hypothetical group of entities are to satisfy have been precisely formulated, the deduction of the further propositions, which also will hold respecting them, can proceed in complete independence of the question as to whether or no any such group of entities can be found in the world of phenomena. Thus rational mechanics, based on the Newtonian Laws, viewed as mathematics is independent of its supposed application, and hydrodynamics remains a coherent and respected science though it is extremely improbable that any perfect fluid exists in the physical world. But this unbendingly logical point of view cannot be the last word upon the matter. For no one can doubt the essential difference between characteristic treatises upon "pure" and "applied" mathematics. The difference is a difference in method. In pure mathematics the hypotheses which a set of entities are to satisfy are given, and a group of interesting deductions are sought. In "applied mathematics" the "deductions" are given in the shape of the experimental evidence of natural science, and the hypotheses from which the "deductions" can be deduced are sought. Accordingly, every treatise on applied mathematics, properly so-called, is directed to the criticism of the "laws" from which the reasoning starts, or to a suggestion of results which experiment may hope to find. Thus if it calculates the result of some experiment, it is not the experimentalist's well-attested results which are on their trial, but the basis of the calculation. Newton's *Hypotheses non fingo* was a proud boast, but it rests upon an entire misconception of the capacities of the mind of man in dealing with external nature.

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[1] "Una questione sui numeri transfiniti," *Rend. del circolo mat. di Palermo*, vol. xi. (1897); and Russell, *loc. cit.*, ch. xxxviii.

[2] Cf. Russell, *loc. cit.*, ch. x.

[3] Cf. *Pragmatism: a New Name for some Old Ways of Thinking* (1907).

[4] Due to Bertrand Russell, cf. "Mathematical Logic as based on the Theory of Types," *Amer. Journ. of Math.* vol. xxx. (1908). It is more fully explained by him, with later simplifications, in *Principia mathematica* (Cambridge).

[5] Cf. Stanley's *Eastern Church*, Lecture v.

Synopsis of Existing Developments of Pure Mathematics.—A complete classification of mathematical sciences, as they at present exist, is to be found in the *International Catalogue of Scientific Literature* promoted by the Royal Society. The classification in question was drawn up by an international committee of eminent mathematicians, and thus has the highest authority. It would be unfair to criticize it from an exacting philosophical point of view. The practical object of the enterprise required that the proportionate quantity of yearly output in the various branches, and that the liability of various topics as a matter of fact to occur in connexion with each other, should modify the classification.

Section A deals with pure mathematics. Under the general heading "*Fundamental Notions*" occur the subheadings "*Foundations of Arithmetic,*" with the topics rational, irrational and transcendental numbers, and aggregates; "*Universal Algebra,*" with the topics complex numbers, quaternions, ausdehnungslehre, vector analysis, matrices, and algebra of logic; and "*Theory of Groups,*" with the topics finite and continuous groups. For the subjects of this general heading see the articles ALGEBRA, UNIVERSAL; GROUPS, THEORY OF; INFINITESIMAL CALCULUS; NUMBER; QUATERNIONS; VECTOR ANALYSIS. Under the general heading "*Algebra and Theory of Numbers*" occur the subheadings "*Elements of Algebra,*" with the topics rational polynomials, permutations, &c., partitions, probabilities; "*Linear Substitutions,*" with the topics determinants, &c., linear substitutions, general theory of quantics; "*Theory of Algebraic Equations,*" with the topics existence of roots, separation of and approximation to, theory of Galois, &c. "*Theory of Numbers,*" with the topics congruences, quadratic residues, prime numbers, particular irrational and transcendental numbers. For the subjects of this general heading see the articles ALGEBRA; ALGEBRAIC FORMS; ARITHMETIC; COMBINATORIAL ANALYSIS; DETERMINANTS; EQUATION; FRACTION, CONTINUED; INTERPOLATION; LOGARITHMS; MAGIC SQUARE; PROBABILITY. Under the general heading "*Analysis*" occur the subheadings "*Foundations of Analysis,*" with the topics theory of functions of real variables, series and other infinite processes, principles and elements of the differential and of the integral calculus, definite integrals, and calculus of variations; "*Theory of Functions of Complex Variables,*" with the topics functions of one variable and of several variables; "*Algebraic Functions and their Integrals,*" with the topics algebraic functions of one and of several variables, elliptic functions and single theta functions, Abelian integrals; "*Other Special Functions,*" with the topics Euler's, Legendre's, Bessel's and automorphic functions; "*Differential Equations,*" with the topics existence theorems, methods of solution, general theory; "*Differential Forms and Differential Invariants,*" with the topics differential forms, including Pfaffians, transformation of differential forms, including tangential (or contact) transformations, differential invariants; "*Analytical Methods connected with Physical Subjects,*" with the topics harmonic analysis, Fourier's series, the differential equations of applied mathematics, Dirichlet's problem; "*Difference Equations and Functional Equations,*" with the topics recurring series, solution of equations of finite differences and functional equations. For the subjects of this heading see the articles DIFFERENTIAL EQUATIONS; FOURIER'S SERIES; CONTINUED FRACTIONS; FUNCTION; FUNCTION OF REAL VARIABLES; FUNCTION COMPLEX; GROUPS, THEORY OF; INFINITESIMAL CALCULUS; MAXIMA AND MINIMA; SERIES; SPHERICAL HARMONICS; TRIGONOMETRY; VARIATIONS, CALCULUS OF. Under the general heading "*Geometry*" occur the subheadings "*Foundations,*" with the topics principles of geometry, non-Euclidean geometries, hyperspace, methods of analytical geometry; "*Elementary Geometry,*" with the topics planimetry, stereometry, trigonometry, descriptive geometry; "*Geometry of Conics and Quadrics,*" with the implied topics; "*Algebraic Curves and Surfaces of Degree higher than the Second,*" with the implied topics; "*Transformations and General Methods for Algebraic Configurations,*" with the topics collineation, duality, transformations, correspondence, groups of points on algebraic curves and surfaces, genus of curves and surfaces, enumerative geometry, connexes, complexes, congruences, higher elements in space, algebraic configurations in hyperspace; "*Infinitesimal Geometry: applications of Differential and Integral Calculus to Geometry,*" with the topics kinematic geometry, curvature, rectification and quadrature, special transcendental curves and surfaces; "*Differential Geometry: applications of Differential Equations to Geometry,*" with the topics curves on surfaces, minimal surfaces, surfaces determined by differential properties, conformal and other representation of surfaces on others, deformation of surfaces, orthogonal and isothermic surfaces. For the subjects under this heading see the articles CONIC SECTIONS; CIRCLE; CURVE; GEOMETRICAL CONTINUITY; GEOMETRY, *Axioms of*; GEOMETRY, *Euclidean*; GEOMETRY, *Projective*; GEOMETRY, *Analytical*; GEOMETRY, *Line*; KNOTS, MATHEMATICAL THEORY OF; MENSURATION; MODELS; PROJECTION; SURFACE; TRIGONOMETRY.

This survey of the existing developments of pure mathematics confirms the conclusions arrived at from the previous survey of the theoretical principles of the subject. Functions, operations, transformations, substitutions, correspondences, are but names for various types of relations. A group is a class of relations possessing a special property. Thus the modern ideas, which have so powerfully extended and unified the subject, have loosened its connexion with "number" and "quantity," while bringing ideas of form and structure into increasing prominence. Number must indeed ever remain the great topic of mathematical interest, because it is in reality the great topic of applied mathematics. All the world, including savages who cannot count beyond five, daily "apply" theorems of number. But the complexity of the idea of number is practically illustrated by the fact that it is best studied as a department of a science wider than itself.

Synopsis of Existing Developments of Applied Mathematics.—Section B of the *International Catalogue* deals with mechanics. The heading "*Measurement of Dynamical Quantities*" includes the topics units, measurements, and the constant of gravitation. The topics of the other headings do not require express mention. These headings are: "*Geometry and Kinematics of Particles and Solid Bodies*"; "*Principles of Rational Mechanics*"; "*Statics of Particles, Rigid Bodies, &c.*"; "*Kinetics of Particles, Rigid Bodies, &c.*"; "*General Analytical Mechanics*"; "*Statics and Dynamics of Fluids*"; "*Hydraulics and Fluid Resistances*"; "*Elasticity.*" For the subjects of this general heading see the articles MECHANICS; DYNAMICS, ANALYTICAL; GYROSCOPE; HARMONIC ANALYSIS; WAVE; HYDROMECHANICS; ELASTICITY; MOTION, LAWS OF; ENERGY; ENERGETICS; ASTRONOMY (*Celestial Mechanics*); TIDE. Mechanics (including dynamical astronomy) is that subject among those traditionally classed as "applied" which has been most completely transfused by mathematics—that is to say, which is studied with the deductive spirit of the pure mathematician, and not with the covert inductive intention overlaid with the superficial forms of deduction, characteristic of the applied mathematician.

Every branch of physics gives rise to an application of mathematics. A prophecy may be hazarded that in the future these applications will unify themselves into a mathematical theory of a hypothetical substructure of the universe, uniform under all the diverse phenomena. This reflection is suggested by the following articles: AETHER; MOLECULE; CAPILLARY ACTION; DIFFUSION; RADIATION, THEORY OF; and others.

The applications of mathematics to statistics (see STATISTICS and PROBABILITY) should not be lost sight of; the leading fields for these applications are insurance, sociology, variation in zoology and economics.

The History of Mathematics.—The history of mathematics is in the main the history of its various branches. A short account of the history of each branch will be found in connexion with the article which deals with it. Viewing the subject as a whole, and apart from remote developments which have not in fact seriously influenced the great structure of the mathematics of the European races, it may be said to have had its origin with the Greeks, working on pre-existing fragmentary lines of thought derived from the Egyptians and Phoenicians. The Greeks created the sciences of geometry and of number as applied to the measurement of continuous quantities. The great abstract ideas (considered directly and not merely in tacit use) which have dominated the science were due to them—namely, ratio, irrationality, continuity, the point, the straight line, the plane. This period lasted[1] from the time of Thales, *c.* 600 B.C., to the capture of Alexandria by the Mahommedans, A.D. 641. The medieval Arabians invented our system of numeration and developed algebra. The next period of advance stretches from the Renaissance to Newton and Leibnitz at the end of the 17th century. During this period logarithms were invented, trigonometry and algebra developed, analytical geometry invented, dynamics put upon a sound basis, and the period closed with the magnificent invention of (or at least the perfecting of) the differential calculus by Newton and Leibnitz and the discovery of gravitation. The 18th century witnessed a rapid development of analysis, and the period culminated with the genius of Lagrange and Laplace. This period may be conceived as continuing throughout the first quarter of the 19th century. It was remarkable both for the brilliance of its achievements and for the large number of French mathematicians of the first rank who flourished during it. The next period was inaugurated in analysis by K. F. Gauss, N. H. Abel and A. L. Cauchy. Between them the general theory of the complex variable, and of the various "infinite" processes of mathematical analysis, was established, while other mathematicians, such as Poncelet, Steiner, Lobatschewsky and von Staudt, were founding modern geometry, and Gauss inaugurated the differential geometry of surfaces. The applied mathematical sciences of light, electricity and electromagnetism and of heat, were now largely developed. This school of mathematical thought lasted beyond the middle of the century, after which a change and further development can be traced. In the next and last period the progress of pure mathematics has been dominated by the critical spirit introduced by the German mathematicians under the guidance of Weierstrass, though foreshadowed by earlier analysts, such as Abel. Also such ideas as those of invariants, groups and of form, have modified the entire science. But the progress in all directions has been too rapid to admit of any one adequate characterization. During the same period a brilliant group of mathematical physicists, notably Lord Kelvin (W. Thomson), H. V. Helmholtz, J. C. Maxwell, H. Hertz, have transformed applied mathematics by systematically basing their deductions upon the Law of the conservation of energy, and the hypothesis of an ether pervading space.

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[1] Cf *A Short History of Mathematics*, by W. W. R. Ball.

Bibliography.—References to the works containing expositions of the various branches of mathematics are given in the appropriate articles. It must suffice here to refer to sources in which the subject is considered as one whole. Most philosophers refer in their works to mathematics more or less cursorily, either in the treatment of the ideas of number and magnitude, or in their consideration of the alleged a priori and necessary truths. A bibliography of such references would be in effect a bibliography of metaphysics, or rather of epistemology. The founder of the modern point of view, explained in this article, was Leibnitz, who, however, was so far in advance of contemporary thought that his ideas remained neglected and undeveloped until recently; cf. *Opuscules et fragments inédits de Leibnitz. Extraits des manuscrits de la bibliothèque royale de Hanovre*, by Louis Couturat (Paris, 1903), especially pp. 356–399, "Generales inquisitiones de analysi notionum et veritatum" (written in 1686); also cf. *La Logique de Leibnitz*, already referred to. For the modern authors who have rediscovered and improved upon the position of Leibnitz, cf. *Grundgesetze der Arithmetik, begriffsschriftlich abgeleitet von Dr G. Frege, a.o. Professor an der Univ. Jena* (Bd. i., 1893; Bd. ii., 1903, Jena); also cf. Frege's earlier works, *Begriffsschrift, eine der arithmetischen nachgebildete Formelsprache des reinen Denkens* (Halle, 1879), and *Die Grundlagen der Arithmetik* (Breslau, 1884); also cf. Bertrand Russell, *The Principles of Mathematics* (Cambridge, 1903), and his article on "Mathematical Logic" in *Amer. Quart. Journ. of Math.* (vol. xxx., 1908). Also the following works are of importance, though not all expressly expounding the Leibnitzian point of view: cf. G. Cantor, "Grundlagen einer allgemeinen Mannigfaltigkeitslehre," *Math. Annal.*, vol. xxi. (1883) and subsequent articles in vols. xlvi. and xlix.; also R. Dedekind, *Stetigkeit und irrationales Zahlen* (1st ed., 1872), and *Was sind und was sollen die Zahlen?* (1st ed., 1887), both tracts translated into English under the title *Essays on the Theory of Numbers* (Chicago, 1901). These works of G. Cantor and Dedekind were of the greatest importance in the progress of the subject. Also cf. G. Peano (with various collaborators of the Italian school), *Formulaire de mathématiques* (Turin, various editions, 1894–1908; the earlier editions are the more interesting philosophically); Felix Klein, *Lectures on Mathematics* (New York, 1894); W. K. Clifford, *The Common Sense of the exact Sciences* (London, 1885); H. Poincaré, *La Science et l'hypothèse* (Paris, 1st ed., 1902), English translation under the title, *Science and Hypothesis* (London, 1905); L. Couturat, *Les Principes des mathématiques* (Paris, 1905); E. Mach, *Die Mechanik in ihrer Entwickelung* (Prague, 1883), English translation under the title, *The Science of Mechanics* (London, 1893); K. Pearson, *The Grammar of Science* (London, 1st ed., 1892; 2nd ed., 1900, enlarged); A. Cayley, *Presidential Address* (Brit. Assoc., 1883); B. Russell and A. N. Whitehead, *Principia Mathematica* (Cambridge, 1911). For the history of mathematics the one modern and complete source of information is M. Cantor's *Vorlesungen über Geschichte der Mathematik* (Leipzig, 1st Bd., 1880; 2nd Bd., 1892; 3rd Bd., 1898; 4th Bd., 1908; 1st Bd., *von den ältesten Zeiten bis zum Jahre 1200, n. Chr.*; 2nd Bd., *von 1200–1668*; 3rd Bd., *von 1668–1758*; 4th Bd., *von 1795 bis 1799*); W. W. R. Ball, *A Short History of Mathematics* (London 1st ed., 1888, three subsequent editions, enlarged and revised, and translations into French and Italian). (A. N. W.)

MATHER, COTTON (1663–1728), American Congregational clergyman and author, was born in Boston, Massachusetts, on the 12th of February 1663. He was the grandson of Richard Mather, and the eldest child of Increase Mather (*q.v.*), and Maria, daughter of John Cotton. After studying under the famous Ezekiel Cheever (1614–1708), he entered Harvard College at twelve, and graduated in 1678. While teaching (1678–1685), he began the study of theology, but soon, on account of an impediment in his speech, discontinued it and took up medicine. Later, however, he conquered the difficulty and finished his preparation for the ministry. He was elected assistant pastor in his father's church, the North, or Second, Church of Boston, in 1681 and was ordained as his father's colleague in 1685. In 1688, when his father went to England as agent for the colony, he was left at twenty-five in charge of the largest congregation in New England, and he ministered to it for the rest of his life. He soon became one of the most influential men in the colonies. He had much to do with the witchcraft persecution of his day; in 1692 when the magistrates appealed to the Boston clergy for advice in regard to the witchcraft cases in Salem he drafted their reply, upon which the prosecutions were based; in 1689 he had written *Memorable Providences Relating to Witchcraft and Possessions*, and even his earlier diaries have many entries showing his belief in diabolical possession and his fear and hatred of it. Thinking as he did that the New World had been the undisturbed realm of Satan before the settlements were made in Massachusetts, he considered it natural that the Devil should make a peculiar effort to bring moral destruction on these godly invaders. He used prayer and fasting to deliver himself from evil enchantment; and when he saw ecstatic and mystical visions promising him the Lord's help and great usefulness in the Lord's work, he feared that these revelations might be of diabolic origin. He used his great influence to bring the suspected persons to trial and punishment. He attended the trials, investigated many of the cases himself, and wrote sermons on witchcraft, the *Memorable Providences* and *The Wonders of the Invisible World* (1693), which increased the excitement of the people. Accordingly, when the persecutions ceased and the reaction set in, much of the blame was laid upon him; the influence of Judge Samuel Sewall, after he had come to think his part in the Salem delusion a great mistake, was turned against the Mathers; and the liberal leaders of Congregationalism in Boston, notably the Brattles, found this a vulnerable point in Cotton Mather's armour and used their knowledge to much effect, notably by assisting Robert Calef (d. *c.* 1723) in the preparation of *More Wonders of the Invisible World* (1700) a powerful criticism of Cotton Mather's part in the delusion at Salem.

Mather took some part as adviser in the Revolution of 1689 in Massachusetts. In 1690 he became a member of the Corporation (probably the youngest ever chosen as Fellow) of Harvard College, and in 1707 he was greatly disappointed at his failure to be chosen president of that institution. He received the degree of D.D. from the University of Glasgow in 1710, and in 1713 was made a Fellow of the Royal Society. Like his father he was deeply grieved by the liberal theology and Church polity of the new Brattle Street Congregation, and conscientiously opposed its pastor Benjamin Colman, who had been irregularly ordained in England and by a Presbyterian body; but with his father he took part in 1700 in services in Colman's church. Harvard College was now controlled by the Liberals of the Brattle Street Church, and as it grew farther and farther away from Calvinism, Mather looked with increasing favour upon the college in Connecticut; before September 1701 he had drawn up a "scheme for a college," the oldest document now in the Yale archives; and finally (Jan. 1718) he wrote to a London merchant, Elihu Yale, and persuaded him to make a liberal gift to the college, which was named in his honour. During the smallpox epidemic of 1721 he attempted in vain to have treatment by inoculation employed, for the first time in America; and for this he was bitterly attacked on all sides, and his life was at one time in danger; but, nevertheless, he used the treatment on his son, who recovered, and he wrote *An Account of the Method and further Success of Inoculating for the Small Pox in London* (1721). In addition he advocated temperance, missions, Bible societies, and the education of the negro; favoured the establishing of libraries for working men and of religious organizations for young people, and organized societies for other branches of philanthropic work. His later years were clouded with many sorrows and disappointments; his relations with Governor Joseph Dudley were unfriendly; he lost much of his former prestige in the Church—his own congregation dwindled—and in the college; his uncle John Cotton was expelled from his charge in the Plymouth Church; his son Increase turned out a ne'er-do-well; four of his children and his second wife died in November 1713; his wife's brothers and the husbands of his sisters were ungodly and violent men; his favourite daughter Katherine, who "understood Latin and read Hebrew fluently," died in 1716; his third wife went mad in 1719; his personal enemies circulated incredible scandals about him; and in 1724–1725 he saw a Liberal once more preferred to him as a new president of Harvard. He died in Boston on the 13th of February 1728 and is buried in the Copps Hill burial-ground, Boston. He was thrice married—to Abigail Phillips (d. 1702) in 1686, to Mrs Elizabeth Hubbard (d. 1713) in 1703, and in 1715 to Mrs Lydia George (d. 1734). Of his fifteen children only two survived him.

Though self-conscious and vain, Cotton Mather had on the whole a noble character. He believed strongly in the power of prayer and repeatedly had assurances that his prayers were heard; and when he was disappointed by non-fulfilment his grief and depression were terrible. His spiritual nature was high-strung and delicate; and this condition was aggravated by his constant study, his long fasts and his frequent vigils—in one year, according to his diary, he kept sixty fasts and twenty vigils. In his later years his diaries have less and less of personal detail, and repeated entries prefaced by the letters "G.D." meaning Good Device, embodying precepts of kindliness and practical Christianity. He was remarkable for his godliness, his enthusiasm for knowledge, and his prodigious memory. He became a skilled linguist, a widely read scholar—though much of his learning was more curious than useful—a powerful preacher, a valued citizen, and a voluminous writer, and did a vast deal for the intellectual and spiritual quickening of New England. He worked with might and main for the continuation of the old theocracy, but before he died it had given way before an increasing Liberalism—even Yale was infected with the Episcopalianism that he hated.

Among his four hundred or more published works, many of which are sermons, tracts and letters, the most notable is his *Magnalia Christi Americana: or the Ecclesiastical History of New England, from Its First Planting in the Year 1620 unto the Year of Our Lord, 1698*. Begun in 1693 and finished in 1697, this work was published in London, in 1702, in one volume, and was republished in Hartford in 1820 and in 1853–1855, in two volumes. It is in seven books and concerns itself mainly with the settlement and religious history of New England. It is often inaccurate, and it abounds in far-fetched conceits and odd and pedantic features. Its style, though in the main rather unnatural and declamatory, is at its best spontaneous, dignified and rhythmical; the book is valuable for occasional facts and for its picture of the times, and it did much to make Mather the most eminent American writer of his day. His other writings include *A Poem Dedicated to the Memory of the Reverend and Excellent Mr Urian Oakes* (1682); *The Present State of New England* (1690); *The Life of the Renowned John Eliot* (1691), later included in Book III. of the *Magnalia*; *The Short History of New England* (1694); *Bonifacius*, usually known as *Essays To Do Good* (Boston, 1710; Glasgow, 1825; Boston, 1845), one of his principal books and one which had a shaping influence on the life of Benjamin Franklin; *Psalterium Americanum* (1718), a blank verse translation of the Psalms from the original Hebrew; *The Christian Philosopher: A Collection of the Best Discoveries in Nature, with Religious Improvements* (1721); *Parentator* (1724), a memoir of his father; *Ratio Disciplinae* (1726), an account of the discipline in New England churches; *Manuductio ad Ministerium: Directions for a Candidate of the Ministry* (1726), one of the most readable of his books. He also left a number of works in manuscript, including diaries, a medical treatise and a huge commentary on the Bible, entitled "Biblia Americana."

See *The Life of Cotton Mather* (Boston, 1729), by his son, Samuel Mather; William B. O. Peabody, *The Life of Cotton Mather* (1836) (in Jared Sparks's "Library of American Biography," vol. vi.); Enoch Pond, *The Mather Family* (Boston, 1844); John L. Sibley, *Biographical Sketches of Graduates of Harvard University*, vol. iii. (Cambridge, 1885); Barrett Wendell, *Cotton Mather, the Puritan Priest* (New York, 1891), a remarkably sympathetic study and particularly valuable for its insight into (and its defence of) Mather's attitude toward witchcraft; Abijah P. Marvin, *The Life and Times of Cotton Mather* (Boston, 1892); M. C. Tyler, *A History of American Literature during the Colonial Period*, vol. ii. (New York, 1878); and Barrett Wendell, *A Literary History of America* (New York, 1900).

Cotton Mather's son, **Samuel Mather** (1706–1785), also a clergyman, graduated at Harvard in 1723, was pastor of the North Church, Boston, from 1732 to 1742, when, owing to a dispute among his congregation over revivals, he resigned to take charge of a church established for him in North Bennett Street.

Among his works are *The Life of Cotton Mather* (1729); *An Apology for the Liberties of the Churches in New England* (1738), and *America Known to the Ancients* (1773). (W. L. C.*)

MATHER, INCREASE (1639–1723), American Congregational minister, was born in Dorchester, Massachusetts, on the 21st of June 1639, the youngest son of Richard Mather.[1] He entered Harvard in 1651, and graduated in 1656. In 1657, on his eighteenth birthday, he preached his first sermon; in the same year he went to visit his eldest brother in Dublin, and studied there at Trinity College, where he graduated M.A. in 1658. He was chaplain to the English garrison at Guernsey in April–December 1659 and again in 1661; and in the latter year, refusing valuable livings in England offered on condition of conformity, he returned to America. In the winter of 1661–1662 he began to preach to the Second (or North) Church of Boston, and was ordained there on the 27th of May 1664. As a delegate from Dorchester, his father's church, to the Synod of 1662, he opposed the Half-Way Covenant adopted by the Synod and defended by Richard Mather and by Jonathan Mitchell (1624–1668) of Cambridge; but soon afterwards he "surrendered a glad captive" to "the truth so victoriously cleared by Mr Mitchell," and like his father and his son became one of the chief exponents of the Half-Way Covenant. He was bitterly opposed, however, to the liberal practices that followed the Half-Way Covenant and (after 1677) in particular to "Stoddardeanism," the doctrine of Solomon Stoddard (1643–1729) that all "such Persons as have a good Conversation and a Competent Knowledge may come to the Lord's Supper," only those of openly immoral life being excluded. In May 1679 Mather was a petitioner to the General Court for the call of a Synod to consider the reformation in New England of "the Evils that have Provoked the Lord to bring his Judgments,"[2] and when the "Reforming Synod" met in September it appointed him one of a committee to draft a creed; this committee reported in May 1680, at the Synod's second session, of which Mather was moderator, the Savoy Declaration (slightly modified, notably in ch. xxiv., "Of the Civil Magistrate"), which was approved but was not made mandatory on the churches by the General Court, and in 1708 was reaffirmed at Saybrook, Connecticut. With the Cambridge Platform of 1646, drafted by his father, the Confession of 1680, for which Increase Mather was largely responsible, was printed as a book of doctrine and government for the churches of Massachusetts.

After the threat of a *Quo Warranto* writ in 1683 for the surrender of the Massachusetts charter, Mather used all his tremendous influence to persuade the colonists not to give up the charter; and the Boston freemen unanimously voted against submission. The royal agents immediately afterwards sent to London a treasonable letter, falsely attributed to Mather; but its spuriousness seems to have been suspected in England and Mather was not "fetch'd over and made a Sacrifice." He became a leader in the opposition to Sir Edmund Andros, to his secretary Edward Randolph, and to Governor Joseph Dudley. He was chosen by the General Court to represent the colony's interests in England, eluded officers sent to arrest him,[3] and in disguise boarded a ship on which he reached Weymouth on the 6th of May 1688. In London he acted with Sir Henry Ashurst, the resident agent, and had two or three fruitless audiences with James II. His first audience with William III. was on the 9th of January 1689; he was active in influencing the Commons to vote (1689) that the New England charters should be restored; and he published *A Narrative of the Miseries of New-England, By Reason of an Arbitrary Government Erected there Under Sir Edmund Andros* (1688), *A Brief Relation for the Confirmation of Charter Privileges* (1691), and other pamphlets. In 1690 he was joined by Elisha Cooke (1638–1715) and Thomas Oakes (1644–1719), additional agents, who were uncompromisingly for the renewal of the old charter. Mather, however, was instrumental in securing a new charter (signed on Oct. 7, 1691), and prevented the annexation of the Plymouth Colony to New York. The nomination of officers left to the Crown was reserved to the agents. Mather had expressed strong dissatisfaction with the clause giving the governor the right of veto, and regretted the less theocratic tone of the charter which made all freemen (and not merely church members) electors. With Sir William Phips, the new governor, a member of Mather's church, he arrived in Boston on the 14th of May 1692. The value of his services to the colony at this time is not easily over-estimated. In England he won the friendship of divines like Baxter, Tillotson and Burnet, and effectively promoted the union in 1691 of English Presbyterians and Congregationalists. He was at heavy expense throughout his stay, and even greater than his financial loss was his loss of authority and control in the church and in Harvard College because of his absence.

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[1] He was so christened "because of the never-to-be-forgotten increase, of every sort, wherewith God favoured the country about the time of his nativity." He often latinized his name, spelling it *Crescentius Matherus*.

[2] That is, King Philip's War, the Boston fires of 1676, when Mather's church and home were burned, and 1679, the threatened introduction of Episcopacy, and the general spiritual decay of the country.

[3] He had previously been arrested and acquitted on a charge of having attributed the forged letter to Randolph.

Mather had been acting president of Harvard College in 1681–1682, and in June 1685 he again became acting president (or rector), but still preached every Sunday in Boston and would not comply with an order of the General Court that he should reside in Cambridge. In 1701 after a short residence there he returned to Boston and wrote to the General Court to "think of another President for the Colledge." The opposition to him had been increasing in strength, his resignation was accepted, and Samuel Willard took charge of the college as vice-president, although he also refused to reside in Cambridge. That Mather's administration of the college was excellent is admitted even by his harsh critic, Josiah Quincy, in his *History of Harvard University*.[1] The Liberal party, which now came into control in the college repeatedly disappointed the hopes of Cotton Mather (*q.v.*) that he might be chosen president, and by its ecclesiastical laxness and its broader views of Church polity forced the Mathers to turn from Harvard to Yale as a truer school of the prophets.

The Liberal leaders, John Leverett (1662–1724), William Brattle (1662–1713)—who graduated with Leverett in 1680, and with him as tutor controlled the college during Increase Mather's absence in England—William Brattle's eldest brother, Thomas Brattle (1658–1713), and Ebenezer Pemberton (1671–1717), pastor of the Old South Church, desired an "enrichment of the service," and greater liberality in the matter of baptism. In 1697 the Second Boston Church, in which Cotton Mather had been his father's colleague since 1685, upbraided the Charlestown Church "for betraying the liberties of the churches in their late putting into the hands of the whole inhabitants the choice of a minister." In 1699 Increase Mather published *The Order of the Gospel*, which severely (although indirectly, criticized the methods of the "Liberals" in establishing the Brattle Street Church and especially the ordination of their minister Benjamin Colman by a Presbyterian body in London; the Liberals replied with *The Gospel Order Revived*, which was printed in New York to lend colour to the (partly true) charge of its authors that the printers of Massachusetts would print nothing hostile to Increase Mather.[2] The autocracy of the Mathers in church, college, colony and press, had slipped from them. The later years of Mather's life were spent almost entirely in the work of the ministry, now beginning to be a less varied career than when he entered on it. He died on the 23rd of August 1723. He married in 1662 Maria, daughter of Sarah and John Cotton. His first wife died in 1714; and in 1715 he married Ann Lake, widow of John Cotton, of Hampton, N.H., a grandson of John Cotton of Boston.

Increase Mather was a great preacher with a simple style and a splendid voice, which had a "Tonitruous Cogency," to quote his son's phrase. His style was much simpler and more vernacular than his son's. He was an assiduous student, commonly spending sixteen hours a day among his books; but his learning (to quote Justin Winsor's contrast between Increase and Cotton Mather) "usually left his natural ability and his education free from entanglements." He was not so much self-seeking and personally ambitious as eager to advance the cause of the church in which he so implicitly believed. That it is a mistake to consider him a narrow churchman is shown by his assisting in 1718 at the ordination of Elisha Callender in the First Baptist Church of Boston. Like the most learned men of his time he was superstitious and a firm believer in "praesagious impressions"; his *Essay for the Recording of Illustrious Providences: Wherein an Account is Given of many Remarkable and very Memorable Events which have Hapned in this Last Age, Especially in New England* (1684) shows that he believed only less thoroughly than his son in witchcraft, though in his *Cases of Conscience Concerning Evil Spirits* (1693) he considered some current proofs of witchcraft inadequate. The revulsion of feeling after the witchcraft delusion undermined his authority greatly, and Robert's Calef's *More Wonders of the Spiritual World* (1700) was a personal blow to him as well as to his son. With Jonathan Edwards, than whom he was much more of a man of affairs, and with Benjamin Franklin, whose mission in England somewhat resembled Mather's, he may be ranked among the greatest Americans of the period before the War of Independence.

The first authority for the life of Increase Mather is the work of his son Cotton Mather, *Parentator: Memoirs of Remarkables in the Life and Death of the Ever Memorable Dr Increase Mather* (Boston, 1724); there are also a memoir and constant references in Cotton Mather's *Magnalia* (London, 1702) especially vol. iv.; there is an excellent sketch in the first volume of J. L. Sibley's *Biographical Sketches of Graduates of Harvard University* (Cambridge, 1873), with an exhaustive list of Mather's works (about 150 titles); there is much valuable matter in Williston Walker's *Ten New England Leaders* (New York, 1901) and in his *Creeds and Platforms of Congregationalism* (New York, 1893); for literary criticism of the Mathers see ch. xii. of M. C. Tyler's *History of American Literature, 1607–1676* (New York, 1878), and Barrett Wendell's *Cotton Mather* (New York, 1891). Mather's worth has been under-estimated by Josiah Quincy, Justin Winsor and other historians out of sympathy with his ecclesiastical spirit, who represent him as only an ambitious narrow-minded schemer. (R. We.)

MATHER, RICHARD (1596–1669), American Congregational clergyman, was born in Lowton, in the parish of Winwick, near Liverpool, England, of a family which was in reduced circumstances but entitled to bear a coat-of-arms. He studied at Winwick grammar school, of which he was appointed a master in his fifteenth year, and left it in 1612 to become master of a newly established school at Toxteth Park, Liverpool. After a few months at Brasenose College, Oxford, he began in November 1618 to preach at Toxteth, and was ordained there, possibly only as deacon, early in 1619. In August–November 1633 he was suspended for nonconformity in matters of ceremony; and in 1634 was again suspended by the visitors of Richard Neile, archbishop of York, who, hearing that he had never worn a surplice during the fifteen years of his ministry, refused to reinstate him and said that "it had been better for him that he had gotten Seven Bastards." He had a great reputation as a preacher in and about Liverpool; but, advised by letters of John Cotton and Thomas Hooker, and persuaded by his own elaborate formal “ Arguments tending to prove the Removing from Old-England to New . . . to be not only lawful, but also necessary for them that are not otherwise tyed, but free,” he left England and on the 17th of August 1635, and landed in Boston after an “ extraordinary and miraculous deliverance ” from a terrible storm. As a famous preacher “ he was desired at Plimouth, Dorchester, and Roxbury.” He went to Dorchester, where the Church had been greatly depleted by migrations to Windsor, Connecticut; and where, after a delay of several months, in August 1636 there was constituted by the consent of magistrates and clergy a church of which he was “ teacher ” until his death in Dorchester on the 22nd of April 1669.

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[1] Mather led the resistance to the royal demand instigated by Edward Randolph in 1683, for the annulment of the college charter, and after its vacation in 1684 strove for the grant of a new charter; King James promised him a confirmation of the former charter; the new provincial charter granted by William and Mary confirmed all gifts and grants to colleges; in 1692 Mather drafted an act incorporating the college, which was signed by Phips but was disallowed in England; and in 1696, 1697, 1699, and 1700, Mather repeated his efforts for a college charter.

[2] Mather was made a licenser of the Press in 1674 when the General Court abolished the monopoly of the Cambridge Press.

He was an able preacher, “ aiming,” said his biographer, “ to shoot his arrows not over his people's heads, but into their Hearts and Consciences ”; and he was a leader of New England Congregationalism, whose policy he defended and described in the tract *Church Government and Church Covenant Discussed, in an Answer of the Elders of the Severall Churches of New England to Two and Thirty Questions* (written 1639; printed 1643), and in his *Reply to Mr Rutherford* (1647), a polemic against the Presbyterianism to which the English Congregationalists were then tending. He drafted the Cambridge Platform, an ecclesiastical constitution in seventeen chapters, adopted (with the omission of Mather's paragraph favouring the “ Half-way Covenant,” of which he strongly approved) by the general synod in August 1646. In 1657 he drafted the declaration of the Ministerial Convention on the meaning and force of the Half-way Covenant; this was published in 1659 under the title: *A Disputation concerning Church Members and their Children in Answer to XXI. Questions.* With Thomas Welde and John Eliot he wrote the “ Bay Psalm Book,” or, more accurately, *The Whole Booke of Psalmes Faithfully Translated into English Metre* (1640), probably the first book printed in the English colonies.

He married in 1624 Katherine Hoult or Holt (d. 1655), and secondly in 1656 Sarah Hankredge (d. 1676), the widow of John Cotton. Of six sons, all by his first wife, four were ministers: SAMUEL (1626–1671), the first fellow of Harvard College who was a graduate, chaplain of Magdalen College, Oxford, in 1650–1653, and pastor (1656–1671, excepting suspension in 1660–1662) of St Nicholas's in Dublin; NATHANIEL (1630–1697), who graduated at Harvard in 1647, was vicar of Barnstaple, Devon, in 1656–1662, pastor of the English Church in Rotterdam, his brother's successor in Dublin in 1671–1688, and then until his death pastor of a church in London; ELEAZAR (1637–1669), who graduated at Harvard in 1656 and after preaching in Northampton, Massachusetts, for three years, became in 1661 pastor of the church there; and INCREASE MATHER (*q.v.*). Horace E. Mather, in his *Lineage of Richard Mather* (Hartford, Connecticut, 1890), gives a list of 80 clergymen descended from Richard Mather, of whom 29 bore the name Mather and 51 other names, the more famous being Storrs and Schauffler.

See *The Life and Death of That Reverend Man of God, Mr Richard Mather* (Cambridge, 1670; reprinted 1850, with his *Journal* for 1635, by the Dorchester Antiquarian and Historical Society), with an introduction by Increase Mather, who may have been the author; W. B. Sprague's *Annals of the American Pulpit*, vol. i. (New York, 1857); Cotton Mather's *Magnalia* (London, 1702); an essay on Richard Mather in Williston Walker's *Ten New England Leaders* (New York, 1901); and the works referred to in the article on Increase Mather. (R. WE.)

MATHERAN, a hill sanatorium in India, in the Kolaba district of Bombay, 2460 ft. above the sea, and about 30 m. E. of Bombay city. Pop. (1901), 3060. It consists of several thickly wooded ridges, on a spur of the Western Ghats, with a magnificent outlook over the plain below and the distant sea. First explored in 1850, it has since become the favourite resort of the middle classes of Bombay (especially the Parsis) during the spring and autumn months. It has recently been connected by a 2 ft. gauge mountain line with Neral station on the Great Indian Peninsula railway, 54 m. from Bombay.

MATHESON, GEORGE (1842–1906), Scottish theologian and preacher, was born in Glasgow in 1842, the son of George Matheson, a merchant. He was educated at the university of Glasgow, where he graduated first in classics, logic and philosophy. In his twentieth year he became totally blind, but he held to his resolve to enter the ministry, and gave himself to theological and historical study. His first ministry began in 1868 at Innellan, on the Argyllshire coast between Dunoon and Toward. His books on *Aids to the Study of German Theology*, *Can the Old Faith live with the New?* *The Growth of the Spirit of Christianity from the First Century to the Dawn of the Lutheran Era*, established his reputation as a liberal and spiritually minded theologian; and Queen Victoria invited him to preach at Balmoral. In 1886 he removed to Edinburgh, where he became minister of St Bernard's Parish Church. Here his chief work as a preacher was done. In 1879 the university of Edinburgh conferred upon him the honorary degree of D.D., and the same year he declined an invitation to the pastorate of Crown Court, London, in succession to Dr John Cumming (1807–1881). In 1881 he was chosen as Baird lecturer, and took for his subject “ Natural Elements of Revealed Theology,” and in 1882 he was the St Giles lecturer, his subject being “ Confucianism.” In 1890 he was elected a fellow of the Royal Society of Edinburgh, Aberdeen gave him its honorary LL.D., and in 1899 he was appointed Gifford lecturer by that university, but declined on grounds of health. In the same year he severed his active connexion with St Bernard's. One of his hymns, “ O love that will not let me go,” has passed into the popular hymnology of the Christian Church. He died suddenly of apoplexy on the 28th of August 1906. His exegesis owes its interest to his subjective resources rather than to breadth of learning; his power lay in spiritual vision rather than balanced judgment, and in the vivid apprehension of the factors which make the Christian personality, rather than in constructive doctrinal statement.

MATHEW, THEOBALD (1790–1856), Irish temperance reformer, popularly known as Father Mathew, was descended from a branch of the Llandaff family, and was born at Thomastown, Tipperary, on the 10th of October 1790. He received his school education at Kilkenny, whence he passed for a short time to Maynooth; from 1808 to 1814 he studied at Dublin, where in the latter year he was ordained to the priesthood. Having entered the Capuchin order, he, after a brief time of service at Kilkenny, joined the mission in Cork, which was the scene of his religious and benevolent labours for many years. The movement with which his name is most intimately associated began in 1838 with the establishment of a total abstinence association, which in less than nine months, thanks to his moral influence and eloquence, enrolled no fewer than 150,000 names. It rapidly spread to Limerick and elsewhere, and some idea of its popularity may be formed from the fact that at Nenagh 20,000 persons are said to have taken the pledge in one day, 100,000 at Galway in two days, and 70,000 in Dublin in five days. In 1844 he visited Liverpool, Manchester and London with almost equal success. Meanwhile the expenses of his enterprise had involved him in heavy liabilities, and led on one occasion to his arrest for debt; from this embarrassment he was only partially relieved by a pension of £300 granted by Queen Victoria in 1847. In 1849 he paid a visit to the United States, returning in 1851. He died at Queenstown on the 8th of December, 1856.

See *Father Mathew, a Biography*, by J. F. Maguire, M.P. (1863).

MATHEWS, CHARLES (1776–1835), English actor, was born in London on the 28th of June 1776. His father was “ a serious bookseller,” who also officiated as minister in one of Lady Huntingdon's chapels. Mathews was educated at Merchant Taylors' School. His love for the stage was formed in his boyhood, when he was apprentice to his father, and the latter in 1794 unwillingly permitted him to enter on a theatrical engagement in Dublin. For several years Mathews had not only to content himself with thankless parts at a low salary, but in May 1803 he made his first London appearance at the Haymarket as Jabel in Cumberland's *The Jew* and as Lingo in *The Agreeable Surprise*. From this time his professional career was an uninterrupted triumph. He had a wonderful gift of mimicry, and could completely disguise his personality without the smallest change of dress. The versatility and originality of his powers were admirably displayed in his “ At

Homes," begun in the Lyceum theatre in 1818, which, according to Leigh Hunt, "for the richness and variety of his humour, were as good as half a dozen plays distilled." Off the stage his simple and kind-hearted disposition won him affection and esteem. In 1822 Mathews visited America, his observation on his experiences there forming for the reader a most entertaining portion of his biography. From infancy his health had been uncertain, and the toils of his profession gradually undermined it. In 1834 he paid a second visit to America. His last appearance in New York was on the 11th of February 1835, when he played Samuel Coddle in *Married Life* and Andrew Steward in *The Lone House*. He died at Plymouth on the 28th of June 1835. In 1797 he had married Eliza Kirkham Strong (d. 1802), and in 1803 Anne Jackson, an actress, the author of the popular and diverting *Memoirs, by Mrs Mathews* (4 vols., 1838–1839).

His son **Charles James Mathews** (1803–1878), who was born at Liverpool on the 26th of December 1803, became even better known as an actor. After attending Merchant Taylors' School he was articled as pupil to an architect, and continued for some years nominally to follow this profession. His first public appearance on the stage was made on the 7th of December 1835, at the Olympic, London, as George Rattleton in his own play *The Humpbacked Lover*, and as Tim Topple the Tiger in Leman Rode's *Old and Young Stager*. In 1838 he married Madame Vestris, then lessee of the Olympic, but neither his management of this theatre, nor subsequently of Covent Garden, nor of the Lyceum, resulted in pecuniary success, although the introduction of scenery more realistic and careful in detail than had hitherto been employed was due to his enterprise. In the year of his marriage he visited America, but without receiving a very cordial welcome. As an actor he held in England an unrivalled place in his peculiar vein of light eccentric comedy. The easy grace of his manner, and the imperturbable solemnity with which he perpetrated his absurdities, never failed to charm and amuse; his humour was never broad, but always measured and restrained. It was as the leading character in such plays as the *Game of Speculation*, *My Awful Dad*, *Cool as a Cucumber*, *Patter versus Clatter*, and *Little Toddlekins*, that he specially excelled. In 1856 Mme Vestris died, and in the following year Mathews again visited the United States, where in 1858 he married Mrs A. H. Davenport. In 1861 they gave a series of "At Homes" at the Haymarket theatre, which were almost as popular as had been those of the elder Mathews. Charles James Mathews was one of the few English actors who played in French successfully,—his appearance in Paris in 1863 in a French version of *Cool as a Cucumber*, written by himself, being received with great approbation. He also played there again in 1865 as Sir Charles Coldcream in the original play *L'Homme blasé* (English version by Boucicault, *Used up*). After reaching his sixty-sixth year, Mathews set out on a tour round the world, in which was included a third visit to America, and on his return in 1872 he continued to act without interruption till within a few weeks of his death on the 24th of June 1878. He made his last appearance in New York at Wallack's theatre on the 7th of June 1872, in H. J. Byron's *Not such a Fool as he Looks.* His last appearance in London was at the Opéra Comique on the 2nd of June 1877, in *The Liar* and *The Cosy Couple.* At Stalybridge he gave his last performance on the 8th of June 1878, when he played Adonis Evergreen in his own comedy *My Awful Dad.*

See the *Life of Charles James Mathews*, edited by Charles Dickens (2 vols., 1879); H. G. Paine in *Actors and Actresses of Great Britain and the United States* (New York, 1886).

MATHEWS, THOMAS (1676–1751), British admiral, son of Colonel Edward Mathews (d. 1700), and grandson on his mother's side of Sir Thomas Armstrong (1624–1684), who was executed for the Rye House Plot, was born at Llandaff Court, Llandaff. He entered the navy and became lieutenant in 1699, being promoted captain in 1703. During the short war with Spain (1718–20) he commanded the "Kent" in the fleet of Sir George Byng (Lord Torrington), and from 1722 to 1724 he had the command of a small squadron sent to the East Indies to repress the pirates of the coast of Malabar. He saw no further service till March 1741, when he was appointed to the command in the Mediterranean, and plenipotentiary to the king of Sardinia and the other courts of Italy. It is impossible to understand upon what grounds he was selected. As an admiral he was not distinguished; he was quite destitute of the experience and the tact required for his diplomatic duties; and he was on the worst possible terms with his second in command, Richard Lestock (1679?–1746). Yet the purpose for which he was sent out in his double capacity was not altogether ill performed. In 1742 Mathews sent a small squadron to Naples to compel King Charles III., afterwards king of Spain, to remain neutral. It was commanded by commodore, afterwards admiral, William Martin (1696?–1756), who refused to enter into negotiations, and gave the king half an hour in which to return an answer. In June of the same year a squadron of Spanish galleys, which had taken refuge in the Bay of Saint Tropez, was burnt by the fireships of Mathews' fleet. In the meantime a Spanish squadron of line-of-battleships had taken refuge in Toulon, and was watched by the British fleet from its anchorage at Hyères. In February 1744 the Spaniards put to sea in company with a French force. Mathews, who had now returned to his flagship, followed, and an engagement took place on the 11th of February. The battle was highly discreditable to the British fleet, and not very honourable to their opponents, but it is of the highest historical importance in the history of the navy. It marked the lowest pitch reached in discipline and fighting and efficiency by the fleet in the 18th century, and it had a very bad effect in confirming the pedantic system of tactics set up by the old Fighting Instructions. The British fleet followed the enemy in light winds on the 10th of February, and became scattered. Mathews hoisted the signal to form the line, and then when night fell, to lie to. At that moment Lestock, who commanded in the rear, was at a considerable distance from the body of the fleet, and he ought undoubtedly to have joined his admiral before lying to, but he obeyed the second order, with the result, which it is impossible not to feel that he foresaw and desired, that when morning came he was a long way off the flag of Mathews. The enemy were within striking distance of the van and centre of the British fleet, and Mathews attacked their rear. The battle was ill fought, as it had been ill prepared. Lestock never came into action at all. One Spanish line-of-battleship, the "Poder" (74), was taken, but afterwards burnt. Several of the British captains behaved very badly, and Mathews in a heat of confused anger bore down on the enemy out of his line, while the signal to keep the line was still flying at his mast head. The French and Spaniards got away, and were not pursued by Mathews, though they were of inferior strength.

Deep indignation was aroused at home by this naval miscarriage, and the battle led to more than twenty courts-martial and a parliamentary inquiry. The evils which had overrun the navy were clearly displayed, and in so far some good was done. It was shown for instance that one of the captains whose ship behaved worst was a man of extreme age who was nearly blind and deaf. One of the captains was so frightened at the prospect of a trial that he deserted on his way home and disappeared into Spain. Mathews resigned and returned home after the battle. In consequence of the parliamentary motion for inquiry, Lestock was brought to trial, and acquitted on the ground that he had obeyed orders. Then Mathews was tried in 1746, and was condemned to be dismissed the service on the ground that he had not only failed to pursue the enemy but had taken his fleet into action in a confused manner. He had in fact not waited till he had his fleet in a line with the enemy before bearing down on them, and he had disordered his own line. To the country at large it appeared strange that the admiral who had actually fought should be condemned, while the admiral who had kept at a distance was acquitted. Mathews looked upon his condemnation as the result of mere party spirit. Sheer pedantry on the part of the officers forming the court-martial affords a more satisfactory explanation. They judged that a naval officer was bound not to go beyond the Fighting Instructions as Mathews had undoubtedly done, and therefore condemned him. Their decision had a serious effect in fixing the rule that all battles, at any rate against enemies of equal or nearly equal numbers, were to be fought on one pattern. Mathews died on the 2nd of October 1751 in London. There is a portrait of him in the Painted Hall at Greenwich.

In Beatson's *Naval and Military Memoirs*, vol. i., will be found a fair account of the battle of February 1744. It is fully dealt with by Montagu Burrows in his *Life of Hawke*. The French account may be found in Tronde's *Batailles Navales de la France*. The Spanish view is in the *Vida de Don Josef Navarro* by Don Josef de Vargas. The battle led to a violent pamphlet controversy The charges and findings at the courts-martial on both Lestock and Mathews were published at the time. The minor trials arising out of the action are collected in a folio under the title "Copies of all the Minutes and Proceedings taken at and upon the several Tryals of Captain George Burrish" (1746). A "Narrative" was published by, or for, Lestock in 1744, and answered by, or on behalf of, Mathews under the title "Ad——l M——w's Conduct in the late Engagement Vindicated" in 1745. (D. H.)

MATHY, KARL (1807–1868), Badenese statesman, was born at Mannheim on the 17th of March 1807. He studied law and politics at Heidelberg, and entered the Baden government department of finance in 1829. His sympathy with the revolutionary ideas of 1830, expressed in his paper the *Zeitgeist*, cost him his appointment in 1834, and he made his way to Switzerland, where he contributed to the *Jeune Suisse* directed by Mazzini. On his return to Baden in 1840 he edited the *Landtagszeitung* at Carlsruhe, and in 1842 he entered the estates for the town of Constance. He became one of the opposition leaders and in 1847 helped to found the *Deutsche Zeitung*, a paper which eventually did much to further the cause of German unity. He took part in the preliminary parliament and in the assembly of Frankfort in 1848–1849, where he supported the policy of H. W. A. von Gagern, and after the refusal of Frederick William IV. to accept the imperial crown he still worked for the cause of unity. He was made finance minister in Baden in May 1849, but was dismissed after a few days of office. He then applied his financial knowledge to banking business in Cologne, Berlin, Gotha and Leipzig. He was recalled to Baden in 1862, and in 1864 became president of the new ministry of commerce. He sought to bring Baden institutions into line with those of northern Germany with a view to ultimate union, and when in 1866 Baden took sides with Austria against Prussia he sent in his resignation. After the war he became president of a new cabinet, but he did not live to see the realization of the policy for which he had striven. He died at Carlsruhe on the 3rd of February 1868.

His letters during the years 1846–1848 were edited by Ludwig Mathy (Leipzig, 1899), and his life was written by G. Freytag (Leipzig, 2nd ed., 1872).

MATILDA (1102–1164), queen of England and empress, daughter of Henry I. of England, by Matilda, his first wife, was born in 1102. In 1109 she was betrothed to the emperor-elect, Henry V., and was sent to Germany, but the marriage was delayed till 1114. Her husband died after eleven years of wedlock, leaving her childless; and, since both her brothers were now dead, she was recalled to her father's court in order that she might be recognized as his successor in England and Normandy. The Great Council of England did homage to her under considerable pressure. Their reluctance to acknowledge a female sovereign was increased when Henry gave her in marriage to Geoffrey Plantagenet, the heir of Anjou and Maine (1129); nor was it removed by the birth of the future Henry II. in 1133. On the old king's death both England and Normandy accepted his nephew, Stephen, of Mortain and Boulogne. Matilda and her husband were in Anjou at the time. They wasted the next few years in the attempt to win Normandy; but Earl Robert of Gloucester, the half-brother of the empress, at length induced her to visit England and raise her standard in the western shires, where his influence was supreme. Though on her first landing Matilda only escaped capture through the misplaced chivalry of her opponent, she soon turned the tables upon him with the help of the Church and the barons of the west. Stephen was defeated and captured at Lincoln (1141); the empress was acclaimed lady or queen of England (she used both titles indifferently) and crowned at London. But the arrogance which she displayed in her prosperity alienated the Londoners and the papal legate, Bishop Henry of Winchester. Routed at the siege of Winchester, she was compelled to release Stephen in exchange for Earl Robert, and thenceforward her cause steadily declined in England. In 1148, having lost by the earl's death her principal supporter, she retired to Normandy, of which her husband had in the meantime gained possession. Henceforward she remained in the background, leaving her eldest son Henry to pursue the struggle with Stephen. She outlived Henry's coronation by ten years; her husband had died in 1151. As queen-mother she played the part of a mediator between her sons and political parties. Age mellowed her temper, and she turned more and more from secular ambitions to charity and religious works. She died on the 30th of January 1164.

See O. Rössler, *Kaiserin Mathilde* (Berlin, 1897); J. H. Round, *Geoffrey de Mandeville* (London, 1892). (H. W. C. D.)

MATILDA (1046–1115), countess or margravine of Tuscany popularly known as the Great Countess, was descended from a noble Lombard family. Her great-grandfather, Athone of Canossa, had been made count of Modena and Reggio by the emperor Otto I., and her grandfather had, in addition, acquired Mantua, Ferrara and Brescia. Her own father, Boniface II., the Pious, secured Tuscany, the duchy of Spoleto, the county of Parma, and probably that of Cremona; and was loyal to the emperor until Henry plotted against him. Through the murder of Count Boniface in 1052 and the death of her older brother and sister three years later, Matilda was left, at the age of nine, sole heiress to the richest estate in Italy. She received an excellent education under the care of her mother, Beatrice of Bar, the daughter of Frederick of Lorraine and aunt of Henry III., who, after a brief detention in Germany by the emperor, married Godfrey IV. of Lorraine, brother of Pope Stephen IX. (1057–1058). Thenceforth Matilda's lot was cast against the emperor in the great struggle over investiture, and for over thirty years she maintained the cause of the successive pontiffs, Gregory VII., Victor III., Urban II., Paschal II., with varying fortune, but with undaunted resolution. She aided the pope against the Normans in 1074, and in 1075 attended the synod at which Guibert was condemned and deprived of the archbishopric of Ravenna. Her hereditary fief of Canossa was the scene (Jan. 28, 1077) of the celebrated penance of Henry IV. before Gregory VII. She provided an asylum for Henry's second wife, Praxides, and urged his son Conrad to revolt against his father. In the course of the protracted struggle her villages were plundered, her fortresses demolished, and Pisa and Lucca temporarily lost, but she remained steadfast in her allegiance, and, before her death, had, by means of a league of Lombard cities which she formed, recovered all her possessions. The donation of her estates to the Holy See, originally made in 1077 and renewed on the 17th of November 1102, though never fully consummated on account of imperial opposition, constituted the greater part of the temporal dominion of the papacy. Matilda was twice married, first to Godfrey V. of Lorraine, surnamed the Humpbacked, who was the son of her step-father and was murdered on the 26th of February 1076; and secondly to the 17-year-old Welf V. of Bavaria, from whom she finally separated in 1095—both marriages of policy, which counted for little in her life. Matilda was an eager student: she spoke Italian, French and German fluently, and wrote many Latin letters; she collected a considerable library; she supervised an edition of the Pandects of Justinian; and Anselm of Canterbury sent her his *Meditations*. She combined her devotion to the papacy and her learning with very deep personal piety. She died after a long illness at Bodeno, near Modena, on the 24th of July 1115, and was buried in the Benedictine church at Polirone, whence her remains were taken to Rome by order of Urban VIII. in 1635 and interred in St Peter's.

The contemporary record of Matilda's life in rude Latin verse, by her chaplain Domnizone (Donizo or Domenico), is preserved in the Vatican Library. The best edition is that of Bethmann in the *Monumenta germ. hist. scriptores*, xii. 348–409. The text, with an Italian translation, was published by F. Davoli under the title *Vita della granda contessa Matilda di Canossa* (Reggio nell' Emilia 1888 seq.).

See A. Overmann, *Gräfin Mathilde von Tuscien; ihre Besitzungen . . . u. ihre Regesten* (Innsbruck, 1895); A. Colombo, *Una Nuova vita della contessa Matilda* in *R. accad. d. sci. Atti*, vol. 39 (Turin, 1904); L. Tosti, *La Contessa Matilda ed i romani pontefici* (Florence, 1859); A. Pannenborg, *Studien zur Geschichte der Herzogin Matilde von Canossa* (Göttingen, 1872); F. M. Fiorentini, *Memorie della Matilda* (Lucca, 1756); and Nora Duff, *Matilda of Tuscany* (1910).
(C. H. Ha.)

MATINS (Fr. *matines*, med. Lat. *matutinae*, *sc.* possibly *vigiliae*, morning watches; from *matutinus*, "belonging to the morning"), a word now only used in an ecclesiastical sense for one of the canonical hours in the Roman Breviary, originally intended to be said at midnight, but sometimes said at dawn, after which "lauds" were recited or sung. In the modern Roman Catholic Church, outside monastic services, the office is usually said on the preceding afternoon or evening. The word is also used in the Roman Catholic Church for the public service held on Sunday mornings before the mass (see BREVIARY; and HOURS, CANONICAL). In the Church of England since the Reformation matins is used for the order of public morning prayer.

MATLOCK, a market town in the western parliamentary division of Derbyshire, England, on the river Derwent, 17 m. N. by W. of Derby on the Midland railway. Pop. (1901), of urban district of Matlock, 5979; of Matlock Bath and Scarthin Nick, 1819. The entire township includes the old village of Matlock, the commercial and manufacturing district of Matlock Bridge, and the fashionable health resorts of Matlock Bath and Matlock Bank. The town possesses cotton, corn and paper mills, while in the vicinity there are stone-quarries and lead mines. A peculiar local industry is the manufacture of so-called "petrified" birds' nests, plants, and other objects. These are steeped in water from the mineral springs until they become encrusted with a calcareous deposit which gives them the appearance of fossils. Ornaments fashioned out of spar and stalactites have also a considerable sale.

MATLOCK BATH, one and a half miles south of Matlock, having a separate railway station, overlooks the narrow and precipitous gorge of the Derwent, and stands in the midst of woods and cliffs, deriving its name from three medicinal springs, which first became celebrated towards the close of the 17th century. They were not known to the Romans, although lead-mining was carried on extensively in the district in the 1st and 2nd centuries A.D. The mean temperature of the springs is 68° F. Extensive grounds have been laid out for public use; and in the neighbourhood there are several fine stalactite caverns.

Sheltered under the high moorlands of Darley, MATLOCK BANK has grown up about a mile north-east of the old village, and has become celebrated for the number and excellence of its hydropathic establishments. A tramway, worked by a single cable, over a gradient said to be the steepest in the world, affords easy communication with Matlock Bridge.

MATOS FRAGOSO, JUAN DE (1614?–1689), Spanish dramatist, of Portuguese descent, was born about 1614 at Alsito (Alemtejo). After taking his degree in law at the university of Evora, he proceeded to Madrid, where he made acquaintance with Perez de Montalbán, and thus obtained an introduction to the stage. He quickly displayed great cleverness in hitting the public taste, and many contemporaries of superior talent eagerly sought his aid as a collaborator. The earliest of his printed plays is *La Defensa de la fé y príncipe prodigioso* (1651), and twelve more pieces were published in 1658. But though his popularity continued long after his death (January 4, 1689), Matos Fragoso's dramas do not stand the test of reading. His emphatic preciosity and sophistical insistence on the "point of honour" are tedious and unconvincing; in *La Venganza en el despeño*, in *Á lo que obliga un agravio*, and in other plays, he merely recasts, very adroitly, works by Lope de Vega.

MATRASS (mod. Lat. *matracium*), a glass vessel with a round or oval body and a long narrow neck, used in chemistry, &c., as a digester or distiller. The Florence flask of commerce is frequently used for this purpose. The word is possibly identical with an old name "matrass" (Fr. *materas*, *matelas*) for the bolt or quarrel of a cross-bow. If so, some identity of shape is the reason for the application of the word; "bolt-head" is also used as a name for the vessel. Another connexion is suggested with the Arabic *matra*, a leather bottle.

MATRIARCHATE ("rule of the mother"), a term used to express a supposed earliest and lowest form of family life, typical of primitive societies, in which the promiscuous relations of the sexes result in the child's father being unknown (see FAMILY). In such communities the mother took precedence of the father in certain important respects, especially in line of descent and inheritance. Matriarchate is assumed on this theory to have been universal in prehistoric times. The prominent position then naturally assigned women did not, however, imply any personal power, since they were in the position of mere chattels: it simply constituted them the sole relatives of their children and the only centre of any such family life as existed. The custom of tracing descent through the female is still observed among certain savage tribes. In Fiji father and son are not regarded as relatives. Among the Bechuanas the chieftainship passes to a brother, not to a son. In Senegal, Loango, Congo and Guinea, relationship is traced through the female. Among the Tuareg Berbers a child takes rank, freeman's or slave's, from its mother.

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MATRIMONY (Lat. *matrimonium*, marriage, which is the ordinary English sense), a game at cards played with a full whist pack upon a table divided into three compartments labelled "Matrimony," "Intrigue" and "Confederacy," and two smaller spaces, "Pair" and "Best." These names indicate combinations of two cards, any king and queen being "Matrimony," any queen and knave "Intrigue," any king and knave "Confederacy"; while any two cards of the same denomination form a "Pair" and the diamond ace is "Best." The dealer distributes a number of counters, to which an agreed value has been given, upon the compartments, and the other players do likewise. The dealer then gives one card to each player, face down, and a second, face up. If any turned-up card is the diamond ace, the player holding it takes everything on the space and the deal passes. If not turned, the diamond ace has only the value of the other three aces. If it is not turned, the players, beginning with the eldest hand, expose their second cards, and the resulting combinations, if among the five successful ones, win the counters of the corresponding spaces. If the counters on a space are not won, they remain until the next deal.

MATRIX, a word of somewhat wide application, chiefly used in the sense of a bed or enclosing mass in which something is shaped or formed (Late Lat. *matrix*, womb; in classical Latin *matrix* was only applied to an animal kept for breeding). Matrix is thus used of a mould of metal or other substance in which a design or pattern is made in intaglio, and from which an impression in relief is taken. In die-sinking and coining, the matrix is the hardened steel mould from which the die-punches are taken. The term "seal" should strictly be applied to the impression only on wax of the design of the matrix, but is often used both of the matrix and of the impression (see SEALS). In mineralogy, the matrix is the mass in which a crystal mineral or fossil is embedded. In mathematics, the name "matrix" is used of an arrangement of numbers or symbols in a rectangular or square figure. (See ALGEBRAIC FORMS.)

In med. Latin *matrix* and the diminutive *matricula* had the meaning of a roll or register, particularly one containing the names of the members of an institution, as of the clergy belonging to a cathedral, collegiate or other church, or of the members of a university. From this use is derived "matriculation," the admission to membership of a university, also the name of the examination for such admission. *Matricula* was also the name of the contributions in men and money made by the various states of the Holy Roman Empire, and in the modern German Empire the contributions made by the federal states to the imperial finances are called *Matrikularbeiträge*, matricular contributions. (See GERMANY: *Finance.*)

MATROSS, the name (now obsolete) for a soldier of artillery, who ranked next below a gunner. The duty of a matross was to assist the gunners in loading, firing and sponging the guns. They were provided with firelocks, and marched with the store-wagons, acting as guards. In the American army a matross ranked as a private of artillery. The word is probably derived from Fr. *matelot*, a sailor.

MATSUKATA, MARQUIS (1835–), Japanese statesman, was born at Kagoshima in 1835, being a son of a *samurai* of the Satsuma clan. On the completion of the feudal revolution of 1868 he was appointed governor of the province of Tosa, and having served six years in this office, was transferred to Tōkyō as assistant minister of finance. As representative of Japan at the Paris Exhibition of 1878, he took the opportunity afforded by his mission to study the financial systems of the great European powers. On his return home, he held for a short time in 1880 the portfolio of home affairs, and was in 1881 appointed minister of finance. The condition of the currency of Japan was at that time deplorable, and national bankruptcy threatened. The coinage had not only been seriously debased during the closing years of the Tokugawa régime, but large quantities of paper currency had been issued and circulated, both by many of the feudal lords, and by the central government itself, as a temporary expedient for filling an impoverished exchequer. In 1878 depreciation had set in, and the inconvertible paper had by the close of 1881 grown to such an extent that it was then at a discount of 80% as compared with silver. Matsukata showed the government the danger of the situation, and urged that the issue of further paper currency should be stopped at once, the expenses of administration curtailed, and the resulting surplus of revenue used in the redemption of the paper currency and in the creation of a specie reserve. These proposals were acted upon: the Bank of Japan was established, and the right of issuing convertible notes given to it; and within three years of the initiation of these financial reforms, the paper currency, largely reduced in quantity, was restored to its full par value with silver, and the currency as a whole placed on a solvent basis. From this time forward Japan's commercial and military advancement continued to make uninterrupted progress. But *pari passu* with the extraordinary impetus given to its trade by the successful conclusion of the war with China, the national expenditure enormously increased, rising within a few years from 80 to 250 million yen. The task of providing for this expenditure fell entirely on Matsukata, who had to face strong opposition on the part of the diet. But he distributed the increased taxation so equally, and chose its subjects so wisely, that the ordinary administrative expenditure and the interest on the national debt were fully provided for, while the extraordinary expenditure for military purposes was met from the Chinese indemnity. As far back as 1878 Matsukata perceived the advantages of a gold standard, but it was not until 1897 that his scheme could be realized. In this year the bill authorizing it was under his auspices submitted to the diet and passed; and with this financial achievement Matsukata saw the fulfilment of his ideas of financial reform, which were conceived during his first visit to Europe. Matsukata, who in 1884 was created Count, twice held the office of prime minister (1891–1892, 1896–1898), and during both his administrations he combined the portfolio of finance with the premiership; from October 1898 to October 1900 he was minister of finance only. His name in Japanese history is indissolubly connected with the financial progress of his country at the end of the 19th century. In 1902 he visited England and America, and he was created G.C.M.G., and given the Oxford degree of D.C.L. In September 1907 he was advanced to the rank of Marquis.

MATSYS (MASSYS or METZYS), **QUINTIN** (1466–1530), Flemish artist, was born at Louvain, where he first learned a mechanical art. During the greater part of the 15th century the centres in which the painters of the Low Countries most congregated were Bruges, Ghent and Brussels. Towards the close of the same period Louvain took a prominent part in giving employment to workmen of every craft. It was not till the opening of the 16th century that Antwerp usurped the lead which it afterwards maintained against Bruges and Ghent, Brussels, Mechlin and Louvain. Quintin Matsys was one of the first men of any note who gave repute to the gild of Antwerp. A legend relates how the smith of Louvain was induced by affection for the daughter of an artist to change his trade and acquire proficiency in painting. A less poetic but perhaps more real version of the story tells that Quintin had a brother with whom he was brought up by his father Josse Matsys, a smith, who held the lucrative offices of clockmaker and architect to the municipality of Louvain. It came to be a question which of the sons should follow the paternal business, and which carve out a new profession for himself. Josse the son elected to succeed his father, and Quintin then gave himself to the study of painting. We are not told expressly by whom Quintin was taught, but his style seems necessarily derived from the lessons of Dierick Bouts, who took to Louvain the mixed art of Memlinc and Van der Weyden. When he settled at Antwerp, at the age of twenty-five, he probably had a style with an impress of its own, which certainly contributed most importantly to the revival of Flemish art on the lines of Van Eyck and Van der Weyden. What particularly characterizes Quintin Matsys is the strong religious feeling which he inherited from earlier schools. But that again was permeated by realism which frequently degenerated into the grotesque. Nor would it be too much to say that the facial peculiarities of the boors of Van Steen or Ostade have their counterparts in the pictures of Matsys, who was not, however, trained to use them in the same homely way. From Van der Weyden's example we may trace the dryness of outline and shadeless modelling and the pitiless finish even of trivial detail, from the Van Eycks and Memlinc through Dierick Bouts the superior glow and richness of transparent pigments, which mark the pictures of Matsys. The date of his retirement from Louvain is 1491, when he became a master in the gild of painters at Antwerp. His most celebrated picture is that which he executed in 1508 for the joiners' company in the cathedral of his adopted city. Next in importance to that is the Marys of Scripture round the Virgin and Child, which was ordered for a chapel in the cathedral of Louvain. Both altar-pieces are now in public museums one at Antwerp, the other at Brussels. They display great earnestness in expression, great minuteness of finish, and a general absence of effect by light or shade. As in early Flemish pictures, so in those of Matsys, superfluous care is lavished on jewelry, edgings and ornament. To the great defect of want of atmosphere such faults may be added as affectation, the result of excessive straining after tenderness in women, or common gesture and grimace suggested by a wish to render pictorially the brutality of gaolers and executioners. Yet in every instance an effort is manifest to develop and express individual character. This tendency in Matsys is chiefly illustrated in his pictures of male and female market bankers

(Louvre and Windsor), in which an attempt is made to display concentrated cupidity and avarice. The other tendency to excessive emphasis of tenderness may be seen in two replicas of the "Virgin and Child" at Berlin and Amsterdam, where the ecstatic kiss of the mother is quite unreal. But in these examples there is a remarkable glow of colour which makes up for many defects. Expression of despair is strongly exaggerated in a Lucretia at the museum of Vienna. On the whole the best pictures of Matsys are the quietest; his "Virgin and Christ" or "Ecce Homo" and "Mater Dolorosa" (London and Antwerp) display as much serenity and dignity as seems consistent with the master's art. He had considerable skill as a portrait painter. Egidius at Longford, which drew from Sir Thomas More a eulogy in Latin verse, is but one of a numerous class, to which we may add the portrait of Maximilian of Austria in the gallery of Amsterdam. Matsys in this branch of practice was much under the influence of his contemporaries Lucas of Leiden and Mabuse. His tendency to polish and smoothness excluded to some extent the subtlety of modulation remarkable in Holbein and Dürer. There is reason to think that he was well acquainted with both these German masters. He probably met Holbein more than once on his way to England. He saw Dürer at Antwerp in 1520. Quintin died at Antwerp in 1530. The puritan feeling which slumbered in him was fatal to some of his relatives. His sister Catherine and her husband suffered at Louvain in 1543 for the then capital offence of reading the Bible, he being decapitated, she buried alive in the square fronting the cathedral.

Quintin's son, Jan Matsys, inherited the art but not the skill of his parent. The earliest of his works, a "St Jerome," dated 1537, in the gallery of Vienna, the latest, a "Healing of Tobias," of 1564, in the museum of Antwerp, are sufficient evidence of his tendency to substitute imitation for original thought.

MATTEAWAN, a village of Fishkill township, Dutchess county, New York, U.S.A., on the eastern bank of the Hudson river, opposite Newburgh and 15 m. S. of Poughkeepsie. Pop. (1890), 4278; (1900), 5807 (1044 foreign-born); (1905, state census), 5584; (1910), 6727. The village is served by the Central New England railway, and is the seat of the Matteawan state hospital for the criminal insane, the Highland hospital, and the Sargeant industrial school. The Teller House dates back to the beginning of the 18th century. Near Matteawan is Beacon Hill, the highest of the highlands, which has an electric railway to its summit. There are manufactures of hats, rubber goods, machinery (notably "fuel-economizers"), &c., water-power being furnished by Fishkill Creek. The village owns its water-works, the supply for which is derived from Beacon Hill. Matteawan was incorporated as a village in 1886.

MATTER. Our conceptions of the nature and structure of matter have been profoundly influenced in recent years by investigations on the Conduction of Electricity through Gases (see CONDUCTION, ELECTRIC) and on Radio-activity (*q.v.*). These researches and the ideas which they have suggested have already thrown much light on some of the most fundamental questions connected with matter; they have, too, furnished us with far more powerful methods for investigating many problems connected with the structure of matter than those hitherto available. There is thus every reason to believe that our knowledge of the structure of matter will soon become far more precise and complete than it is at present, for now we have the means of settling by testing directly many points which are still doubtful, but which formerly seemed far beyond the reach of experiment.

The Molecular Theory of Matter—the only theory ever seriously advocated—supposes that all visible forms of matter are collocations of simpler and smaller portions. There has been a continuous tendency as science has advanced to reduce further and further the number of the different kinds of things of which all matter is supposed to be built up. First came the molecular theory teaching us to regard matter as made up of an enormous number of small particles, each kind of matter having its characteristic particle, thus the particles of water were supposed to be different from those of air and indeed from those of any other substance. Then came Dalton's Atomic Theory which taught that these molecules, in spite of their almost infinite variety, were all built up of still smaller bodies, the atoms of the chemical elements, and that the number of different types of these smaller bodies was limited to the sixty or seventy types which represent the atoms of the substance regarded by chemists as elements.

In 1815 Prout suggested that the atoms of the heavier chemical elements were themselves composite and that they were all built up of atoms of the lightest element, hydrogen, so that all the different forms of matter are edifices built of the same material—the atom of hydrogen. If the atoms of hydrogen do not alter in weight when they combine to form atoms of other elements the atomic weights of all elements would be multiples of that of hydrogen; though the number of elements whose atomic weights are multiples or very nearly so of hydrogen is very striking, there are several which are universally admitted to have atomic weights differing largely from whole numbers. We do not know enough about gravity to say whether this is due to the change of weight of the hydrogen atoms when they combine to form other atoms, or whether the primordial form from which all matter is built up is something other than the hydrogen atom. Whatever may be the nature of this primordial form, the tendency of all recent discoveries has been to emphasize the truth of the conception of a common basis of matter of all kinds. That the atoms of the different elements have a common basis, that they behave as if they consisted of different numbers of small particles of the same kind, is proved to most minds by the Periodic Law of Mendeléeff and Newlands (see ELEMENT). This law shows that the physical and chemical properties of the different elements are determined by their atomic weights, or to use the language of mathematics, the properties of an element are functions of its atomic weight. Now if we constructed models of the atoms out of different materials, the atomic weight would be but one factor out of many which would influence the physical and chemical properties of the model, we should require to know more than the atomic weight to fix its behaviour. If we were to plot a curve representing the variation of some property of the substance with the atomic weight we should not expect the curve to be a smooth one, for instance two atoms might have the same atomic weight and yet if they were made of different materials have no other property in common. The influence of the atomic weight on the properties of the elements is nowhere more strikingly shown than in the recent developments of physics connected with the discharge of electricity through gases and with radio-activity. The transparency of bodies to Röntgen rays, to cathode rays, to the rays emitted by radioactive substances, the quality of the secondary radiation emitted by the different elements are all determined by the atomic weight of the element. So much is this the case that the behaviour of the element with respect to these rays has been used to determine its atomic weight, when as in the case of Indium, uncertainty as to the valency of the element makes the result of ordinary chemical methods ambiguous.

The radio-active elements indeed furnish us with direct evidence of this unity of composition of matter, for not only does one element uranium, produce another, radium, but all the radio-active substances give rise to helium, so that the substance of the atoms of this gas must be contained in the atoms of the radio-active elements.

It is not radio-active atoms alone that contain a common constituent, for it has been found that all bodies can by suitable treatment, such as raising them to incandescence or exposing them to ultra-violet light, be made to emit negatively electrified particles, and that these particles are the same from whatever source they may be derived. These particles all carry the same charge of negative electricity and all have the same mass, this mass is exceedingly small even when compared with the mass of an atom of hydrogen, which until the discovery of these particles was the smallest mass known to science. These particles are called corpuscles or electrons; their mass according to the most recent determinations is only about $\frac{1}{1700}$ of that of an atom of hydrogen, and their radius is only about one hundred-thousandth part of the radius of the hydrogen atom. As corpuscles of this kind can be obtained from all substances, we infer that they form a constituent of the atoms of all bodies. The atoms of the different elements do not all contain the same number of corpuscles—there are more corpuscles in the atoms of the heavier elements than in the atoms of the lighter ones; in fact, many different considerations point to the conclusion that the number of corpuscles in the atom of any element is proportional to the atomic weight of the element. Different methods of estimating the exact number of corpuscles in the atom have all led to the conclusion that this number is of the same order as the atomic weight; that, for instance, the number of corpuscles in the atom of oxygen is not a large multiple of 16. Some methods indicate that the number of corpuscles in the atom is equal to the atomic weight, while the maximum value obtained by any method is only about four times the atomic weight. This is one of the points on which further experiments will enable us to speak with greater precision. Thus one of the constituents of all atoms is the negatively charged corpuscle; since the atoms are electrically neutral, this negative charge must be accompanied by an equal positive one, so that on this view the atoms must contain a charge of positive electricity proportional to the atomic weight; the way in which this positive electricity is arranged is a matter of great importance in the consideration of the constitution of matter. The question naturally arises, is the positive electricity done up into definite units like the negative, or does it merely indicate a property acquired by an atom when one or more corpuscles leave it? It is very remarkable that we have up to the present (1910), in spite of many investigations on this point, no direct evidence of the existence of positively charged particles with a mass comparable with that of a corpuscle; the smallest positive particle of which we have any direct indication has a mass equal to the mass of an atom of hydrogen, and it is a most remarkable fact that we get positively charged particles having this mass when we send the electric discharge through gases at low pressures, whatever be the kind of gas. It is no doubt exceedingly difficult to get rid of traces of hydrogen in vessels containing gases at low pressures through which an electric discharge is passing, but the circumstances under which the positively electrified particles just alluded to appear, and the way in which they remain unaltered in spite of all efforts to clear out any traces of hydrogen, all seem to indicate that these positively electrified particles, whose mass is equal to that of an atom of hydrogen, do not come from minute traces of hydrogen present as an impurity but from the oxygen, nitrogen, or helium, or whatever may be the gas through which the discharge passes. If this is so, then the most natural conclusion we can come to is that these positively electrified particles with the mass of the atom of hydrogen are the natural units of positive electricity, just as the corpuscles are those of negative, and that these positive particles form a part of all atoms.

Thus in this way we are led to an electrical view of the constitution of the atom. We regard the atom as built up of units of negative electricity and of an equal number of units of positive electricity; these two units are of very different mass, the mass of the negative unit being only $\frac{1}{1700}$ of that of the positive. The number of units of either kind is proportional to the atomic weight of the element and of the same order as this quantity. Whether this is anything besides the positive and negative electricity in the atom we do not know. In the present state of our knowledge of the properties of matter it is unnecessary to postulate the existence of anything besides these positive and negative units.

The atom of a chemical element on this view of the constitution of matter is a system formed by n corpuscles and n units of positive electricity which is in equilibrium or in a state of steady motion under the electrical forces which the charged $2n$ constituents exert upon each other. Sir J. J. Thomson (*Phil. Mag.*, March 1904, "Corpuscular Theory of Matter") has investigated the systems in steady motion which can be formed by various numbers of negatively electrified particles immersed in a sphere of uniform positive electrification, a case, which in consequence of the enormous volume of the units of positive electricity in comparison with that of the negative has much in common with the problem under consideration, and has shown that some of the properties of n systems of corpuscles vary in a periodic way suggestive of the Periodic Law in Chemistry as n is continually increased.

Mass on the Electrical Theory of Matter.—One of the most characteristic things about matter is the possession of mass. When we take the electrical theory of matter the idea of mass takes new and interesting forms. This point may be illustrated by the case of a single electrified particle; when this moves it produces in the region around it a magnetic field, the magnetic force being proportional to the velocity of the electrified particle.[1] In a magnetic field, however, there is energy, and the amount of energy per unit volume at any place is proportional to the square of the magnetic force at that place. Thus there will be energy distributed through the space around the moving particle, and when the velocity of the particle is small compared with that of light we can easily show that the energy in the region around the charged particle is $\frac{\mu e^2}{3a}$, when v is the velocity of the particle, e its charge, a its radius, and μ the magnetic permeability of the region round the particle. If m is the ordinary mass of the particle, the part of the kinetic energy due to the motion of this mass is $\frac{1}{2}mv^2$, thus the total kinetic energy is $\frac{1}{2}\left(m + \frac{2}{3}\frac{\mu e^2}{a}\right)$. Thus the electric charge on the particle makes it behave as if its mass were increased by $\frac{2}{3}\frac{\mu e^2}{a}$. Since this increase in mass is due to the energy in the region outside the charged particle, it is natural to look to that region for this additional mass. This region is traversed by the tubes of force which start from the electrified body and move with it, and a very simple calculation shows that we should get the increase in the mass which is due to the electrification if we suppose that these tubes of force as they move carry with them a certain amount of the ether, and that this ether had mass. The mass of ether thus carried along must be such that the amount of it in unit volume at any part of the field is such that if this were to move with the velocity of light its kinetic energy would be equal to the potential energy of the electric field in the unit volume under consideration. When a tube moves this mass of ether only participates in the motion at right angles to the tube, it is not set in motion by a movement of the tube along its length. We may compare the mass which a charged body acquires in virtue of its charge with the additional mass which a ball apparently acquires when it is placed in water; a ball placed in water behaves as if its mass were greater than its mass when moving in vacuo; we can easily understand why this should be the case, because when the ball in the water moves the water around it must move as well; so that when a force acting on the ball sets it in motion it has to move some of the water as well as the ball, and thus the ball behaves as if its mass were increased. Similarly in the case of the electrified particle, which when it moves carries with it its lines of force, which grip the ether and carry some of it along with them. When the electrified particle is moved a mass of ether has to be moved too, and thus the apparent mass of the particle is increased. The mass of the electrified particle is thus resident in every part of space reached by its lines of force; in this sense an electrified body may be said to extend to an infinite distance; the amount of the mass of the ether attached to the particle diminishes so rapidly as we recede from it that the contributions of regions remote from the particle are quite insignificant, and in the case of a particle as small as a corpuscle not one millionth part of its mass will be farther away from it than the radius of an atom.

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[1] We may measure this velocity with reference to any axes, provided we refer the motion of all the bodies which come into consideration to the same axes.

The increase in the mass of a particle due to given charges varies as we have seen inversely as the radius of the particle; thus the smaller the particle the greater the increase in the mass. For bodies of appreciable size or even for those as small as ordinary atoms the effect of any realizable electric charge is quite insignificant, on the other hand for the smallest bodies known, the corpuscle, there is evidence that the whole of the mass is due to the electric charge. This result has been deduced by the help of an extremely interesting property of the mass due to a charge of electricity, which is that this mass is not constant but varies with the velocity. This comes about in the following way. When the charged particle, which for simplicity we shall suppose to be spherical, is at rest or moving very slowly the lines of electric force are distributed uniformly around it in all directions; when the sphere moves, however, magnetic forces are produced in the region around it, while these, in consequence of electro-magnetic induction in a moving magnetic field, give rise to electric forces which displace the tubes of electric force in such a way as to make them set themselves so as to be more at right angles to the direction in which they are moving than they were before. Thus if the charged sphere were moving along the line AB, the tubes of force would, when the sphere was in motion, tend to leave the region near AB and crowd towards a plane through the centre of the sphere and at right angles to AB, where they would be moving more nearly at right angles to themselves. This crowding of the lines of force increases, however, the potential energy of the electric field, and since the mass of the ether carried along by the lines of force is proportional to the potential energy, the mass of the charged particle will also be increased. The amount of variation of the mass with the velocity depends to some extent on the assumptions we make as to the shape of the corpuscle and the way in which it is electrified. The simplest expression connecting the mass with the velocity is that when the velocity is v the mass is equal to $\frac{2}{3}\frac{\mu e^2}{a}\frac{1}{\left\{1-\frac{v^2}{c^2}\right\}^{\frac{1}{2}}}$ where c is the velocity of light. We see from this that the variation of mass with velocity is very small unless the velocity of the body approaches that of light, but when, as in the case of the β particles emitted by radium, the velocity is only a few per cent. less than that of light, the effect of velocity on the mass becomes very considerable; the formula indicates that if the particles were moving with a velocity equal to that of light they would behave as if their mass were infinite. By observing the variation in the mass of a corpuscle as its velocity changes we can determine how much of the mass depends upon the electric charge and how much is independent of it. For since the latter part of the mass is independent of the velocity, if it predominates the variation with velocity of the mass of a corpuscle will be small; if on the other hand it is negligible the variation in mass with velocity will be that indicated by theory given above. The experiment of Kaufmann (*Göttingen Nach.*, Nov. 8, 1901), Bucherer (*Ann. der Physik.*, xxviii. 513, 1909) on the masses of the β particles shot out by radium, as well as those by Hupka (*Berichte der deutsch. physik. Gesell.*, 1909, p. 249) on the masses of the corpuscle in cathode rays are in agreement with the view that the *whole* of the mass of these particles is due to their electric charge.

The alteration in the mass of a moving charge with its velocity is primarily due to the increase in the potential energy which accompanies the increase in velocity. The connexion between potential energy and mass is general and holds for any arrangement of electrified particles; thus if we assume the electrical constitution of matter, there will be a part of the mass of any system dependent upon the potential energy and in fact proportional to it. Thus every change in potential energy, such for example as occurs when two elements combine with evolution or absorption of heat, must be attended by a change in mass. The amount of this change can be calculated by the rule that if a mass equal to the change in mass were to move with the velocity of light its kinetic energy would equal the change in the potential energy. If we apply this result to the case of the combination of hydrogen and oxygen, where the evolution of heat, about $1{\cdot}6\times10^{11}$ ergs per gramme of water, is greater than in any other known case of chemical combination, we see that the change in mass would only amount to one part in 3000 million, which is far beyond the reach of experiment. The evolution of energy by radio-active substances is enormously larger than in ordinary chemical transformations; thus one gramme of radium emits per day about as much energy as is evolved in the formation of one gramme of water, and goes on doing this for thousands of years. We see, however, that even in this case it would require hundreds of years before the changes in mass became appreciable.

The evolution of energy from the gaseous emanation given off by radium is more rapid than that from radium itself, since according to the experiments of Rutherford (Rutherford, *Radio-activity*, p. 432) a gramme of the emanation would evolve about $2{\cdot}1\times10^{16}$ ergs in four days; this by the rule given above would diminish the mass by about one part in 20,000; but since only very small quantities of the emanation could be used the detection of the change of mass does not seem feasible even in this case.

On the view we have been discussing the existence of potential energy due to an electric field is always associated with mass; wherever there is potential energy there is mass. On the electro-magnetic theory of light, however, a wave of light is accompanied by electric forces, and therefore by potential energy; thus waves of light must behave as if they possessed mass. It may be shown that it follows from the same principles that they must also possess momentum, the direction of the momentum being the direction along which the light is travelling; when the light is absorbed by an opaque substance the momentum in the light is communicated to the substance, which therefore behaves as if the light pressed upon it. The pressure exerted by light was shown by Maxwell (*Electricity and Magnetism*, 3rd ed., p. 440) to be a consequence of his electro-magnetic theory, its existence has been established by the experiment of Lebedew, of Nichols and Hull, and of Poynting.

Weight.

We have hitherto been considering mass from the point of view that the constitution of matter is electrical; we shall proceed to consider the question of weight from the same point of view. The relation between mass and weight is, while the simplest in expression, perhaps the most fundamental and mysterious property possessed by matter. The weight of a body is proportional to its mass, that is if the weights of a number of substances are equal the masses will be equal, whatever the substances may be. This result was verified to a considerable degree of approximation by Newton by means of experiments with pendulums; later, in 1830 Bessel by a very extensive and accurate series of experiments, also made on pendulums, showed that the ratio of mass to weight was certainly to one part in 60,000 the same for all the substances examined by him, these included brass, silver, iron, lead, copper, ivory, water.

The constancy of this ratio acquires new interest when looked at from the point of view of the electrical constitution of matter. We have seen that the atoms of all bodies contain corpuscles, that the mass of a corpuscle is only $\frac{1}{1700}$ of the mass of an atom of hydrogen, that it carries a constant charge of negative electricity, and that its mass is entirely due to this charge, and can be regarded as arising from ether gripped by the lines of force starting from the electrical charge. The question at once suggests itself, Is this kind of mass ponderable? does it add to the weight of the body? and, if so, is the proportion between mass and weight the same as for ordinary bodies? Let us suppose for a moment that this mass is not ponderable, so that the corpuscles increase the mass but not the weight of an atom. Then, since the mass of a corpuscle is $\frac{1}{1700}$ of that of an atom of hydrogen, the addition or removal of one corpuscle would in the case of an atom of atomic weight x alter the mass by one part in 1700 x, without altering the weight, this would produce an effect of the same magnitude on the ratio of mass to weight and would in the case of the atoms of the lighter elements be easily measurable in experiments of the same order of accuracy as those made by Bessel. If the number of corpuscles in the atom were proportional to the atomic weight, then the ratio of mass to weight would be constant whether the corpuscles were ponderable or not. If the number were not proportional there would be greater discrepancies in the ratio of mass to weight than is consistent with Bessel's experiments if the corpuscles had no weight. We have seen there are other grounds for concluding that the number of corpuscles in an atom is proportional to the atom weight, so that the constancy of the ratio of mass to weight for a large number of substances does not enable us to determine whether or not mass due to charges of electricity is ponderable or not.

There seems some hope that the determination of this ratio for radio-active substances may throw some light on this point. The enormous amount of heat evolved by these bodies may indicate that they possess much greater stores of potential energy than other substances. If we suppose that the heat developed by one gramme of a radio-active substance in the transformations which it undergoes before it reaches the non-radio-active stage is a measure of the excess of the potential energy in a gramme of this substance above that in a gramme of non-radio-active substance, it would follow that a larger part of the mass was due to electric charges in radio-active than in non-radio-active substances; in the case of uranium this difference would amount to at least one part in 20,000 of the total mass. If this extra mass had no weight the ratio of mass to weight for uranium would differ from the normal amount by more than one part in 20,000, a quantity quite within the range of pendulum experiments. It thus appears very desirable to make experiments on the ratio of mass to weight for radio-active substances. Sir J. J. Thomson, by swinging a small pendulum whose bob was made of radium bromide, has shown that this ratio for radium does not differ from the normal by one part in 2000. The small quantity of radium available prevented the attainment of greater accuracy. Experiments just completed (1910) by Southerns at the Cavendish Laboratory on this ratio for uranium show that it is normal to an accuracy of one part in 200,000; indicating that in non-radio-active, as in radio-active, substances the electrical mass is proportional to the atomic weight.

Though but few experiments have been made in recent years on the value of the ratio of mass to weight, many important investigations have been made on the effect of alterations in the chemical and physical conditions on the weight of bodies. These have all led to the conclusion that no change which can be detected by our present means of investigation occurs in the weight of a body in consequence of any physical or chemical changes yet investigated. Thus Landolt, who devoted a great number of years to the question whether any change in weight occurs during chemical combination, came finally to the conclusion that in no case out of the many he investigated did any measurable change of weight occur during chemical combination. Poynting and Phillips (*Proc. Roy. Soc.*, 76, p. 445), as well as Southerns (78, p. 392), have shown that change in temperature produces no change in the weight of a body; and Poynting has also shown that neither the weight of a crystal nor the attraction between two crystals depends at all upon the direction in which the axis of the crystal points. The result of these laborious and very carefully made experiments has been to strengthen the conviction that the weight of a given portion of matter is absolutely independent of its physical condition or state of chemical combinations. It should, however, be noticed that we have as yet no accurate investigation as to whether or not any changes of weight occur during radio-active transformations, such for example as the emanation from radium undergoes when the atoms themselves of the substance are disrupted.

It is a matter of some interest in connexion with a discussion of any views of the constitution of matter to consider the theories of gravitation which have been put forward to explain that apparently invariable property of matter—its weight. It would be impossible to consider in detail the numerous theories which have been put forward to account for gravitation; a concise summary of many of these has been given by Drude (Wied. *Ann.* 62, p. 1):[1] there is no dearth of theories as to the cause of gravitation, what is lacking is the means of putting any of them to a decisive test.

There are, however, two theories of gravitation, both old, which seem to be especially closely connected with the idea of the electrical constitution of matter. The first of these is the theory, associated with the two fluid theory of electricity, that gravity is a kind of residual electrical effect, due to the attraction between the units of positive and negative electricity being a little greater than the repulsion between the units of electricity of the same kind. Thus on this view two charges of equal magnitude, but of opposite sign, would exert an attraction varying inversely as the square of the distance on a charge of electricity of either sign, and therefore an attraction on a system consisting of two charges equal in magnitude but opposite in sign forming an electrically neutral system. Thus if we had two neutral systems, A and B, A consisting of m positive units of electricity and an equal number of negative, while B has n units of each kind, then the gravitational attraction between A and B would be inversely proportional to the square of the distance and proportional to $n\,m$. The connexion between this view of gravity and that of the electrical constitution of matter is evidently very close, for if gravity arose in this way the weight of a body would only depend upon the number of units of electricity in the body. On the view that the constitution of matter is electrical, the fundamental units which build up matter are the units of electric charge, and as the magnitude of these charges does not change, whatever chemical or physical vicissitudes matter, the weight of matter ought not to be affected by such changes. There is one result of this theory which might possibly afford a means of testing it: since the charge on a corpuscle is equal to that on a positive unit, the weights of the two are equal; but the mass of the corpuscle is only $\frac{1}{1700}$ of that of the positive unit, so that the acceleration of the corpuscle under gravity will be 1700 times that of the positive unit, which we should expect to be the same as that for ponderable matter or 981.

The acceleration of the corpuscle under gravity on this view would be $1{\cdot}6 \times 10^6$. It does not seem altogether impossible that with methods slightly more powerful than those we now possess we might measure the effect of gravity on a corpuscle if the acceleration were as large as this.

The other theory of gravitation to which we call attention is that due to Le Sage of Geneva and published in 1818. Le Sage supposed that the universe was thronged with exceedingly small particles moving with very great velocities. These particles he called ultra-mundane corpuscles, because they came to us from regions far beyond the solar system. He assumed that these were so penetrating that they could pass through masses as large as the sun or the earth without being absorbed to more than a very small extent. There is, however, some absorption, and if bodies are made up of the same kind of atoms, whose dimensions are small compared with the distances between them, the absorption will be proportional to the mass of the body. So that as the ultra-mundane corpuscles stream through the body a small fraction, proportional to the mass of the body, of their momentum is communicated to it. If the direction of the ultra-mundane corpuscles passing through the body were uniformly distributed, the momentum communicated by them to the body would not tend to move it in one direction rather than in another, so that a body, A, alone in the universe and exposed to bombardment by the ultra-mundane corpuscles would remain at rest. If, however, there were a second body, B, in the neighbourhood of A, B will shield A from some of the corpuscles moving in the direction BA; thus A will not receive as much momentum in this direction as when it was alone; but in this case it only received just enough to keep it in equilibrium, so that when B is present the momentum in the opposite direction will get the upper hand and A will move in the direction AB, and will thus be attracted by B. Similarly, we see that B will be attracted by A. Le Sage proved that the rate at which momentum was being communicated to A or B by the passage through them of his corpuscles was proportional to the product of the masses of A and B, and if the distance between A and B was large compared with their dimensions, inversely proportional to the square of the distance between them; in fact, that the forces acting on them would obey the same laws as the gravitational attraction between them. Clerk Maxwell (article "ATOM," *Ency. Brit.*, 9th ed.) pointed out that this transference of momentum from the ultra-mundane corpuscles to the body through which they passed involved the loss of kinetic energy by the corpuscles, and if the loss of momentum were large enough to account for the gravitational attraction, the loss of kinetic energy would be so large that if converted into heat it would be sufficient to keep the body white hot. We need not, however, suppose that this energy is converted into heat; it might, as in the case where Röntgen rays are produced by the passage of electrified corpuscles through matter, be transformed into the energy of a still more penetrating form of radiation, which might escape from the gravitating body without heating it. It is a very interesting result of recent discoveries that the machinery which Le Sage introduced for the purpose of his theory has a very close analogy with things for which we have now direct experimental evidence. We know that small particles moving with very high speeds do exist, that they possess considerable powers of penetrating solids, though not, as far as we know at present, to an extent comparable with that postulated by Le Sage; and we know that the energy lost by them as they pass through a solid is to a large extent converted into a still more penetrating form of radiation, Röntgen rays. In Le Sage's theory the only function of the corpuscles is to act as carriers of momentum, any systems which possessed momentum, moved with a high velocity and had the power of penetrating solids, might be substituted for them; now waves of electric and magnetic force, such as light waves or Röntgen rays, possess momentum, move with a high velocity, and the latter at any rate possess considerable powers of penetration; so that we might formulate a theory in which penetrating Röntgen rays replaced Le Sage's corpuscles. Röntgen rays, however, when absorbed do not, as far as we know, give rise to more penetrating Röntgen rays as they should to explain attraction, but either to less penetrating rays or to rays of the same kind.

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[1] A theory published after Drude's paper in that of Professor Osborne Reynolds, given in his Rede lecture "**On an Inversion of Ideas as to the Structure of the Universe.**"

We have confined our attention in this article to the view that the constitution of matter is electrical; we have done so because this view is more closely in touch with experiment than any other yet advanced. The units of which matter is built up on this theory have been isolated and detected in the laboratory, and we may hope to discover more and more of their properties. By seeing whether the properties of matter are or are not such as would arise from a collection of units having these properties, we can apply to this theory tests of a much more definite and rigorous character than we can apply to any other theory of matter. (J. J. T.)

MATTERHORN, one of the best known mountains (14,782 ft.) in the Alps. It rises S.W. of the village of Zermatt, and on the frontier between Switzerland (canton of the Valais) and Italy. Though on the Swiss side it appears to be an isolated obelisk, it is really but the butt end of a ridge, while the Swiss slope is not nearly as steep or difficult as the grand terraced walls of the Italian slope. It was first conquered, after a number of attempts chiefly on the Italian side, on the 14th of July 1865, by Mr E. Whymper's party, three members of which (Lord Francis Douglas, the Rev. C. Hudson and Mr Hadow) with the guide, Michel Croz, perished by a slip on the descent. Three days later it was scaled from the Italian side by a party of men from Val Tournanche. Nowadays it is frequently ascended in summer, especially from Zermatt.

MATTEUCCI, CARLO (1811–1868), Italian physicist, was born at Forlì on the 20th of June 1811. After attending the École Polytechnique at Paris, he became professor of physics successively at Bologna (1832), Ravenna (1837) and Pisa (1840). From 1847 he took an active part in politics, and in 1860 was chosen an Italian senator, at the same time becoming inspector-general of the Italian telegraph lines. Two years later he was minister of education. He died near Leghorn on the 25th of June 1868.

He was the author of four scientific treatises: *Lezioni di fisica* (2 vols., Pisa, 1841), *Lezioni sui fenomeni fisicochimici dei corpi viventi* (Pisa, 1844), *Manuale di telegrafia elettrica* (Pisa, 1850) and *Cours spécial sur l'induction, le magnetisme de rotation*, &c. (Paris, 1854). His numerous papers were published in the *Annales de chimie et de physique* (1829–1858); and most of them also appeared at the time in the Italian scientific journals. They relate almost entirely to electrical phenomena, such as the magnetic rotation of light, the action of gas batteries, the effects of torsion on magnetism, the polarization of electrodes, &c., sufficiently complete accounts of which are given in Wiedemann's *Galvanismus*. Nine memoirs, entitled "Electro-Physiological Researches," were published in the *Philosophical Transactions*, 1845–1860. See Bianchi's *Carlo Matteucci e l'Italia del suo tempo* (Rome, 1874).

MATTHEW, ST (*Μαθθαῖος* or *Ματθαῖος*, probably a shortened form of the Hebrew equivalent to Theodorus), one of the twelve apostles, and the traditional author of the First Gospel, where he is described as having been a tax-gatherer or customs-officer (*τελώνης*, x. 3), in the service of the tetrarch Herod. The circumstances of his call to become a follower of Jesus, received as he sat in the "customs house" in one of the towns by the Sea of Galilee—apparently Capernaum (Mark ii. 1, 13), are briefly related in ix. 9. We should gather from the parallel narrative in Mark ii. 14, Luke v. 27, that he was at the time known as "Levi the son of Alphaeus" (compare Simon Cephas, Joseph Barnabas): if so, "James the son of Alphaeus" may have been his brother. Possibly "Matthew" (Yahweh's gift) was his Christian surname, since two native names, neither being a patronymic, is contrary to Jewish usage. It must be noted, however, that Matthew and Levi were sometimes distinguished in early times, as by Heracleon (*c.* 170 A.D.), and more dubiously by Origen (*c. Celsum*, i. 62), also apparently in the Syriac *Didascalia* (sec. iii.), V. xiv. 14. It has generally been supposed, on the strength of Luke's account (v. 29), that Matthew gave a feast in Jesus' honour (like Zacchaeus, Luke xix. 6 seq.). But Mark (ii. 15), followed by Matthew (ix. 10), may mean that the meal in question was one in Jesus' own home at Capernaum (cf. v. 1). In the lists of the Apostles given in the Synoptic Gospels and in Acts, Matthew ranks third or fourth in the second group of four—a fair index of his relative importance in the apostolic age. The only other facts related of Matthew on good authority concern him as Evangelist. Eusebius (*H.E.* iii. 24) says that he, like John, wrote only at the spur of necessity. "For Matthew, after preaching to Hebrews, when about to go also to others, committed to writing in his native tongue the Gospel that bears his name; and so by his writing supplied, for those whom he was leaving, the loss of his presence." The value of this tradition, which may be based on Papias, who certainly reported that "Matthew compiled the Oracles (of the Lord) in Hebrew," can be estimated only in connexion with the study of the Gospel itself (see below). No historical use can be made of the artificial story, in *Sanhedrin* 43a, that Matthew was condemned to death by a Jewish court (see Laible, *Christ in the Talmud*, 71 seq.). According to the Gnostic Heracleon, quoted by Clement of Alexandria (*Strom.* iv. 9), Matthew died a natural death. The tradition as to his ascetic diet (in Clem. Alex. *Paedag.* ii. 16) may be due to confusion with Matthias (cf. *Mart. Matthaei*, i.). The earliest legend as to his later labours, one of Syrian origin, places them in the Parthian kingdom, where it represents him as dying a natural death at Hierapolis (= Mabog on the Euphrates). This agrees with his legend as known to Ambrose and Paulinus of Nola, and is the most probable in itself. The legends which make him work with Andrew among the Anthropophagi near the Black Sea, or again in Ethiopia (Rufinus, and Socrates, *H.E.* i. 19), are due to confusion with Matthias, who from the first was associated in his Acts with Andrew (see M. Bonnet, *Acta Apost. apocr.*, 1898, II. i. 65). Another legend, his *Martyrium*, makes him labour and suffer in Mysore. He is commemorated as a martyr by the Greek Church on the 16th of November, and by the Roman on the 21st of September, the scene of his martyrdom being placed in Ethiopia. The Latin Breviary also affirms that his body was afterwards translated to Salerno, where it is said to lie in the church built by Robert Guiscard. In Christian art (following Jerome) the Evangelist Matthew is generally symbolized by the "man" in the imagery of Ezek. i. 10, Rev. iv. 7.

For the historical Matthew, see *Ency. Bibl.* and Zahn, *Introd. to New Test.*, 506 seq., 522 seq. For his legends, as under MARK.

(J. V. B.)

MATTHEW, TOBIAS, or TOBIE (1546–1628), archbishop of York, was the son of Sir John Matthew of Ross in Herefordshire, and of his wife Eleanor Crofton of Ludlow. He was born at Bristol in 1546. He was educated at Wells, and then in succession at University College and Christ Church, Oxford. He proceeded B.A. in 1564, and M.A. in 1566. He attracted the favourable notice of Queen Elizabeth, and his rise was steady though not very rapid. He was public orator in 1569, president of St John's College, Oxford, in 1572, dean of Christ Church in 1576, vice-chancellor of the university in 1579, dean of Durham in 1583, bishop of Durham in 1595, and archbishop of York in 1606. In 1581 he had a controversy with the Jesuit Edmund Campion, and published at Oxford his arguments in 1638 under the title, *Piissimi et eminentissimi viri Tobiae Matthew, archiepiscopi olim Eboracencis concio apologetica adversus Campianam*. While in the north he was active in forcing the recusants to conform to the Church of England, preaching hundreds of sermons and carrying out thorough visitations. During his later years he was to some extent in opposition to the administration of James I. He was exempted from attendance in the parliament of 1625 on the ground of age and infirmities, and died on the 29th of March 1628. His wife, Frances, was the daughter of William Barlow, bishop of Chichester.

His son, SIR TOBIAS, or TOBIE, MATTHEW (1577–1655), is remembered as the correspondent and friend of Francis Bacon. He was educated at Christ Church, and was early attached to the court, serving in the embassy at Paris. His debts and dissipations were a great source of sorrow to his father, from whom he is known to have received at different times £14,000, the modern equivalent of which is much larger. He was chosen member for Newport in Cornwall in the parliament of 1601, and member for St Albans in 1604. Before this time he had become the intimate friend of Bacon, whom he replaced as member for St Albans. When peace was made with Spain, on the accession of James I., he wished to travel abroad. His family, who feared his conversion to Roman Catholicism, opposed his wish, but he promised not to go beyond France. When once safe out of England he broke his word and went to Italy. The persuasion of some of his countrymen in Florence, one of whom is said to have been the Jesuit Robert Parsons, and a story he heard of the miraculous liquefaction of the blood of San Januarius at Naples, led to his conversion in 1606. When he returned to England he was imprisoned, and many efforts were made to obtain his reconversion without success. He would not take the oath of allegiance to the king. In 1608 he was exiled, and remained out of England for ten years, mostly in Flanders and Spain. He returned in 1617, but went abroad again in 1619. His friends obtained his leave to return in 1621. At home he was known as the intimate friend of Gondomar, the Spanish ambassador. In 1623 he was sent to join Prince Charles, afterwards Charles I., at Madrid, and was knighted on the 23rd of October of that year. He remained in England till 1640, when he was finally driven abroad by the parliament, which looked upon him as an agent of the pope. He died in the English college in Ghent on the 13th of October 1655. In 1618 he published an Italian translation of Bacon's essays. The "Essay on Friendship" was written for him. He was also the author of a translation of *The Confessions of the Incomparable Doctor St Augustine*, which led him into controversy. His correspondence was published in London in 1660.

For the father, see John Le Neve's *Fasti ecclesiae anglicanae* (London, 1716), and Anthony Wood's *Athenae oxonienses*. For the son, the notice in *Athenae oxonienses*, an abridgment of his autobiographical *Historical Relation* of his own life, published by Alban Butler in 1795, and A. H. Matthew and A. Calthrop, *Life of Sir Tobie Matthew* (London, 1907).

MATTHEW, GOSPEL OF ST, the first of the four canonical Gospels of the Christian Church. The indications of the use of this Gospel in the two or three generations following the Apostolic Age (see GOSPEL) are more plentiful than of any of the others. Throughout the history of the Church, also, it has held a place second to none of the Gospels alike in public instruction and in the private reading of Christians. The reasons for its having impressed itself in this way and become thus familiar are in large part to be found in the characteristics noticed below. But in addition there has been from an early time the belief that it was the work of one of those publicans whose heart Jesus touched and of whose call to follow Him the three Synoptics contain an interesting account, but who is identified as Matthew (*q.v.*) only in this one (Matt. ix. 9–13 = Mark ii. 13–17 = Luke v. 27–32).

1. *The Connexion of our Greek Gospel of Matthew with the Apostle whose name it bears.*—The earliest reference to a writing by Matthew occurs in a fragment taken by Eusebius from the same work of Papias from which he has given an account of the composition of a record by Mark (Euseb. *Hist. Eccl.* iii. 39; see MARK, GOSPEL OF ST). The statement about Matthew is much briefer and is harder to interpret. In spite of much controversy, the same measure of agreement as to its meaning cannot be said to have been attained. This is the fragment: "Matthew, however, put together and wrote down the Oracles (τὰ λόγια συνέγραψεν) in the Hebrew language, and each man interpreted them as he was able." Whether "the elder" referred to in the passage on Mark, or some other like authority, was the source of this statement also does not appear; but it is probable that this was the case from the context in which Eusebius gives it. Conservative writers on the Gospels have frequently maintained that the writing here referred to was virtually the Hebrew original of our Greek Gospel which bears his name. And it is indeed likely that Papias himself closely associated the latter with the Hebrew (or Aramaic) work by Matthew, of which he had been told, since the traditional connexion of this Greek Gospel with Matthew can hardly have begun later than this time. It is reasonable also to suppose that there was some ground for it. The description, however, of what Matthew did suits better the making of a collection of Christ's discourses and sayings than the composition of a work corresponding in form and character to our Gospel of Matthew.

The next reference in Christian literature to a Gospel-record by Matthew is that of Irenaeus in his famous passage on the four Gospels (*Adv. haer.* iii. i. 1). He says that it was written in Hebrew; but in all probability he regarded the Greek Gospel, which stood first in his, as it does in our, enumeration, as in the strict sense a translation of the Apostle's work; and this was the view of it universally taken till the 16th century, when some of the scholars of the Reformation maintained that the Greek Gospel itself was by Matthew.

The actual phenomena, however, of this Gospel, and of its relation to sources that have been used in it, cannot be explained consistently with either of the two views just mentioned. It is a composite work in which two chief sources, known in Greek to the author of our present Gospel, have, together with some other matter, been combined. It is inconceivable that one of the Twelve should have proceeded in this way in giving an account of Christ's ministry. One of the chief documents, however, here referred to seems to correspond in character with the description given in Papias' fragment of a record of the compilation of "the divine utterances" made by Matthew; and the use made of it in our first Gospel may explain the connexion of this Apostle's name with it. In the Gospel of Luke also, it is true, this same source has been used for the teaching of Jesus. But the original Aramaic Logian document may have been more largely reproduced in our Greek Matthew. Indeed, in the case of one important passage (v. 17–48) this is suggested by a comparison with

Luke itself, and there are one or two others where from the character of the matter it seems not improbable, especially vi. 1–18 and xxiii. 1–5, 7b–10, 15–22. On the whole, as will be seen below, what appears to be a Palestinian form of the Gospel-tradition is most fully represented in this Gospel; but in many instances at least this may well be due to some other cause than the use of the original Logian document.

2. *The Plan on which the Contents is arranged.*—In two respects the arrangement of the book itself is significant.

(*a*) As to the general outline in the first half of the account of the Galilean ministry (iv. 23–xi. 30). Immediately after relating the call of the first four disciples (iv. 18–22) the evangelist gives in iv. 23 a comprehensive summary of Christ's work in Galilee under its two chief aspects, teaching and healing. In the sequel both these are illustrated. First, he gives in the Sermon on the Mount (v.–vii.) a considerable body of teaching, of the kind required by the disciples of Jesus generally, and a large portion of which probably also stood not far from the beginning of the Logian document. After this he turns to the other aspect. Up to this point he has mentioned no miracle. He now describes a number in succession, introducing all but the first of those told between Mark i. 23 and ii. 12, and also four specially remarkable ones, which occurred a good deal later according to Mark's order (Matt. viii. 23–34 = Mark iv. 35–v. 20; Matt. ix. 18–26 = Mark v. 21–43); and he also adds some derived from another source, or other sources (viii. 5–13; ix. 27–34). Then, after another general description at ix. 35, similar to that at iv. 23, he brings strikingly before us the needs of the masses of the people and Christ's compassion for them, and so introduces the mission of the Twelve (which again occurs later according to Mark's order, viz. at vi. 7 seq.), whereby the ministry both of teaching and of healing was further extended (ix. 36–x. 42). Finally, the message of John the Baptist, and the reply of Jesus, and the reflections that follow (xi.), bring out the significance of the preceding narrative. It should be observed that examples have been given of every kind of mighty work referred to in the reply of Jesus to the messengers of the Baptist; and that in the discourse which follows their departure the perversity and unbelief of the people generally are condemned, and the faith of the humble-minded is contrasted therewith. The greater part of the matter from ix. 37 to end of xi. is taken from the Logian document. After this point, *i.e.* from xii. 1 onwards, the first evangelist follows Mark almost step by step down to the point (Mark xvi. 8), after which Mark's Gospel breaks off, and another ending has been supplied; and gives in substance almost the whole of Mark's contents, with the exception that he passes over the few narratives that he has (as we have seen) placed earlier. At the same time he brings in additional matter in connexion with most of the Marcan sections.

(*b*) With the accounts of the words of Jesus spoken on certain occasions, which our first evangelist found given in one or another of his sources, he has combined other pieces, taken from other parts of the same source or from different sources, which seemed to him connected in subject, *e.g.* into the discourse spoken on a mountain, when crowds from all parts were present, given in the Logian document, he has introduced some pieces which, as we infer from Luke, stood separately in that document (cf. Matt. vi. 19–21 with Luke xii. 33, 34; Matt. vi. 22, 23 with Luke xi. 34–36; Matt. vi. 24 with Luke xvi. 13; Matt. vi. 25–34 with Luke xii. 22–32; Matt. vii. 7–11 with Luke xi. 9–13). Again, the address to the Twelve in Mark vi. 7–11, which in Matthew is combined with an address to disciples, from the Logian document, is connected by Luke with the sending out of seventy disciples (Luke x. 1–16). Our first evangelist has also added here various other sayings (Matt. x. 17–39, 42). Again, with the Marcan account of the charge of collusion with Satan and Christ's reply (Mark iii. 22–30), the first evangelist (xii. 24–45) combines the parallel account in the Logian document and adds Christ's reply to another attack (Luke xi. 14–16, 17–26, 29–32). These are some examples. He has in all in this manner constructed eight discourses or collections of sayings, into which the greater part of Christ's teaching is gathered: (1) On the character of the heirs of the kingdom (v.–vii.); (2) The Mission address (x.); (3) Teaching suggested by the message of John the Baptist (xi.); (4) The reply to an accusation and a challenge (xii. 22–45); (5) The teaching by parables (xiii.); (6) On offences (xviii.); (7) Concerning the Scribes and Pharisees (xxiii.); (8) On the Last Things (xxiv., xxv.). In this arrangement of his material the writer has in many instances disregarded chronological considerations. But his documents also gave only very imperfect indications of the occasions of many of the utterances; and the result of his method of procedure has been to give us an exceedingly effective representation of the teaching of Jesus.

In the concluding verses of the Gospel, where the original Marcan parallel is wanting, the evangelist may still have followed in part that document while making additions as before. The account of the silencing of the Roman guard by the chief priests is the sequel to the setting of this guard and their presence at the Resurrection, which at an earlier point are peculiar to Matthew (xxvii. 62–66, xxviii. 4). And, further, this matter seems to belong to the same cycle of tradition as the story of Pilate's wife and his throwing the guilt of the Crucifixion of Jesus upon the Jews, and the testimony borne by the Roman guard (as well as the centurion) who kept watch by the cross (xxvii. 15–26, 54), all which also are peculiar to this Gospel. It cannot but seem probable that these are legendary additions which had arisen through the desire to commend the Gospel to the Romans.

On the other hand, the meeting of Jesus with the disciples in Galilee (Matt. xxviii. 16 seq.) is the natural sequel to the message to them related in Mark xvi. 7, as well as in Matt. xxviii. 7. Again, the commission to them to preach throughout the world is supported by Luke xxiv. 47, and by the present ending of Mark (xvi. 15), though neither of these mention Galilee as the place where it was given. The baptismal formula in Matt. xxviii. 19, is, however, peculiar, and in view of its non-occurrence in the Acts and Epistles of the New Testament must be regarded as probably an addition in accordance with Church usage at the time the Gospel was written.

3. *The Palestinian Element.*—Teaching is preserved in this Gospel which would have peculiar interest and be specially required in the home of Judaism. The best examples of this are the passages already referred to near end of §1, as probably derived from the Logian document. There are, besides, a good many turns of expression and sayings peculiar to this Gospel which have a Semitic cast, or which suggest a point of view that would be natural to Palestinian Christians, *e.g.* "kingdom of heaven" frequently for "kingdom of God"; xiii. 52 ("every scribe"); xxiv. 20 ("neither on a Sabbath"). See also v. 35 and xix. 9; x. 5, 23. Again, several of the quotations which are peculiar to this Gospel are not taken from the LXX., as those in the other Gospels and in the corresponding contexts in this Gospel commonly are, but are wholly or partly independent renderings from the Hebrew (ii. 6, 15, 18; viii. 17, xii. 17–21, &c.). Once more, there is somewhat more parallelism between the fragments of the Gospel according to the Hebrews and this Gospel than is the case with Luke, not to say Mark.

4. *Doctrinal Character.*—In this Gospel, more decidedly than in either of the other two Synoptics, there is a doctrinal point of view from which the whole history is regarded. Certain aspects which are of profound significance are dwelt upon, and this without there being any great difference between this Gospel and the two other Synoptics in respect to the facts recorded or the beliefs implied. The effect is produced partly by the comments of the evangelist, which especially take the form of citations from the Old Testament; partly by the frequency with which certain expressions are used, and the prominence that is given in this and other ways to particular traits and topics.

He sets forth the restriction of the mission of Jesus during His life on earth to the people of Israel in a way which suggests at first sight a spirit of Jewish exclusiveness. But there are various indications that this is not the true explanation. In particular the evangelist brings out more strongly than either Mark or Luke the national rejection of Jesus, while the Gospel ends with the commission of Jesus to His disciples after His resurrection to "make disciples of all the peoples." One may divine in all this an intention to "justify the ways of God" to the Jew, by proving that God in His faithfulness to His ancient people had given them the first opportunity of salvation through Christ, but that now their national privilege had been rightly forfeited. He was also specially concerned to show that prophecy is fulfilled in the life and work of Jesus, but the conception of this fulfilment which is presented to us is a large one; it is to be seen not merely in particular events or features of Christ's ministry, but in the whole new dispensation, new relations between God and men, and new rules of conduct which Christ has introduced. The divine meaning of the work of Jesus is thus made apparent, while of the majesty and glory of His person a peculiarly strong impression is conveyed.

Some illustrations in detail of these points are subjoined. Where there are parallels in the other Gospels they should be compared and the words in Matthew noted which in many instances serve to emphasize the points in question.

(a) *The Ministry of Jesus among the Jewish People as their promised Messiah; their rejection of Him, and the extension of the Gospel to the Gentiles.* The mission to Israel: Matt. i. 21; iv. 23 (note in these passages the use of ὁ λαός, which here, as generally in Matthew, denotes the chosen nation), ix. 33, 35, xv. 31. For the rule limiting the work of Jesus while on earth see xv. 24 (and note ἐξελθοῦσα in verse 22, which implies that Jesus had not himself entered the heathen borders), and for a similar rule prescribed to the disciples, x. 5, 6 and 23.

The rejection of Jesus by the people in Galilee, xi. 21; xiii. 13–15, and by the heads of "the nation," xxvi. 3, 47 and by "the whole nation," xxvii. 25; their condemnation xxiii. 38.

Mercy to the Gentiles and the punishment of "the sons of the kingdom" is foretold viii. 11, 12. The commission to go and convert Gentile peoples (ἔθνη) is given after Christ's resurrection (xxviii. 19).

(b) *The Fulfilment of Prophecy.*—In the birth and childhood of Jesus, i. 23; ii. 6, 15, 18, 23. By these citations attention is drawn to the lowliness of the beginnings of the Saviour's life, the unexpected and secret manner of His appearing, the dangers to which from the first He was exposed and from which He escaped.

The ministry of Christ's forerunner, iii. 3. (The same prophecy, Isa. xl. 3, is also quoted in the other Gospels.)

The ministry of Jesus. The quotations serve to bring out the significance of important events, especially such as were turning-points, and also to mark the broad features of Christ's life and work, iv. 15, 16; viii. 17; xii. 18 seq.; xiii. 35; xxi. 5; xxvii. 9.

(c) *The Teaching on the Kingdom of God.*—Note the collection of parables "of the Kingdom" in xiii.; also the use of ἡ βασιλεία ("the Kingdom") without further definition as a term the reference of which could not be misunderstood, especially in the following phrases peculiar to this Gospel: τὸ εὐαγγέλιον τῆς βασιλείας ("the Gospel of the Kingdom") iv. 23, ix. 35, xxiv. 14; and ὁ λόγος τῆς βασιλείας ("the word of the kingdom") xiii. 19. The following descriptions of the kingdom, peculiar to this Gospel, are also interesting ἡ βασιλεία τοῦ πατρὸς αὐτῶν ("the kingdom of their father") xiii. 43 and τοῦ πατρός μου ("of my father") xxvi. 29.

(d) *The Relation of the New Law to the Old.*—Verses 17–48, cf. also, addition at xxii. 40 and xix. 19b. Further, his use of δικαιοσύνη ("righteousness") and δίκαιος ("righteous") (specially frequent in this Gospel) is such as to connect the New with the Old; the standard in mind is the law which "fulfilled" that previously given.

(e) *The Christian Ecclesia.*—Chap. xvi. 18, xviii. 17.

(f) *The Messianic Dignity and Glory of Jesus.*—The narrative in i. and ii. show the royalty of the new-born child. The title "Son of David" occurs with special frequency in this Gospel. The following instances are without parallels in the other Gospels: ix. 27; xii. 23; xv. 22; xxi. 9; xxi. 15. The title "Son of God" is also used with somewhat greater frequency than in Mark and Luke: ii. 15; xiv. 33; xvi. 16; xxii. 2 seq. (where it is implied); xxvii. 40, 43.

The thought of the future coming of Christ, and in particular of the judgment to be executed by Him then, is much more prominent in this Gospel than in the others. Some of the following predictions are peculiar to it, while in several others there are additional touches: vii. 22, 23; x. 23, 32, 33; xiii. 39–43; xvi. 27, 28; xix. 28; xxiv. 3, 27, 30, 31, 37, 39; xxv. 31–46; xxvi. 64.

The majesty of Christ is also impressed upon us by the signs at His crucifixion, some of which are related only in this Gospel, xxvii. 51–53, and by the sublime vision of the Risen Christ at the close, xxviii. 16–20.

(5) *Time of Composition and Readers addressed.*—The signs of dogmatic reflection in this Gospel point to its having been composed somewhat late in the 1st century, probably after Luke's Gospel, and this is in accord with the conclusion that some insertions had been made in the Marcan document used by this evangelist which were not in that used by Luke (see LUKE, GOSPEL OF ST). We may assign A.D. 80–100 as a probable time for the composition.

The author was in all probability a Jew by race, and he would seem to have addressed himself especially to Jewish readers; but they were Jews of the Dispersion. For although he was in specially close touch with Palestine, either personally or through the sources at his command, or both, his book was composed in Greek by the aid of Greek documents.

See commentaries by Th. Zahn (1903) and W. C. Allen (in the series of International Critical Commentaries, 1907); also books on the Four Gospels or the Synoptic Gospels cited at the end of GOSPEL. (V. H. S.)

MATTHEW CANTACUZENUS, Byzantine emperor, was the son of John VI. Cantacuzenus (*q.v.*). In return for the support he gave to his father during his struggle with John V. he was allowed to annex part of Thrace under his own dominion and in 1353 was proclaimed joint emperor. From his Thracian principality he levied several wars against the Servians. An attack which he prepared in 1350 was frustrated by the defection of his Turkish auxiliaries. In 1357 he was captured by his enemies, who delivered him to the rival emperor, John V. Compelled to abdicate, he withdrew to a monastery, where he busied himself with writing commentaries on the Scriptures.

MATTHEW OF PARIS (d. 1259), English monk and chronicler known to us only through his voluminous writings. In spite of his surname, and of his knowledge of the French language, his attitude towards foreigners attests that he was of English birth. He may have studied at Paris in his youth, but the earliest fact which he records of himself is his admission as a monk at St Albans in the year 1217. His life was mainly spent in this religious house. In 1248, however, he was sent to Norway as the bearer of a message from Louis IX. of France to Haakon VI.; he made himself so agreeable to the Norwegian sovereign that he was invited, a little later, to superintend the reformation of the Benedictine monastery of St Benet Holme at Trondhjem. Apart from these missions, his activities were devoted to the composition of history, a pursuit for which the monks of St Albans had long been famous. Matthew edited anew the works of Abbot John de Cella and Roger of Wendover, which in their altered form constitute the first part of his most important work, the *Chronica majora*. From 1235, the point at which Wendover dropped his pen, Matthew continued the history on the plan which his predecessors had followed. He derived much of his information from the letters of important personages, which he sometimes inserts, but much more from conversation with the eye-witnesses of events. Among his informants were Earl Richard of Cornwall and Henry III. With the latter he appears to have been on terms of intimacy. The king knew that Matthew was writing a history, and showed some anxiety that it should be as exact as possible. In 1257, in the course of a week's visit to St Albans, Henry kept the chronicler beside him night and day, "and guided my pen," says Paris, "with much good will and diligence." It is therefore curious that the *Chronica majora* should give so unfavourable an account of the king's policy. Luard supposes that Matthew never intended his work to see the light in its present form, and many passages of the autograph have against them the note *offendiculum*, which shows that the writer understood the danger which he ran. On the other hand, unexpurgated copies were made in Matthew's lifetime; though the offending passages are duly omitted or softened in his abridgment of his longer work, the *Historia Anglorum* (written about 1253). the real sentiments of the author must have been an open secret. In any case there is no ground for the old theory that he was an official historiographer.

Matthew Paris was unfortunate in living at a time when English politics were peculiarly involved and tedious. His talent is for narrative and description. Though he took a keen interest in the personal side of politics he has no claim to be considered a judge of character. His appreciations of his contemporaries throw more light on his own prejudices than on their aims and ideas. His work is always vigorous, but he imputes motives in the spirit of a partisan who never pauses to weigh the evidence or to take a comprehensive view of the situation. His redeeming feature is his generous admiration for strength of character, even when it goes along with a policy of which he disapproves. Thus he praises Grosseteste, while he denounces Grosseteste's scheme of monastic reform. Matthew is a vehement supporter of the monastic orders against their rivals, the secular clergy and the mendicant friars. He is violently opposed to the court and the foreign favourites. He despises the king as a statesman, though for the man he has some kindly feeling. The frankness with which he attacks the court of Rome for its exactions is remarkable; so, too, is the intense nationalism which he displays in dealing with this topic. His faults of presentment are more often due to carelessness and narrow views than to deliberate purpose. But he is sometimes guilty of inserting rhetorical speeches which are not only fictitious, but also misleading as an account of the speaker's sentiments. In other cases he tampers with the documents which he inserts (as, for instance, with the text of Magna Carta). His chronology is, for a contemporary, inexact; and he occasionally inserts duplicate versions of the same incident in different places. Hence he must always be rigorously checked where other authorities exist and used with caution where he is our sole informant. None the less, he gives a more vivid impression of his age than any other English chronicler; and it is a matter for regret that his great history breaks off in 1259, on the eve of the crowning struggle between Henry III and the baronage.

AUTHORITIES.—The relation of Matthew Paris's work to those of John de Cella and Roger of Wendover may best be studied in H. R. Luard's edition of the *Chronica majora* (7 vols., Rolls series, 1872–1883), which contains valuable prefaces. The *Historia*

Anglorum sive historia minor (1067–1253) has been edited by F. Madden (3 vols., Rolls series, 1866–1869). Matthew Paris is often confused with "Matthew of Westminster," the reputed author of the *Flores historiarum* edited by H. R. Luard (3 vols., Rolls series, 1890). This work, compiled by various hands, is an edition of Matthew Paris, with continuations extending to 1326. Matthew Paris also wrote a life of Edmund Rich (*q.v.*), which is probably the work printed in W. Wallace's *St Edmund of Canterbury* (London, 1893) pp. 543–588, though this is attributed by the editor to the monk Eustace; *Vitae abbatum S Albani* (up to 1225) which have been edited by W. Watts (1640, &c.); and (possibly) the *Abbreviatio chronicorum* (1000–1255), edited by F. Madden, in the third volume of the *Historia Anglorum*. On the value of Matthew as an historian see F. Liebermann in G. H. Pertz's *Scriptores* xxviii. pp. 74–106; A. Jessopp's *Studies by a Recluse* (London, 1893); H. Plehn's *Politische Character Matheus Parisiensis* (Leipzig, 1897).

(H. W. C. D.)

MATTHEW OF WESTMINSTER, the name of an imaginary person who was long regarded as the author of the *Flores Historiarum*. The error was first discovered in 1826 by Sir F. Palgrave, who said that Matthew was "a phantom who never existed," and later the truth of this statement was completely proved by H. R. Luard. The name appears to have been taken from that of Matthew of Paris, from whose *Chronica majora* the earlier part of the work was mainly copied, and from Westminster, the abbey in which the work was partially written.

The *Flores historiarum* is a Latin chronicle dealing with English history from the creation to 1326, although some of the earlier manuscripts end at 1306; it was compiled by various persons, and written partly at St Albans and partly at Westminster. The part from 1306 to 1326 was written by Robert of Reading (d. 1325) and another Westminster monk. Except for parts dealing with the reign of Edward I. its value is not great. It was first printed by Matthew Parker, archbishop of Canterbury, in 1567, and the best edition is the one edited with introduction by H. R. Luard for the Rolls series (London, 1890). It has been translated into English by C. D. Yonge (London, 1853). See Luard's introduction, and C. Bémont in the *Revue critique d'histoire* (Paris, 1891).

MATTHEWS, STANLEY (1824–1889), American jurist, was born in Cincinnati, Ohio, on the 21st of July 1824. He graduated from Kenyon College in 1840, studied law, and in 1842 was admitted to the bar of Maury county, Tennessee. In 1844 he became assistant prosecuting attorney of Hamilton county, Ohio; and in 1846–1849 edited a short-lived anti-slavery paper, the *Cincinnati Herald*. He was clerk of the Ohio House of Representatives in 1848–1849, a judge of common pleas of Hamilton county in 1850–1853, state senator in 1856–1858, and U.S. district-attorney for the southern district of Ohio in 1858–1861. First a Whig and then a Free-Soiler, he joined the Republican party in 1861. After the outbreak of the Civil War he was commissioned a lieutenant of the 23rd Ohio, of which Rutherford B. Hayes was major; but saw service only with the 57th Ohio, of which he was colonel, and with a brigade which he commanded in the Army of the Cumberland. He resigned from the army in 1863, and was judge of the Cincinnati superior court in 1863–1864. He was a Republican presidential elector in 1864 and 1868. In 1872 he joined the Liberal Republican movement, and was temporary chairman of the Cincinnati convention which nominated Horace Greeley for the presidency, but in the campaign he supported Grant. In 1877, as counsel before the Electoral Commission, he opened the argument for the Republican electors of Florida and made the principal argument for the Republican electors of Oregon. In March of the same year he succeeded John Sherman as senator from Ohio, and served until March 1879. In 1881 President Hayes nominated him as associate justice of the Supreme Court, to succeed Noah H. Swayne; there was much opposition, especially in the press, to this appointment, because Matthews had been a prominent railway and corporation lawyer and had been one of the Republican "visiting statesmen" who witnessed the canvass of the vote of Louisiana[1] in 1876; and the nomination had not been approved when the session of Congress expired. Matthews was renominated by President Garfield on the 15th of March, and the nomination was confirmed by the Senate (22 for, 21 against) on the 12th of May. He was an honest, impartial and conscientious judge. He died in Washington, on the 22nd of March 1889.

MATTHIAE, AUGUST HEINRICH (1769–1835), German classical scholar, was born at Göttingen, on the 25th of December 1769, and educated at the university. He then spent some years as a tutor in Amsterdam. In 1798 he returned to Germany, and in 1802 was appointed director of the Friedrichsgymnasium at Altenburg, which post he held till his death, on the 6th of January 1835. Of his numerous important works the best-known are his *Greek Grammar* (3rd ed., 1835), translated into English by E. V. Blomfield (5th ed., by J. Kenrick, 1832), his edition of *Euripides* (9 vols., 1813–1829), *Grundriss der Geschichte der griechischen und römischen Litteratur* (3rd ed., 1834, Eng. trans., Oxford, 1841) *Lehrbuch für den ersten Unterricht in der Philosophie* (3rd ed., 1833), *Encyklopädie und Methodologie der Philologie* (1835). His *Life* was written by his son Constantin (1845).

His brother, **Friedrich Christian Matthiae** (1763–1822), rector of the Frankfort gymnasium, published valuable editions of Seneca's *Letters*, Aratus, and Dionysius Periegetes.

MATTHIAS, the disciple elected by the primitive Christian community to fill the place in the Twelve vacated by Judas Iscariot (Acts i. 21–26). Nothing further is recorded of him in the New Testament. Eusebius (*Hist. Eccl.*, I. xii.) says he was, like his competitor, Barsabas Justus, one of the seventy, and the Syriac version of Eusebius calls him throughout not Matthias but Tolmai, *i.e.* Bartholomew, without confusing him with the Bartholomew who was originally one of the Twelve, and is often identified with the Nathanael mentioned in the Fourth Gospel (*Expository Times*, ix. 566). Clement of Alexandria says some identified him with Zacchaeus, the Clementine *Recognitions* identify him with Barnabas, Hilgenfeld thinks he is the same as Nathanael.

Various works—a Gospel, Traditions and Apocryphal Words—were ascribed to him; and there is also extant *The Acts of Andrew and Matthias*, which places his activity in "the city of the cannibals" in Ethiopia. Clement of Alexandria quotes two sayings from the Traditions: (1) Wonder at the things before you (suggesting, like Plato, that wonder is the first step to new knowledge); (2) If an elect man's neighbour sin, the elect man has sinned.

MATTHIAS (1557–1619), Roman emperor, son of the emperor Maximilian II. and Maria, daughter of the emperor Charles V., was born in Vienna, on the 24th of February 1557. Educated by the diplomatist O. G. de Busbecq, he began his public life in 1577, soon after his father's death, when he was invited to assume the governorship of the Netherlands, then in the midst of the long struggle with Spain. He eagerly accepted this invitation, although it involved a definite breach with his Spanish kinsman, Philip II., and entering Brussels in January 1578 was named governor-general; but he was merely a cipher, and only held the position for about three years, returning to Germany in October 1581. Matthias was appointed governor of Austria in 1593 by his brother, the emperor Rudolph II.; and two years later, when another brother, the archduke Ernest, died, he became a person of more importance as the eldest surviving brother of the unmarried emperor. As governor of Austria Matthias continued the policy of crushing the Protestants, although personally he appears to have been inclined to religious tolerance; and he dealt with the rising of the peasants in 1595, in addition to representing Rudolph at the imperial diets, and gaining some fame as a soldier during the Turkish War. A few years later the discontent felt by the members of the Habsburg family at the incompetence of the emperor became very acute, and the lead was taken by Matthias. Obtaining in May 1605 a reluctant consent from his brother, he took over the conduct of affairs in Hungary, where a revolt had broken out, and was formally recognized by the Habsburgs as their head in April 1606, and was promised the succession to the Empire. In June 1606 he concluded the peace of Vienna with the rebellious Hungarians, and was thus in a better position to treat with the sultan, with whom peace was made in November. This pacific policy was displeasing to Rudolph, who prepared to renew the Turkish War; but having secured the support of the national party in Hungary and gathered an army, Matthias forced his brother to cede to him this kingdom, together with Austria and Moravia, both of which had thrown in their lot with Hungary (1608). The king of Hungary, as Matthias now became, was reluctantly compelled to grant religious liberty to the inhabitants of Austria. The strained relations which had arisen between Rudolph and Matthias as a result of these proceedings were temporarily improved, and a formal reconciliation took place in 1610; but affairs in Bohemia soon destroyed this fraternal peace. In spite of the letter of majesty (*Majestätsbrief*) which the Bohemians had extorted from Rudolph, they were very dissatisfied with their ruler, whose troops were ravaging their land; and in 1611 they invited Matthias to come to their aid. Accepting this invitation, he inflicted another humiliation upon his brother, and was crowned king of Bohemia in May 1611. Rudolph, however, was successful in preventing the election of Matthias as German king, or king of the Romans, and when he died, in January 1612, no provision had been made for a successor. Already king of Hungary and Bohemia, however, Matthias obtained the remaining hereditary dominions of the Habsburgs, and in June 1612 was crowned emperor, although the ecclesiastical electors favoured his younger brother, the archduke Albert (1559–1621).

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[1] It seems certain that Matthews and Charles Foster of Ohio gave their written promise that Hayes, if elected, would recognize the Democratic governors in Louisiana and South Carolina.

The short reign of the new emperor was troubled by the religious dissensions of Germany. His health became impaired and his indolence increased, and he fell completely under the influence of Melchior Klesl (*q.v.*), who practically conducted the imperial business. By Klesl's advice he took up an attitude of moderation and sought to reconcile the contending religious parties; but the proceedings at the diet of Regensburg in 1613 proved the hopelessness of these attempts, while their author was regarded with general distrust. Meanwhile the younger Habsburgs, led by the emperor's brother, the archduke Maximilian, and his cousin, Ferdinand, archduke of Styria, afterwards the emperor Ferdinand II., disliking the peaceful policy of Klesl, had allied themselves with the unyielding Roman Catholics, while the question of the imperial succession was forcing its way to the front. In 1611 Matthias had married his cousin Anna (d. 1618), daughter of the archduke Ferdinand (d. 1595), but he was old and childless and the Habsburgs were anxious to retain his extensive possessions in the family. Klesl, on the one hand, wished the settlement of the religious difficulties to precede any arrangement about the imperial succession; the Habsburgs, on the other, regarded the question of the succession as urgent and vital. Meanwhile the disputed succession to the duchies of Cleves and Jülich again threatened a European war; the imperial commands were flouted in Cologne and Aix-la-Chapelle, and the Bohemians were again becoming troublesome. Having decided that Ferdinand should succeed Matthias as emperor, the Habsburgs had secured his election as king of Bohemia in June 1617, but were unable to stem the rising tide of disorder in that country. Matthias and Klesl were in favour of concessions, but Ferdinand and Maximilian met this move by seizing and imprisoning Klesl. Ferdinand had just secured his coronation as king of Hungary when there broke out in Bohemia those struggles which heralded the Thirty Years' War; and on the 20th of March 1619 the emperor died at Vienna.

For the life and reign of Matthias the following works may be consulted: J. Heling, *Die Wahl des römischen Königs Matthias* (Belgrade, 1892); A. Gindely, *Rudolf II. und seine Zeit* (Prague, 1862–1868); F. Stieve, *Die Verhandlungen über die Nachfolge Kaisers Rudolf II.* (Munich, 1880); P. von Chlumecky, *Karl von Zierotin und seine Zeit* (Brünn, 1862–1879); A. Kerschbaumer, *Kardinal Klesel* (Vienna, 1865); M. Ritter, *Quellenbeiträge zur Geschichte des Kaisers Rudolf II.* (Munich, 1872); *Deutsche Geschichte im Zeitalter der Gegenreformation und des dreissigjährigen Krieges* (Stuttgart, 1887, seq.); and the article on Matthias in the *Allgemeine deutsche Biographie*, Bd. XX. (Leipzig, 1884); L. von Ranke, *Zur deutschen Geschichte vom Religionsfrieden bis zum 30-jährigen Kriege* (Leipzig, 1888); and J. Janssen, *Geschichte des deutschen Volks seit dem Ausgang des Mittelalters* (Freiburg, 1878 seq.), Eng. trans. by M. A. Mitchell and A. M. Christie (London, 1896, seq.).

MATTHIAS I., HUNYADI (1440–1490), king of Hungary, also known as Matthias Corvinus, a surname which he received from the raven (*corvus*) on his escutcheon, second son of János Hunyadi and Elizabeth Szilágyi, was born at Kolozsvár, probably on the 23rd of February 1440. His tutors were the learned János Vitéz, bishop of Nagyvárad, whom he subsequently raised to the primacy, and the Polish humanist Gregory Sanocki. The precocious lad quickly mastered the German, Latin and principal Slavonic languages, frequently acting as his father's interpreter at the reception of ambassadors. His military training proceeded under the eye of his father, whom he began to follow on his campaigns when only twelve years of age. In 1453 he was created count of Bistercze, and was knighted at the siege of Belgrade in 1454. The same care for his welfare led his father to choose him a bride in the powerful Cilli family, but the young Elizabeth died before the marriage was consummated, leaving Matthias a widower at the age of fifteen. On the death of his father he was inveigled to Buda by the enemies of his house, and, on the pretext of being concerned in a purely imaginary conspiracy against Ladislaus V., was condemned to decapitation, but was spared on account of his youth, and on the king's death fell into the hands of George Poděbrad, governor of Bohemia, the friend of the Hunyadis, in whose interests it was that a national king should sit on the Magyar throne. Poděbrad treated Matthias hospitably and affianced him with his daughter Catherine, but still detained him, for safety's sake, in Prague, even after a Magyar deputation had hastened thither to offer the youth the crown. Matthias was the elect of the Hungarian people, gratefully mindful of his father's services to the state and inimical to all foreign candidates; and though an influential section of the magnates, headed by the palatine László Garai and the voivode of Transylvania, Miklós Ujlaki, who had been concerned in the judicial murder of Matthias's brother László, and hated the Hunyadis as semi-foreign upstarts, were fiercely opposed to Matthias's election, they were not strong enough to resist the manifest wish of the nation, supported as it was by Matthias's uncle Mihály Szilágyi at the head of 15,000 veterans. On the 24th of January 1458, 40,000 Hungarian noblemen, assembled on the ice of the frozen Danube, unanimously elected Matthias Hunyadi king of Hungary, and on the 14th of February the new king made his state entry into Buda.

The realm at this time was environed by perils. The Turks and the Venetians threatened it from the south, the emperor Frederick III. from the west, and Casimir IV. of Poland from the north, both Frederick and Casimir claiming the throne. The Czech mercenaries under Giszkra held the northern counties and from thence plundered those in the centre. Meanwhile Matthias's friends had only pacified the hostile dignitaries by engaging to marry the daughter of the palatine Garai to their nominee, whereas Matthias not unnaturally refused to marry into the family of one of his brother's murderers, and on the 9th of February confirmed his previous nuptial contract with the daughter of George Poděbrad, who shortly afterwards was elected king of Bohemia (March 2, 1458). Throughout 1458 the struggle between the young king and the magnates, reinforced by Matthias's own uncle and guardian Szilágyi, was acute. But Matthias, who began by deposing Garai and dismissing Szilágyi, and then proceeded to levy a tax, without the consent of the Diet, in order to hire mercenaries, easily prevailed. Nor did these complications prevent him from recovering the fortress of Galamboc from the Turks, successfully invading Servia, and reasserting the suzerainty of the Hungarian crown over Bosnia. In the following year there was a fresh rebellion, when the emperor Frederick was actually crowned king by the malcontents at Vienna-Neustadt (March 4, 1459); but Matthias drove him out, and Pope Pius II. intervened so as to leave Matthias free to engage in a projected crusade against the Turks, which subsequent political complications, however, rendered impossible. From 1461 to 1465 the career of Matthias was a perpetual struggle punctuated by truces. Having come to an understanding with his father-in-law Poděbrad, he was able to turn his arms against the emperor Frederick, and in April 1462 Frederick restored the holy crown for 60,000 ducats and was allowed to retain certain Hungarian counties with the title of king; in return for which concessions, extorted from Matthias by the necessity of coping with a simultaneous rebellion of the Magyar noble in league with Poděbrad's son Victorinus, the emperor recognized Matthias as the actual sovereign of Hungary. Only now was Matthias able to turn against the Turks, who were again threatening the southern provinces. He began by defeating Ali Pasha, and then penetrated into Bosnia, and captured the newly built fortress of Jajce after a long and obstinate defence (Dec. 1463). On returning home he was crowned with the holy crown on the 29th of March 1464, and, after driving the Czechs out of his northern counties, turned southwards again, this time recovering all the parts of Bosnia which still remained in Turkish hands.

A political event of the first importance now riveted his attention upon the north. Poděbrad, who had gained the throne of Bohemia with the aid of the Hussites and Utraquists, had long been in ill odour at Rome, and in 1465 Pope Paul II. determined to depose the semi-Catholic monarch. All the neighbouring princes, the emperor, Casimir IV. of Poland and Matthias, were commanded in turn to execute the papal decree of deposition, and Matthias gladly placed his army at the disposal of the Holy See. The war began on the 31st of May 1468, but, as early as the 27th of February 1469, Matthias anticipated an alliance between George and Frederick by himself concluding an armistice with the former. On the 3rd of May the Czech Catholics elected Matthias king of Bohemia, but this was contrary to the wishes of both pope and emperor, who preferred to partition Bohemia. But now George discomfited all his enemies by suddenly excluding his own son from the throne in favour of Ladislaus, the eldest son of Casimir IV., thus skilfully enlisting Poland on his side. The sudden death of Poděbrad on the 22nd of March 1471 led to fresh complications. At the very moment when Matthias was about to profit by the disappearance of his most capable rival, another dangerous rebellion, headed by the primate and the chief dignitaries of the state, with the object of placing Casimir, son of Casimir IV., on the throne, paralysed Matthias's foreign policy during the critical years 1470–1471. He suppressed this domestic rebellion indeed, but in the meantime the Poles had invaded the Bohemian domains with 60,000 men, and when in 1474 Matthias was at last able to take the field against them in order to raise the siege of Breslau, he was obliged to fortify himself in an entrenched camp, whence he so skilfully harried the enemy that the Poles, impatient to return to their own country, made peace at Breslau (Feb. 1475) on an *uti possidetis* basis, a peace subsequently confirmed by the congress of Olmütz (July 1479). During the interval between these peaces, Matthias, in self-defence, again made war on the emperor, reducing Frederick to such extremities that he was glad to accept peace on any terms. By the final arrangement made between the contending princes, Matthias recognized Ladislaus as king of Bohemia proper in return for the surrender of Moravia, Silesia and Upper and Lower Lusatia, hitherto component parts of the Czech monarchy, till he should have redeemed them for 400,000 florins. The emperor promised to pay Matthias 100,000 florins as a war indemnity, and recognized him as the legitimate king of Hungary on the understanding that he should succeed him if he died without male issue, a contingency at this time somewhat improbable, as Matthias, only three years previously (Dec. 15, 1476), had married his third wife, Beatrice of Naples, daughter of Ferdinand of Aragon.

The endless tergiversations and depredations of the emperor speedily induced Matthias to declare war against him for the third time (1481), the Magyar king conquering all the fortresses in Frederick's hereditary domains. Finally, on the 1st of June 1485, at the head of 8000 veterans, he made his triumphal entry into Vienna, which he henceforth made his capital. Styria, Carinthia and Carniola were next subdued, and Trieste was only saved by the intervention of the Venetians. Matthias consolidated his position by alliances with the dukes of Saxony and Bavaria, with the Swiss Confederation, and the archbishop of Salzburg, and was henceforth the greatest potentate in central Europe. His far-reaching hand even extended to Italy. Thus, in 1480, when a Turkish fleet seized Otranto, Matthias, at the earnest solicitation of the pope, sent Balasz Magyar to recover the fortress, which surrendered to him on the 10th of May 1481. Again in 1488, Matthias took Ancona under his protection for a time and occupied it with a Hungarian garrison.

Though Matthias's policy was so predominantly occidental that he soon abandoned his youthful idea of driving the Turks out of Europe, he at least succeeded in making them respect Hungarian territory. Thus in 1479 a huge Turkish army, on its return home from ravaging Transylvania, was annihilated at Szászváros (Oct. 13), and in 1480 Matthias recaptured Jajce, drove the Turks from Servia and erected two new military banates, Jajce and Srebernik, out of reconquered Bosnian territory. On the death of Mahommed II. in 1481, a unique opportunity for the intervention of Europe in Turkish affairs presented itself. A civil war ensued in Turkey between his sons Bayezid and Jem, and the latter, being worsted, fled to the knights of Rhodes, by whom he was kept in custody in France (see BAYEZID II.). Matthias, as the next-door neighbour of the Turks, claimed the custody of so valuable a hostage, and would have used him as a means of extorting concessions from Bayezid. But neither the pope nor the Venetians would hear of such a transfer, and the negotiations on this subject greatly embittered Matthias against the Curia. The last days of Matthias were occupied in endeavouring to secure the succession to the throne for his illegitimate son János (see CORVINUS, JÁNOS); but Queen Beatrice, though childless, fiercely and openly opposed the idea and the matter was still pending when Matthias, who had long been crippled by gout, expired very suddenly on Palm Sunday, the 4th of April 1490.

Matthias Hunyadi was indisputably the greatest man of his day, and one of the greatest monarchs who ever reigned. The precocity and universality of his genius impress one the most. Like Napoleon, with whom he has often been compared, he was equally illustrious as a soldier, a statesman, an orator, a legislator and an administrator. But in all moral qualities the brilliant adventurer of the 15th was infinitely superior to the brilliant adventurer of the 19th century. Though naturally passionate, Matthias's self-control was almost superhuman, and throughout his stormy life, with his innumerable experiences of ingratitude and treachery, he never was guilty of a single cruel or vindictive action. His capacity for work was inexhaustible. Frequently half his nights were spent in reading, after the labour of his most strenuous days. There was no branch of knowledge in which he did not take an absorbing interest, no polite art which he did not cultivate and encourage. His camp was a school of chivalry, his court a nursery of poets and artists. Matthias was a middle-sized, broad-shouldered man of martial bearing, with a large fleshy nose, hair reaching to his heels, and the clean-shaven, heavy chinned face of an early Roman emperor.

See Vilmós Fraknói, *King Matthias Hunyadi* (Hung., Budapest, 1890, German ed., Freiburg, 1891); Ignácz Acsády *History of the Hungarian Realm* (Hung. vol. i., Budapest, 1904); József Teleki, *The Age of the Hunyadis in Hungary* (Hung., vols. 3–5, Budapest, 1852–1890); V. Fraknói *Life of János Vitez* (Hung. Budapest 1879); Karl Schober, *Die Eroberung Niederösterreichs durch Matthias Corvinus* (Vienna, 1879); János Huszár, *Matthias's Black Army* (Hung. Budapest, 1890); Antonio Bonfini, *Rerum hungaricarum decades* (7th ed., Leipzig, 1771); Aeneas Sylvius, *Opera* (Frankfort, 1707); *The Correspondence of King Matthias* (Hung. and Lat., Budapest, 1893); V. Fraknói, *The Embassies of Cardinal Carvajal to Hungary* (Hung., Budapest, 1889); Marzio Galeotti, *De egregie sapienter et jocose dictis ac factis Matthiae regis* (*Script. reg. hung. I.*) (Vienna, 1746). Of the above the first is the best general sketch and is rich in notes; the second somewhat chauvinistic but excellently written; the third the best work for scholars; the seventh, eighth and eleventh are valuable as being by contemporaries.

(R. N. B.)

MATTHISSON, FRIEDRICH VON (1761–1831), German poet, was born at Hohendodeleben near Magdeburg, the son of the village pastor, on the 23rd of January 1761. After studying theology and philology at the university of Halle, he was appointed in 1781 master at the classical school Philanthropin in Dessau. This once famous seminary was, however, then rapidly decaying in public favour, and in 1784 Matthisson was glad to accept a travelling tutorship. He lived for two years with the Swiss author Bonstetten at Nyon on the lake of Geneva.

In 1794 he was appointed reader and travelling companion to the princess Louisa of Anhalt-Dessau. In 1812 he entered the service of the king of Württemberg, was ennobled, created counsellor of legation, appointed intendant of the court theatre and chief librarian of the royal library at Stuttgart. In 1828 he retired and settled at Wörlitz near Dessau, where he died on the 12th of March 1831. Matthisson enjoyed for a time a great popularity on account of his poems, *Gedichte* (1787; 15th ed., 1851; new ed., 1876), which Schiller extravagantly praised for their melancholy sweetness and their fine descriptions of scenery. The verse is melodious and the language musical, but the thought and sentiments they express are too often artificial and insincere. His *Adelaide* has been rendered famous owing to Beethoven's setting of the song. Of his elegies, *Die Elegie in den Ruinen eines alten Bergschlosses* is still a favourite. His reminiscences, *Erinnerungen* (5 vols., 1810–1816), contain interesting accounts of his travels.

Matthisson's *Schriften* appeared in eight volumes (1825–1829), of which the first contains his poems, the remainder his *Erinnerungen*; a ninth volume was added in 1833 containing his biography by H. Döring. His *Literarischer Nachlass*, with a selection from his correspondence, was published in four volumes by F. R. Schoch in 1832.

MATTING, a general term embracing many coarse woven or plaited fibrous materials used for covering floors or furniture, for hanging as screens, for wrapping up heavy merchandise and for other miscellaneous purposes. In the United Kingdom, under the name of "coir" matting, a large amount of a coarse kind of carpet is made from coco-nut fibre; and the same material, as well as strips of cane, Manila hemp, various grasses and rushes, is largely employed in various forms for making door mats. Large quantities of the coco-nut fibre are woven in heavy looms, then cut up into various sizes, and finally bound round the edges by a kind of rope made from the same material. The mats may be of one colour only, or they may be made of different colours and in different designs. Sometimes the names of institutions are introduced into the mats. Another type of mat is made exclusively from the above-mentioned rope by arranging alternate layers in sinuous and straight paths, and then stitching the parts together. It is also largely used for the outer covering of ships' fenders. Perforated and otherwise prepared rubber, as well as wire-woven material, are also largely utilized for door and floor mats. Matting of various kinds is very extensively employed throughout India for floor coverings, the bottoms of bedsteads, fans and fly-flaps, &c.; and a considerable export trade in such manufactures is carried on. The materials used are numerous; but the principal substances are straw, the bulrushes *Typha elephantina* and *T. angustifolia*, leaves of the date palm (*Phoenix sylvestris*), of the dwarf palm (*Chamaerops Ritchiana*), of the Palmyra palm (*Borassus flabelliformis*), of the coco-nut palm (*Cocos nucifera*) and of the screw pine (*Pandanus odoratissimus*), the munja or munj grass (*Saccharum Munja*) and allied grasses, and the mat grasses *Cyperus textilis* and *C. Pangorei*, from the last of which the well-known Palghat mats of the Madras Presidency are made. Many of these Indian grass-mats are admirable examples of elegant design, and the colours in which they are woven are rich, harmonious and effective in the highest degree. Several useful household articles are made from the different kinds of grasses. The grasses are dyed in all shades and plaited to form attractive designs suitable for the purposes to which they are to be applied. This class of work obtains in India, Japan and other Eastern countries. Vast quantities of coarse matting used for packing furniture, heavy and coarse goods, flax and other plants, &c., are made in Russia from the bast or inner bark of the lime tree. This industry centres in the great forest governments of Viatka, Nizhniy-Novgorod, Kostroma, Kazan, Perm and Simbirsk.

MATTOCK (O.E. *mattuc*, of uncertain origin), a tool having a double iron head, of which one end is shaped like an adze, and the other like a pickaxe. The head has a socket in the centre in which the handle is inserted transversely to the blades. It is used chiefly for grubbing and rooting among tree stumps in plantations and copses, where the roots are too close for the use of a spade, or for loosening hard soil.

MATTO GROSSO, an inland state of Brazil, bounded N. by Amazonas and Pará, E. by Goyaz, Minas Geraes, São Paulo and Paraná, S. by Paraguay and S.W. and W. by Bolivia. It ranks next to Amazonas in size, its area, which is largely unsettled and unexplored, being 532,370 sq. m., and its population only 92,827 in 1890 and 118,025 in 1900. No satisfactory estimate of its Indian population can be made. The greater part of the state belongs to the western extension of the Brazilian plateau, across which, between the 14th and 16th parallels, runs the water-shed which separates the drainage basins of the Amazon and La Plata. This elevated region is known as the plateau of Matto Grosso, and its elevations so far as known rarely exceed 3000 ft. The northern slope of this great plateau is drained by the Araguaya-Tocantins, Xingú, Tapajos and Guaporé-Mamoré-Madeira, which flow northward, and, except the first, empty into the Amazon; the southern slope drains southward through a multitude of streams flowing into the Paraná and Paraguay. The general elevation in the south part of the state is much lower, and large areas bordering the Paraguay are swampy, partially submerged plains which the sluggish rivers are unable to drain. The lowland elevations in this part of the state range from 300 to 400 ft. above sea-level, the climate is hot, humid and unhealthy, and the conditions for permanent settlement are apparently unfavourable. On the highlands, however, which contain extensive open *campos*, the climate, though dry and hot, is considered healthy. The basins of the Paraná and Paraguay are separated by low mountain ranges extending north from the *sierras* of Paraguay. In the north, however, the ranges which separate the river valleys are apparently the remains of the table-land through which deep valleys have been eroded. The resources of Matto Grosso are practically undeveloped, owing to the isolated situation of the state, the costs of transportation and the small population.

The first industry was that of mining, gold having been discovered in the river valleys on the southern slopes of the plateau, and diamonds on the head-waters of the Paraguay, about Diamantino and in two or three other districts. Gold is found chiefly in placers, and in colonial times the output was large, but the deposits were long ago exhausted and the industry is now comparatively unimportant. As to other minerals little is definitely known. Agriculture exists only for the supply of local needs, though tobacco of a superior quality is grown. Cattle-raising, however, has received some attention and is the principal industry of the landowners. The forest products of the state include fine woods, rubber, ipecacuanha, sarsaparilla, jaborandi, vanilla and copaiba. There is little export, however, the only means of communication being down the Paraguay and Paraná rivers by means of subsidized steamers. The capital of the state is Cuyabá, and the chief commercial town is Corumbá at the head of navigation for the larger river boats, and 1986 m. from the mouth of the La Plata. Communication between these two towns is maintained by a line of smaller boats, the distance being 517 m.

The first permanent settlements in Matto Grosso seem to have been made in 1718 and 1719, in the first year at Forquilha and in the second at or near the site of Cuyabá, where rich placer mines had been found. At this time all this inland region was considered a part of São Paulo, but in 1748 it was made a separate *capitania* and was named Matto Grosso ("great woods"). In 1752 its capital was situated on the right bank of the Guaporé river and was named Villa Bella da Santissima Trindade de Matto Grosso, but in 1820 the seat of government was removed to Cuyabá and Villa Bella has fallen into decay. In 1822 Matto Grosso became a province of the empire and in 1889 a republican state. It was invaded by the Paraguayans in the war of 1860–65.

MATTOON, a city of Coles county, Illinois, U.S.A., in the east central part of the state, about 12 m. south-east of Peoria. Pop. (1890), 6833; (1900), 9622, of whom 430 were foreign-born; (1910 census) 11,456. It is served by the Illinois Central and Cleveland, Cincinnati, Chicago & St Louis railways, which have repair shops here, and by inter-urban electric lines. The city has a public library, a Methodist Episcopal Hospital, and an Old Folks' Home, the last supported by the Independent Order of Odd Fellows. Mattoon is an important shipping point for Indian corn and broom corn, extensively grown in the vicinity, and for fruit and livestock. Among its manufactures are foundry and machine shop products, stoves and bricks; in 1905 the factory product was valued at $1,308,781, an increase of 71·2% over that in 1900. The municipality owns the waterworks and an electric lighting plant. Mattoon was first settled about 1855, was named in honour of William Mattoon, an early landowner, was first chartered as a city in 1857, and was reorganized under a general state law in 1879.

MATTRESS (O.Fr. *materas*, mod. *matelas*; the origin is the Arab. *al-materah*, cushion, whence Span. and Port. *almadraque*, Ital. *materasso*), the padded foundation of a bed, formed of canvas or other stout material stuffed with wool, hair, flock or straw; in the last case it is properly known as a "palliasse" (Fr. *paille*, straw; Lat. *palea*); but this term is often applied to an under-mattress stuffed with substances other than straw. The padded mattress on which lay the feather-bed has been replaced by the "wire-mattress," a network of wire stretched on a light wooden or iron frame, which is either a separate structure or a component part of the bedstead itself. The "wire-mattress" has taken the place of the "spring mattress," in which spiral springs support the stuffing. The term "mattress" is used in engineering for a mat of brushwood, faggots, &c., corded together and used as a foundation or as surface in the construction of dams, jetties, dikes, &c.

MATURIN, CHARLES ROBERT (1782–1824), Irish novelist and dramatist, was born in Dublin in 1782. His grandfather, Gabriel Jasper Maturin, had been Swift's successor in the deanery of St Patrick. Charles Maturin was educated at Trinity College, Dublin, and became curate of Loughrea and then of St Peter's, Dublin. His first novels, *The Fatal Revenge; or, the Family of Montorio* (1807), *The Wild Irish Boy* (1808), *The Milesian Chief* (1812), were issued under the pseudonym of "Dennis Jasper Murphy." All these were mercilessly ridiculed, but the irregular power displayed in them attracted the notice of Sir Walter Scott, who recommended the author to Byron. Through their influence Maturin's tragedy of *Bertram* was produced at Drury Lane in 1816, with Kean and Miss Kelly in the leading parts. A French version by Charles Nodier and Baron Taylor was produced in Paris at the Théâtre Favart. Two more tragedies, *Manuel* (1817) and *Fredolfo* (1819), were failures, and his poem *The Universe* (1821) fell flat. He wrote three more novels, *Women* (1818), *Melmoth, the Wanderer* (1820), and *The Albigenses* (1824). *Melmoth*, which forms its author's title to remembrance, is the best of them, and has for hero a kind of "Wandering Jew." Honoré de Balzac wrote a sequel to it under the title of *Melmoth réconcilié à l'église* (1835). Maturin died in Dublin on the 30th of October 1824.

MATVYEEV, ARTAMON SERGYEEVICH (–1682), Russian statesman and reformer, was one of the greatest of the precursors of Peter the Great. His parentage and the date of his birth are uncertain. Apparently his birth was humble, but when the obscure figure of the young Artamon emerges into the light of history we find him equipped at all points with the newest ideas, absolutely free from the worst prejudices of his age, a ripe scholar, and even an author of some distinction. In 1671 the tsar Alexius and Artamon were already on intimate terms, and on the retirement of Orduin-Nashchokin Matvyeev became the tsar's chief counsellor. It was at his house, full of all the wondrous, half-forbidden novelties of the west, that Alexius, after the death of his first consort, Martha, met Matvyeev's favourite pupil, the beautiful Natalia Naruishkina, whom he married on the 21st of January 1672. At the end of the year Matvyeev was raised to the rank of *okolnichy*, and on the 1st of September 1674 attained the still higher dignity of *boyar*. Matvyeev remained paramount to the end of the reign and introduced play-acting and all sorts of refining western novelties into Muscovy. The deplorable physical condition of Alexius's immediate successor, Theodore III. suggested to Matvyeev the desirability of elevating to the throne the sturdy little tsarevich Peter, then in his fourth year. He purchased the allegiance of the *stryeltsi*, or musketeers, and then, summoning the boyars of the council, earnestly represented to them that Theodore, scarce able to live, was surely unable to reign, and urged the substitution of little Peter. But the reactionary boyars, among whom were the near kinsmen of Theodore, proclaimed him tsar and Matvyeev was banished to Pustozersk, in northern Russia, where he remained till Theodore's death (April 27, 1682). Immediately afterwards Peter was proclaimed tsar by the patriarch, and the first *ukas* issued in Peter's name summoned Matvyeev to return to the capital and act as chief adviser to the tsaritsa Natalia. He reached Moscow on the 15th of May, prepared "to lay down his life for the tsar," and at once proceeded to the head of the Red Staircase to meet and argue with the assembled stryeltsi, who had been instigated to rebel by the anti-Petrine faction. He had already succeeded in partially pacifying them, when one of their colonels began to abuse the still hesitating and suspicious musketeers. Infuriated, they seized and flung Matvyeev into the square below, where he was hacked to pieces by their comrades.

See R. Nisbet Bain, *The First Romanovs* (London, 1905); M. P. Pogodin, *The First Seventeen Years of the Life of Peter the Great* (Rus.), (Moscow, 1875); S. M. Solovev, *History of Russia* (Rus.), (vols. 12, 13, (St Petersburg, 1895, &c.); L. Shchepotev, *A.S. Matvyeev as an Educational and Political Reformer* (Rus.), (St Petersburg, 1906). (R. N. B.)

MAUBEUGE, a town of northern France, in the department of Nord, situated on both banks of the Sambre, here canalized, 23½ m. by rail E. by S. of Valenciennes, and about 2 m. from the Belgian frontier. Pop. (1906), town 13,569, commune 21,520. As a fortress Maubeuge has an old enceinte of bastion trace which serves as the centre of an important entrenched camp of 18 m. perimeter, constructed for the most part after the war of 1870, but since modernized and augmented. The town has a board of trade arbitration, a communal college, a commercial and industrial school; and there are important foundries, forges and blast-furnaces, together with manufactures of machine-tools, porcelain, &c. It is united by electric tramway with Hautmont (pop. 12,473), also an important metallurgical centre.

Maubeuge (*Malbodium*) owes its origin to a double monastery, for men and women, founded in the 7th century by St Aldegonde relics of whom are preserved in the church. It subsequently belonged to the territory of Hainault. It was burnt by Louis XI., by Francis I., and by Henry II., and was finally assigned to France by the Treaty of Nijmwegen. It was fortified at Vauban by the command of Louis XIV., who under Turenne first saw military service there. Besieged in 1793 by Prince Josias of Coburg, it was relieved by the victory of Wattignies, which is commemorated by a monument in the town. It was unsuccessfully besieged in 1814, but was compelled to capitulate, after a vigorous resistance, in the Hundred Days.

MAUCH CHUNK, a borough and the county-seat of Carbon county, Pennsylvania, U.S.A., on the W. bank of the Lehigh river and on the Lehigh Coal and Navigation Company's Canal, 46 m. by rail W.N.W. of Easton. Pop. (1890), 4101; (1900), 4029 (571 foreign-born); (1910), 3952. Mauch Chunk is served by the Central of New Jersey railway and, at East Mauch Chunk, across the river, connected by electric railway, by the Lehigh Valley railway. The borough lies in the valley of the Lehigh river, along which runs one of its few streets and in another deeply cut valley at right angles to the river; through this second valley east and west runs the main street, on which is an electric railway; parallel to it on the south is High Street, formerly an Irish settlement; half way up the steep hill, and on the north at the top of the opposite hill is the ward of Upper Mauch Chunk, reached by the electric railway. An incline railway, originally used to transport coal from the mines to the river and named the "Switch-Back," now carries tourists up the steep slopes of Mount Pisgah and Mount Jefferson, to Summit Hill, a rich anthracite coal region, with a famous "burning mine," which has been on fire since 1832, and then back. An electric railway to the top of Flagstaff Mountain, built in 1900, was completed in 1901 to Lehighton, 4 m. south-east of Mauch Chunk, where coal is mined and silk and stoves are manufactured, and which had a population in 1900 of 4629, and in 1910 of 5316. Immediately above Mauch Chunk the river forms a horseshoe; on the opposite side, connected by a bridge, is the borough of East Mauch Chunk (pop. 1900, 3458; 1910, 3548); and 2 m. up the river is Glen Onoko, with fine falls and cascades. The principal buildings in Mauch Chunk are the county court house, a county gaol, a Young Men's Christian Association building, and the Dimmick Memorial Library (1890). The borough was long a famous shipping point for coal. It now has ironworks and foundries, and in East Mauch Chunk there are silk mills. The name is Indian and means "Bear Mountain," this English name being used for a mountain on the east side of the river. The borough was founded by the Lehigh Coal and Navigation Company in 1818. This company began in 1827 the operation of the "Switch-Back," probably the first railway in the country to be used for transporting coal. In 1831 the town was opened to individual enterprise, and in 1850 it was incorporated as a borough. Mauch Chunk was for many years the home of Asa Packer, the projector and builder of the Lehigh Valley railroad from Mauch Chunk to Easton.

MAUCHLINE, a town in the division of Kyle, Ayrshire, Scotland. Pop. (1901), 1767. It lies 8 m. E.S.E. of Kilmarnock and 11 m. E. by N. of Ayr by the Glasgow and South-Western railway. It is situated on a gentle slope about 1 m. from the river Ayr, which flows through the south of the parish of Mauchline. It is noted for its manufacture of snuff-boxes and knick-knacks in wood, and of curling-stones. There is also some cabinet-making, besides spinning and weaving, and its horse fairs and cattle markets have more than local celebrity. The parish church, dating from 1829, stands in the middle of the village, and on the green a monument, erected in 1830, marks the spot where five Covenanters were killed in 1685. Robert Burns lived with his brother Gilbert on the farm of Mossgiel, about a mile to the north, from 1784 to 1788. Mauchline kirkyard was the scene of the "Holy Fair"; at "Poosie Nansie's" (Agnes Gibson's)—still, though much altered, a popular inn—the "Jolly Beggars" held their high jinks; near the church (in the poet's day an old, barn-like structure) was the Whiteford Arms inn, where on a pane of glass Burns wrote the epitaph on John Dove, the landlord; "auld Nanse Tinnock's" house, with the date of 1744 above the door, nearly faces the entrance to the churchyard; the Rev. William Auld was minister of Mauchline, and "Holy Willie," whom the poet scourged in the celebrated "Prayer," was one of "Daddy Auld's" elders; behind the kirkyard stands the house of Gavin Hamilton, the lawyer and firm friend of Burns, in which the poet was married. The braes of Ballochmyle, where he met the heroine of his song, "The Lass o' Ballochmyle," lie about a mile to the south-east. Adjoining them is the considerable manufacturing town of CATRINE (pop. 2340), with cotton factories, bleach fields and brewery, where Dr Matthew Stewart (1717–1785), the father of Dugald Stewart—had a mansion, and where there is a big water-wheel said to be inferior in size only to that of Laxey in the Isle of Man. Barskimming House, 2 m. south by west of Mauchline, the seat of Lord-President Miller (1717–1789), was burned down in 1882. Near the confluence of the Fail and the Ayr was the scene of Burns's parting with Highland Mary.

MAUDE, CYRIL (1862–), English actor, was born in London and educated at Charterhouse. He began his career as an actor in 1883 in America, and from 1896 to 1905 was co-manager with F. Harrison of the Haymarket Theatre, London. There he became distinguished for his quietly humorous acting in many parts. In 1906 he went into management on his own account, and in 1907 opened his new theatre The Playhouse. In 1888 he married the actress Winifred Emery (b. 1862), who had made her London début as a child in 1875, and acted with Irving at the Lyceum between 1881 and 1887. She was a daughter of Samuel Anderson Emery (1817–1881) and grand-daughter of John Emery (1777–1822), both well-known actors in their day.

MAULE, a coast province of central Chile, bounded N. by Talca, E. by Linares and Nuble, and S. by Concepción, and lying between the rivers Maule and Itata, which form its northern and southern boundaries. Pop. (1895), 119,791; area, 2475 sq. m. Maule is traversed from north to south by the coast range and its surfaces are much broken. The Buchupureo river flows westward across the province. The climate is mild and healthy. Agriculture and stock-raising are the principal occupations, and hides, cattle, wheat and timber are exported. Transport facilities are afforded by the Maule and the Itata, which are navigable, and by a branch of the government railway from Cauquenes to Parral, an important town of southern Linares. The provincial capital, Cauquenes (pop., in 1895, 8574; 1902 estimate, 9895), is centrally situated on the Buchupureo river, on the eastern slopes of the coast cordilleras. The town and port of Constitución (pop., in 1900, about 7000) on the south bank of the Maule, one mile above its mouth, was formerly the capital of the province. The port suffers from a dangerous bar at the mouth of the river, but is connected with Talca by rail and has a considerable trade.

The Maule river, from which the province takes its name, is of historic interest because it is said to have marked the southern limits of the Inca Empire. It rises in the Laguna del Maule, an Andean lake near the Argentine frontier, 7218 ft. above sea-level, and flows westward about 140 m. to the Pacific, into which it discharges in 35° 18′ S. The upper part of its drainage basin, to which the *Anuario Hydrografico* gives an area of 8000 sq. m., contains the volcanoes of San Pedro (11,800 ft.), the Descabezado (12,795 ft.), and others of the same group of lower elevations. The upper course and tributaries of the Maule, principally in the province of Linares, are largely used for irrigation.

MAULÉON, SAVARI DE (d. 1236), French soldier, was the son of Raoul de Mauléon, vicomte de Thouars and lord of Mauléon (now Châtillon-sur-Sèvre). Having espoused the cause of Arthur of Brittany, he was captured at Mirebeau (1202), and imprisoned in the château of Corfe. But John set him at liberty in 1204, gained him to his side and named him seneschal of Poitou (1205). In 1211 Savari de Mauléon assisted Raymond VI. count of Toulouse, and with him besieged Simon de Montfort in Castelnaudary. Philip Augustus bought his services in 1212 and gave him command of a fleet which was destroyed in the Flemish port of Damme. Then Mauléon returned to John, whom he aided in his struggle with the barons in 1215. He was one of those whom John designated on his deathbed for a council of regency (1216). Then he went to Egypt (1219), and was present at the taking of Damietta. Returning to Poitou he was a second time seneschal for the king of England. He defended Saintonge against Louis VIII. in 1224, but was accused of having given La Rochelle up to the king of France, and the suspicions of the English again threw him back upon the French. Louis VIII. then turned over to him the defence of La Rochelle and the coast of Saintonge. In 1227 he took part in the rising of the barons of Poitiers and Anjou against the young Louis IX. He enjoyed a certain reputation for his poems in the *langue d'oc*.

See Chilhaud-Dumaine, "Savari de Mauléon," in *Positions des Thèses des élèves de l'École des Chartes* (1877); *Histoire littéraire de la France*, xviii. 671–682.

MAULSTICK, or MAHLSTICK, a stick with a soft leather or padded head, used by painters to support the hand that holds the brush. The word is an adaptation of the Dutch *maalstok*, *i.e.* the painter's stick, from *malen*, to paint.

MAUNDY THURSDAY (through O. Fr. *mandé* from Lat. *mandatum*, commandment, in allusion to Christ's words: "A new commandment give I unto you," after he had washed the disciples' feet at the Last Supper), the Thursday before Easter. Maundy Thursday is sometimes known as *Sheer* or *Chare* Thursday, either in allusion, it is thought, to the "shearing" of heads and beards in preparation for Easter, or more probably in the word's Middle English sense of "pure," in allusion to the ablutions of the day. The chief ceremony, as kept from the early middle ages onwards—the washing of the feet of twelve or more poor men or beggars—was in the early Church almost unknown. Of Chrysostom and St Augustine, who both speak of Maundy Thursday as being marked by a solemn celebration of the Sacrament, the former does not mention the foot-washing, and the latter merely alludes to it. Perhaps an indication of it may be discerned as early as the 4th century in a custom, current in Spain, northern Italy and elsewhere, of washing the feet of the catechumens towards the end of Lent before their baptism. It was not, however, universal, and in the 48th canon of the synod of Elvira (A.D. 306) it is expressly prohibited (cf. *Corp. Jur. Can.*, c. 104, *caus.* i. *qu.* 1). From the 4th century ceremonial foot-washing became yearly more common, till it was regarded as a necessary rite, to be performed by the pope, all Catholic sovereigns, prelates, priests and nobles. In England the king washed the feet of as many poor men as he was years old, and then distributed to them meat, money and clothes. At Durham Cathedral, until the 16th century, every charity-boy had a monk to wash his feet. At Peterborough Abbey, in 1530, Wolsey made "his maund in Our Lady's Chapel, having fifty-nine poor men whose feet he washed and kissed; and after he had wiped them he gave every of the said poor men twelve pence in money, three ells of good canvas to make them shirts, a pair of new shoes, a cast of red herrings and three white herrings." Queen Elizabeth performed the ceremony, the paupers' feet, however, being first washed by the yeomen of the laundry with warm water and sweet herbs. James II. was the last English monarch to perform the rite. William III. delegated the washing to his almoner, and this was usual until the middle of the 18th century. Since 1754 the foot-washing has been abandoned, and the ceremony now consists of the presentation of Maundy money, officially called Maundy Pennies. These were first coined in the reign of Charles II. They come straight from the Mint, and have their edges unmilled. The service which formerly took place in the Chapel Royal, Whitehall, is now held in Westminster Abbey. A procession is formed in the nave, consisting of the lord high almoner representing the sovereign, the clergy and the yeomen of the guard, the latter carrying white and red purses in baskets. The clothes formerly given are now commuted for in cash. The full ritual is gone through by the Roman Catholic archbishop of Westminster, and abroad it survives in all Catholic countries, a notable example being that of the Austrian emperor. In the Greek Church the rite survives notably at Moscow, St Petersburg and Constantinople. It is on Maundy Thursday that in the Church of Rome the sacred oil is blessed, and the chrism prepared according to an elaborate ritual which is given in the *Pontificale.*

MAUPASSANT, HENRI RENÉ ALBERT GUY DE (1850–1893), French novelist and poet, was born at the Château of Miromesnil in the department of Seine-Inférieure on the 5th August 1850. His grandfather, a landed proprietor of a good Lorraine family, owned an estate at Neuville-Champ-d'Oisel near Rouen, and bequeathed a moderate fortune to his son, a Paris stockbroker, who married Mademoiselle Laure Lepoitevin. Maupassant was educated at Yvetot and at the Rouen lycée. A copy of verses entitled *Le Dieu créateur*, written during his year of philosophy, has been preserved and printed. He entered the ministry of marine, and was promoted by M. Bardoux to the Cabinet de l'Instruction publique. A pleasant legend says that, in a report by his official chief, Maupassant is mentioned as not reaching the standard of the department in the matter of style. He may very well have been an unsatisfactory clerk, as he divided his time between rowing expeditions and attending the literary gatherings at the house of Gustave Flaubert, who was not, as he is often alleged to be, connected with Maupassant by any blood tie. Flaubert was not his uncle, nor his cousin, nor even his godfather, but merely an old friend of Madame de Maupassant, whom he had known from childhood. At the literary meetings Maupassant seldom shared in the conversation. Upon those who met him—Tourgenieff, Alphonse Daudet, Catulle Mendès, José-Maria de Heredia and Émile Zola—he left the impression of a simple young athlete. Even Flaubert, to whom Maupassant submitted some sketches, was not greatly struck by their talent, though he encouraged the youth to persevere. Maupassant's first essay was a dramatic piece twice given at Étretat in 1873 before an audience which included Tourgenieff, Flaubert and Meilhac. In this indecorous performance, of which nothing more is heard, Maupassant played the part of a woman. During the next seven years he served a severe apprenticeship to Flaubert, who by this time realized his pupil's exceptional gifts. In 1880 Maupassant published a volume of poems, *Des Vers*, against which the public prosecutor of Etampes took proceedings that were finally withdrawn through the influence of the senator Cordier. From Flaubert, who had himself been prosecuted for his first book, *Madame Bovary*, there came a letter congratulating the poet on the similarity between their first literary experiences. *Des Vers* is an extremely interesting experiment, which shows Maupassant to us still hesitating in his choice of a medium; but he recognized that it was not wholly satisfactory, and that its chief deficiency—the absence of verbal melody—was fatal. Later in the same year he contributed to the *Soirées de Médan*, a collection of short stories by MM. Zola, J.-K. Huysmans, Henry Céard, Léon Hennique and Paul Alexis; and in *Boule de suif* the young unknown author revealed himself to his amazed collaborators and to the public as an admirable writer of prose and a consummate master of the *conte*. There is perhaps no other instance in modern literary history of a writer beginning, as a fully equipped artist, with a genuine masterpiece. This early success was quickly followed by another. The volume entitled *La Maison Tellier* (1881) confirmed the first impression, and vanquished even those who were repelled by the author's choice of subjects. In *Mademoiselle Fifi* (1883) he repeated his previous triumphs as a *conteur*, and in this same year he, for the first time, attempted to write on a larger scale. Choosing to portray the life of a blameless girl, unfortunate in her marriage, unfortunate in her son, consistently unfortunate in every circumstance of existence, he leaves her, ruined and prematurely old, clinging to the tragic hope, which time, as one feels, will belie, that she may find happiness in her grandson. This picture of an average woman undergoing the constant agony of disillusion Maupassant calls *Une Vie* (1883), and as in modern literature there is no finer example of cruel observation, so there is no sadder book than this, while the effect of extreme truthfulness which it conveys justifies its sub-title—*L'Humble vérité*. Certain passages of *Une Vie* are of such a character that the sale of the volume at railway bookstalls was forbidden throughout France. The matter was brought before the chamber of deputies, with the result of drawing still more attention to the book, and of advertising the *Contes de la bécasse* (1883), a collection of stories as improper as they are clever. *Au soleil* (1884), a book of travels which has the eminent qualities of lucid observation and exact description, was less read than *Clair de lune*, *Miss Harriet*, *Les Sœurs Rondoli* and *Yvette*, all published in 1883–1884 when Maupassant's powers were at their highest level. Three further collections of short tales, entitled *Contes et nouvelles*, *Monsieur Parent*, and *Contes du jour et de la nuit*, issued in 1885, proved that while the author's vision was as incomparable as ever, his fecundity had not improved his impeccable form. To 1885 also belongs an elaborate novel, *Bel-ami*, the cynical history of a particularly detestable, brutal scoundrel who makes his way in the world by means of his handsome face. Maupassant is here no less vivid in realizing his literary men, financiers and frivolous women than in dealing with his favourite peasants, boors and servants, to whom he returned in *Toine* (1886) and in *La Petite roque* (1886). About this time appeared the first symptoms of the malady which destroyed him; he wrote less, and though the novel *Mont-Oriol* (1887) shows him apparently in undiminished possession of his faculty, *Le Horla* (1887) suggests that he was already subject to alarming hallucinations. Restored to some extent by a sea-voyage, recorded in *Sur l'eau* (1888), he went back to short stories in *Le Rosier de Madame Husson* (1888), a burst of Rabelaisian humour equal to anything he had ever written. His novels *Pierre et Jean* (1888), *Fort comme la mort* (1889), and *Notre cœur* (1890) are penetrating studies touched with a profounder sympathy than had hitherto distinguished him; and this softening into pity for the tragedy of life is deepened in some of the tales included in *Inutile beauté* (1890). One of these, *Le Champ d'Oliviers*, is an unsurpassable example of poignant, emotional narrative. With *La Vie errante* (1890), a volume of travels, Maupassant's career practically closed. *Musotte*, a theatrical piece written in collaboration with M. Jacques Normand, was published in 1891. By this time inherited nervous maladies, aggravated by excessive physical exercises and by the imprudent use of drugs, had undermined his constitution. He began to take an interest in religious problems, and for a while made the *Imitation* his handbook; but his misanthropy deepened, and he suffered from curious delusions as to his wealth and rank. A victim of general paralysis, of which *La Folie des grandeurs* was one of the symptoms, he drank the waters at Aix-les-Bains during the summer of 1891, and retired to Cannes, where he purposed passing the winter. The singularities of conduct which had been observed at Aix-les-Bains grew more and more marked. Maupassant's reason slowly gave way. On the 6th of January 1892 he attempted suicide, and was removed to Paris, where he died in the most painful circumstances on the 6th of July 1893. He is buried in the cemetery of Montparnasse. The opening chapters of two projected novels, *L'Angélus* and *L'Ame étrangère*, were found among his papers; these, with *La Paix du ménage*, a comedy in two acts, and two collections of tales, *Le Père Milon* (1898) and *Le Colporteur* (1899), have been published posthumously. A correspondence, called *Amitié amoureuse* (1897), and dedicated to his mother, is probably unauthentic. Among the prefaces which he wrote for the works of others, only one—an introduction to a French prose version of Mr Swinburne's *Poems and Ballads*—is likely to interest English readers.

Maupassant began as a follower of Flaubert and of M. Zola, but, whatever the masters may have called themselves, they both remained essentially *romantiques*. The pupil is the last of the "naturalists": he even destroyed naturalism, since he did all that can be done in that direction. He had no psychology, no theories of art, no moral or strong social prejudices, no disturbing imagination, no wealth of perplexing ideas. It is no paradox to say that his marked limitations made him the incomparable artist that he was. Undisturbed by any external influence, his marvellous vision enabled him to become a supreme observer, and, given his literary sense, the rest was simple. He prided himself in having no invention; he described nothing that he had not seen. The peasants whom he had known as a boy figure in a score of tales; what he saw in Government offices is set down in *L'Héritage;* from Algiers he gathers the material for *Marocca;* he drinks the waters and builds up *Mont-Oriol;* he enters journalism, constructs *Bel-ami*, and, for the sake of precision, makes his brother, Hervé de Maupassant, sit for the infamous hero's portrait; he sees fashionable society, and, though it wearied him intensely, he transcribes its life in *Fort comme la mort* and *Notre cœur*. Fundamentally he finds all men alike. In every grade he finds the same ferocious, cunning, animal instincts at work: it is not a gay world, but he knows no other; he is possessed by the dread of growing old, of ceasing to enjoy; the horror of death haunts him like a spectre. It is an extremely simple outlook. Maupassant does not prefer good to bad, one man to another; he never pauses to argue about the meaning of life, a senseless thing which has the one advantage of yielding materials for art; his one aim is to discover the hidden aspect of visible things, to relate what he has observed, to give an objective rendering of it, and he has seen so intensely and so serenely that he is the most exact transcriber in literature. And as the substance is, so is the form: his style is exceedingly simple and exceedingly strong; he uses no rare or superfluous word, and is content to use the humblest word if only it conveys the exact picture of the thing seen. In ten years he produced some thirty volumes. With the exception of *Pierre et Jean*, his novels, excellent as they are, scarcely represent him at his best, and of over two hundred *contes* a proportion must be rejected. But enough will remain to vindicate his claim to a permanent place in literature as an unmatched observer and the most perfect master of the short story.

See also F. Brunetière, *Le Roman naturaliste* (1883); J. Lemaître, *Les Contemporains* (vols. i. v. vi.); R. Doumic, *Écrivains d'aujourd'hui* (1894); an introduction by Henry James to *The Odd Number* . . . (1891); a critical preface by the earl of Crewe to *Pierre and Jean* (1902); A. Symons, *Studies in Prose and Verse* (1904). There are many references to Maupassant in the *Journal des Goncourt*, and some correspondence with Marie Bashkirtseff was printed with *Further Memoirs* of that lady in 1901. (J. F.-K.)

MAUPEOU, RENÉ NICOLAS CHARLES AUGUSTIN (1714–1792), chancellor of France, was born on the 25th of February 1714, being the eldest son of René Charles de Maupeou (1688–1775), who was president of the parlement of Paris from 1743 to 1757. He married in 1744 a rich heiress, Anne de Roncherolles, a cousin of Madame d'Epinay. Entering public life, he was his father's right hand in the conflicts between the parlement and Christophe de Beaumont, archbishop of Paris, who was supported by the court. Between 1763 and 1768, dates which cover the revision of the case of Jean Calas and the trial of the comte de Lally, Maupeou was himself president of the parlement. In 1768, through the protection of Choiseul, whose fall two years later was in large measure his work, he became chancellor in succession to his father, who had held the office for a few days only. He determined to support the royal authority against the parlement, which in league with the provincial magistratures was seeking to arrogate to itself the functions of the states-general. He allied himself with the duc d'Aiguillon and Madame du Barry, and secured for a creature of his own, the Abbé Terrai, the office of comptroller-general. The struggle came over the trial of the case of the duc d'Aiguillon, ex-governor of Brittany, and of La Chalotais, procureur-général of the province, who had been imprisoned by the governor for accusations against his administration. When the parlement showed signs of hostility against Aiguillon, Maupeou read letters patent from Louis XV. annulling the proceedings. Louis replied to remonstrances from the parlement by a *lit de justice*, in which he demanded the surrender of the minutes of procedure. On the 27th of November 1770 appeared the *Édit de règlement et de discipline*, which was promulgated by the chancellor, forbidding the union of the various branches of the parlement and correspondence with the provincial magistratures. It also made a strike on the part of the parlement punishable by confiscation of goods, and forbade further obstruction to the registration of royal decrees after the royal reply had been given to a first remonstrance. This edict the magistrates refused to register, and it was registered in a *lit de justice* held at Versailles on the 7th of December, whereupon the parlement suspended its functions. After five summonses to return to their duties, the magistrates were surprised individually on the night of the 19th of January 1771 by musketeers, who required them to sign yes or no to a further request to return. Thirty-eight magistrates gave an affirmative answer, but on the exile of their former colleagues by *lettres de cachet* they retracted, and were also exiled. Maupeou installed the council of state to administer justice pending the establishment of six superior courts in the provinces, and of a new parlement in Paris. The *cour des aides* was next suppressed.

Voltaire praised this revolution, applauding the suppression of the old hereditary magistrature, but in general Maupeou's policy was regarded as the triumph of tyranny. The remonstrances of the princes, of the nobles, and of the minor courts, were met by exile and suppression, but by the end of 1771 the new system was established, and the Bar, which had offered a passive resistance, recommenced to plead. But the death of Louis XV. in May 1774 ruined the chancellor. The restoration of the parlements was followed by a renewal of the quarrels between the new king and the magistrature. Maupeou and Terrai were replaced by Malesherbes and Turgot. Maupeou lived in retreat until his death at Thuit on the 29th of July 1792, having lived to see the overthrow of the *ancien régime*. His work, in so far as it was directed towards the separation of the judicial and political functions and to the reform of the abuses attaching to a hereditary magistrature, was subsequently endorsed by the Revolution; but no justification of his violent methods or defence of his intriguing and avaricious character is possible. He aimed at securing absolute power for Louis XV., but his action was in reality a serious blow to the monarchy.

The chief authority for the administration of Maupeou is the *compte rendu* in his own justification presented by him to Louis XVI. in 1789, which included a dossier of his speeches and edicts, and is preserved in the Bibliothèque nationale. These documents, in the hands of his former secretary, C. F. Lebrun, duc de Plaisance, formed the basis of the judicial system of France as established under the consulate (cf. C. F. Lebrun, *Opinions, rapports et choix d'écrits politiques*, published posthumously in 1829). See further *Maupeouana* (6 vols., Paris, 1775), which contains the pamphlets directed against him; *Journal hist. de la révolution opérée . . . par M. de Maupeou* (7 vols., 1775); the official correspondence of Mercy-Argenteau, the letters of Mme d'Épinay; and Jules Flammermont, *Le Chancelier Maupeou et les parlements* (1883).

MAUPERTUIS, PIERRE LOUIS MOREAU DE (1698–1759), French mathematician and astronomer, was born at St Malo on the 17th of July 1698. When twenty years of age he entered the army, becoming lieutenant in a regiment of cavalry, and employing his leisure on mathematical studies. After five years he quitted the army and was admitted in 1723 a member of the Academy of Sciences. In 1728 he visited London, and was elected a fellow of the Royal Society. In 1736 he acted as chief of the expedition sent by Louis XV. into Lapland to measure the length of a degree of the meridian (see EARTH, FIGURE OF), and on his return home he became a member of almost all the scientific societies of Europe. In 1740 Maupertuis went to Berlin on the invitation of the king of Prussia, and took part in the battle of Mollwitz, where he was taken prisoner by the Austrians. On his release he returned to Berlin, and thence to Paris, where he was elected director of the Academy of Sciences in 1742, and in the following year was admitted into the Academy. Returning to Berlin in 1744, at the desire of Frederick II., he was chosen president of the Royal Academy of Sciences in 1746. Finding his health declining, he repaired in 1757 to the south of France, but went in 1758 to Basel, where he died on the 27th of July 1759. Maupertuis was unquestionably a man of considerable ability as a mathematician, but his restless, gloomy disposition involved him in constant quarrels, of which his controversies with König and Voltaire during the latter part of his life furnish examples.

The following are his most important works: *Sur la figure de la terre* (Paris, 1738); *Discours sur la parallaxe de la lune* (Paris, 1741); *Discours sur la figure des astres* (Paris, 1742); *Éléments de la géographie* (Paris, 1742); *Lettre sur la comète de 1742* (Paris, 1742); *Astronomie nautique* (Paris, 1745 and 1746); *Vénus physique* (Paris, 1745); *Essai de cosmologie* (Amsterdam, 1750). His *Œuvres* were published in 1752 at Dresden and in 1756 at Lyons.

MAU RANIPUR, a town of British India in Jahnsi district, in the United Provinces. Pop. (1901), 17,231. It contains a large community of wealthy merchants and bankers. A special variety of red cotton cloth, known as *kharua*, is manufactured and exported to all parts of India. Trees line many of the streets, and handsome temples ornament the town.

MAUREL, ABDIAS (d. 1705), Camisard leader, became a cavalry officer in the French army and gained distinction in Italy; here he served under Marshal Catinat, and on this account he himself is sometimes known as Catinat. In 1702, when the revolt in the Cévennes broke out, he became one of the Camisard leaders, and in this capacity his name was soon known and feared. He refused to accept the peace made by Jean Cavalier in 1704, and after passing a few weeks in Switzerland he returned to France and became one of the chiefs of those Camisards who were still in arms. He was deeply concerned in a plot to capture some French towns, a scheme which, it was hoped, would be helped by England and Holland. But it failed; Maurel was betrayed, and with three other leaders of the movement was burned to death at Nîmes on the 22nd of April 1705. He was a man of great physical strength; but he was very cruel, and boasted he had killed 200 Roman Catholics with his own hands.

MAUREL, VICTOR (1848–   ), French singer, was born at Marseilles, and educated in music at the Paris Conservatoire. He made his début in opera at Paris in 1868, and in London in 1873, and from that time onwards his admirable acting and vocal method established his reputation as one of the finest of operatic baritones. He created the leading part in Verdi's *Otello*, and was equally fine in Wagnerian and Italian opera.

MAURENBRECHER, KARL PETER WILHELM (1838–1892), German historian, was born at Bonn on the 21st of December, 1838, and studied in Berlin and Munich under Ranke and Von Sybel, being especially influenced by the latter historian. After doing some research work at Simancas in Spain, he became professor of history at the university of Dorpat in 1867; and was then in turn professor at Königsberg, Bonn and Leipzig. He died at Leipzig on the 6th of November, 1892.

Many of Maurenbrecher's works are concerned with the Reformation, among them being *England im Reformationszeitalter* (Düsseldorf, 1866); *Karl V. und die deutschen Protestanten* (Düsseldorf, 1865); *Studien und Skizzen zur Geschichte der Reformationszeit* (Leipzig, 1874); and the incomplete *Geschichte der Katholischen Reformation* (Nördlingen, 1880). He also wrote *Don Karlos* (Berlin, 1876); *Gründung des deutschen Reiches 1859–1871* (Leipzig, 1892, and again 1902); and *Geschichte der deutschen Königswahlen* (Leipzig, 1889). See G. Wolf, *Wilhelm Maurenbrecher* (Berlin, 1893).

MAUREPAS, JEAN FRÉDÉRIC PHÉLYPEAUX, COMTE DE (1701–1781), French statesman, was born on the 9th of July 1701 at Versailles, being the son of Jérôme de Pontchartrain, secretary of state for the marine and the royal household. Maurepas succeeded to his father's charge at fourteen, and began his functions in the royal household at seventeen, while in 1725 he undertook the actual administration of the navy. Although essentially light and frivolous in character, Maurepas was seriously interested in scientific matters, and he used the best brains of France to apply science to questions of navigation and of naval construction. He was disgraced in 1749, and exiled from Paris for an epigram against Madame de Pompadour. On the accession of Louis XVI., twenty-five years later, he became a minister of state and Louis XVI.'s chief adviser. He gave Turgot the direction of finance, placed Lamoignon-Malesherbes over the royal household and made Vergennes minister for foreign affairs. At the outset of his new career he showed his weakness by recalling to their functions, in deference to popular clamour, the members of the old parlement ousted by Maupeou, thus reconstituting the most dangerous enemy of the royal power. This step, and his intervention on behalf of the American states, helped to pave the way for the French revolution. Jealous of his personal ascendancy over Louis XVI., he intrigued against Turgot, whose disgrace in 1776 was followed after six months of disorder by the appointment of Necker. In 1781 Maurepas deserted Necker as he had done Turgot, and he died at Versailles on the 21st of November 1781.

Maurepas is credited with contributions to the collection of facetiae known as the *Étrennes de la Saint Jean* (2nd ed., 1742). Four volumes of *Mémoires de Maurepas*, purporting to be collected by his secretary and edited by J. L. G. Soulavie in 1792, must be regarded as apocryphal. Some of his letters were published in 1896 by the *Soc. de l'hist. de Paris*. His *éloge* in the Academy of Sciences was pronounced by Condorcet.

MAURER, GEORG LUDWIG VON (1790–1872), German statesman and historian, son of a Protestant pastor, was born at Erpolzheim, near Dürkheim, in the Rhenish Palatinate, on the 2nd of November 1790. Educated at Heidelberg, he went in 1812 to reside in Paris, where he entered upon a systematic study of the ancient legal institutions of the Germans. Returning to Germany in 1814, he received an appointment under the Bavarian government, and afterwards filled several important official positions. In 1824 he published at Heidelberg his *Geschichte des altgermanischen und namentlich altbayrischen öffentlichmündlichen Gerichtsverfahrens*, which obtained the first prize of the academy of Munich, and in 1826 he became professor in the university of Munich. In 1829 he returned to official life, and was soon offered an important post. In 1832, when Otto (Otho), son of Louis I., king of Bavaria, was chosen to fill the throne of Greece, a council of regency was nominated during his minority, and Maurer was appointed a member. He applied himself energetically to the task of creating institutions adapted to the requirements of a modern civilized community; but grave difficulties soon arose and Maurer was recalled in 1834, when he returned to Munich. This loss was a serious one for Greece. Maurer was the ablest, most energetic and most liberal-minded member of the council, and it was through his enlightened efforts that Greece obtained a revised penal code, regular tribunals and an improved system of civil procedure. Soon after his recall he published *Das griechische Volk in öffentlicher, kirchlicher, und privatrechtlicher Beziehung vor und nach dem Freiheitskampfe bis zum 31 Juli 1834* (Heidelberg, 1835–1836), a useful source of information for the history of Greece before Otto ascended the throne, and also for the labours of the council of regency to the time of the author's recall. After the fall of the ministry of Karl von Abel (1788–1859) in 1847, he became chief Bavarian minister and head of the departments of foreign affairs and of justice, but was overthrown in the same year. He died at Munich on the 9th of May 1872. His only son, Conrad von Maurer (1823–1902), was a Scandinavian scholar of some repute, and like his father was a professor at the university of Munich.

Maurer's most important contribution to history is a series of books on the early institutions of the Germans. These are: *Einleitung zur Geschichte der Mark-, Hof-, Dorf-, und Stadtverfassung und der öffentlichen Gewalt* (Munich, 1854); *Geschichte der Markenverfassung in Deutschland* (Erlangen, 1856); *Geschichte der Fronhöfe, der Bauernhöfe, und der Hofverfassung in Deutschland* (Erlangen, 1862–1863); *Geschichte der Dorfverfassung in Deutschland* (Erlangen, 1865–1866); and *Geschichte der Städteverfassung in Deutschland* (Erlangen, 1869–1871). These works are still important authorities for the early history of the Germans. Among other works are, *Das Stadt- und Landrechtsbuch Ruprechts von Freising, ein Beitrag zur Geschichte des Schwabenspiegels* (Stuttgart, 1839); *Über die Freipflege (plegium liberale), und die Entstehung der grossen und kleinen Jury in England* (Munich, 1848); and *Über die deutsche Reichsterritorial- und Rechtsgeschichte* (1830).

See K. T. von Heigel, *Denkwürdigkeiten des bayrischen Staatsrats G. L. von Maurer* (Munich, 1903).

MAURETANIA, the ancient name of the north-western angle of the African continent, and under the Roman Empire also of a large territory eastward of that angle. The name had different significations at different times; but before the Roman occupation, Mauretania comprised a considerable part of the modern Morocco *i.e.* the northern portion bounded on the east by Algiers. Towards the south we may suppose it bounded by the Atlas range, and it seems to have been regarded by geographers as extending along the coast to the Atlantic as far as the point where that chain descends to the sea, in about 30 N. lat. (Strabo, p. 825). The magnificent plateau in which the city of Morocco is situated seems to have been unknown to ancient geographers, and was certainly never included in the Roman Empire. On the other hand, the Gaetulians to the south of the Atlas range, on the date-producing slopes towards the Sahara, seem to have owned a precarious subjection to the kings of Mauretania, as afterwards to the Roman government. A large part of the country is of great natural fertility, and in ancient times produced large quantities of corn, while the slopes of Atlas were clothed with forests, which, besides other kinds of timber, produced the celebrated ornamental wood called *citrum* (Plin. *Hist. Nat.* 13–96), for tables of which the Romans gave fabulous prices. (For physical geography, see MOROCCO.)

Mauretania, or Maurusia as it was called by Greek writers, signified the land of the Mauri, a term still retained in the modern name of Moors (*q.v.*). The origin and ethnical affinities of the race are uncertain; but it is probable that all the inhabitants of this northern tract of Africa were kindred races belonging to the great Berber family, possibly with an intermingled fair-skinned race from Europe (see Tissot, *Géographie comparée de la province romaine d'Afrique*, i. 400 seq.; also BERBERS). They first appear in history at the time of the Jugurthine War (110–106 B.C.), when Mauretania was under the government of Bocchus and seems to have been recognized as organized state (Sallust, *Jugurtha*, 19). To this Bocchus was given, after the war, the western part of Jugurtha's kingdom of Numidia, perhaps as far east as Saldae (Bougie). Sixty years later, at the time of the dictator Caesar, we find two Mauretanian kingdoms, one to the west of the river Mulucha under Bogud, and the other to the east under a Bocchus; as to the date or cause of the division we are ignorant. Both these kings took Caesar's part in the civil wars, and had their territory enlarged by him (Appian, B.C. 4, 54). In 25 B.C., after their deaths, Augustus gave the two kingdoms to Juba II. of Numidia (see under JUBA), with the river Ampsaga as the eastern frontier (Plin. 5. 22; Ptol. 4. 3. 1). Juba and his son Ptolemaeus after him reigned till A.D. 40, when the latter was put to death by Caligula, and shortly afterwards Claudius incorporated the kingdom into the Roman state as two provinces, viz. Mauretania Tingitana to the west of the Mulucha and M. Caesariensis to the east of that river, the latter taking its name from the city Caesarea (formerly Iol), which Juba had thus named and adopted as his capital. Thus the dividing line between the two provinces was the same as that which had originally separated Mauretania from Numidia (*q.v.*). These provinces were governed until the time of Diocletian by imperial procurators, and were occasionally united for military purposes. Under and after Diocletian M. Tingitana was attached administratively to the *dioicesis* of Spain, with which it was in all respects closely connected; while M. Caesariensis was divided by making its eastern part into a separate government, which was called M. Sitifensis from the Roman colony Sitifis.

In the two provinces of Mauretania there were at the time of Pliny a number of towns, including seven (possibly eight) Roman colonies in M. Tingitana and eleven in M. Caesariensis; others were added later. These were mostly military foundations, and served the purpose of securing civilization against the inroads of the natives, who were not in a condition to be used as material for town-life as in Gaul and Spain, but were under the immediate government of the procurators, retaining their own clan organization. Of these colonies the most important, beginning from the west, were Lixus on the Atlantic, Tingis (Tangier), Rusaddir (Melila, Melilla), Cartenna (Tenes), Iol or Caesarea (Cherchel), Icosium (Algiers), Saldae (Bougie), Igilgili (Jijelli) and Sitifis (Setif). All these were on the coast but the last, which was some distance inland. Besides these there were many municipia or *oppida civium romanorum* (Plin. 5. 19 seq.), but, as has been made clear by French archaeologists who have explored these regions, Roman settlements are less frequent the farther we go west, and M. Tingitana has as yet yielded but scanty evidence of Roman civilization. On the whole Mauretania was in a flourishing condition down to the irruption of the Vandals in A.D. 429; in the *Notitia* nearly a hundred and seventy episcopal sees are enumerated here, but we must remember that numbers of these were mere villages.

In 1904 the term Mauretania was revived as an official designation by the French government, and applied to the territory north of the lower Senegal under French protection (see SENEGAL).

To the authorities quoted under AFRICA, ROMAN, may be added here Göbel, *Die West-küste Afrikas im Alterthum.* (W. W. F.*)

MAURIAC, a town of central France, capital of an arrondissement in the department of Cantal, 39 m. N.N.W. of Aurillac by rail. Pop. (1906), 2558. Mauriac, built on the slope of a volcanic hill, has a church of the 12th century, and the buildings of an old abbey now used as public offices and dwellings; the town owes its origin to the abbey, founded during the 6th century. It is the seat of a sub-prefect and has a tribunal of first instance and a communal college. There are marble quarries in the vicinity.

MAURICE [or MAURITIUS], **ST** (d. *c.* 286), an early Christian martyr, who, with his companions, is commemorated by the Roman Catholic Church on the 22nd of September. The oldest form of his story is found in the *Passio* ascribed to Eucherius, bishop of Lyons, *c.* 450, who relates how the "Theban" legion commanded by Mauritius was sent to north Italy to reinforce the army of Maximinian. Maximinian wished to use them in persecuting the Christians, but as they themselves were of this faith, they refused, and for this, after having been twice decimated, the legion was exterminated at Octodurum (Martigny) near Geneva. In late versions this legend was expanded and varied, the martyrdom was connected with a refusal to take part in a great sacrifice ordered at Octodurum and the name of Exsuperius was added to that of Mauritius. Gregory of Tours (*c.* 539–593) speaks of a company of the same legion which suffered at Cologne.

The *Magdeburg Centuries*, in spite of Mauritius being the patron saint of Magdeburg, declared the whole legend fictitious; J. A. du Bordier *La Légion thébéenne* (Amsterdam, 1705); J. J. Hottinger in *Helvetische Kirchengeschichte* (Zürich, 1708); and F. W. Rettberg, *Kirchengeschichte Deutschlands* (Göttingen, 1845–1848) have also demonstrated its untrustworthiness, while the Bollandists, De Rivaz and Joh. Friedrich uphold it. Apart from the a priori improbability of a whole legion being martyred, the difficulties are that in 286 Christians everywhere throughout the empire were not molested, that at no later date have we evidence of the presence of Maximinian in the Valais, and that none of the writers nearest to the event (Eusebius, Lactantius, Orosius, Sulpicius Severus) know anything of it. It is of course quite possible that isolated cases of officers being put to death for their faith occurred during Maximinian's reign, and on some such cases the legend may have grown up during the century and a half between Maximinian and Eucherius. The cult of St Maurice and the Theban legion is found in Switzerland (where two places bear the name in Valais, besides St Moritz in Grisons), along the Rhine, and in north Italy. The foundation of the abbey of St Maurice (Agaunum) in the Valais is usually ascribed to Sigismund of Burgundy (515). Relics of the saint are preserved here and at Brieg and Turin.

MAURICE (Mauricius Flavius Tiberius) (*c.* 539–602), East Roman emperor from 582 to 602, was of Roman descent, but a native of Arabissus in Cappadocia. He spent his youth at the court of Justin II., and, having joined the army, fought with distinction in the Persian War (578–581). At the age of forty-three he was declared Caesar by the dying emperor Tiberius II., who bestowed upon him the hand of his daughter Constantina. Maurice brought the Persian War to a successful close by the restoration of Chosroes II. to the throne (591). On the northern frontier he at first bought off the Avars by payments which compelled him to exercise strict economy in his general administration, but after 595 inflicted several defeats upon them through his general Crispus. By his strict discipline and his refusal to ransom a captive corps he provoked to mutiny the army on the Danube. The revolt spread to the popular factions in Constantinople, and Maurice consented to abdicate. He withdrew to Chalcedon, but was hunted down and put to death after witnessing the slaughter of his five sons.

The work on military art (*στρατηγικά*) ascribed to him is a contemporary work of unknown authorship (ed. Scheffer, *Arriani tactica et Mauricii ars militaris*, Upsala, 1664; see Max Jähns, *Gesch. d. Kriegswissensch.*, i. 152–156).

See Theophylactus Simocatta, *Vita Mauricii* (ed. de Boor, 1887); E. Gibbon, *The Decline and Fall of the Roman Empire* (ed. Bury, London, 1896, v. 19–21, 57); J. B. Bury, *The Later Roman Empire* (London, 1889, ii. 83–94); G. Finlay, *History of Greece* (ed. 1877, Oxford, i. 299–306).

MAURICE (1521–1553), elector of Saxony, elder son of Henry, duke of Saxony, belonging to the Albertine branch of the Wettin family, was born at Freiberg on the 21st of March 1521. In January 1541 he married Agnes, daughter of Philip, landgrave of Hesse. In that year he became duke of Saxony by his father's death, and he continued Henry's work in forwarding the progress of the Reformation. Duke Henry had decreed that his lands should be divided between his two sons, but as a partition was regarded as undesirable the whole of the duchy came to his elder son. Maurice, however, made generous provision for his brother Augustus, and the desire to compensate him still further was one of the minor threads of his subsequent policy. In 1542 he assisted the emperor Charles V. against the Turks, in 1543 against William, duke of Cleves, and in 1544 against the French; but his ambition soon took a wider range. The harmonious relations which subsisted between the two branches of the Wettins were disturbed by the interference of Maurice in Cleves, a proceeding distasteful to the Saxon elector, John Frederick; and a dispute over the bishopric of Meissen having widened the breach, war was only averted by the mediation of Philip of Hesse and Luther. About this time Maurice seized the idea of securing for himself the electoral dignity held by John Frederick, and his opportunity came when Charles was preparing to attack the league of Schmalkalden. Although educated as a Lutheran, religious questions had never seriously appealed to Maurice. As a youth he had joined the league of Schmalkalden, but this adhesion, as well as his subsequent declaration to stand by the confession of Augsburg, cannot be regarded as the decision of his maturer years. In June 1546 he took a decided step by making a secret agreement with Charles at Regensburg. Maurice was promised some rights over the archbishopric of Magdeburg and the bishopric of Halberstadt; immunity, in part at least, for his subjects from the Tridentine decrees; and the question of transferring the electoral dignity was discussed. In return the duke probably agreed to aid Charles in his proposed attack on the league as soon as he could gain the consent of the Saxon estates, or at all events to remain neutral during the impending war. The struggle began in July 1546, and in October Maurice declared war against John Frederick. He secured the formal consent of Charles to the transfer of the electoral dignity and took the field in November. He had gained a few successes when John Frederick hastened from south Germany to defend his dominions. Maurice's ally, Albert Alcibiades, prince of Bayreuth, was taken prisoner at Rochlitz; and the duke, driven from electoral Saxony, was unable to prevent his own lands from being overrun. Salvation, however, was at hand. Marching against John Frederick, Charles V., aided by Maurice, gained a decisive victory at Mühlberg in April 1547, after which by the capitulation of Wittenberg John Frederick renounced the electoral dignity in favour of Maurice, who also obtained a large part of his kinsman's lands. The formal investiture of the new elector took place at Augsburg in February 1548.

The plans of Maurice soon took a form less agreeable to the emperor. The continued imprisonment of his father-in-law, Philip of Hesse, whom he had induced to surrender to Charles and whose freedom he had guaranteed, was neither his greatest nor his only cause of complaint. The emperor had refused to complete the humiliation of the family of John Frederick; he had embarked upon a course of action which boded danger to the elector's Lutheran subjects, and his increased power was a menace to the position of Maurice. Assuring Charles of his continued loyalty, the elector entered into negotiations with the discontented Protestant princes. An event happened which gave him a base of operations, and enabled him to mask his schemes against the emperor. In 1550 he had been entrusted with the execution of the imperial ban against the city of Magdeburg, and under cover of these operations he was able to collect troops and to concert measures with his allies. Favourable terms were granted to Magdeburg, which surrendered and remained in the power of Maurice, and in January 1552 a treaty was concluded with Henry II. of France at Chambord. Meanwhile Maurice had refused to recognize the *Interim* issued from Augsburg in May 1548 as binding on Saxony; but a compromise was arranged on the basis of which the Leipzig *Interim* was drawn up for his lands. It is uncertain how far Charles was ignorant of the elector's preparations, but certainly he was unprepared for the attack made by Maurice and his allies in March 1552. Augsburg was taken, the pass of Ehrenberg was forced, and in a few days the emperor left Innsbruck as a fugitive. Ferdinand undertook to make peace, and the Treaty of Passau, signed in August 1552, was the result. Maurice obtained a general amnesty and freedom for Philip of Hesse, but was unable to obtain a perpetual religious peace for the Lutherans. Charles stubbornly insisted that this question must be referred to the Diet, and Maurice was obliged to give way. He then fought against the Turks, and renewed his communications with Henry of France. Returning from Hungary the elector placed himself at the head of the princes who were seeking to check the career of his former ally, Albert Alcibiades, whose depredations were making him a curse to Germany. The rival armies met at Sievershausen on the 9th of July 1553, where after a fierce encounter Albert was defeated. The victor, however, was wounded during the fight and died two days later.

Maurice was a friend to learning, and devoted some of the secularized church property to the advancement of education. Very different estimates have been formed of his character. He has been represented as the saviour of German Protestantism on the one hand, and on the other as a traitor to his faith and country. In all probability he was neither the one nor the other, but a man of great ambition who, indifferent to religious considerations, made good use of the exigencies of the time. He was generous and enlightened, a good soldier and a clever diplomatist. He left an only daughter Anna (d. 1577), who became the second wife of William the Silent, prince of Orange.

The elector's *Politische Korrespondenz* has been edited by E. Brandenburg (Leipzig, 1900–1904); and a sketch of him is given by Roger Ascham in *A Report and Discourse of the Affairs and State of Germany* (London, 1864–1865). See also F. A. von Langenn, *Moritz Herzog und Churfürst zu Sachsen* (Leipzig, 1841); G. Voigt, *Moritz von Sachsen* (Leipzig, 1876); E. Brandenburg, *Moritz von Sachsen* (Leipzig, 1898); S. Issleib, *Moritz von Sachsen als protestantischer Fürst* (Hamburg, 1898); J. Witter, *Die Beziehung und der Verkehr des Kurfürsten Moritz mit König Ferdinand* (Jena, 1886); L. von Ranke, *Deutsche Geschichte im Zeitalter der Reformation*, Bde. IV. and V. (Leipzig, 1882); and W. Maurenbrecher in the *Allgemeine deutsche Biographie*, Bd. XXII. (Leipzig, 1885). For bibliography see Maurenbrecher; and *The Cambridge Modern History*, vol. ii. (Cambridge, 1903).

MAURICE, JOHN FREDERICK DENISON (1805–1872), English theologian, was born at Normanston, Suffolk, on the 29th of August, 1805. He was the son of a Unitarian minister, and entered Trinity College, Cambridge, in 1823, though it was then impossible for any but members of the Established Church to obtain a degree. Together with John Sterling (with whom he founded the Apostles' Club) he migrated to Trinity Hall, whence he obtained a first class in civil law in 1827; he then came to London, and gave himself to literary work, writing a novel, *Eustace Conyers*, and editing the *London Literary Chronicle* until 1830, and also for a short time the *Athenaeum*. At this time he was much perplexed as to his religious opinions, and he ultimately found relief in a decision to take a further university course and to seek Anglican orders. Entering Exeter College, Oxford, he took a second class in classics in 1831. He was ordained in 1834, and after a short curacy at Bubbenhall in Warwickshire was appointed chaplain of Guy's Hospital, and became thenceforward a sensible factor in the intellectual and social life of London. From 1839 to 1841 Maurice was editor of the *Education Magazine*. In 1840 he was appointed professor of English history and literature in King's College, and to this post in 1846 was added the chair of divinity. In 1845 he was Boyle lecturer and Warburton lecturer. These chairs he held till 1853. In that year he published *Theological Essays*, wherein were stated opinions which savoured to the principal, Dr R. W. Jelf, and to the council, of unsound theology in regard to eternal punishment. He had previously been called on to clear himself from charges of heterodoxy brought against him in the *Quarterly Review* (1851), and had been acquitted by a committee of inquiry. Now again he maintained with great warmth of conviction that his views were in close accordance with Scripture and the Anglican standards, but the council, without specifying any distinct "heresy" and declining to submit the case to the judgment of competent theologians, ruled otherwise, and he was deprived of his professorships. He held at the same time the chaplaincy of Lincoln's Inn, for which he had resigned Guy's (1846–1860), but when he offered to resign this the benchers refused. Nor was he assailed in the incumbency of St. Peter's, Vere Street, which he held for nine years (1860–1869), and where he drew round him a circle of thoughtful people. During the early years of this period he was engaged in a hot and bitter controversy with H. L. Mansel (afterwards dean of St Paul's), arising out of the latter's Bampton lecture upon reason and revelation.

During his residence in London Maurice was specially identified with two important movements for education. He helped to found Queen's College for the education of women (1848), and the Working Men's College (1854), of which he was the first principal. He strongly advocated the abolition of university tests (1853), and threw himself with great energy into all that affected the social life of the people. Certain abortive attempts at co-operation among working men, and the movement known as Christian Socialism, were the immediate outcome of his teaching. In 1866 Maurice was appointed professor of moral philosophy at Cambridge, and from 1870 to 1872 was incumbent of St Edward's in that city. He died on the 1st of April 1872.

He was twice married, first to Anna Barton, a sister of John Sterling's wife, secondly to a half-sister of his friend Archdeacon Hare. His son Major-General Sir J. Frederick Maurice (b. 1841), became a distinguished soldier and one of the most prominent military writers of his time.

Those who knew Maurice best were deeply impressed with the spirituality of his character. "Whenever he woke in the night," says his wife, "he was always praying." Charles Kingsley called him "the most beautiful human soul whom God has ever allowed me to meet with." As regards his intellectual attainments we may set Julius Hare's verdict "the greatest mind since Plato" over against Ruskin's "by nature puzzle-headed and indeed wrong-headed." Such contradictory impressions bespeak a life made up of contradictory elements. Maurice was a man of peace, yet his life was spent in a series of conflicts; of deep humility, yet so polemical that he often seemed biased; of large charity, yet bitter in his attack upon the religious press of his time; a loyal churchman who detested the label "Broad," yet poured out criticism upon the leaders of the Church. With an intense capacity for visualizing the unseen, and a kindly dignity, he combined a large sense of humour. While most of the "Broad Churchmen" were influenced by ethical and emotional considerations in their repudiation of the dogma of everlasting torment, he was swayed by purely intellectual and theological arguments, and in questions of a more general liberty he often opposed the proposed Liberal theologians, though he as often took their side if he saw them hard pressed. He had a wide metaphysical and philosophical knowledge which he applied to the history of theology. He was a strenuous advocate of ecclesiastical control in elementary education, and an opponent of the new school of higher biblical criticism, though so far an evolutionist as to believe in growth and development as applied to the history of nations.

As a preacher, his message was apparently simple; his two great convictions were the fatherhood of God, and that all religious systems which had any stability lasted because of a portion of truth which had to be disentangled from the error differentiating them from the doctrines of the Church of England as understood by himself. His love to God as his Father was a passionate adoration which filled his whole heart. The prophetic, even apocalyptic, note of his preaching was particularly impressive. He prophesied in London as Isaiah prophesied to the little towns of Palestine and Syria, "often with dark foreboding, but seeing through all unrest and convulsion the working out of a sure divine purpose." Both at King's College and at Cambridge Maurice gathered round him a band of earnest students, to whom he directly taught much that was valuable drawn from wide stores of his own reading, wide rather than deep, for he never was, strictly speaking, a learned man. Still more did he encourage the habit of inquiry and research, more valuable than his direct teaching. In his Socratic power of convincing his pupils of their ignorance he did more than perhaps any other man of his time to awaken in those who came under his sway the desire for knowledge and the process of independent thought.

As a social reformer, Maurice was before his time, and gave his eager support to schemes for which the world was not ready. From an early period of his life in London the condition of the poor pressed upon him with consuming force; the enormous magnitude of the social questions involved was a burden which he could hardly bear. For many years he was the clergyman whom working men of all opinions seemed to trust even if their faith in other religious men and all religious systems had faded, and he had a marvellous power of attracting the zealot and the outcast.

His works cover nearly 40 volumes, often obscure, often tautological, and with no great distinction of style. But their high purpose and philosophical outlook give his writings a permanent place in the history of the thought of his time. The following are the more important works—some of them were rewritten and in a measure recast, and the date given is not necessarily that of the first appearance of the book, but of its more complete and abiding form: *Eustace Conway, or the Brother and Sister*, a novel (1834); *The Kingdom of Christ* (1842); *Christmas Day and Other Sermons* (1843); *The Unity of the New Testament* (1844); *The Epistle to the Hebrews* (1846); *The Religions of the World* (1847); *Moral and Metaphysical Philosophy* (at first an article in the *Encyclopaedia Metropolitana*, 1848); *The Church a Family* (1850); *The Old Testament* (1851); *Theological Essays* (1853); *The Prophets and Kings of the Old Testament* (1853); *Lectures on Ecclesiastical History* (1854); *The Doctrine of Sacrifice* (1854); *The Patriarchs and Lawgivers of the Old Testament* (1855); *The Epistles of St John* (1857); *The Commandments as Instruments of National Reformation* (1866); *On the Gospel of St Luke* (1868); *The Conscience: Lectures on Casuistry* (1868); *The Lord's Prayer, a Manual* (1870). The greater part of these works were first delivered as sermons or lectures. Maurice also contributed many prefaces and introductions to the works of friends, as to Archdeacon Hare's *Charges*, Kingsley's *Saint's Tragedy*, &c.

See *Life* by his son (2 vols., London, 1884), and a monograph by C. F. G. Masterman (1907) in "Leader of the Church" series; W. E. Collins in *Typical English Churchmen*, pp. 327-360 (1902), and T. Hughes in *The Friendship of Books* (1873).

MAURICE OF NASSAU, prince of Orange (1567–1625), the second son of William the Silent, by Anna, only daughter of the famous Maurice, elector of Saxony, was born at Dillenburg. At the time of his father's assassination in 1584 he was being educated at the university of Leiden, at the expense of the states of Holland and Zeeland. Despite his youth he was made stadtholder of those two provinces and president of the council of state. During the period of Leicester's governorship he remained in the background, engaged in acquiring a thorough knowledge of the military art, and in 1586 the States of Holland conferred upon him the title of prince. On the withdrawal of Leicester from the Netherlands in August 1587, Johan van Oldenbarneveldt, the advocate of Holland, became the leading statesman of the country, a position which he retained for upwards of thirty years. He had been a devoted adherent of William the Silent and he now used his influence to forward the interests of Maurice. In 1588 he was appointed by the States-General captain and admiral-general of the Union, in 1590 he was elected stadtholder of Utrecht and Overysel, and in 1591 of Gelderland. From this time forward, Oldenbarneveldt at the head of the civil government and Maurice in command of the armed forces of the republic worked together in the task of rescuing the United Netherlands from Spanish domination (for details see HOLLAND). Maurice soon showed himself to be a general second in skill to none of his contemporaries. He was especially famed for his consummate knowledge of the science of sieges. The twelve years' truce on the 9th of April 1609 brought to an end the cordial relations between Maurice and Oldenbarneveldt. Maurice was opposed to the truce, but the advocate's policy triumphed and henceforward there was enmity between them. The theological disputes between the Remonstrants and contra-Remonstrants found them on different sides; and the theological quarrel soon became a political one. Oldenbarneveldt, supported by the states of Holland, came forward as the champion of provincial sovereignty against that of the states-general; Maurice threw the weight of his sword on the side of the union. The struggle was a short one, for the army obeyed the general who had so often led them to victory. Oldenbarneveldt perished on the scaffold, and the share which Maurice had in securing the illegal condemnation by a packed court of judges of the aged patriot must ever remain a stain upon his memory.

Maurice, who had on the death of his elder brother Philip William, in February 1618, become prince of Orange, was now supreme in the state, but during the remainder of his life he sorely missed the wise counsels of the experienced Oldenbarneveldt. War broke out again in 1621, but success had ceased to accompany him on his campaigns. His health gave way, and he died, a prematurely aged man, at the Hague on the 4th of April 1625. He was buried by his father's side at Delft.

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MAURISTS, a congregation of French Benedictines called after St Maurus (d. 565), a disciple of St Benedict and the legendary introducer of the Benedictine rule and life into Gaul.[1] At the end of the 16th century the Benedictine monasteries of France had fallen into a state of disorganization and relaxation. In the abbey of St Vaune near Verdun a reform was initiated by Dom Didier de la Cour, which spread to other houses in Lorraine, and in 1604 the reformed congregation of St Vaune was established, the most distinguished members of which were Ceillier and Calmet. A number of French houses joined the new congregation; but as Lorraine was still independent of the French crown, it was considered desirable to form on the same lines a separate congregation for France. Thus in 1621 was established the famous French congregation of St Maur. Most of the Benedictine monasteries of France, except those belonging to Cluny, gradually joined the new congregation, which eventually embraced nearly two hundred houses. The chief house was Saint-Germain-des-Prés, Paris, the residence of the superior-general and centre of the literary activity of the congregation. The primary idea of the movement was not the undertaking of literary and historical work, but the return to a strict monastic régime and the faithful carrying out of Benedictine life; and throughout the most glorious period of Maurist history the literary work was not allowed to interfere with the due performance of the choral office and the other duties of the monastic life. Towards the end of the 18th century a tendency crept in, in some quarters, to relax the monastic observances in favour of study; but the constitutions of 1770 show that a strict monastic régime was maintained until the end. The course of Maurist history and work was checkered by the ecclesiastical controversies that distracted the French Church during the 17th and 18th centuries. Some of the members identified themselves with the Jansenist cause; but the bulk, including nearly all the greatest names, pursued a middle path, opposing the lax moral theology condemned in 1679 by Pope Innocent XI., and adhering to those strong views on grace and predestination associated with the Augustinian and Thomist schools of Catholic theology; and like all the theological faculties and schools on French soil, they were bound to teach the four Gallican articles. It seems that towards the end of the 18th century a rationalistic and free-thinking spirit invaded some of the houses. The congregation was suppressed and the monks scattered at the revolution, the last superior-general with forty of his monks dying on the scaffold in Paris. The present French congregation of Benedictines initiated by Dom Guéranger in 1833 is a new creation and has no continuity with the congregation of St Maur.

The great claim of the Maurists to the gratitude and admiration of posterity is their historical and critical school, which stands quite alone in history, and produced an extraordinary number of colossal works of erudition which still are of permanent value. The foundations of this school were laid by Dom Tarisse, the first superior-general, who in 1632 issued instructions to the superiors of the monasteries to train the young monks in the habits of research and of organized work. The pioneers in production were Ménard and d'Achery.

The following tables give, divided into groups, the most important Maurist works, along with such information as may be useful to students. All works are folio when not otherwise noted:—

I.—THE EDITIONS OF THE FATHERS

Epistle of Barnabas (editio princeps)	Ménard	1645	1 in4^{to}
Lanfranc	d'Achery	1648	1
Guibert of Nogent	d'Achery	1651	1
Robert Pulleyn and Peter of Poitiers	Mathou	1655	1
Bernard	Mabillon	1667	2
Anselm	Gerberon	1675	1
Cassiodorus	Garet	1679	1
Augustine (see Kukula, *Die Mauriner-Ausgabe des Augustinus*, 1898)	Delfau, Blampin, Coustant, Guesnie	1681–1700	11
Ambrose	du Frische	1686–1690	2
Acta martyrum sincera	Ruinart	1689	1
Hilary	Coustant	1693	1
Jerome	Martianay	1693–1706	5
Athanasius	Loppin and Montfaucon	1698	3
Gregory of Tours	Ruinart	1699	1
Gregory the Great	Sainte-Marthe	1705	4
Hildebert of Tours	Beaugendre	1708	1
Irenaeus	Massuet	1710	1
Chrysostom	Montfaucon	1718–1738	13
Cyril of Jerusalem	Touttée and Maran	1720	1
Epistolae romanorum pontificum[2]	Coustant	1721	1
Basil	Garnier and Maran	1721–1730	3
Cyprian	(Baluze, not a Maurist) finished by Maran	1726	1
Origen	Ch. de la Rue (1. 2, 3) V. de la Rue (4)	1733–1759	4
Justin and the Apologists	Maran	1742	1
Gregory Nazianzen[3]	Maran and Clémencet	1778	1

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[1] His festival is kept on the 15th of January. He founded the monastery of Glanfeuil or St Maur-sur-Loire.

[2] 14 vols. of materials collected for the continuation are at Paris.

[3] The printing of vol. ii. was impeded by the Revolution.

II.—BIBLICAL WORKS

St Jerome's Latin Bible	Martianay	1693	1
Origen's Hexapla	Montfaucon	1713	2
Old Latin versions	Sabbathier	1743–1749	3

III.—GREAT COLLECTIONS OF DOCUMENTS

Spicilegium	d'Achery	1655–1677	13 in 4^{to}
Veterae analecta	Mabillon	1675–1685	4 in 8^{vo}
Musæum italicum	Mabillon	1687–1689	2 in 4^{to}
Collectio nova patrum graecorum	Montfaucon	1706	2
Thesaurus novus anecdotorum	Martène and Durand	1717	5
Veterum scriptorum collectio	Martène and Durand	1724–1733	9
De antiquis ecclesiae ritibus	Martène (Final form)	1690–1706 1736–1738	4

IV.—MONASTIC HISTORY

Acta of the Benedictine Saints	d'Achery, Mabillon and Ruinart	1668–1701	9
Benedictine Annals (to 1157)	Mabillon (1–4), Massuet (5), Martène (6)	1703–1739	6

V.—ECCLESIASTICAL HISTORY AND ANTIQUITIES OF FRANCE

A.—*General.*

Gallia christiana (3 other vols. were published 1856–1865)	Sainte-Marthe (1, 2, 3)	1715–1785	13
Monuments de la monarchie française	Montfaucon	1729–1733	5
Histoire littéraire de la France (16 other vols. were published 1814–1881)	Rivet, Clémencet, Clément	1733–1763	12 in 4^{to}
Recueil des historiens de la France (4 other vols. were published 1840–1876)	Bouquet (1–8), Brial (12–19)	1738–1833	19
Concilia Galliae (the printing of vol. ii. was interrupted by the Revolution; there were to have been 8 vols.	Labbat	1789	1

B.—*Histories of the Provinces.*

Bretagne	Lobineau	1707	2
Paris	Félibien and Lobineau	1725	5
Languedoc	Vaissette and de Vic	1730–1745	5
Bourgogne	Plancher (1–3), Merle (4)	1739–1748, 1781	4
Bretagne	Morice	1742–1756	5

VI.—MISCELLANEOUS WORKS OF TECHNICAL ERUDITION

De re diplomatica	Mabillon	1681	1
Ditto Supplement	Mabillon	1704	1
Nouveau traité de diplomatique	Toustain and Tassin	1750–1765	6 in 4^{to}
Paleographia graeca	Montfaucon	1708	1
Bibliotheca coisliniana	Montfaucon	1715	1
Bibliotheca bibliothecarum manuscriptorum nova	Montfaucon	1739	2
L'Antiquité expliqué	Montfaucon	1719–1724	15
New ed. of Du Cange's glossarium	Dantine and Carpentier	1733–1736	6
Ditto Supplement	Carpentier	1766	4
Apparatus ad bibliothecam maximam patrum	le Nourry	1703	2
L'Art de vérifier les dates	Dantine, Durand, Clémencet	1750	1 in 4^{to}
Ed. 2	Clément	1770	1
Ed. 3	Clément	1783–1787	3

The 58 works in the above list comprise 199 great folio volumes and 39 in 4^{to} or 8^{vo}. The full Maurist bibliography contains the names of some 220 writers and more than 700 works. The lesser works in large measure cover the same fields as those in the list, but the number of works of purely religious character, of piety, devotion and edification, is very striking. Perhaps the most wonderful phenomenon of Maurist work is that what was produced was only a portion of what was contemplated and prepared for. The French Revolution cut short many gigantic undertakings, the collected materials for which fill hundreds of manuscript volumes in the Bibliothèque nationale of Paris and other libraries of France. There are at Paris 31 volumes of Berthereau's materials for the Historians of the Crusades, not only in Latin and Greek, but in the oriental tongues; from them have been taken in great measure the *Recueil des historiens des croisades*, whereof 15 folio volumes have been published by the Académie des Inscriptions. There exist also the preparations for an edition of Rufinus and one of Eusebius, and for the continuation of the Papal Letters and of the Concilia Galliae. Dom Caffiaux and Dom Villevielle left 236 volumes of materials for a *Trésor généalogique*. There are Benedictine Antiquities (37 vols.), a Monasticon Gallicanum and a Monasticon Benedictinum (54 vols.). Of the Histories of the Provinces of France barely half a dozen were printed, but all were in hand, and the collections for the others fill 800 volumes of MSS. The materials for a geography of Gaul and France in 50 volumes perished in a fire during the Revolution.

When these figures were considered, and when one contemplates the vastness of the works in progress during any decade of the century 1680–1780; and still more, when not only the quantity but the quality of the work, and the abiding value of most of it is realised, it will be recognized that the output was prodigious and unique in the history of letters, as coming from a single society. The qualities that have made Maurist work proverbial for sound learning are its fine critical tact and its thoroughness.

The chief source of information on the Maurists and their work is Dom Tassin's *Histoire littéraire de la congregation de Saint-Maur* (1770); it has been reduced to a bare bibliography and completed by de Lama, *Bibliothèque des écrivains de la congr. de S.-M.* (1882). The two works of de Broglie, *Mabillon* (2 vols., 1888) and *Montfaucon* (2 vols., 1891), give a charming picture of the inner life of the great Maurists of the earlier generation in the midst of their work and their friends. Sketches of the lives of a few of the chief Maurists will be found in McCarthy's *Principal Writers of the Congr. of S. M.* (1868). Useful information about their literary undertakings will be found in De Lisle's *Cabinet des MSS. de la Bibl. Nat. Fonds St Germain-des-Prés*. General information will be found in the standard authorities: Helyot, *Hist. des ordres religieux* (1718), vi. c. 37; Heimbucher, *Orden und Kongregationen* (1907) i. § 36; Wetzer und Welte, *Kirchenlexicon* (ed. 2) and Herzog-Hauck's *Realencyklopädie* (ed. 3), the latter an interesting appreciation by the Protestant historian Otto Zöckler of the spirit and the merits of the work of the Maurists.

(E. C. B.)

MAURITIUS, an island and British colony in the Indian Ocean (known whilst a French possession as the *Île de France*). It lies between 57° 18′ and 57° 49′ E., and 19° 58′ and 20° 32′ S., 550 m. E. of Madagascar, 2300 m. from the Cape of Good Hope, and 9500 m. from England via Suez. The island is irregularly elliptical—somewhat triangular—in shape, and is 36 m. long from N.N.E. to S.S.W., and about 23 m. broad. It is 130 m. in circumference, and its total area is about 710 sq. m. (For map see MADAGASCAR.) The island is surrounded by coral reefs, so that the ports are difficult of access.

From its mountainous character Mauritius is a most picturesque island, and its scenery is very varied and beautiful. It has been admirably described by Bernardin de St Pierre, who lived in the island towards the close of the 18th century, in *Paul et Virginie*. The most level portions of the coast districts are the north and north-east, all the rest being broken by hills, which vary from 500 to 2700 ft. in height. The principal mountain masses are the north-western or Pouce range, in the district of Port Louis; the south-western, in the districts of Rivière Noire and Savanne; and the south-eastern range, in the Grand Port district. In the first of these, which consists of one principal ridge with several lateral spurs, overlooking Port Louis, are the singular peak of the Pouce (2650 ft.), so called from its supposed resemblance to the human thumb; and the still loftier Pieter Botte (2685 ft.), a tall obelisk of bare rock, crowned with a globular mass of stone. The highest summit in the island is in the south-western mass of hills, the Piton de la Rivière Noire, which is 2711 ft. above the sea. The south-eastern group of hills consists of the Montagne du Bambou, with several spurs running down to the sea. In the interior are extensive fertile plains, some 1200 ft. in height, forming the districts of Moka, Vacois, and Plaines Wilhelms; and from nearly the centre of the island an abrupt peak, the Piton du Milieu de l'Île rises to a height of 1932 ft. Other prominent summits are the Trois Mamelles, the Montagne du Corps de Garde, the Signal Mountain, near Port Louis, and the Morne Brabant, at the south-west corner of the island.

The rivers are small, and none is navigable beyond a few hundred yards from the sea. In the dry season little more than brooks, they become raging torrents in the wet season. The principal stream is the Grande Rivière, with a course of about 10 m. There is a remarkable and very deep lake, called

Grand Bassin, in the south of the island, it is probably the extinct crater of an ancient volcano; similar lakes are the Mare aux Vacois and the Mare aux Joncs, and there are other deep hollows which have a like origin.

Geology.—The island is of volcanic origin, but has ceased to show signs of volcanic activity. All the rocks are of basalt and greyish-tinted lavas, excepting some beds of upraised coral. Columnar basalt is seen in several places. The remains of ancient craters can be distinguished, but their outlines have been greatly destroyed by denudation. There are many caverns and steep ravines, and from the character of the rocks the ascents are rugged and precipitous. The island has few minerals, although iron, lead and copper in very small quantities have in former times been obtained. The greater part of the surface is composed of a volcanic breccia, with here and there lava-streams exposed in ravines, and sometimes on the surface. The commonest lavas are dolerites. In at least two places sedimentary rocks are found at considerable elevations. In the Black River Mountains, at a height of about 1200 ft., there is a clay-slate; and near Midlands, in the Grand Port group of mountains, a chloritic schist occurs about 1700 ft. above the sea, forming the hill of La Selle. This schist is much contorted, but seems to have a general dip to the south or south-east. Evidence of recent elevation of the island is furnished by masses of coral reef and beach coral rock standing at heights of 40 ft. above sea-level in the south, 12 ft. in the north and 7 ft. on the islands situated on the bank extending to the north-east.[1]

Climate.—The climate is pleasant during the cool season of the year, but oppressively hot in summer (December to April), except in the elevated plains of the interior, where the thermometer ranges from 70° to 80° F., while in Port Louis and on the coast generally it ranges from 90° to 96°. The mean temperature for the year at Port Louis is 78·6°. There are two seasons, the cool and comparatively dry season, from April to November, and the hotter season, during the rest of the year. The climate is now less healthy than it was, severe epidemics of malarial fever having frequently occurred, so that malaria now appears to be endemic among the non-European population. The rainfall varies greatly in different parts of the island. Cluny in the Grand Port (south-eastern) district has a mean annual rainfall of 145 in.; Albion on the west coast is the driest station, with a mean annual rainfall of 31 in. The mean monthly rainfall for the whole island varies from 12 in. in March to 2·6 in. in September and October. The Royal Alfred Observatory is situated at Pamplemousses, on the north-west or dry side of the island. From January to the middle of April, Mauritius, in common with the neighbouring islands and the surrounding ocean from 8° to 30° of southern latitude is subject to severe cyclones, accompanied by torrents of rain, which often cause great destruction to houses and plantations. These hurricanes generally last about eight hours, but they appear to be less frequent and violent than in former times, owing, it is thought, to the destruction of the ancient forests and the consequent drier condition of the atmosphere.

Fauna and Flora.—Mauritius being an oceanic island of small size, its present fauna is very limited in extent. When first seen by Europeans it contained no mammals except a large fruit-eating bat (*Pteropus vulgaris*), which is plentiful in the woods; but several mammals have been introduced, and are now numerous in the uncultivated region. Among these are two monkeys of the genera *Macacus* and *Cercopithecus*, a stag (*Cervus hippelaphus*), a small hare, a shrew-mouse, and the ubiquitous rat. A lemur and one of the curious hedgehog-like *Insectivora* of Madagascar (*Centetes ecaudatus*) have probably both been brought from the larger island. The avifauna resembles that of Madagascar; there are species of a peculiar genus of caterpillar shrikes (*Campephagidae*), as well as of the genera *Pratincola*, *Hypsipetes*, *Phedina*, *Tchitrea*, *Zosterops*, *Foudia*, *Collocalia* and *Coracopsis*, and peculiar forms of doves and parakeets. The living reptiles are small and few in number. The surrounding seas contain great numbers of fish; the coral reefs abound with a great variety of molluscs; and there are numerous land-shells. The extinct fauna of Mauritius has considerable interest. In common with the other Mascarene islands, it was the home of the dodo (*Didus ineptus*); there were also *Aphanapteryx*, a species of rail, and a short-winged heron (*Ardea megacephala*), which probably seldom flew. The defenceless condition of these birds led to their extinction after the island was colonized. Considerable quantities of the bones of the dodo and other extinct birds—a rail (*Aphanapteryx*), and a short-winged heron—have been discovered in the beds of some of the ancient lakes (see DODO). Several species of large fossil tortoises have also been discovered; they are quite different from the living ones of Aldabra, in the same zoological region.

Owing to the destruction of the primeval forests for the formation of sugar plantations, the indigenous flora is only seen in parts of the interior plains, in the river valleys and on the hills; and it is not now easy to distinguish between what is native and what has come from abroad. The principal timber tree is the ebony (*Diospyros ebenum*), which grows to a considerable size. Besides this there are bois de cannelle, olive-tree, benzoin (*Croton Benzoe*), colophane (*Colophonia*), and iron-wood, all of which are useful in carpentry; the coco-nut palm, an importation, but a tree which has been so extensively planted during the last hundred years that it is extremely plentiful; the palmiste (*Palma dactylifera latifolia*), the latanier (*Corypha umbraculifera*) and the date-palm. The vacoa or vacois, (*Pandanus utilis*) is largely grown, the long tough leaves being manufactured into bags for the export of sugar, and the roots being also made of use; and in the few remnants of the original forests the traveller's tree (*Urania speciosa*), grows abundantly. A species of bamboo is very plentiful in the river valleys and in marshy situations. A large variety of fruit is produced, including the tamarind, mango, banana, pine-apple, guava, shaddock, fig, avocado-pear, litchi, custard-apple and the mabolo (*Diospyros discolor*), a fruit of exquisite flavour, but very disagreeable odour. Many of the roots and vegetables of Europe have been introduced, as well as some of those peculiar to the tropics, including maize, millet, yams, manioc, dhol, gram, &c. Small quantities of tea, rice and sago, have been grown, as well as many of the spices (cloves, nutmeg, ginger, pepper and allspice), and also cotton, indigo, betel, camphor, turmeric and vanilla. The Royal Botanical Gardens at Pamplemousses, which date from the French occupation of the island, contain a rich collection of tropical and extra-tropical species.

Inhabitants.—The inhabitants consist of two great divisions, those of European blood, chiefly French and British, together with numerous half-caste people, and those of Asiatic or African blood. The population of European blood, which calls itself Creole, is greater than that of any other tropical colony; many of the inhabitants trace their descent from ancient French families, and the higher and middle classes are distinguished for their intellectual culture. French is more commonly spoken than English. The Creole class is, however, diminishing, though slowly, and the most numerous section of the population is of Indian blood.

The introduction of Indian coolies to work the sugar plantations dates from the period of the emancipation of the slaves in 1834–1839. At that time the negroes who showed great unwillingness to work on their late masters' estates, numbered about 66,000. Immigration from India began in 1834, and at a census taken in 1846, when the total population was 158,462, there were already 56,245 Indians in the island. In 1851 the total population had increased to 180,823, while in 1861 it was 310,050. This great increase was almost entirely due to Indian immigration, the Indian population, 77,996 in 1851, being 192,634 in 1861. From that year the increase in the Indian population has been more gradual but steady, while the non-Indian population has decreased. From 102,827 in 1851 it rose to 117,416 in 1861 to sink to 99,784 in 1871. The figures for the three following census years were:—

	1881.	1891.	1901.
Indians	248,993	255,920	259,086
Others	110,881	114,668	111,937
Total	359,874	370,588	371,023

Including the military and crews of ships in harbour, the total population in 1901 was 373,336.[2] This total included 198,958 Indo-Mauritians, *i.e.* persons of Indian descent born in Mauritius, and 62,022 other Indians. There were 3,509 Chinese, while the remaining 108,847 included persons of European, African or mixed descent, Malagasy, Malays and Sinhalese. The Indian female population increased from 51,019 in 1861 to 115,986 in 1901. In the same period the non-Indian female population but slightly varied, being 56,070 in 1861 and 55,485 in 1901. The Indo-Mauritians are now dominant in commercial, agricultural and domestic callings, and much town and agricultural land has been transferred from the Creole planters to Indians and Chinese. The tendency to an Indian peasant proprietorship is marked. Since 1864 real property to the value of over £1,250,000 has been acquired by Asiatics. Between 1881 and 1901 the number of sugar estates decreased from 171 to 115, those sold being held in small parcels by Indians. The average death-rate for the period 1873–1901 was 32·6 per 1000. The average birth-rate in the Indian community is 37 per 1000; in the non-Indian community 34 per 1000. Many Mauritian Creoles have emigrated to South Africa. The great increase in the population since 1851 has made Mauritius one of the most densely peopled regions of the world, having over 520 persons per square mile.

Chief Towns.—The capital and seat of government, the city of Port Louis, is on the north-western side of the island, in 20° 10′ S., 57° 30′ E. at the head of an excellent harbour, a deep inlet about a mile long, available for ships of the deepest draught. This is protected by Fort William and Fort George, as well as by the citadel (Fort Adelaide), and it has three graving-docks connected with the inner harbour, the depths alongside quays and berths being from 12 to 28 ft. The trade of the island passes almost entirely through the port. Government House is a three-storeyed structure with broad verandas, of no particular style of architecture, while the Protestant cathedral was formerly a powder magazine, to which a tower and spire have been added. The Roman Catholic cathedral is more pretentious in style, but is tawdry in its interior. There are, besides the town-hall, Royal College, public offices and theatre, large barracks and military stores. Port Louis, which is governed by an elective municipal council, is surrounded by lofty hills and its unhealthy situation is aggravated by the difficulty of effective drainage owing to the small amount of tide in the harbour. Though much has been done to make the town sanitary, including the provision of a good water-supply, the death-rate is generally over 44 per 1000. Consequently all those who can make their homes in the cooler uplands of the interior. As a result the population of the city decreased from about 70,000 in 1891 to 53,000 in 1901. The favourite residential town is Curepipe, where the climate resembles that of the south of France. It is built on the central plateau about 20 m. distant from Port Louis by rail and 1800 ft. above the sea. Curepipe was incorporated in 1888 and had a population (1901) of 13,000. On the railway between Port Louis and Curepipe are other residential towns—Beau Bassin, Rose Hill and Quatre Bornes. Mahébourg, pop. (1901), 4810, is a town on the shores of Grand Port on the south-east side of the island, Souillac a small town on the south coast.

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[1] See *Geog. Journ.* (June 1895), p. 597.

[2] The total population of the colony (including dependencies) on the 1st of January 1907 was estimated at 383,206.

Industries.—The Sugar Plantations: The soil of the island is of considerable fertility; it is a ferruginous red clay, but so largely mingled with stones of all sizes that no plough can be used, and the hoe has to be employed to prepare the ground for cultivation. The greater portion of the plains is now a vast sugar plantation. The bright green of the sugar fields is a striking feature in a view of Mauritius from the sea, and gives a peculiar beauty and freshness to the prospect. The soil is suitable for the cultivation of almost all kinds of tropical produce, and it is to be regretted that the prosperity of the colony depends almost entirely on one article of production, for the consequences are serious when there is a failure, more or less, of the sugar crop. Guano is extensively imported as a manure, and by its use the natural fertility of the soil has been increased to a wonderful extent. Since the beginning of the 20th century some attention has been paid to the cultivation of tea and cotton, with encouraging results. Of the exports, sugar amounts on an average to about 95 % of the total. The quantity of sugar exported rose from 102,000 tons in 1854 to 189,164 tons in 1877. The competition of beet-sugar and the effect of bounties granted by various countries then began to tell on the production in Mauritius, the average crop for the seven years ending 1900–1901 being only 150,449 tons. The Brussels Sugar Convention of 1902 led to an increase in production, the average annual weight of sugar exported for the three years 1904–1906 being 182,000 tons. The value of the crop was likewise seriously affected by the causes mentioned, and by various diseases which attacked the canes. Thus in 1878 the value of the sugar exported was £3,408,000; in 1888 it had sunk to £1,911,000, and in 1898 to £1,632,000. In 1900 the value was £1,922,000, and in 1905 it had risen to £2,172,000. India and the South African colonies between them take some two-thirds of the total produce. The remainder is taken chiefly by Great Britain, Canada and Hong-Kong. Next to sugar, aloe-fibre is the most important export, the average annual export for the five years ending 1906 being 1840 tons. In addition, a considerable quantity of molasses and smaller quantities of rum, vanilla and coco-nut oil are exported. The imports are mainly rice, wheat, cotton goods, wine, coal, hardware and haberdashery, and guano. The rice comes principally from India and Madagascar; cattle are imported from Madagascar, sheep from South Africa and Australia, and frozen meat from Australia. The average annual value of the exports for the ten years 1896–1905 was £2,153,159; the average annual value of the imports for the same period £1,453,089. These figures when compared with those in years before the beet and bounty-fed sugar had entered into severe competition with cane sugar, show how greatly the island had thereby suffered. In 1864 the exports were valued at £2,249,000; in 1868 at £2,339,000; in 1877 at £4,201,000 and in 1880 at £3,634,000. And in each of the years named the imports exceeded £2,000,000 in value. Nearly all the aloe-fibre exported is taken by Great Britain and France, while the molasses goes to India. Among the minor exports is that of *bambara* or sea-slugs, which are sent to Hong-Kong and Singapore. This industry is chiefly in Chinese hands. The great majority of the imports are from Great Britain or British possessions.

The currency of Mauritius is rupees and cents of a rupee, the Indian rupee (=16*d.*) being the standard unit. The metric system of weights and measures has been in force since 1878.

Communications.—There is a regular fortnightly steamship service between Marseilles and Port Louis by the Messageries Maritimes, a four-weekly service with Southampton via Cape Town by the Union Castle, and a four-weekly service with Colombo direct by the British India Co.'s boats. There is also frequent communication with Madagascar, Réunion and Natal. The average annual tonnage of ships entering Port Louis is about 750,000 of which five-sevenths is British. Cable communication with Europe, via the Seychelles, Zanzibar and Aden, was established in 1893, and the Mauritius section of the Cape-Australian cable, via Rodriguez, was completed in 1902.

Railways connect all the principal places and sugar estates on the island, that known as the Midland line, 36 miles long, beginning at Port Louis crosses the island to Mahébourg, passing through Curepipe, where it is 1822 ft. above the sea. There are in all over 120 miles of railway, all owned and worked by the government. The first railway was opened in 1864. The roads are well kept and there is an extensive system of tramways for bringing produce from the sugar estates to the railway lines. Traction engines are also largely used. There is a complete telegraphic and telephonic service.

Government and Revenue.—Mauritius is a crown colony. The governor is assisted by an executive council of five official and two elected members, and a legislative council of 27 members, 8 sitting *ex officio*, 9 being nominated by the governor and 10 elected on a moderate franchise. Two of the elected members represent St Louis, the 8 rural districts into which the island is divided electing each one member. At least one-third of the nominated members must be persons not holding any public office. The number of registered electors in 1908 was 6186. The legislative session usually lasts from April to December. Members may speak either in French or English. The average annual revenue of the colony for the ten years 1896–1905, was £608,245, the average annual expenditure during the same period £663,606. Up to 1854 there was a surplus in hand, but since that time expenditure has on many occasions exceeded income, and the public debt in 1908 was £1,305,000, mainly incurred however on reproductive works.

The island has largely retained the old French laws, the *codes civil, de procédure, du commerce*, and *d'instruction criminelle* being still in force, except so far as altered by colonial ordinances. A supreme court of civil and criminal justice was established in 1831 under a chief judge and three puisne judges.

Religion and Education.—The majority of the European inhabitants belong to the Roman Catholic faith. They numbered at the 1901 census 117,102, and the Protestants 6644. Anglicans, Roman Catholics and the Church of Scotland are helped by state grants. At the head of the Anglican community is the bishop of Mauritius; the chief Romanist dignitary is styled bishop of Port Louis. The Mahommedans number over 30,000, but the majority of the Indian coolies are Hindus.

The educational system, as brought into force in 1900, is under a director of public instruction assisted by an advisory committee, and consists of two branches (1) superior or secondary instruction, (2) primary instruction. For primary instruction there are government schools and schools maintained by the Roman Catholics, Protestants and other faiths, to which the government gives grants in aid. In 1908 there were 67 government schools with 8400 scholars and 90 grant schools with 10,200 scholars, besides Hindu schools receiving no grant. The Roman Catholic scholars number 67·72 %; the Protestants 3·80 %; Mahommedans 8·37 %; and Hindus and others 20·11 %. Secondary and higher education is given in the Royal College and associated schools at Port Louis and Curepipe.

Defence.—Mauritius occupies an important strategic position on the route between South Africa and India and in relation to Madagascar and East Africa, while in Port Louis it possesses one of the finest harbours in the Indian Ocean. A permanent garrison of some 3000 men is maintained in the island at a cost of about £180,000 per annum. To the cost of the troops Mauritius contributes 5½ % of its annual revenue—about £30,000.

History.—Mauritius appears to have been unknown to European nations, if not to all other peoples, until the year 1505, when it was discovered by Mascarenhas, a Portuguese navigator. It had then no inhabitants, and there seem to be no traces of a previous occupation by any people. The island was retained for most of the 16th century by its discoverers, but they made no settlements in it. In 1598 the Dutch took possession, and named the island "Mauritius," in honour of their stadtholder, Count Maurice of Nassau. It had been previously called by the Portuguese "Ilha do Cerné," from the belief that it was the island so named by Pliny. But though the Dutch built a fort at Grand Port and introduced a number of slaves and convicts, they made no permanent settlement in Mauritius, finally abandoning the island in 1710. From 1715 to 1767 (when the French government assumed direct control) the island was held by agents of the French East India Company, by whom its name was again changed to "Île de France." The Company was fortunate in having several able men as governors of its colony, especially the celebrated Mahé de Labourdonnais (*q.v.*), who made sugar planting the main industry of the inhabitants.[1] Under his direction roads were made, forts built, and considerable portions of the forest were cleared, and the present capital, Port Louis, was founded. Labourdonnais also promoted the planting of cotton and indigo, and is remembered as the most enlightened and best of all the French governors. He also put down the maroons or runaway slaves who had long been the pest of the island. The colony continued to rise in value during the time it was held by the French crown, and to one of the intendants,[2] Pierre Poivre, was due the introduction of the clove, nutmeg and other spices. Another governor was D'Entrecasteaux, whose name is kept in remembrance by a group of islands east of New Guinea.

During the long war between France and England, at the commencement of the 19th century, Mauritius was a continual source of much mischief to English Indiamen and other merchant vessels; and at length the British government determined upon an expedition for its capture. This was effected in 1810; and upon the restoration of peace in 1814 the possession of the island was confirmed to Britain by the Treaty of Paris. By the eighth article of capitulation it was agreed that the inhabitants should retain their own laws, customs, and religion; and thus the island is still largely French in language, habits, and predilections; but its name has again been changed to that given by the Dutch. One of the most distinguished of the British governors was Sir Robert Farquhar (1810–1823), who did much to abolish the Malagasy slave trade and to establish friendly relations with the rising power of the Hova sovereign of Madagascar. Later governors of note were Sir Henry Barkly (1863–1871), and Sir J. Pope Hennessy (1883–1886 and 1888).

The history of the colony since its acquisition by Great Britain has been one of social and political evolution. At first all power was concentrated in the hands of the governor, but in 1832 a legislative council was constituted on which non-official nominated members served. In 1884–1885 this council was transformed into a partly elected body. Of more importance than the constitutional changes were the economic results which followed the freeing of the slaves (1834–1839)—for the loss of whose labour the planters received over £2,000,000 compensation. Coolies were introduced to supply the place of the negroes, immigration being definitely sanctioned by the government of India in 1842. Though under government control the system of coolie labour led to many abuses. A royal commission investigated the matter in 1871 and since that time the evils which were attendant on the system have been gradually remedied. One result of the introduction of free labour has been to reduce the descendants of the slave population to a small and unimportant class—Mauritius in this respect offering a striking contrast to the British colonies in the West Indies. The last half of the 19th century was, however, chiefly notable in Mauritius for the number of calamities which overtook the island. In 1854 cholera caused the death of 17,000 persons; in 1867 over 30,000 people died of malarial fever; in 1892 a hurricane of terrific violence caused immense destruction of property and serious loss of life; in 1893 great part of Port Louis was destroyed by fire. There were in addition several epidemics of small-pox and plague, and from about 1880 onward the continual decline in the price of sugar seriously affected the islanders, especially the Creole population. During 1902–1905 an outbreak of surra, which caused great mortality among draught animals, further tried the sugar planters and necessitated government help. Notwithstanding all these calamities the Mauritians, especially the Indo-Mauritians, have succeeded in maintaining the position of the colony as an important sugar-producing country.

Dependencies.—Dependent upon Mauritius and forming part of the colony are a number of small islands scattered over a large extent of the Indian Ocean. Of these the chief is Rodriguez (*q.v.*), 375 m. east of Mauritius. Considerably north-east of Rodriguez lie the Oil Islands or Chagos archipelago, of which the chief is Diego Garcia (see CHAGOS). The Cargados, Carayos or St Brandon islets, deeps and shoals, lie at the south end of the Nazareth Bank about 250 m. N.N.E. of Mauritius. Until 1903 the Seychelles, Amirantes, Aldabra and other islands lying north of Madagascar were also part of the colony of Mauritius. In the year named they were formed into a separate colony (see SEYCHELLES). Two islands, Farquhar and Coetivy, though geographically within the Seychelles area, remained dependent on Mauritius, being owned by residents in that island. In 1908, however, Coetivy was transferred to the Seychelles administration. Amsterdam and St Paul, uninhabited islands in the South Indian Ocean, included in an official list of the dependencies of Mauritius drawn up in 1880, were in 1893 annexed by France. The total population of the dependencies of Mauritius was estimated in 1905 at 5400.

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MAURY, JEAN SIFFREIN (1746–1817), French cardinal and archbishop of Paris, the son of a poor cobbler, was born on the 26th of June 1746 at Valréas in the Comtat-Venaissin, the district in France which belonged to the pope. His acuteness was observed by the priests of the seminary at Avignon, where he was educated and took orders. He tried his fortune by writing *éloges* of famous persons, then a favourite practice; and in 1771 his *éloge* on Fénelon was pronounced next best to Laharpe's by the Academy. The real foundation of his fortunes was the success of a panegyric on St Louis delivered before the Academy in 1772, which caused him to be recommended for an abbacy. In 1777 he published under the title of *Discours choisis* his panegyrics on Saint Louis, Saint Augustine and Fénelon, his remarks on Bossuet and his *Essai sur l'éloquence de la chaire*, a volume which contains much good criticism, and remains a French classic. The book was often reprinted as *Principes de l'éloquence*. He became a favourite preacher in Paris, and was Lent preacher at court in 1781, when King Louis XVI. said of his sermon: "If the abbé had only said a few words on religion he would have discussed every possible subject." In 1781 he obtained the rich priory of Lyons, near Péronne, and in 1785 he was elected to the Academy, as successor of Lefranc de Pompignan. His morals were as loose as those of his great rival Mirabeau, but he was famed in Paris for his wit and gaiety. In 1789 he was elected a member of the states-general by the clergy of the bailliage of Péronne, and from the first proved to be the most able and persevering defender of the *ancien régime*, although he had drawn up the greater part of the *cahier* of the clergy of Péronne, which contained a considerable programme of reform. It is said that he attempted to emigrate both in July and in October 1789; but after that time he held firmly to his place, when almost universally deserted by his friends. In the Constituent Assembly he took an active part in every important debate, combating with especial vigour the alienation of the property of the clergy. His life was often in danger, but his ready wit always saved it, and it was said that one *bon mot* would preserve him for a month.

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[1] Labourdonnais is credited by several writers with the introduction of the sugar cane into the island. Leguat, however, mentions it as being cultivated during the Dutch occupation.

[2] The régime introduced in 1767 divided the administration between a governor, primarily charged with military matters, and an intendant.

When he did emigrate in 1792 he found himself regarded as a martyr to the church and the king, and was at once named archbishop *in partibus*, and extra nuncio to the diet at Frankfort, and in 1794 cardinal. He was finally made bishop of Montefiascone, and settled down in that little Italian town—but not for long, for in 1798 the French drove him from his retreat, and he sought refuge in Venice and St Petersburg. Next year he returned to Rome as ambassador of the exiled Louis XVIII. at the papal court. In 1804 he began to prepare his return to France by a well-turned letter to Napoleon, congratulating him on restoring religion to France once more. In 1806 he did return; in 1807 he was again received into the Academy; and in 1810, on the refusal of Cardinal Fesch, was made archbishop of Paris. He was presently ordered by the pope to surrender his functions as archbishop of Paris. This he refused to do. On the restoration of the Bourbons he was summarily expelled from the Academy and from the archiepiscopal palace. He retired to Rome, where he was imprisoned in the castle of St Angelo for six months for his disobedience to the papal orders, and died in 1817, a year or two after his release, of disease contracted in prison and of chagrin. As a critic he was a very able writer, and Sainte-Beuve gives him the credit of discovering Father Jacques Bridayne, and of giving Bossuet his rightful place as a preacher above Massillon; as a politician, his wit and eloquence make him a worthy rival of Mirabeau. He sacrificed too much to personal ambition, yet it would have been a graceful act if Louis XVIII. had remembered the courageous supporter of Louis XVI., and the pope the one intrepid defender of the Church in the states-general.

The *Œuvres choisies du Cardinal Maury* (5 vols., 1827) contain what is worth preserving. Mgr Ricard has published Maury's *Correspondance diplomatique* (2 vols., Lille, 1891). For his life and character see *Vie du Cardinal Maury*, by Louis Siffrein Maury, his nephew (1828); J. J. F. Poujoulat, *Cardinal Maury, sa vie et ses œuvres* (1855); Sainte-Beuve, *Causeries du lundi* (vol. iv.); Mgr Ricard, *L'Abbé Maury* (1746–1791), *L'Abbé Maury avant 1789*, *L'Abbé Maury et Mirabeau* (1887); G. Bonet-Maury, *Le Cardinal Maury d'après ses mémoires et sa correspondance inédits* (Paris, 1892); A. Aulard, *Les Orateurs de la constituante* (Paris, 1882). Of the many libels written against him during the Revolution the most noteworthy are the *Petit carême de l'abbé Maury*, with a supplement called the *Seconde année* (1790), and the *Vie privée de l'abbé Maury* (1790), claimed by J. R. Hébert, but attributed by some writers to Restif de la Bretonne. For further bibliographical details see J. M. Quérard, *La France littéraire*, vol. v. (1833).

MAURY, LOUIS FERDINAND ALFRED (1817–1892), French scholar, was born at Meaux on the 23rd of March 1817. In 1836, having completed his education, he entered the Bibliothèque Nationale, and afterwards the Bibliothèque de l'Institut (1844), where he devoted himself to the study of archaeology, ancient and modern languages, medicine and law. Gifted with a great capacity for work, a remarkable memory and an unbiassed and critical mind, he produced without great effort a number of learned pamphlets and books on the most varied subjects. He rendered great service to the Académie des Inscriptions et Belles Lettres, of which he had been elected a member in 1857. Napoleon III. employed him in research work connected with the *Histoire de César*, and he was rewarded, proportionately to his active, if modest, part in this work, with the positions of librarian of the Tuileries (1860), professor at the College of France (1862) and director-general of the Archives (1868). It was not, however, to the imperial favour that he owed these high positions. He used his influence for the advancement of science and higher education, and with Victor Duruy was one of the founders of the École des Hautes Études. He died at Paris four years after his retirement from the last post, on the 11th of February 1892.

Bibliography.—His works are numerous: *Les Fées au moyen âge* and *Histoire des légendes pieuses au moyen âge*; two books filled with ingenious ideas, which were published in 1843, and reprinted after the death of the author, with numerous additions under the title *Croyances et légendes du moyen âge* (1896); *Histoire des grandes forêts de la Gaule et de l'ancienne France* (1850, a 3rd ed. revised appeared in 1867 under the title *Les Forêts de la Gaule et de l'ancienne France*); *La Terre et l'homme*, a general historical sketch of geology, geography and ethnology, being the introduction to the *Histoire universelle*, by Victor Duruy (1854); *Histoire des religions de la Grèce antique*, (3 vols., 1857–1859); *La Magie et l'astrologie dans l'antiquité et dans le moyen âge* (1863); *Histoire de l'ancienne académie des sciences* (1864); *Histoire de l'Académie des Inscriptions et Belles Lettres* (1865); a learned paper on the reports of French archaeology, written on the occasion of the universal exhibition (1867); a number of articles in the *Encyclopédie moderne* (1846–1851), in Michaud's *Biographie universelle* (1858 and seq.), in the *Journal des savants* in the *Revue des deux mondes* (1873, 1877, 1879–1880, &c.). A detailed bibliography of his works has been placed by Auguste Longnon at the beginning of the volume *Les Croyances et légendes du moyen âge*.

MAURY, MATTHEW FONTAINE (1806–1873), American naval officer and hydrographer, was born near Fredericksburg in Spottsylvania county, Virginia, on the 24th of January 1806. He was educated at Harpeth academy, and in 1825 entered the navy as midshipman, circumnavigating the globe in the "Vincennes," during a cruise of four years (1826–1830). In 1831 he was appointed master of the sloop "Falmouth" on the Pacific station, and subsequently served in other vessels before returning home in 1834, when he married his cousin, Ann Herndon. In 1835–1836 he was actively engaged in producing for publication a treatise on navigation, a remarkable achievement at so early a stage in his career; he was at this time made lieutenant, and gazetted astronomer to a South Sea exploring expedition, but resigned this position and was appointed to the survey of southern harbours. In 1839 he met with an accident which resulted in permanent lameness, and unfitted him for active service. In the same year, however, he began to write a series of articles on naval reform and other subjects, under the title of *Scraps from the Lucky-Bag*, which attracted much attention; and in 1841 he was placed in charge of the Dépôt of Charts and Instruments, out of which grew the United States Naval Observatory and the Hydrographic Office. He laboured assiduously to obtain observations as to the winds and currents by distributing to captains of vessels specially prepared log-books; and in the course of nine years he had collected a sufficient number of logs to make two hundred manuscript volumes, each with about two thousand five hundred days' observations. One result was to show the necessity for combined action on the part of maritime nations in regard to ocean meteorology. This led to an international conference at Brussels in 1853, which produced the greatest benefit to navigation as well as indirectly to meteorology. Maury attempted to organize co-operative meteorological work on land, but the government did not at this time take any steps in this direction. His oceanographical work, however, received recognition in all parts of the civilized world, and in 1855 it was proposed in the senate to remunerate him, but in the same year the Naval Retiring Board, erected under an act to promote the efficiency of the navy, placed him on the retired list. This action aroused wide opposition, and in 1858 he was reinstated with the rank of commander as from 1855. In 1853 Maury had published his *Letters on the Amazon and Atlantic Slopes of South America*, and the most widely popular of his works, the *Physical Geography of the Sea*, was published in London in 1855, and in New York in 1856; it was translated into several European languages. On the outbreak of the American Civil War in 1861, Maury threw in his lot with the South, and became head of coast, harbour and river defences. He invented an electric torpedo for harbour defence, and in 1862 was ordered to England to purchase torpedo material, &c. Here he took active part in organizing a petition for peace to the American people, which was unsuccessful. Afterwards he became imperial commissioner of emigration to the emperor Maximilian of Mexico, and attempted to form a Virginian colony in that country. Incidentally he introduced there the cultivation of cinchona. The scheme of colonization was abandoned by the emperor (1866), and Maury, who had lost nearly his all during the war, settled for a while in England, where he was presented with a testimonial raised by public subscription, and among other honours received the degree of LL.D. of Cambridge University (1868). In the same year, a general amnesty admitting of his return to America, he accepted the professorship of meteorology in the Virginia Military Institute, and settled at Lexington, Virginia, where he died on the 1st of February 1873.

Among works published by Maury, in addition to those mentioned, are the papers contributed by him to the *Astronomical Observations* of the United States Observatory, *Letter concerning Lanes for Steamers crossing the Atlantic* (1855); *Physical Geography* (1864) and *Manual of Geography* (1871). In 1859 he began the publication of a series of *Nautical Monographs*.

See Diana Fontaine Maury Corbin (his daughter), *Life of Matthew Fontaine Maury* (London, 1888).

MAUSOLEUM, the term given to a monument erected to receive the remains of a deceased person, which may sometimes take the form of a sepulchral chapel. The term *cenotaph* (Gr. *κενός*, empty, *τάφος*, tomb) is employed for a similar monument where the body is not buried in the structure. The term "mausoleum" originated with the magnificent monument erected by Queen Artemisia in 353 B.C. in memory of her husband King Mausolus, of which the remains were brought to England in 1859 by Sir Charles Newton and placed in the British Museum. The tombs of Augustus and of Hadrian in Rome are perhaps the largest monuments of the kind ever erected.

MAUSOLUS (more correctly MAUSSOLLUS), satrap and practically ruler of Caria (377–353 B.C.). The part he took in the revolt against Artaxerxes Mnemon, his conquest of a great part of Lycia, Ionia and of several of the Greek islands, his co-operation with the Rhodians and their allies in the war against Athens, and the removal of his capital from Mylasa, the ancient seat of the Carian kings, to Halicarnassus are the leading facts of his history. He is best known from the tomb erected for him by his widow Artemisia. The architects Satyrus and Pythis, and the sculptors Scopas, Leochares, Bryaxis and Timotheus, finished the work after her death. (See HALICARNASSUS.) An inscription discovered at Mylasa (Böckh, *Inscr. gr.* ii. 2691 *c.*) details the punishment of certain conspirators who had made an attempt upon his life at a festival in a temple at Labranda in 353.

See Diod. Sic. xv. 90, 3, xvi. 7, 4, 36, 2; Demosthenes, *De Rhodiorum libertate*; J. B. Bury, *Hist. of Greece* (1902), ii. 271; W. Judeich, *Kleinasiatische Studien* (Marburg, 1892), pp. 226–256, and authorities under HALICARNASSUS.

MAUVE, ANTON (1838–1888), Dutch landscape painter, was born at Zaandam, the son of a Baptist minister. Much against the wish of his parents he took up the study of art and entered the studio of Van Os, whose dry academic manner had, however, but little attraction for him. He benefited far more by his intimacy with his friends Jozef Israels and W. Maris. Encouraged by their example he abandoned his early tight and highly finished manner for a freer, looser method of painting, and the brilliant palette of his youthful work for a tender lyric harmony which is generally restricted to delicate greys, greens, and light blue. He excelled in rendering the soft hazy atmosphere that lingers over the green meadows of Holland, and devoted himself almost exclusively to depicting the peaceful rural life of the fields and country lanes of Holland—especially of the districts near Oosterbeek and Wolfhezen, the sand dunes of the coast at Scheveningen, and the country near Laren, where he spent the last years of his life. A little sad and melancholy, his pastoral scenes are nevertheless conceived in a peaceful soothing lyrical mood, which is in marked contrast to the epic power and almost tragic intensity of J. F. Millet. There are fourteen of Mauve's pictures at the Mesdag Museum at the Hague, and two ("Milking Time" and "A Fishing Boat putting to Sea") at the Ryks Museum in Amsterdam. The Glasgow Corporation Gallery owns his painting of "A Flock of Sheep." The finest and most representative private collection of pictures by Mauve was made by Mr J. C. J. Drucker, London.

MAVROCORDATO, MAVROCORDAT or MAVROGORDATO, the name of a family of Phanariot Greeks, distinguished in the history of Turkey, Rumania and modern Greece. The family was founded by a merchant of Chios, whose son Alexander Mavrocordato (*c.* 1636–1709), a doctor of philosophy and medicine of Bologna, became dragoman to the sultan in 1673, and was much employed in negotiations with Austria. It was he who drew up the treaty of Karlowitz (1699). He became a secretary of state, and was created a count of the Holy Roman Empire. His authority, with that of Hussein Kupruli and Rami Pasha, was supreme at the court of Mustapha II., and he did much to ameliorate the condition of the Christians in Turkey. He was disgraced in 1703, but was recalled to court by Sultan Ahmed III. He left some historical, grammatical, &c. treatises of little value.

His son NICHOLAS MAVROCORDATO (1670–1730) was grand dragoman to the Divan (1697), and in 1708 was appointed hospodar (prince) of Moldavia. Deposed, owing to the sultan's suspicions, in favour of Demetrius Cantacuzene, he was restored in 1711, and soon afterwards became hospodar of Walachia. In 1716 he was deposed by the Austrians, but was restored after the peace of Passarowitz. He was the first Greek set to rule the Danubian principalities, and was responsible for establishing the system which for a hundred years was to make the name of Greek hateful to the Rumanians. He introduced Greek manners, the Greek language and Greek costume, and set up a splendid court on the Byzantine model. For the rest he was a man of enlightenment, founded libraries and was himself the author of a curious work entitled Περὶ καθήκοντων (Bucharest, 1719). He was succeeded as grand dragoman (1709) by his son John (Ioannes), who was for a short while hospodar of Moldavia, and died in 1720.

Nicholas Mavrocordato was succeeded as prince of Walachia in 1730 by his son Constantine. He was deprived in the same year, but again ruled the principality from 1735 to 1741 and from 1744 to 1748; he was prince of Moldavia from 1741 to 1744 and from 1748 to 1749. His rule was distinguished by numerous tentative reforms in the fiscal and administrative systems. He was wounded and taken prisoner in the affair of Galati during the Russo-Turkish War, on the 5th of November 1769, and died in captivity.

PRINCE ALEXANDER MAVROCORDATO (1791–1865), Greek statesman, a descendant of the hospodars, was born at Constantinople on the 11th of February 1791. In 1812 he went to the court of his uncle Ioannes Caradja, hospodar of Walachia, with whom he passed into exile in Russia and Italy (1817). He was a member of the Hetairia Philike and was among the Phanariot Greeks who hastened to the Morea on the outbreak of the War of Independence in 1821. He was active in endeavouring to establish a regular government, and in January 1822 presided over the first Greek national assembly at Epidaurus. He commanded the advance of the Greeks into western Hellas the same year, and suffered a defeat at Peta on the 16th of July, but retrieved this disaster somewhat by his successful resistance to the first siege of Missolonghi (Nov. 1822 to Jan. 1823). His English sympathies brought him, in the subsequent strife of factions, into opposition to the "Russian" party headed by Demetrius Ypsilanti and Kolokotrones; and though he held the portfolio of foreign affairs for a short while under the presidency of Petrobey (Petros Mavromichales), he was compelled to withdraw from affairs until February 1825, when he again became a secretary of state. The landing of Ibrahim Pasha followed, and Mavrocordato again joined the army, only escaping capture in the disaster at Sphagia (Spakteria), on the 9th of May 1815, by swimming to Navarino. After the fall of Missolonghi (April 22, 1826) he went into retirement, until President Capo d'Istria made him a member of the committee for the administration of war material, a position he resigned in 1828. After Capo d'Istria's murder (Oct. 9, 1831) and the resignation of his brother and successor, Agostino Capo d'Istria (April 13, 1832), Mavrocordato became minister of finance. He was vice-president of the National Assembly at Argos (July, 1832), and was appointed by King Otto minister of finance, and in 1833 premier. From 1834 onwards he was Greek envoy at Munich, Berlin, London and—after a short interlude as premier in Greece in 1841—Constantinople. In 1843, after the revolution of September, he returned to Athens as minister without portfolio in the Metaxas cabinet, and from April to August 1844 was head of the government formed after the fall of the "Russian" party. Going into opposition, he distinguished himself by his violent attacks on the Kolettis government. In 1854–1855 he was again head of the government for a few months. He died in Aegina on the 18th of August 1865.

See E. Legrand, *Genealogie des Mavrocordato* (Paris, 1886).

MAWKMAI (Burmese *Maukmè*), one of the largest states in the eastern division of the southern Shan States of Burma. It lies approximately between 19° 30′ and 20° 30′ N. and 97° 30′ and 98° 15′ E., and has an area of 2,787 sq. m. The central portion of the state consists of a wide plain well watered and under rice cultivation. The rest is chiefly hills in ranges running north and south. There is a good deal of teak in the state, but it has been ruinously worked. The sawbwa now works as contractor for government, which takes one-third of the net profits. Rice is the chief crop, but much tobacco of good quality is grown in the Langkö district on the Têng river. There is also a great deal of cattle-breeding. The population in 1901 was 29,454, over two-thirds of whom were Shans and the remainder Taungthu, Burmese, Yangsek and Red Karens. The capital, MAWKMAI, stands in a fine rice plain in 20° 9′ N. and 97° 25′ E. It had about 150 houses when it first submitted in 1887, but was burnt out by the Red Karens in the following year. It has since recovered. There are very fine orange groves a few miles south of the town at Kantu-awn, called Kadugate by the Burmese.

MAXENTIUS, MARCUS AURELIUS VALERIUS, Roman emperor from A.D. 306 to 312, was the son of Maximianus Herculius, and the son-in-law of Galerius. Owing to his vices and incapacity he was left out of account in the division of the empire which took place in 305. A variety of causes, however, had produced strong dissatisfaction at Rome with many of the arrangements established by Diocletian, and on the 28th of October 306, the public discontent found expression in the massacre of those magistrates who remained loyal to Flavius Valerius Severus and in the election of Maxentius to the imperial dignity. With the help of his father, Maxentius was enabled to put Severus to death and to repel the invasion of Galerius; his next steps were first to banish Maximianus, and then, after achieving a military success in Africa against the rebellious governor, L. Domitius Alexander, to declare war against Constantine as having brought about the death of his father Maximianus. His intention of carrying the war into Gaul was anticipated by Constantine, who marched into Italy. Maxentius was defeated at Saxa Rubra near Rome and drowned in the Tiber while attempting to make his way across the Milvian bridge into Rome. He was a man of brutal and worthless character; but although Gibbon's statement that he was "just, humane and even partial towards the afflicted Christians" may be exaggerated, it is probable that he never exhibited any special hostility towards them.

See De Broglie, *L'Église et l'empire Romain au quatrième siècle* (1856–1866), and on the attitude of the Romans towards Christianity generally, app. 8 in vol. ii. of J. B. Bury's edition of Gibbon (Zosimus ii. 9–18; Zonaras xii. 33, xiii. 1; Aurelius Victor, *Epit.* 40; Eutropius, x. 2).

MAXIM, SIR HIRAM STEVENS (1840–), Anglo-American engineer and inventor, was born at Sangerville, Maine, U.S.A., on the 5th of February 1840. After serving an apprenticeship with a coachbuilder, he entered the machine works of his uncle, Levi Stevens, at Fitchburg, Massachusetts, in 1864, and four years later he became a draughtsman in the Novelty Iron Works and Shipbuilding Company in New York City. About this period he produced several inventions connected with illumination by gas; and from 1877 he was one of the numerous inventors who were trying to solve the problem of making an efficient and durable incandescent electric lamp, in this connexion introducing the widely-used process of treating the carbon filaments by heating them in an atmosphere of hydrocarbon vapour. In 1880 he came to Europe, and soon began to devote himself to the construction of a machine-gun which should be automatically loaded and fired by the energy of the recoil (see MACHINE-GUN). In order to realize the full usefulness of the weapon, which was first exhibited in an underground range at Hatton Garden, London, in 1884, he felt the necessity of employing a smokeless powder, and accordingly he devised maximite, a mixture of trinitrocellulose, nitroglycerine and castor oil, which was patented in 1889. He also undertook to make a flying machine, and after numerous preliminary experiments constructed an apparatus which was tried at Bexley Heath, Kent, in 1894. (See FLIGHT.) Having been naturalized as a British subject, he was knighted in 1901. His younger brother, Hudson Maxim (b. 1853), took out numerous patents in connexion with explosives.

MAXIMA AND MINIMA, in mathematics. By the *maximum* or *minimum* value of an expression or quantity is meant primarily the "greatest" or "least" value that it can receive. In general, however, there are points at which its value ceases to increase and begins to decrease; its value at such a point is called a maximum. So there are points at which its value ceases to decrease and begins to increase; such a value is called a minimum. There may be several maxima or minima, and a minimum is not necessarily less than a maximum. For instance, the expression $(x^2+x+2)/(x-1)$ can take all values from $-\infty$ to -1 and from $+7$ to $+\infty$, but has, so long as x is real, no value between -1 and $+7$. Here -1 is a maximum value, and $+7$ is a minimum value of the expression, though it can be made greater or less than any assignable quantity.

The first general method of investigating maxima and minima seems to have been published in A.D. 1629 by Pierre Fermat. Particular cases had been discussed. Thus Euclid in book III. of the *Elements* finds the greatest and least straight lines that can be drawn from a point to the circumference of a circle, and in book VI. (in a proposition generally omitted from editions of his works) finds the parallelogram of greatest area with a given perimeter. Apollonius investigated the greatest and least distances of a point from the perimeter of a conic section, and discovered them to be the normals, and that their feet were the intersections of the conic with a rectangular hyperbola. Some remarkable theorems on maximum areas are attributed to Zenodorus, and preserved by Pappus and Theon of Alexandria. The most noteworthy of them are the following:—

1. Of polygons of n sides with a given perimeter the regular polygon encloses the greatest area.

2. Of two regular polygons of the same perimeter, that with the greater number of sides encloses the greater area.

3. The circle encloses a greater area than any polygon of the same perimeter.

4. The sum of the areas of two isosceles triangles on given bases, the sum of whose perimeters is given, is greatest when the triangles are similar.

5. Of segments of a circle of given perimeter, the semicircle encloses the greatest area.

6 The sphere is the surface of given area which encloses the greatest volume.

Serenus of Antissa investigated the somewhat trifling problem of finding the triangle of greatest area whose sides are formed by the intersections with the base and curved surface of a right circular cone of a plane drawn through its vertex.

The next problem on maxima and minima of which there appears to be any record occurs in a letter from Regiomontanus to Roder (July 4, 1471), and is a particular numerical example of the problem of finding the point on a given straight line at which two given points subtend a maximum angle. N. Tartaglia in his *General trattato de numeri et mesuri* (*c.* 1556) gives, without proof, a rule for dividing a number into two parts such that the continued product of the numbers and their difference is a maximum.

Fermat investigated maxima and minima by means of the principle that in the neighbourhood of a maximum or minimum the differences of the values of a function are insensible, a method virtually the same as that of the differential calculus, and of great use in dealing with geometrical maxima and minima. His method was developed by Huygens, Leibnitz, Newton and others, and in particular by John Hudde, who investigated maxima and minima of functions of more than one independent variable, and made some attempt to discriminate between maxima and minima, a question first definitely settled, so far as one variable is concerned, by Colin Maclaurin in his *Treatise on Fluxions* (1742). The method of the differential calculus was perfected by Euler and Lagrange.

John Bernoulli's famous problem of the "brachistochrone," or curve of quickest descent from one point to another under the action of gravity, proposed in 1696, gave rise to a new kind of maximum and minimum problem in which we have to find a curve and not points on a given curve. From these problems arose the "Calculus of Variations." (See VARIATIONS, CALCULUS OF.)

The only general methods of attacking problems on maxima and minima are those of the differential calculus or, in geometrical problems, what is practically Fermat's method. Some problems may be solved by algebra; thus if $y=f(x)+\phi(x)$, where $f(x)$ and $\phi(x)$ are polynomials in x, the limits to the values of y may be found from the consideration that the equation $y\phi(x)-f(x)=0$ must have real roots. This is a useful method in the case in which $\phi(x)$ and $f(x)$ are quadratics, but scarcely ever in any other case. The problem of finding the maximum product of n positive quantities whose sum is given may also be found, algebraically, thus. If a and b are any two real unequal quantities whatever $\{\frac{1}{2}(a+b)\}^2>ab$, so that we can increase the product leaving the sum unaltered by replacing any two terms by half their sum, and so long as any two of the quantities are unequal we can increase the product. Now, the quantities being all positive, the product cannot be increased without limit and must somewhere attain a maximum, and no other form of the product than that in which they are all equal can be the maximum, so that the product is a maximum when they are all equal. Its minimum value is obviously zero. If the restriction that all the quantities shall be positive is removed, the product can be made equal to any quantity, positive or negative. So other theorems of algebra, which are stated as theorems on inequalities, may be regarded as algebraic solutions of problems on maxima and minima.

For purely geometrical questions the only general method available is practically that employed by Fermat. If a quantity depends on the position of some point P on a curve, and if its value is equal at two neighbouring points P and P′, then at some position between P and P′ it attains a maximum or minimum, and this position may be found by making P and P′ approach each other indefinitely. Take for instance the problem of Regiomontanus "to find a point on a given straight line which subtends a maximum angle at two given points A and B." Let P and P′ be two near points on the given straight line such that the angles APB and AP′B are equal. Then ABPP′ lie on a circle. By making P and P′ approach each other we see that for a maximum or minimum value of the angle APB, P is a point in which a circle drawn through AB touches the given straight line. There are two such points, and unless the given straight line is at right angles to AB the two angles obtained are not the same. It is easily seen that both angles are maxima, one for points on the given straight line on one side of its intersection with AB, the other for points on the other side. For further examples of this method together with most other geometrical problems on maxima and minima of any interest or importance the reader may consult such a book as J. W. Russell's *A Sequel to Elementary Geometry* (Oxford, 1907).

The method of the differential calculus is theoretically very simple. Let u be a function of several variables $x_1, x_2, x_3, \dots x_n$, supposed for the present independent; if u is a maximum or minimum for the set of values $x_1, x_2, x_3, \dots x_n$, and u becomes $u+\delta u$, when $x_1, x_2, x_3, \dots x_n$ receive small increments $\delta x_1, \delta x_2, \dots \delta x_n$; then δu must have the same sign for all possible values of $\delta x_1, \delta x_2, \dots \delta x_n$.

Now
$$\delta u=\Sigma\frac{\delta u}{\delta x_1}\delta x_1+\tfrac{1}{2}\left\{\Sigma\frac{\delta^2 u}{\delta x_1^2}\delta x_1^2+2\Sigma\frac{\delta^2 u}{\delta x_1\delta x_2}\delta x_1\,\delta x_2\ \dots\right\}+\ \dots$$

The sign of this expression in general is that of $\Sigma(\delta u/\delta x_1)\delta x_1$, which cannot be one-signed when $x_1, x_2, \dots x_n$ can take all possible values, for a set of increments $\delta x_1, \delta x_2, \dots \delta x_n$ will give an opposite sign to the set $-\delta x_1, -\delta x_2, \dots -\delta x_n$. Hence $\Sigma(\delta u/\delta x_1)\delta x_1$ must vanish for all sets of increments $\delta x_1, \dots \delta x_n$, and since these are independent, we must have $\delta u/\delta x_1=0$, $\delta u/\delta x_2=0, \dots \delta u/\delta x_n=0$. A value of u given by a set of solutions of these equations is called a "critical value" of u. The value of δu now becomes
$$\tfrac{1}{2}\left\{\Sigma\frac{\delta^2 u}{\delta x_1^2}\,\delta x_1^2+2\,\Sigma\frac{\delta^2 u}{\delta x_1 dx_2}\delta x_1\delta x_2+\dots\right\};$$
for u to be a maximum or minimum this must have always the same sign. For the case of a single variable x, corresponding to a value of x given by the equation $du/dx=0$, u is a maximum or minimum as d^2u/dx^2 is negative or positive. If d^2u/dx^2 vanishes, then there is no maximum or minimun unless d^3u/dx^3 vanishes, and there is a maximum or minimum according as d^4u/dx^4 is negative or positive. Generally, if the first differential coefficient which does not vanish is even, there is a maximum or minimum according as this is negative or positive. If it is odd, there is no maximum or minimum.

In the case of several variables, the quadratic
$$\Sigma\frac{\delta^2 u}{\delta x_1^2}\delta x_1^2+2\,\Sigma\frac{\delta^2 u}{\delta x_1\delta x_2}\,\delta x_1\delta x_2\ +\dots$$
must be one-signed. The condition for this is that the series of discriminants
$$a_{11}\,,\ \begin{vmatrix} a_{11} & a_{12}\\ a_{21} & a_{22}\end{vmatrix}\ ,\ \begin{vmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{vmatrix},\dots.$$
where a_{pq} denotes $\delta^2u/\delta a_p\delta a_q$ should be all positive, if the quadratic is always positive, and alternately negative and positive, if the quadratic is always negative. If the first condition is satisfied the critical value is a minimum, if the second it is a maximum. For the case of two variables the conditions are
$$\frac{\delta^2 u}{\delta x_1^2}\cdot\frac{\delta^2 u}{\delta x_2^2}>\left(\frac{\delta^2 u}{\delta x_1\delta x_2}\right)^2$$
for a maximum or minimum at all and $\delta^2u/\delta x_1^2$ and $\delta^2u/\delta x_2^2$ both negative for a maximum, and both positive for a minimum. It is important to notice that by the quadratic being one-signed is meant that it cannot be made to vanish except when $\delta x_1, \delta x_2, \dots \delta x_n$ all vanish. If, in the case of two variables,
$$\frac{\delta^2 u}{\delta x_1^2}\cdot\frac{\delta^2 u}{\delta x_2^2}=\left(\frac{\delta^2 u}{\delta x_1\delta x^2}\right)^2$$
then the quadratic is one-signed unless it vanishes, but the value of u is not necessarily a maximum or minimum, and the terms of the third and possibly fourth order must be taken account of.

Take for instance the function $u-x^3-xy^2+y^3$. Here the values $x=0$, $y=0$ satisfy the equations $\delta u/\delta x=0$, $\delta u/\delta y=0$, so that zero is a critical value of u, but it is neither a maximum nor a minimum although the terms of the second order are $(\delta x)^2$, and are never negative. Here $\delta u=\delta x^2-\delta x\delta y^2+\delta y^3$, and by putting $\delta x=0$ or an infinitesimal of the same order as δy^3, we can make the sign of δu depend on that of δy^3, and so be positive or negative as we please. On the other hand, if we take the function $u=x^2-xy^2+y^4$, $x=0$, $y=0$ make zero a critical value of u, and here $\delta u=\delta x^2-\delta x\delta y^2+\delta y^4$, which is always positive, because we can write it as the sum of two squares, viz. $(\delta x-\frac{1}{2}\delta y^2)^2+\frac{3}{4}\delta y^4$; so that in this case zero is a minimum value of u.

A critical value usually gives a maximum or minimum in the case of a function of one variable, and often in the case of several independent variables, but all maxima and minima, particularly absolutely greatest and least values, are not necessarily critical values. If, for example, x is restricted to lie between the values a and b and $\phi'(x)=0$ has no roots in this interval, it follows that $\phi'(x)$ is one-signed as x increases from a to b, so that $\phi(x)$ is increasing or diminishing all the time, and the greatest and least values of $\phi(x)$ are $\phi(a)$ and $\phi(b)$, though neither of them is a critical value. Consider the following example: A person in a boat a miles from the nearest point of the beach wishes to reach as quickly as possible a point b miles from that point along the shore. The ratio of his rate of walking to his rate of rowing is cosec α. Where should he land?

Here let AB be the direction of the beach, A the nearest point to the boat O, and B the point he wishes to reach. Clearly he must land, if at all, between A and B. Suppose he lands at P. Let the angle AOP be θ, so that $\mathrm{OP}=a\sec\theta$, and $\mathrm{PB}=b-a\tan\theta$. If his rate of rowing is V miles an hour his time will be $a\sec\theta/\mathrm{V}+(b-a\tan\theta)\sin\alpha/\mathrm{V}$ hours. Call this T. Then to the first power of $\delta\theta$, $\delta\mathrm{T}=(a/\mathrm{V})\sec^2\theta\,(\sin\theta-\sin\alpha)\delta\theta$, so that if $\mathrm{AOB}>\alpha$, $\delta\mathrm{T}$ and $\delta\theta$ have opposite signs from $\theta=0$ to $\theta=\alpha$, and the same signs from $\theta=\alpha$ to $\theta=\mathrm{AOB}$. So that when AOB is $>\alpha$, T decreases from $\theta=0$ to $\theta=\alpha$, and then increases, so that he should land at a point distant $a\tan\alpha$ from A, unless $a\tan\alpha>b$. When this is the case, $\delta\mathrm{T}$ and $\delta\theta$ have opposite signs throughout the whole range of θ, so that T decreases as θ increases, and he should row direct to B. In the first case the minimum value of T is also a critical value; in the second case it is not.

The greatest and least values of the bending moments of loaded rods are often at the extremities of the divisions of the rods and not at points given by critical values.

In the case of a function of several variables, $x_1, x_2, \dots x_n$, not independent but connected by m functional relations $u_1=0$, $u_2=0, \dots, u_m=0$, we might proceed to eliminate m of the variables; but Lagrange's "Method of undetermined Multipliers" is more elegant and generally more useful.

We have $\delta u_1=0$, $\delta u_2=0, \dots, \delta u_m=0$. Consider instead of δu, what is the same thing, viz., $\delta u+\lambda_1\delta u_1+\lambda_2\delta u_2+\dots+\lambda_m\delta u_m$, where $\lambda_1, \lambda_2, \dots \lambda_m$, are arbitrary multipliers. The terms of the first order in this expression are

$$\Sigma\frac{\delta u}{\delta x_1}\delta x_1+\lambda_1\Sigma\frac{\delta u_1}{\delta x_1}\delta x_1+\ldots+\lambda_m\Sigma\frac{\delta u_m}{\delta x_1}\delta x_1.$$

We can choose $\lambda_1, \ldots \lambda_m$, to make the coefficients of δx_1, δx_2, $\ldots \delta x_m$, vanish, and the remaining δx_{m+1} to δx_n may be regarded as independent, so that, when u has a critical value, their coefficients must also vanish. So that we put

$$\frac{\delta u}{\delta x_r}+\lambda_1\frac{\delta u_1}{\delta x_r}+\ldots+\lambda_m\frac{\delta u_m}{\delta x_r}=0$$

for all values of r. These equations with the equations $u_1=0, \ldots$, $u_m=0$ are exactly enough to determine $\lambda_1, \ldots, \lambda_m$, x_1 $x_1, \ldots, x_n$, so that we find critical values of u, and examine the terms of the second order to decide whether we obtain a maximum or minimum.

To take a very simple illustration; consider the problem of determining the maximum and minimum radii vectors of the ellipsoid $x^2/a^2+y^2/b^2+z^2/c^2=1$, where $a^2>b^2>c^2$. Here we require the maximum and minimum values of $x^2+y^2+z^2$ where $x^2/a^2+y^2/b^2+z^2/c^2=1$.

$$\text{We have } \delta u=2x\delta x\left(1+\frac{\lambda}{a^2}\right)+2y\delta y\left(1+\frac{\lambda}{b^2}\right)+2z\delta z\left(1+\frac{\lambda}{c^2}\right)$$
$$+\delta x^2\left(1+\frac{\lambda}{a^2}\right)+\delta y^2\left(1+\frac{\lambda}{b^2}\right)+\delta z^2\left(1+\frac{\lambda}{c^2}\right).$$

To make the terms of the first order disappear, we have the three equations:—

$$x(1+\lambda/a^2)=0,\ y(1+\lambda/b^2)=0,\ z(1+\lambda/c^2)=0.$$

These have three sets of solutions consistent with the conditions $x^2/a^2+y^2/b^2+z^2/c^2=1$, $a^2>b^2>c^2$, viz.:—

(1) $y=0$, $z=0$, $\lambda=-a^2$; (2) $z=0$, $x=0$, $\lambda=-b^2$;
(3) $x=0$, $y=0$, $\lambda=-c^2$.

In the case of (1) $\delta u=\delta y^2\,(1-a^2/b^2)+\delta z^2\,(1-a^2/c^2)$, which is always negative, so that $u=a^2$ gives a maximum.

In the case of (3) $\delta u=\delta x^2\,(1-c^2/a^2)+\delta y^2\,(1-c^2/b^2)$, which is always positive, so that $u=c^2$ gives a minimum.

In the case of (2) $\delta u=\delta x^2(1-b^2/a^2)-\delta z^2(b^2/c^2-1)$, which can be made either positive or negative, or even zero if we move in the planes $x^2(1-b^2/a^2)=z^2(b^2/c^2-1)$, which are well known to be the central planes of circular section. So that $u=b^2$, though a critical value, is neither a maximum nor minimum, and the central planes of circular section divide the ellipsoid into four portions in two of which $a^2>r^2>b^2$, and in the other two $b^2>r^2>c^2$

(A. E. J.)

MAXIMIANUS, a Latin elegiac poet who flourished during the 6th century A.D. He was an Etruscan by birth, and spent his youth at Rome, where he enjoyed a great reputation as an orator. At an advanced age he was sent on an important mission to the East, perhaps by Theodoric, if he is the Maximianus to whom that monarch addressed a letter preserved in Cassiodorus (*Variarum*, i. 21). The six elegies extant under his name, written in old age, in which he laments the loss of his youth, contain descriptions of various amours. They show the author's familiarity with the best writers of the Augustan age.

Editions by J. C. Wernsdorf, *Poetae latini minores*, vi.; E. Bährens, *Poetae latini minores*, v.; M. Petschenig (1890), in C. F. Ascherson's *Berliner Studien*, xi.; R. Webster (Princeton, 1901; see *Classical Review*, Oct. 1901), with introduction and commentary; see also Robinson Ellis in *American Journal of Philology*, v. (1884) and Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans.), § 490. There is an English version (as from Cornelius Gallus), by Hovenden Walker (1689), under the title of *The Impotent Lover*.

MAXIMIANUS, MARCUS AURELIUS VALERIUS, surnamed HERCULIUS, Roman emperor from A.D. 286 to 305, was born of humble parents at Sirmium in Pannonia. He achieved distinction during long service in the army, and having been made Caesar by Diocletian in 285, received the title of Augustus in the following year (April 1, 286). In 287 he suppressed the rising of the peasants (Bagaudae) in Gaul, but in 289, after a three years' struggle, his colleague and he were compelled to acquiesce in the assumption by his lieutenant Carausius (who had crossed over to Britain) of the title of Augustus. After 293 Maximianus left the care of the Rhine frontier to Constantius Chlorus, who had been designated Caesar in that year, but in 297 his arms achieved a rapid and decisive victory over the barbarians of Mauretania, and in 302 he shared at Rome the triumph of Diocletian, the last pageant of the kind ever witnessed by that city. On the 1st of May 305, the day of Diocletian's abdication, he also, but without his colleague's sincerity, divested himself of the imperial dignity at Mediolanum (Milan), which had been his capital, and retired to a villa in Lucania; in the following year, however, he was induced by his son Maxentius to reassume the purple. In 307 he brought the emperor Flavius Valerius Severus a captive to Rome, and also compelled Galerius to retreat, but in 308 he was himself driven by Maxentius from Italy into Illyricum, whence again he was compelled to seek refuge at Arelate (Arles), the court of his son-in-law, Constantine. Here a false report was received, or invented, of the death of Constantine, at that time absent on the Rhine. Maximianus at once grasped at the succession, but was soon driven to Massilia (Marseilles), where, having been delivered up to his pursuers, he strangled himself.

See Zosimus ii. 7-11; Zonaras xii. 31-33; Eutropius ix. 20, x. 2, 3; Aurelius Victor p. 39. For the emperor Galerius Valerius Maximianus see GALERIUS.

MAXIMILIAN I. (1573-1651), called "the Great," elector and duke of Bavaria, eldest son of William V. of Bavaria, was born at Munich on the 17th of April 1573. He was educated by the Jesuits at the university of Ingolstadt, and began to take part in the government in 1591. He married in 1595 his cousin, Elizabeth, daughter of Charles II., duke of Lorraine, and became duke of Bavaria upon his father's abdication in 1597. He refrained from any interference in German politics until 1607, when he was entrusted with the duty of executing the imperial ban against the free city of Donauwörth, a Protestant stronghold. In December 1607 his troops occupied the city, and vigorous steps were taken to restore the supremacy of the older faith. Some Protestant princes, alarmed at this action, formed a union to defend their interests, which was answered in 1609 by the establishment of a league, in the formation of which Maximilian took an important part. Under his leadership an army was set on foot, but his policy was strictly defensive and he refused to allow the league to become a tool in the hands of the house of Habsburg. Dissensions among his colleagues led the duke to resign his office in 1616, but the approach of trouble brought about his return to the league about two years later.

Having refused to become a candidate for the imperial throne in 1619, Maximilian was faced with the complications arising from the outbreak of war in Bohemia. After some delay he made a treaty with the emperor Ferdinand II. in October 1619, and in return for large concessions placed the forces of the league at the emperor's service. Anxious to curtail the area of the struggle, he made a treaty of neutrality with the Protestant Union, and occupied Upper Austria as security for the expenses of the campaign. On the 8th of November 1620 his troops under Count Tilly defeated the forces of Frederick, king of Bohemia and count palatine of the Rhine, at the White Hill near Prague. In spite of the arrangement with the union Tilly then devastated the Rhenish Palatinate, and in February 1623 Maximilian was formally invested with the electoral dignity and the attendant office of imperial steward, which had been enjoyed since 1356 by the counts palatine of the Rhine. After receiving the Upper Palatinate and restoring Upper Austria to Ferdinand, Maximilian became leader of the party which sought to bring about Wallenstein's dismissal from the imperial service. At the diet of Regensburg in 1630 Ferdinand was compelled to assent to this demand, but the sequel was disastrous both for Bavaria and its ruler. Early in 1632 the Swedes marched into the duchy and occupied Munich, and Maximilian could only obtain the assistance of the imperialists by placing himself under the orders of Wallenstein, now restored to the command of the emperor's forces. The ravages of the Swedes and their French allies induced the elector to enter into negotiations for peace with Gustavus Adolphus and Cardinal Richelieu. He also proposed to disarm the Protestants by modifying the Restitution edict of 1629, but these efforts were abortive. In March 1647 he concluded an armistice with France and Sweden at Ulm, but the entreaties of the emperor Ferdinand III. led him to disregard his undertaking. Bavaria was again ravaged, and the elector's forces defeated in May 1648 at Zusmarshausen. But the peace of Westphalia soon put an end to the struggle. By this treaty it was agreed that Maximilian should retain the electoral dignity, which was made hereditary in his family; and the Upper Palatinate was incorporated with Bavaria. The elector died at Ingolstadt on the 27th of September 1651. By his second wife

Maria Anne, daughter of the emperor Ferdinand II., he left two sons, Ferdinand Maria, who succeeded him, and Maximilian Philip. In 1839 a statue was erected to his memory at Munich by Louis I., king of Bavaria. Weak in health and feeble in frame, Maximilian had high ambitions both for himself and his duchy, and was tenacious and resourceful in prosecuting his designs. As the ablest prince of his age he sought to prevent Germany from becoming the battleground of Europe, and although a rigid adherent of the Catholic faith, was not always subservient to the priest.

See P. P. Wolf, *Geschichte Kurfürst Maximilians I. und seiner Zeit* (Munich, 1807–1809); C. M. Freiherr von Aretin, *Geschichte des bayerschen Herzogs und Kurfürsten Maximilian des Ersten* (Passau, 1842); M. Lossen, *Die Reichstadt Donauwörth und Herzog Maximilian* (Munich, 1866); F. Stieve, *Kurfürst Maximilian I. von Bayern* (Munich, 1882); F. A. W. Schreiber, *Maximilian I. der Katholische Kurfürst von Bayern, und der dreissigjährige Krieg* (Munich, 1868); M. Högl, *Die Bekehrung der Oberpfalz durch Kurfürst Maximilian I.* (Regensburg, 1903).

MAXIMILIAN I. (Maximilian Joseph) (1756–1825), king of Bavaria, was the son of the count palatine Frederick of Zweibrücken-Birkenfeld, and was born on the 27th of May 1756. He was carefully educated under the supervision of his uncle, Duke Christian IV. of Zweibrücken, took service in 1777 as a colonel in the French army, and rose rapidly to the rank of major-general. From 1782 to 1789 he was stationed at Strassburg, but at the outbreak of the revolution he exchanged the French for the Austrian service, taking part in the opening campaigns of the revolutionary wars. On the 1st of April 1795 he succeeded his brother, Charles II., as duke of Zweibrücken, and on the 16th of February 1799 became elector of Bavaria on the extinction of the Sulzbach line with the death of the elector Charles Theodore.

The sympathy with France and with French ideas of enlightenment which characterized his reign was at once manifested. In the newly organized ministry Count Max Josef von Montgelas (*q.v.*), who, after falling into disfavour with Charles Theodore, had acted for a time as Maximilian Joseph's private secretary, was the most potent influence, an influence wholly "enlightened" and French. Agriculture and commerce were fostered, the laws were ameliorated, a new criminal code drawn up, taxes and imposts equalized without regard to traditional privileges, while a number of religious houses were suppressed and their revenues used for educational and other useful purposes. In foreign politics Maximilian Joseph's attitude was from the German point of view less commendable. With the growing sentiment of German nationality he had from first to last no sympathy, and his attitude throughout was dictated by wholly dynastic, or at least Bavarian, considerations. Until 1813 he was the most faithful of Napoleon's German allies, the relation being cemented by the marriage of his daughter to Eugène Beauharnais. His reward came with the treaty of Pressburg (Dec. 26, 1805), by the terms of which he was to receive the royal title and important territorial acquisitions in Swabia and Franconia to round off his kingdom. The style of king he actually assumed on the 1st of January 1806.

The new king of Bavaria was the most important of the princes belonging to the Confederation of the Rhine, and remained Napoleon's ally until the eve of the battle of Leipzig, when by the convention of Ried (Oct. 8, 1813) he made the guarantee of the integrity of his kingdom the price of his joining the Allies. By the first treaty of Paris (June 3, 1814), however, he ceded Tirol to Austria in exchange for the former duchy of Würzburg. At the congress of Vienna, too, which he attended in person, Maximilian had to make further concessions to Austria, ceding the quarters of the Inn and Hausruck in return for a part of the old Palatinate. The king fought hard to maintain the contiguity of the Bavarian territories as guaranteed at Ried; but the most he could obtain was an assurance from Metternich in the matter of the Baden succession, in which he was also doomed to be disappointed (see Baden: *History*, iii. 506).

At Vienna and afterwards Maximilian sturdily opposed any reconstitution of Germany which should endanger the independence of Bavaria, and it was his insistence on the principle of full sovereignty being left to the German reigning princes that largely contributed to the loose and weak organization of the new German Confederation. The Federal Act of the Vienna congress was proclaimed in Bavaria, not as a law but as an international treaty. It was partly to secure popular support in his resistance to any interference of the federal diet in the internal affairs of Bavaria, partly to give unity to his somewhat heterogeneous territories, that Maximilian on the 26th of May 1818 granted a liberal constitution to his people. Montgelas, who had opposed this concession, had fallen in the previous year, and Maximilian had also reversed his ecclesiastical policy, signing on the 24th of October 1817 a concordat with Rome by which the powers of the clergy, largely curtailed under Montgelas's administration, were restored. The new parliament proved so intractable that in 1819 Maximilian was driven to appeal to the powers against his own creation; but his Bavarian "particularism" and his genuine popular sympathies prevented him from allowing the Carlsbad decrees to be strictly enforced within his dominions. The suspects arrested by order of the Mainz Commission he was accustomed to examine himself, with the result that in many cases the whole proceedings were quashed, and in not a few the accused dismissed with a present of money. Maximilian died on the 13th of October 1825 and was succeeded by his son Louis I.

In private life Maximilian was kindly and simple. He loved to play the part of *Landesvater*, walking about the streets of his capital *en bourgeois* and entering into conversation with all ranks of his subjects, by whom he was regarded with great affection. He was twice married: (1) in 1785 to Princess Wilhelmine Auguste of Hesse-Darmstadt, (2) in 1797 to Princess Caroline Friederike of Baden.

See G. Freiherr von Lerchenfeld, *Gesch. Bayerns unter König Maximilian Joseph I.* (Berlin, 1854); J. M. Söltl, *Max Joseph, König von Bayern* (Stuttgart, 1837); L. von Kobell, *Unter den vier ersten Königen Bayerns. Nach Briefen und eigenen Erinnerungen* (Munich, 1894).

MAXIMILIAN II. (1811–1864), king of Bavaria, son of king Louis I. and of his consort Theresa of Saxe-Hildburghausen, was born on the 28th of November 1811. After studying at Göttingen and Berlin and travelling in Germany, Italy and Greece, he was introduced by his father into the council of state (1836). From the first he showed a studious disposition, declaring on one occasion that had he not been born in a royal cradle his choice would have been to become a professor. As crown prince, in the château of Hohenschwangau near Füssen, which he had rebuilt with excellent taste, he gathered about him an intimate society of artists and men of learning, and devoted his time to scientific and historical study. When the abdication of Louis I. (March 28, 1848) called him suddenly to the throne, his choice of ministers promised a liberal régime. The progress of the revolution, however, gave him pause. He strenuously opposed the unionist plans of the Frankfort parliament, refused to recognize the imperial constitution devised by it, and assisted Austria in restoring the federal diet and in carrying out the federal execution in Hesse and Holstein. Although, however, from 1850 onwards his government tended in the direction of absolutism, he refused to become the tool of the clerical reaction, and even incurred the bitter criticism of the Ultramontanes by inviting a number of celebrated men of learning and science (*e.g.* Liebig and Sybel) to Munich, regardless of their religious views. Finally, in 1859, he dismissed the reactionary ministry of von der Pfordten, and met the wishes of his people for a moderate constitutional government. In his German policy he was guided by the desire to maintain the union of the princes, and hoped to attain this as against the perilous rivalry of Austria and Prussia by the creation of a league of the "middle" and small states—the so-called Trias. In 1863, however, seeing what he thought to be a better way, he supported the project of reform proposed by Austria at the Fürstentag of Frankfort. The failure of this proposal, and the attitude of Austria towards the Confederation and in the Schleswig-Holstein question, undeceived him; but before he could deal with the new situation created by the outbreak of the war with Denmark he died suddenly at Munich, on the 10th of March 1864.

Maximilian was a man of amiable qualities and of intellectual attainments far above the average, but as a king he was hampered by constant ill-health, which compelled him to be often abroad, and when at home to live much in the country. By his wife, Maria Hedwig, daughter of Prince William of Prussia, whom he married in 1842, he had two sons, Louis II., king of Bavaria, and Otto, king of Bavaria, both of whom lost their reason.

See J. M. Söltl, *Max der Zweite, König von Bayern* (Munich, 1865); biography by G. K. Heigel in *Allgem. Deutsche Biographie*, vol. xxi. (Leipzig, 1885). Maximilian's correspondence with Schlegel was published at Stuttgart in 1890.

MAXIMILIAN I. (1459–1519), Roman emperor, son of the emperor Frederick III. and Leonora, daughter of Edward, king of Portugal, was born at Vienna Neustadt on the 22nd of March 1459. On the 18th of August 1477, by his marriage at Ghent to Mary, who had just inherited Burgundy and the Netherlands from her father Charles the Bold, duke of Burgundy, he effected a union of great importance in the history of the house of Habsburg. He at once undertook the defence of his wife's dominions from an attack by Louis XI., king of France, and defeated the French forces at Guinegatte, the modern Enguinegatte, on the 7th of August 1479. But Maximilian was regarded with suspicion by the states of Netherlands, and after suppressing a rising in Gelderland his position was further weakened by the death of his wife on the 27th of March 1482. He claimed to be recognized as guardian of his young son Philip and as regent of the Netherlands, but some of the states refused to agree to his demands and disorder was general. Maximilian was compelled to assent to the treaty of Arras in 1482 between the states of the Netherlands and Louis XI. This treaty provided that Maximilian's daughter Margaret should marry Charles, the dauphin of France, and have for her dowry Artois and Franche-Comté, two of the provinces in dispute, while the claim of Louis on the duchy of Burgundy was tacitly admitted. Maximilian did not, however, abandon the struggle in the Netherlands. Having crushed a rebellion at Utrecht, he compelled the burghers of Ghent to restore Philip to him in 1485, and returning to Germany was chosen king of the Romans, or German king, at Frankfort on the 16th of February 1486, and crowned at Aix-la-Chapelle on the 9th of the following April. Again in the Netherlands, he made a treaty with Francis II., duke of Brittany, whose independence was threatened by the French regent, Anne of Beaujeu, and the struggle with France was soon renewed. This war was very unpopular with the trading cities of the Netherlands, and early in 1488 Maximilian, having entered Bruges, was detained there as a prisoner for nearly three months, and only set at liberty on the approach of his father with a large force. On his release he had promised he would maintain the treaty of Arras and withdraw from the Netherlands; but he delayed his departure for nearly a year and took part in a punitive campaign against his captors and their allies. On his return to Germany he made peace with France at Frankfort in July 1489, and in October several of the states of the Netherlands recognized him as their ruler and as guardian of his son. In March 1490 the county of Tirol was added to his possessions through the abdication of his kinsman, Count Sigismund, and this district soon became his favourite residence.

Meanwhile the king had formed an alliance with Henry VII. king of England, and Ferdinand II., king of Aragon, to defend the possessions of the duchess Anne, daughter and successor of Francis, duke of Brittany. Early in 1490 he took a further step and was betrothed to the duchess, and later in the same year the marriage was celebrated by proxy; but Brittany was still occupied by French troops, and Maximilian was unable to go to the assistance of his bride. The sequel was startling. In December 1491 Anne was married to Charles VIII., king of France, and Maximilian's daughter Margaret, who had resided in France since her betrothal, was sent back to her father. The inaction of Maximilian at this time is explained by the condition of affairs in Hungary, where the death of king Matthias Corvinus had brought about a struggle for this throne. The Roman king, who was an unsuccessful candidate, took up arms, drove the Hungarians from Austria, and regained Vienna, which had been in the possession of Matthias since 1485; but he was compelled by want of money to retreat, and on the 7th of November 1491 signed the treaty of Pressburg with Ladislaus, king of Bohemia, who had obtained the Hungarian throne. By this treaty it was agreed that Maximilian should succeed to the crown in case Ladislaus left no legitimate male issue. Having defeated the invading Turks at Villach in 1492, the king was eager to take revenge upon the king of France; but the states of the Netherlands would afford him no assistance. The German diet was indifferent, and in May 1493 he agreed to the peace of Senlis and regained Artois and Franche-Comté.

In August 1493 the death of the emperor left Maximilian sole ruler of Germany and head of the house of Habsburg; and on the 16th of March 1494 he married at Innsbruck Bianca Maria Sforza, daughter of Galeazzo Sforza, duke of Milan (d. 1476). At this time Bianca's uncle, Ludovico Sforza, was invested with the duchy of Milan in return for the substantial dowry which his niece brought to the king. Maximilian harboured the idea of driving the Turks from Europe; but his appeal to all Christian sovereigns was ineffectual. In 1494 he was again in the Netherlands, where he led an expedition against the rebels of Gelderland, assisted Perkin Warbeck to make a descent upon England, and formally handed over the government of the Low Countries to Philip. His attention was next turned to Italy, and, alarmed at the progress of Charles VIII. in the peninsula, he signed the league of Venice in March 1495, and about the same time arranged a marriage between his son Philip and Joanna, daughter of Ferdinand and Isabella, king and queen of Castile and Aragon. The need for help to prosecute the war in Italy caused the king to call the diet to Worms in March 1495, when he urged the necessity of checking the progress of Charles. As during his father's lifetime Maximilian had favoured the reforming party among the princes, proposals for the better government of the empire were brought forward at Worms as a necessary preliminary to financial and military support. Some reforms were adopted, the public peace was proclaimed without any limitation of time and a general tax was levied. The three succeeding years were mainly occupied with quarrels with the diet, with two invasions of France, and a war in Gelderland against Charles, count of Egmont, who claimed that duchy, and was supported by French troops. The reforms of 1495 were rendered abortive by the refusal of Maximilian to attend the diets or to take any part in the working of the new constitution, and in 1497 he strengthened his own authority by establishing an Aulic Council (*Reichshofrath*), which he declared was competent to deal with all business of the empire, and about the same time set up a court to centralize the financial administration of Germany.

In February 1499 the king became involved in a war with the Swiss, who had refused to pay the imperial taxes or to furnish a contribution for the Italian expedition. Aided by France they defeated the German troops, and the peace of Basel in September 1499 recognized them as virtually independent of the empire. About this time Maximilian's ally, Ludovico of Milan, was taken prisoner by Louis XII., king of France, and Maximilian was again compelled to ask the diet for help. An elaborate scheme for raising an army was agreed to, and in return a council of regency (*Reichsregiment*) was established, which amounted, in the words of a Venetian envoy, to a deposition of the king. The relations were now very strained between the reforming princes and Maximilian, who, unable to raise an army, refused to attend the meetings of the council at Nuremberg, while both parties treated for peace with France. The hostility of the king rendered the council impotent. He was successful in winning the support of many of the younger princes, and in establishing a new court of justice, the members of which were named by himself. The negotiations with France ended in the treaty of Blois, signed in September 1504, when

Maximilian's grandson Charles was betrothed to Claude, daughter of Louis XII., and Louis, invested with the duchy of Milan, agreed to aid the king of the Romans to secure the imperial crown. A succession difficulty in Bavaria-Landshut was only decided after Maximilian had taken up arms and narrowly escaped with his life at Regensburg. In the settlement of this question, made in 1505, he secured a considerable increase of territory, and when the king met the diet at Cologne in 1505 he was at the height of his power. His enemies at home were crushed, and their leader, Berthold, elector of Mainz, was dead; while the outlook abroad was more favourable than it had been since his accession.

It is at this period that Ranke believes Maximilian to have entertained the idea of a universal monarchy; but whatever hopes he may have had were shattered by the death of his son Philip and the rupture of the treaty of Blois. The diet of Cologne discussed the question of reform in a halting fashion, but afforded the king supplies for an expedition into Hungary, to aid his ally Ladislaus, and to uphold his own influence in the East. Having established his daughter Margaret as regent for Charles in the Netherlands, Maximilian met the diet at Constance in 1507, when the imperial chamber (*Reichskammergericht*) was revised and took a more permanent form, and help was granted for an expedition to Italy. The king set out for Rome to secure his coronation, but Venice refused to let him pass through her territories; and at Trant, on the 4th of February 1508, he took the important step of assuming the title of Roman Emperor Elect, to which he soon received the assent of pope Julius II. He attacked the Venetians, but finding the war unpopular with the trading cities of southern Germany, made a truce with the republic for three years. The treaty of Blois had contained a secret article providing for an attack on Venice, and this ripened into the league of Cambray, which was joined by the emperor in December 1509. He soon took the field, but after his failure to capture Padua the league broke up; and his sole ally, the French king, joined him in calling a general council at Pisa to discuss the question of Church reform. A breach with pope Julius followed, and at this time Maximilian appears to have entertained, perhaps quite seriously, the idea of seating himself in the chair of St Peter. After a period of vacillation he deserted Louis and joined the Holy League, which had been formed to expel the French from Italy; but unable to raise troops, he served with the English forces as a volunteer and shared in the victory gained over the French at the battle of the Spurs near Thérouanne on the 16th of August 1513. In 1500 the diet had divided Germany into six circles, for the maintenance of peace, to which the emperor at the diet of Cologne in 1512 added four others. Having made an alliance with Christian II., king of Denmark, and interfered to protect the Teutonic Order against Sigismund I., king of Poland, Maximilian was again in Italy early in 1516 fighting the French who had overrun Milan. His want of success compelled him on the 4th of December 1516 to sign the treaty of Brussels, which left Milan in the hands of the French king, while Verona was soon afterwards transferred to Venice. He attempted in vain to secure the election of his grandson Charles as king of the Romans, and in spite of increasing infirmity was eager to lead the imperial troops against the Turks. At the diet of Augsburg in 1518 the emperor heard warnings of the Reformation in the shape of complaints against papal exactions, and a repetition of the complaints preferred at the diet of Mainz in 1517 about the administration of Germany. Leaving the diet, he travelled to Wels in Upper Austria, where he died on the 12th of January 1519. He was buried in the church of St George in Vienna Neustadt, and a superb monument, which may still be seen, was raised to his memory at Innsbruck.

Maximilian had many excellent personal qualities. He was not handsome, but of a robust and well-proportioned frame. Simple in his habits, conciliatory in his bearing, and catholic in his tastes, he enjoyed great popularity and rarely made a personal enemy. He was a skilled knight and a daring huntsman, and although not a great general, was intrepid on the field of battle. His mental interests were extensive. He knew something of six languages, and could discuss art, music, literature or theology. He reorganized the university of Vienna and encouraged the development of the universities of Ingolstadt and Freiburg. He was the friend and patron of scholars, caused manuscripts to be copied and medieval poems to be collected. He was the author of military reforms, which included the establishment of standing troops, called *Landsknechte*, the improvement of artillery by making cannon portable, and some changes in the equipment of the cavalry. He was continually devising plans for the better government of Austria, and although they ended in failure, he established the unity of the Austrian dominions. Maximilian has been called the second founder of the house of Habsburg, and certainly by bringing about marriages between Charles and Joanna and between his grandson Ferdinand and Anna, daughter of Ladislaus, king of Hungary and Bohemia, he paved the way for the vast empire of Charles V. and for the influence of the Habsburgs in eastern Europe. But he had many qualities less desirable. He was reckless and unstable, resorting often to lying and deceit, and never pausing to count the cost of an enterprise or troubling to adapt means to ends. For absurd and impracticable schemes in Italy and elsewhere he neglected Germany, and sought to involve its princes in wars undertaken solely for private aggrandizement or personal jealousy. Ignoring his responsibilities as ruler of Germany, he only considered the question of its government when in need of money and support from the princes. As the "last of the knights" he could not see that the old order of society was passing away and a new order arising, while he was fascinated by the glitter of the medieval empire and spent the better part of his life in vague schemes for its revival. As "a gifted amateur in politics" he increased the disorder of Germany and Italy and exposed himself and the empire to the jeers of Europe.

Maximilian was also a writer of books, and his writings display his inordinate vanity. His *Geheimes Jagdbuch*, containing about 2500 words, is a treatise purporting to teach his grandsons the art of hunting. He inspired the production of *The Dangers and Adventures of the Famous Hero and Knight Sir Teuerdank*, an allegorical poem describing his adventures on his journey to marry Mary of Burgundy. The emperor's share in the work is not clear, but it seems certain that the general scheme and many of the incidents are due to him. It was first published at Nuremberg by Melchior Pfintzing in 1517, and was adorned with woodcuts by Hans Leonhard Schäufelein. The *Weisskunig* was long regarded as the work of the emperor's secretary, Marx Treitzsaurwein, but it is now believed that the greater part of the book at least is the work of the emperor himself. It is an unfinished autobiography containing an account of the achievements of Maximilian, who is called "the young white king." It was first published at Vienna in 1775. He also is responsible for *Freydal*, an allegorical account of the tournaments in which he took part during his wooing of Mary of Burgundy; *Ehrenpforten*, *Triumphwagen* and *Der weisen könige Stammbaum*, books concerning his own history and that of the house of Habsburg, and works on various subjects, as *Das Stahlbuch*, *Die Baumeisterei* and *Die Gärtnerei*. These works are all profusely illustrated, some by Albrecht Dürer, and in the preparation of the woodcuts Maximilian himself took the liveliest interest. A facsimile of the original editions of Maximilian's autobiographical and semi-autobiographical works has been published in nine volumes in the *Jahrbücher der kunsthistorischen Sammlungen des Kaiserhauses* (Vienna, 1880–1888). For this edition S. Laschitzer wrote an introduction to *Sir Teuerdank*, Q. von Leitner to *Freydal*, and N. A. von Schultz to *Der Weisskunig*. The Holbein society issued a facsimile of *Sir Teuerdank* (London, 1884) and *Triumphwagen* (London, 1883).

See *Correspondance de l'empereur Maximilien I. et de Marguerite d'Autriche, 1507–1519*, edited by A. G. le Glay (Paris, 1839).; *Maximilians I. vertraulicher Briefwechsel mit Sigmund Prüschenk*, edited by V. von Kraus (Innsbruck, 1875); J. Chmel, *Urkunden, Briefe und Aktenstücke zur Geschichte Maximilians I. und seiner Zeit.* (Stuttgart, 1845) and *Aktenstücke und Briefe zur Geschichte des Hauses Habsburg im Zeitalter Maximilians I.* (Vienna, 1854–1858); K. Klüpfel, *Kaiser Maximilian I.* (Berlin, 1854); H. Ulmann, *Kaiser Maximilian I.* (Stuttgart, 1884); L. P. Gachard, *Lettres inédites de Maximilien I. sur les affaires des Pays Bas* (Brussels, 1851–1852); L. von Ranke, *Geschichte der romanischen und germanischen Völker, 1494–1514* (Leipzig, 1874); R. W. S. Watson, *Maximilian I.* (London, 1902); A. Jäger, *Über Kaiser Maximilians I. Verhältnis zum Papstthum* (Vienna, 1854); H. Ulmann, *Kaiser Maximilians I. Absichten auf das Papstthum* (Stuttgart, 1888), and A. Schulte, *Kaiser Maximilian I. als Kandidat für den päpstlichen Stuhl* (Leipzig, 1906).

(A. W. H.*)

MAXIMILIAN II. (1527–1576), Roman emperor, was the eldest son of the emperor Ferdinand I. by his wife Anne, daughter of Ladislaus, king of Hungary and Bohemia, and was born in Vienna on the 31st of July 1527. Educated principally in Spain, he gained some experience of warfare during the campaign of Charles V. against France in 1544, and also during the war of the league of Schmalkalden, and soon began to take part in imperial business. Having in September 1548 married his cousin Maria, daughter of Charles V., he acted as the emperor's representative in Spain from 1548 to 1550, returning to Germany in December 1550 in order to take part in the discussion over the imperial succession. Charles V. wished his son Philip (afterwards king of Spain) to succeed him as emperor, but his brother Ferdinand, who had already been designated as the next occupant of the imperial throne, and Maximilian objected to this proposal. At length a compromise was reached. Philip was to succeed Ferdinand, but during the former's reign Maximilian, as king of the Romans, was to govern Germany. This arrangement was not carried out, and is only important because the insistence of the emperor seriously disturbed the harmonious relations which had hitherto existed between the two branches of the Habsburg family; and the estrangement went so far that an illness which befell Maximilian in 1552 was attributed to poison given to him in the interests of his cousin and brother-in-law, Philip of Spain. About this time he took up his residence in Vienna, and was engaged mainly in the government of the Austrian dominions and in defending them against the Turks. The religious views of the king of Bohemia, as Maximilian had been called since his recognition as the future ruler of that country in 1549, had always been somewhat uncertain, and he had probably learned something of Lutheranism in his youth; but his amicable relations with several Protestant princes, which began about the time of the discussion over the succession, were probably due more to political than to religious considerations. However, in Vienna he became very intimate with Sebastian Pfauser (1520–1569), a court preacher with strong leanings towards Lutheranism, and his religious attitude caused some uneasiness to his father. Fears were freely expressed that he would definitely leave the Catholic Church, and when Ferdinand became emperor in 1558 he was prepared to assure Pope Paul IV. that his son should not succeed him if he took this step. Eventually Maximilian remained nominally an adherent of the older faith, although his views were tinged with Lutheranism until the end of his life. After several refusals he consented in 1560 to the banishment of Pfauser, and began again to attend the services of the Catholic Church. This uneasiness having been dispelled, in November 1562 Maximilian was chosen king of the Romans, or German king, at Frankfort, where he was crowned a few days later, after assuring the Catholic electors of his fidelity to their faith, and promising the Protestant electors that he would publicly accept the confession of Augsburg when he became emperor. He also took the usual oath to protect the Church, and his election was afterwards confirmed by the papacy. In September 1563 he was crowned king of Hungary, and on his father's death, in July 1564, succeeded to the empire and to the kingdoms of Hungary and Bohemia.

The new emperor had already shown that he believed in the necessity for a thorough reform of the Church. He was unable, however, to obtain the consent of Pope Pius IV. to the marriage of the clergy, and in 1568 the concession of communion in both kinds to the laity was withdrawn. On his part Maximilian granted religious liberty to the Lutheran nobles and knights in Austria, and refused to allow the publication of the decrees of the council of Trent. Amid general expectations on the part of the Protestants he met his first Diet at Augsburg in March 1566. He refused to accede to the demands of the Lutheran princes; on the other hand, although the increase of sectarianism was discussed, no decisive steps were taken to suppress it, and the only result of the meeting was a grant of assistance for the Turkish War, which had just been renewed. Collecting a large and splendid army Maximilian marched to defend his territories; but no decisive engagement had taken place when a truce was made in 1568, and the emperor continued to pay tribute to the sultan for Hungary. Meanwhile the relations between Maximilian and Philip of Spain had improved; and the emperor's increasingly cautious and moderate attitude in religious matters was doubtless due to the fact that the death of Philip's son, Don Carlos, had opened the way for the succession of Maximilian, or of one of his sons, to the Spanish throne. Evidence of this friendly feeling was given in 1570, when the emperor's daughter, Anne, became the fourth wife of Philip; but Maximilian was unable to moderate the harsh proceedings of the Spanish king against the revolting inhabitants of the Netherlands. In 1570 the emperor met the diet at Spires and asked for aid to place his eastern borders in a state of defence, and also for power to repress the disorder caused by troops in the service of foreign powers passing through Germany. He proposed that his consent should be necessary before any soldiers for foreign service were recruited in the empire; but the estates were unwilling to strengthen the imperial authority, the Protestant princes regarded the suggestion as an attempt to prevent them from assisting their coreligionists in France and the Netherlands, and nothing was done in this direction, although some assistance was voted for the defence of Austria. The religious demands of the Protestants were still unsatisfied, while the policy of toleration had failed to give peace to Austria. Maximilian's power was very limited; it was inability rather than unwillingness that prevented him from yielding to the entreaties of Pope Pius V. to join in an attack on the Turks both before and after the victory of Lepanto in 1571; and he remained inert while the authority of the empire in north-eastern Europe was threatened. His last important act was to make a bid for the throne of Poland, either for himself or for his son Ernest. In December 1575 he was elected by a powerful faction, but the diet which met at Regensburg was loath to assist; and on the 12th of October 1576 the emperor died, refusing on his deathbed to receive the last sacraments of the Church.

By his wife Maria he had a family of nine sons and six daughters. He was succeeded by his eldest surviving son, Rudolph, who had been chosen king of the Romans in October 1575. Another of his sons, Matthias, also became emperor; three others, Ernest, Albert and Maximilian, took some part in the government of the Habsburg territories or of the Netherlands, and a daughter, Elizabeth, married Charles IX. king of France.

The religious attitude of Maximilian has given rise to much discussion, and on this subject the writings of W. Maurenbrecher, W. Goetz and E. Reimann in the *Historische Zeitschrift*, Bände VII., XV., XXXII. and LXXVII. (Munich, 1870 fol.) should be consulted, and also O. H. Hopfen, *Maximilian II. und der Kompromisskatholizismus* (Munich, 1895); C. Haupt. *Melanchthons und seiner Lehrer Einfluss auf Maximilian II.* (Wittenberg, 1897); F. Walter, *Die Wahl Maximilians II.* (Heidelberg, 1892); W. Goetz, *Maximilians II. Wahl zum römischen Könige* (Würzburg, 1891), and T. J. Scherg, *Über die religiöse Entwickelung Kaiser Maximilians II. bis zu seiner Wahl zum römischen Könige* (Würzburg, 1903). For a more general account of his life and work see *Briefe und Akten zur Geschichte Maximilians II.*, edited by W. E. Schwarz (Paderborn, 1889–1891); M. Koch, *Quellen zur Geschichte des Kaisers Maximilian II. in Archiven gesammelt* (Leipzig, 1857–1861); R. Holtzmann, *Kaiser Maximilian II. bis zu seiner Thronbesteigung* (Berlin, 1903); E. Wertheimer, *Zur Geschichte der Türkenkriege Maximilians II* (Vienna, 1875); L. von Ranke, *Über die Zeiten Ferdinands I. und Maximilians II.* in Band VII. of his *Sämmtliche Werke* (Leipzig, 1874), and J. Janssen, *Geschichte des deutschen Volkes seit dem Ausgang des Mittelalters*, Bände IV. to VIII. (Freiburg, 1885–1894), English translation by M. A. Mitchell and A. M. Christie (London, 1896 fol.).

MAXIMILIAN (1832–1867), emperor of Mexico, second son of the archduke Francis Charles of Austria, was born in the palace of Schönbrunn, on the 6th of July 1832. He was a particularly clever boy, showed considerable taste for the arts, and early displayed an interest in science, especially botany. He was trained for the navy, and threw himself into this career with so much zeal that he quickly rose to high command, and was mainly instrumental in creating the naval port of Trieste and the fleet with which Tegethoff won his victories in the Italian War. He had some reputation as a Liberal, and this led, in February 1857, to his appointment as viceroy of the Lombardo-Venetian kingdom; in the same year he married the Princess Charlotte, daughter of Leopold I., king of the Belgians. On the outbreak of the war of 1859 he retired into private life, chiefly at Trieste, near which he built the beautiful chateau of Miramar. In this same year he was first approached by Mexican exiles with the proposal to become the candidate for the throne of Mexico. He did not at first accept, but sought to satisfy his restless desire for adventure by a botanical expedition to the tropical forests of Brazil. In 1863, however, under pressure from Napoleon III., and after General Forey's capture of the city of Mexico and the plebiscite which confirmed his proclamation of the empire, he consented to accept the crown. This decision was contrary to the advice of his brother, the emperor Francis Joseph, and involved the loss of all his rights in Austria. Maximilian landed at Vera Cruz on the 28th of May 1864; but from the very outset he found himself involved in difficulties of the most serious kind, which in 1866 made apparent to almost every one outside of Mexico the necessity for his abdicating. Though urged to this course by Napoleon himself, whose withdrawal from Mexico was the final blow to his cause, Maximilian refused to desert his followers. Withdrawing, in February 1867, to Querétaro, he there sustained a siege for several weeks, but on the 15th of May resolved to attempt an escape through the enemy's lines. He was, however, arrested before he could carry out this resolution, and after trial by court-martial was condemned to death. The sentence was carried out on the 19th of June 1867. His remains were conveyed to Vienna, where they were buried in the imperial vault early in the following year. (See Mexico.)

Maximilian's papers were published at Leipzig in 1867, in seven volumes, under the title *Aus meinem Leben, Reiseskizzen, Aphorismen, Gedichte*. See Pierre de la Gorce, *Hist. du Second Empire*, IV., liv. xxv. ii. (Paris, 1904); article by von Hoffinger in *Allgemeine Deutsche Biographie*, xxi. 70, where authorities are cited.

MAXIMINUS, GAIUS JULIUS VERUS, Roman emperor from A.D. 235 to 238, was born in a village on the confines of Thrace. He was of barbarian parentage and was brought up as a shepherd. His immense stature and enormous feats of strength attracted the attention of the emperor Septimius Severus. He entered the army, and under Caracalla rose to the rank of centurion. He carefully absented himself from court during the reign of Heliogabalus, but under his successor Alexander Severus, was appointed supreme commander of the Roman armies. After the murder of Alexander in Gaul, hastened, it is said, by his instigation, Maximinus was proclaimed emperor by the soldiers on the 19th of March 235. The three years of his reign, which were spent wholly in the camp, were marked by great cruelty and oppression; the widespread discontent thus produced culminated in a revolt in Africa and the assumption of the purple by Gordian (*q.v.*). Maximinus, who was in Pannonia at the time, marched against Rome, and passing over the Julian Alps descended on Aquileia; while detained before that city he and his son were murdered in their tent by a body of praetorians. Their heads were cut off and despatched to Rome, where they were burnt on the Campus Martius by the exultant crowd.

Capitolinus, *Maximini duo*; Herodian vi. 8, vii., viii. 1–5; Zosimus i. 13–15).

MAXIMINUS [Maximin], **GALERIUS VALERIUS**, Roman emperor from A.D. 308 to 314, was originally an Illyrian shepherd named Daia. He rose to high distinction after he had joined the army, and in 305 he was raised by his uncle, Galerius, to the rank of Caesar, with the government of Syria and Egypt. In 308, after the elevation of Licinius, he insisted on receiving the title of Augustus; on the death of Galerius, in 311, he succeeded to the supreme command of the provinces of Asia, and when Licinius and Constantine began to make common cause with one another Maximinus entered into a secret alliance with Maxentius. He came to an open rupture with Licinius in 313, sustained a crushing defeat in the neighbourhood of Heraclea Pontica on the 30th of April, and fled, first to Nicomedia and afterwards to Tarsus, where he died in August following. His death was variously ascribed "to despair, to poison, and to the divine justice." Maximinus has a bad name in Christian annals, as having renewed persecution after the publication of the toleration edict of Galerius, but it is probable that he has been judged too harshly.

See Maxentius; Zosimus ii. 8; Aurelius Victor, *Epit.* 40.

MAXIMS, LEGAL. A maxim is an established principle or proposition. The Latin term *maxima* is not to be found in Roman law with any meaning exactly analogous to that of a legal maxim in the modern sense of the word, but the treatises of many of the Roman jurists on *Regulae definitiones*, and *Sententiae juris* are, in some measure, collections of maxims (see an article on "Latin Maxims in English Law" in *Law Mag. and Rev.* xx. 285); Fortescue (*De laudibus*, c. 8) and Du Cange treat *maxima* and *regula* as identical. The attitude of early English commentators towards the maxims of the law was one of unmingled adulation. In *Doctor and Student* (p. 26) they are described as "of the same strength and effect in the law as statutes be." Coke (Co. *Litt.* 11 A) says that a maxim is so called "Quia maxima est ejus dignitas et certissima auctoritas, atque quod maxime omnibus probetur." "Not only," observes Bacon in the Preface to his *Collection of Maxims*, "will the use of maxims be in deciding doubt and helping soundness of judgment, but, further, in gracing argument, in correcting unprofitable subtlety, and reducing the same to a more sound and substantial sense of law, in reclaiming vulgar errors, and, generally, in the amendment in some measure of the very nature and complexion of the whole law." A similar note was sounded in Scotland; and it has been well observed that "a glance at the pages of Morrison's *Dictionary* or at other early reports will show how frequently in the older Scots law questions respecting the rights, remedies and liabilities of individuals were determined by an immediate reference to legal maxims" (J. M. Irving, *Encyclo. Scots Law*, *s.v.* "Maxims"). In later times less value has been attached to the maxims of the law, as the development of civilization and the increasing complexity of business relations have shown the necessity of qualifying the propositions which they enunciate (see Stephen, *Hist. Crim. Law*, ii. 94 *n: Yarmouth* v. *France*, 1887, 19 Q.B.D., per Lord Esher, at p. 653, and American authorities collected in Bouvier's *Law Dict. s.v.* "Maxim"). But both historically and practically they must always possess interest and value.

A brief reference need only be made here, with examples by way of illustration, to the field which the maxims of the law cover.

Commencing with rules founded on public policy, we may note the famous principle—*Salus populi suprema lex* (xii. Tables: Bacon, *Maxims*, reg. 12)—"the public welfare is the highest law." It is on this maxim that the coercive action of the State towards individual liberty in a hundred matters is based. To the same category belong the maxims—*Summa ratio est quae pro religione facit* (Co. *Litt.* 341 a)—"the best rule is that which advances religion"—a maxim which finds its application when the enforcement of foreign laws or judgments supposed to violate our own laws or the principles of natural justice is in question; and *Dies dominicus non est juridicus*, which exempts Sunday from the lawful days for juridical acts. Among the maxims relating to the crown, the most important are *Rex non potest peccare* (2 Rolle R. 304)—"The King can do no wrong"—which enshrines the principle of ministerial responsibility, and *Nullum tempus occurrit regi* (2 Co. Inst. 273)—"lapse of time does not bar the crown," a maxim qualified by various enactments in modern times. Passing to the judicial office and the administration of justice, we may refer to the rules—*Audi alteram partem*—a proposition too familiar to need either translation or comment; *Nemo debet esse judex in propriâ suâ causâ* (12 Co. *Rep.* 114)—"no man ought to be judge in his own cause"—a maxim which French law, and the legal systems based upon or allied to it, have embodied in an elaborate network of rules for judicial challenge; and the maxim which defines the relative functions of judge and jury, *Ad quaestionem facti non respondent judices, ad quaestionem legis non respondent juratores* (8 Co. *Rep.* 155). The maxim *Boni judicis est ampliare jurisdictionem* (Ch. Prec. 329) is certainly erroneous as it stands, as a judge has no right to "extend his jurisdiction." If *justitiam* is substituted for *jurisdictionem*, as Lord Mansfield said it should be (1 Burr. 304), the maxim is near the truth. A group of maxims supposed to embody certain fundamental principles of legal right and obligations may next be referred to: (a) *Ubi jus ibi remedium* (see Co. *Litt.* 197 b)—a maxim to which the evolution of the flexible "action on the case," by which wrongs unknown to the "original writs" were dealt with, was historically due, but which must be taken with the gloss *Damnum absque injuria*—"there are forms of actual damage which do not constitute legal injury" for which the law supplies no remedy; (b) *Actus Dei nemini facit injuriam* (2 Blackstone, 122)—and its allied maxim, *Lex non cogit ad impossibilia* (Co. *Litt.* 231 b)—on which the whole doctrine of *vis major* (*force majeure*) and impossible conditions in the law of contract has been built up. In this category may also be classed *Volenti non fit injuria* (Wingate, *Maxims*), out of which sprang the theory—now profoundly modified by statute—of "common employment" in the law of employers' liability; see *Smith* v. *Baker*, 1891, A.C. 325. Other maxims deal with rights of property—*Qui prior est tempore, potior est jure* (Co. *Litt.* 14 a), which consecrates the position of the *beati possidentes* alike in municipal and in international law; *Sic utere tuo ut alienum non laedas* (9 Co. *Rep.* 59), which has played its part in the determination of the rights of adjacent owners; and *Domus sua cuique est tutissimum refugium* (5 Co. *Rep.* 92)—"a man's house is his castle," a doctrine which has imposed limitations on the rights of execution creditors (see EXECUTION). In the laws of family relations there are the maxims *Consensus non concubitus facit matrimonium* (Co. *Litt.* 33 a)—the canon law of Europe prior to the council of Trent, and still law in Scotland, though modified by legislation in England; and *Pater is est quem nuptiae demonstrant* (see Co. *Litt.* 7 b), on which, in most civilized countries, the presumption of legitimacy depends. In the interpretation of written instruments, the maxim *Noscitur a sociis* (3 *Term Reports*, 87), which proclaims the importance of the context, still applies. So do the rules *Expressio unius est exclusio alterius* (Co. *Litt.* 210 a), and *Contemporanea expositio est optima et fortissima in lege*(2 Co. *Inst.* 11), which lets in evidence of contemporaneous user as an aid to the interpretation of statutes or documents; see *Van Diemen's Land Co.* v. *Table Cape Marine Board*, 1906, A.C. 92, 98. We may conclude this sketch with a miscellaneous summary: *Caveat emptor* (Hob. 99)—"let the purchaser beware"; *Qui facit per alium facite per se*, which affirms the principal's liability for the acts of his agent; *Ignorantia juris neminem excusat*, on which rests the ordinary citizen's obligation to know the law; and *Vigilantibus non dormientibus jura subveniunt* (2 Co. *Inst.* 690), one of the maxims in accordance with which courts of equity administer relief. Among other "maxims of equity" come the rules that "he that seeks equity must do equity," *i.e.* must act fairly, and that "equity looks upon that as done which ought to be done"—a principle from which the "conversion" into money of land directed to be sold, and of money directed to be invested in the purchase of land, is derived.

The principal collections of legal maxims are: *English Law*: Bacon, *Collection of Some Principal Rules and Maxims of the Common Law* (1630); Noy, *Treatise of the principal Grounds and Maxims of the Law of England* (1641, 8th ed., 1824); Wingate, *Maxims of Reason* (1728); Francis, *Grounds and Rudiments of Law and Equity* (2nd ed. 1751); Lofft (annexed to his *Reports*, 1776); Broom, *Legal Maxims* (7th ed. London, 1900). *Scots Law*: Lord Trayner, *Latin Maxims and Phrases* (2nd ed., 1876); Stair, *Institutions of the Law of Scotland*, with Index by More (Edinburgh, 1832). *American Treatises*: A. I. Morgan, *English Version of Legal Maxims* (Cincinnati, 1878); S. S. Peloubet, *Legal Maxims in Law and Equity* (New York, 1880). (A. W. R.)

MAXIMUS, the name of four Roman emperors.

I. M. CLODIUS PUPIENUS MAXIMUS, joint emperor with D. Caelius Calvinus Balbinus during a few months of the year A.D. 238. Pupienus was a distinguished soldier, who had been proconsul of Bithynia, Achaea, and Gallia Narbonensis. At the advanced age of seventy-four, he was chosen by the senate with Balbinus to resist the barbarian Maximinus. Their complete equality is shown by the fact that each assumed the titles of pontifex maximus and princeps senatus. It was arranged that Pupienus should take the field against Maximinus, while Balbinus remained at Rome to maintain order, a task in which he signally failed. A revolt of the praetorians was not repressed till much blood had been shed and a considerable part of the city reduced to ashes. On his march, Pupienus, having received the news that Maximinus had been assassinated by his own troops, returned in triumph to Rome. Shortly afterwards, when both emperors were on the point of leaving the city on an expedition—Pupienus against the Persians and Balbinus against the Goths—the praetorians, who had always resented the appointment of the senatorial emperors and cherished the memory of the soldier-emperor Maximinus, seized the opportunity of revenge. When most of the people were at the Capitoline games, they forced their way into the palace, dragged Balbinus and Pupienus through the streets, and put them to death.

See Capitolinus, *Life of Maximus and Balbinus*; Herodian vii. 10, viii. 6; Zonaras xii. 16; Orosius vii. 19; Eutropius ix. 2; Zosimus i. 14; Aurelius Victor, *Caesares*, 26, *epit.* 26; H. Schiller, *Geschichte der römischen Kaiserzeit*, i. 2; Gibbon, *Decline and Fall*, ch. 7 and (for the chronology) appendix 12 (Bury's edition).

II. MAGNUS MAXIMUS, a native of Spain, who had accompanied Theodosius on several expeditions and from 368 held high military rank in Britain. The disaffected troops having proclaimed Maximus emperor, he crossed over to Gaul, attacked Gratian (*q.v.*), and drove him from Paris to Lyons, where he was murdered by a partisan of Maximus. Theodosius being unable to avenge the death of his colleague, an agreement was made (384 or 385) by which Maximus was recognized as Augustus and sole emperor in Gaul, Spain and Britain, while Valentinian II. was to remain unmolested in Italy and Illyricum, Theodosius retaining his sovereignty in the East. In 387 Maximus crossed the Alps, Valentinian was speedily put to flight, while the invader established himself in Milan and for the time became master of Italy. Theodosius now took vigorous measures. Advancing with a powerful army, he twice defeated the troops of Maximus—at Siscia on the Save, and at Poetovio on the Danube. He then hurried on to Aquileia, where Maximus had shut himself up, and had him beheaded. Under the name of Maxen Wledig, Maximus appears in the list of Welsh royal heroes (see R. Williams , *Biog. Dict. of Eminent Welshmen*, 1852; "The Dream of Maxen Wledig," in the *Mabinogion*).

Full account with classical references in H. Richter, *Das weströmische Reich, besonders unter den Kaisern Gratian, Valentinian II. und Maximus* (1865); see also H. Schiller, *Geschichte der römischen Kaiserzeit*, ii. (1887); Gibbon, *Decline and Fall*, ch. 27; Tillemont, *Hist. des empereurs*, v.

III. MAXIMUS TYRANNUS, made emperor in Spain by the Roman general, Gerontius, who had rebelled against the usurper Constantine in 408. After the defeat of Gerontius at Arelate (Arles) and his death in 411 Maximus renounced the imperial title and was permitted by Constantine to retire into private life. About 418 he rebelled again, but, failing in his attempt, was seized, carried into Italy, and put to death at Ravenna in 422.

See Orosius vii. 42; Zosimus vi. 5; Sozomen ix. 3; E. A. Freeman, "The Tyrants of Britain, Gaul and Spain, A.D. 406–411," in *English Historical Review*, i. (1886).

IV. PETRONIUS MAXIMUS, a member of the higher Roman nobility, had held several court and public offices, including those of *praefectus Romae* (420) and *Italiae* (439–441 and 445), and consul (433, 443). He was one of the intimate associates of Valentinian III., whom he assisted in the palace intrigues which led to the death of Aëtius in 454; but an outrage committed on the wife of Maximus by the emperor turned his friendship into hatred. Maximus was proclaimed emperor immediately after Valentinian's murder (March 16, 455), but after reigning less than three months, he was murdered by some Burgundian mercenaries as he was fleeing before the troops of Genseric, who, invited by Eudoxia, the widow of Valentinian, had landed at the mouth of the Tiber (May or June 455).

See Procopius, *Vand.* i. 4; Sidonius Apollinaris, *Panegyr. Aviti*, ep. ii. 13; the various *Chronicles*; Gibbon, *Decline and Fall*, chs. 35, 36; Tillemont, *Hist. des empereurs*, vi.

MAXIMUS, ST (*c.* 580–662), abbot of Chrysopolis, known as "the Confessor" from his orthodox zeal in the Monothelite (*q.v.*) controversy, or as "the monk," was born of noble parentage at Constantinople about the year 580. Educated with great care, he early became distinguished by his talents and acquirements, and some time after the accession of the emperor Heraclius in 610 was made his private secretary. In 630 he abandoned the secular life and entered the monastery of Chrysopolis (Scutari), actuated, it was believed, less by any longing for the life of a recluse than by the dissatisfaction he felt with the Monothelite leanings of his master. The date of his promotion to the abbacy is uncertain. In 633 he was one of the party of Sophronius of Jerusalem (the chief original opponent of the Monothelites) at the council of Alexandria; and in 645 he was again in Africa, when he held in presence of the governor and a number of bishops the disputation with Pyrrhus, the deposed and banished patriarch of Constantinople, which resulted in the (temporary) conversion of his interlocutor to the Dyothelite view. In the following year several African synods, held under the influence of Maximus, declared for orthodoxy. In 649, after the accession of Martin I., he went to Rome, and did much to fan the zeal of the new pope, who in

October of that year held the (first) Lateran synod, by which not only the Monothelite doctrine but also the moderating *ecthesis* of Heraclius and *typus* of Constans II. were anathematized. About 653 Maximus, for the part he had taken against the latter document especially, was apprehended (together with the pope) by order of Constans and carried a prisoner to Constantinople. In 655, after repeated examinations, in which he maintained his theological opinions with memorable constancy, he was banished to Byzia in Thrace, and afterwards to Perberis. In 662 he was again brought to Constantinople and was condemned by a synod to be scourged, to have his tongue cut out by the root, and to have his right hand chopped off. After this sentence had been carried out he was again banished to Lazica, where he died on the 13th of August 662. He is venerated as a saint both in the Greek and in the Latin Churches. Maximus was not only a leader in the Monothelite struggle but a mystic who zealously followed and advocated the system of Pseudo-Dionysius, while adding to it an ethical element in the conception of the freedom of the will. His works had considerable influence in shaping the system of John Scotus Erigena.

The most important of the works of Maximus will be found in Migne, *Patrologia graeca*, xc. xci., together with an anonymous life; an exhaustive list in Wagenmann's article in vol. xii. (1903) of Hauck-Herzog's *Realencyklopädie* where the following classification is adopted: (*a*) exegetical, (*b*) scholia on the Fathers, (*c*) dogmatic and controversial, (*d*) ethical and ascetic, (*e*) miscellaneous. The details of the disputation with Pyrrhus and of the martyrdom are given very fully and clearly in Hefele's *Conciliengeschichte*, iii For further literature see H. Gelzer in C. Krumbacher's *Geschichte der byzantinischen Litteratur* (1897).

MAXIMUS OF SMYRNA, a Greek philosopher of the Neoplatonist school, who lived towards the end of the 4th century A.D. He was perhaps the most important of the followers of Iamblichus. He is said to have been of a rich and noble family, and exercised great influence over the emperor Julian, who was commended to him by Aedesius. He pandered to the emperor's love of magic and theurgy, and by judicious administration of the omens won a high position at court. His overbearing manner made him numerous enemies, and, after being imprisoned on the death of Julian, he was put to death by Valens. He is a representative of the least attractive side of Neoplatonism. Attaching no value to logical proof and argument, he enlarged on the wonders and mysteries of nature, and maintained his position by the working of miracles. In logic he is reported to have agreed with Eusebius, Iamblichus and Porphyry in asserting the validity of the second and third figures of the syllogism.

MAXIMUS OF TYRE (CASSIUS MAXIMUS TYRIUS), a Greek rhetorician and philosopher who flourished in the time of the Antonines and Commodus (2nd century A.D). After the manner of the sophists of his age, he travelled extensively, delivering lectures on the way. His writings contain many allusions to the history of Greece, while there is little reference to Rome; hence it is inferred that he lived longer in Greece, perhaps as a professor at Athens. Although nominally a Platonist, he is really an Eclectic and one of the precursors of Neoplatonism There are still extant by him forty-one essays or discourses (διαλέξεις) on theological, ethical, and other philosophical commonplaces. With him God is the supreme being, one and indivisible though called by many names, accessible to reason alone, but as animals form the intermediate stage between plants and human beings, so there exist intermediaries between God and man, viz. daemons, who dwell on the confines of heaven and earth. The soul in many ways bears a great resemblance to the divinity; it is partly mortal, partly immortal, and, when freed from the fetters of the body, becomes a daemon Life is the sleep of the soul, from which it awakes at death The style of Maximus is superior to that of the ordinary sophistical rhetorician, but scholars differ widely as to the merits of the essays themselves.

Maximus of Tyre must be distinguished from the Stoic Maximus, tutor of Marcus Aurelius.

Editions by J. Davies, revised with valuable notes by J. Markland (1740); J. J. Reiske (1774); F. Dübner (1840, with Theophrastus, &c., in the Didot series). Monographs by R. Rohdich (Beuthen, 1879); H. Hobein, *De Maximo Tyrio quaestiones philol.* (Jena, 1895). There is an English translation (1804) by Thomas Taylor, the Platonist.

MAX MÜLLER, FRIEDRICH (1823–1900), Anglo-German orientalist and comparative philologist, was born at Dessau on the 6th of December 1823, being the son of Wilhelm Müller (1794–1827), the German poet, celebrated for his phil-Hellenic lyrics, who was ducal librarian at Dessau. The elder Müller had endeared himself to the most intellectual circles in Germany by his amiable character and his genuine poetic gift; his songs had been utilized by musical composers, notably Schubert; and it was his son's good fortune to meet in his youth with a succession of eminent friends, who, already interested in him for his father's sake, and charmed by the qualities which they discovered in the young man himself, powerfully aided him by advice and patronage. Mendelssohn, who was his godfather, dissuaded him from indulging his natural bent to the study of music; Professor Brockhaus of the University of Leipzig, where Max Müller matriculated in 1841, induced him to take up Sanskrit; Bopp, at the University of Berlin (1844), made the Sanskrit student a scientific comparative philologist; Schelling at the same university, inspired him with a love for metaphysical speculation, though failing to attract him to his own philosophy; Burnouf, at Paris in the following year, by teaching him Zend, started him on the track of inquiry into the science of comparative religion, and impelled him to edit the *Rig Veda*; and when, in 1846, Max Müller came to England upon this errand, Bunsen, in conjunction with Professor H. H. Wilson, prevailed upon the East India Company to undertake the expense of publication. Up to this time Max Müller had lived the life of a poor student, supporting himself partly by copying manuscripts, but Bunsen's introductions to Queen Victoria and the prince consort, and to Oxford University, laid the foundation for him of fame and fortune. In 1848 the printing of his *Rig Veda* at the University Press obliged him to settle in Oxford, a step which decided his future career. He arrived at a favourable conjuncture: the Tractarian strife, which had so long thrust learning into the background, was just over, and Oxford was becoming accessible to modern ideas. The young German excited curiosity and interest, and it was soon discovered that, although a genuine scholar, he was no mere bookworm. Part of his social success was due to his readiness to exert his musical talents at private parties. Max Müller was speedily subjugated by the *genius loci*. He was appointed deputy Taylorian professor of modern languages in 1850, and the German government failed to tempt him back to Strassburg. In the following year he was made M.A and honorary fellow of Christ Church, and in 1858 he was elected a fellow of All Souls. In 1854 the Crimean War gave him the opportunity of utilizing his oriental learning in vocabularies and schemes of transliteration. In 1857 he successfully essayed another kind of literature in his beautiful story *Deutsche Liebe*, written both in German and English. He had by this time become an extensive contributor to English periodical literature, and had written several of the essays subsequently collected as *Chips from a German Workshop*. The most important of them was the fascinating essay on "Comparative Mythology" in the *Oxford Essays* for 1856. His valuable *History of Ancient Sanskrit Literature*, so far as it illustrates the primitive religion of the Brahmans (and hence the Vedic period only), was published in 1859.

Though Max Müller's reputation was that of a comparative philologist and orientalist, his professional duties at Oxford were long confined to lecturing on modern languages, or at least their medieval forms. In 1860 the death of Horace Hayman Wilson, professor of Sanskrit, seemed to open a more congenial sphere to him His claims to the succession seemed incontestable, for his opponent, Monier Williams, though well qualified as a Sanskritist, lacked Max Müller's brilliant versatility, and although educated at Oxford, had held no University office. But Max Müller was a Liberal, and the friend of Liberals in university matters, in politics, and in theology, and this consideration united with his foreign birth to bring the country clergy in such hosts to the poll that the voice of resident Oxford was overborne, and Monier Williams was elected by a large majority. It was the one great disappointment of Max Müller's life, and made a lasting impression upon him. It was, nevertheless, serviceable to his influence and reputation by permitting him to enter upon a wider field of subjects than would have been possible otherwise. Directly, Sanskrit philology received little more from him, except in connexion with his later undertaking of *The Sacred Books of the East*; but indirectly he exalted it more than any predecessor by proclaiming its commanding position in the history of the human intellect by his *Science of Language*, two courses of lectures delivered at the Royal Institution in 1861 and 1863. Max Müller ought not to be described as "the introducer of comparative philology into England." Prichard had proved the Aryan affinities of the Celtic languages by the methods of comparative philology so long before as 1831; Winning's *Manual of Comparative Philology* had been published in 1838; the discoveries of Bopp and Pott and Pictet had been recognized in brilliant articles in the *Quarterly Review*, and had guided the researches of Rawlinson. But Max Müller undoubtedly did far more to popularize the subject than had been done, or could have been done, by any predecessor. He was on less sure ground in another department of the study of language—the problem of its origin. He wrote upon it as a disciple of Kant, whose *Critique of Pure Reason* he translated. His essays on mythology are among the most delightful of his writings, but their value is somewhat impaired by a too uncompromising adherence to the seductive generalization of the solar myth.

Max Müller's studies in mythology led him to another field of activity in which his influence was more durable and extensive, that of the comparative science of religions. Here, so far as Great Britain is concerned, he does deserve the fame of an originator, and his *Introduction to the Science of Religion* (1873: the same year in which he lectured on the subject, at Dean Stanley's invitation, in Westminster Abbey, this being the only occasion on which a layman had given an address there) marks an epoch. It was followed by other works of importance, especially the four volumes of Gifford lectures, delivered between 1888 and 1892; but the most tangible result of the impulse he had given was the publication under his editorship, from 1875 onwards, of *The Sacred Books of the East*, in fifty-one volumes, including indexes, all but three of which appeared under his superintendence during his lifetime. These comprise translations by the most competent scholars of all the really important non-Christian scriptures of Oriental nations, which can now be appreciated without a knowledge of the original languages. Max Müller also wrote on Indian philosophy in his latter years, and his exertions to stimulate search for Oriental manuscripts and inscriptions were rewarded with important discoveries of early Buddhist scriptures, in their Indian form, made in Japan. He was on particularly friendly terms with native Japanese scholars, and after his death his library was purchased by the university of Tôkyô.

In 1868 Max Müller had been indemnified for his disappointment over the Sanskrit professorship by the establishment of a chair of Comparative Philology to be filled by him. He retired, however, from the actual duties of the post in 1875, when entering upon the editorship of *The Sacred Books of the East*. The most remarkable external events of his latter years were his delivery of lectures at the restored university of Strassburg in 1872, when he devoted his honorarium to the endowment of a Sanskrit lectureship, and his presidency over the International Congress of Orientalists in 1892. But his days, if uneventful, were busy. He participated in every movement at Oxford of which he could approve, and was intimate with nearly all its men of light and leading; he was a curator of the Bodleian Library, and a delegate of the University Press. He was acquainted with most of the crowned heads of Europe, and was an especial favourite with the English royal family. His hospitality was ample, especially to visitors from India, where he was far better known than any other European Orientalist. His distinctions, conferred by foreign governments and learned societies, were innumerable, and, having been naturalized shortly after his arrival in England, he received the high honour of being made a privy councillor. In 1898 and 1899 he published autobiographical reminiscences under the title of *Auld Lang Syne*. He was writing a more detailed autobiography when overtaken by death on the 28th of October 1900. Max Müller married in 1859 Georgiana Adelaide Grenfell, sister of the wives of Charles Kingsley and J. A. Froude. One of his daughters, Mrs Conybeare, distinguished herself by a translation of Scherer's *History of German Literature*.

Though undoubtedly a great scholar, Max Müller did not so much represent scholarship pure and simple as her hybrid types—the scholar-author and the scholar-courtier. In the former capacity, though manifesting little of the originality of genius, he rendered vast service by popularizing high truths among high minds. In his public and social character he represented Oriental studies with a brilliancy, and conferred upon them a distinction, which they had not previously enjoyed in Great Britain. There were drawbacks in both respects: the author was too prone to build upon insecure foundations, and the man of the world incurred censure for failings which may perhaps be best indicated by the remark that he seemed too much of a diplomatist. But the sum of foibles seems insignificant in comparison with the life of intense labour dedicated to the service of culture and humanity.

Max Müller's *Collected Works* were published in 1903. (R. G.)

MAXWELL, the name of a Scottish family, members of which have held the titles of earl of Morton, earl of Nithsdale, Lord Maxwell, and Lord Herries. The name is taken probably from Maccuswell, or Maxwell, near Kelso, whither the family migrated from England about 1100. Sir Herbert Maxwell won great fame by defending his castle of Carlaverock against Edward I. in 1300; another Sir Herbert was made a lord of the Scottish parliament before 1445; and his great-grandson John, 3rd Lord Maxwell, was killed at Flodden in 1513. John's son Robert, the 4th lord (d. 1546), was a member of the royal council under James V.; he was also an extraordinary lord of session, high admiral, and warden of the west marches, and was taken prisoner by the English at the rout of Solway Moss in 1542. Robert's grandson John, 7th Lord Maxwell (1553–1593), was the second son of Robert, the 5th lord (d. 1552), and his wife Beatrix, daughter of James Douglas, 3rd earl of Morton. After the execution of the regent Morton, the 4th earl, in 1581 this earldom was bestowed upon Maxwell, but in 1586 the attainder of the late earl was reversed and he was deprived of his new title. He had helped in 1585 to drive the royal favourite James Stewart, earl of Arran, from power, and he made active preparations to assist the invading Spaniards in 1588. His son John, the 8th lord (*c.* 1586–1613), was at feud with the Johnstones, who had killed his father in a skirmish, and with the Douglases over the earldom of Morton, which he regarded as his inheritance. After a life of exceptional and continuous lawlessness he escaped from Scotland and in his absence was sentenced to death; having returned to his native country he was seized and was beheaded in Edinburgh. In 1618 John's brother and heir Robert (d. 1646) was restored to the lordship of Maxwell, and in 1620 was created earl of Nithsdale, surrendering at this time his claim to the earldom of Morton. He and his son Robert, afterwards the 2nd earl, fought under Montrose for Charles I. during the Civil War. Robert died without sons in October 1667, when a cousin John Maxwell, 7th Lord Herries (d. 1677), became third earl.

William, 5th earl of Nithsdale (1676–1744), a grandson of the third earl, was like his ancestor a Roman Catholic and was attached to the cause of the exiled house of Stuart. In 1715 he joined the Jacobite insurgents, being taken prisoner at the battle of Preston and sentenced to death. He escaped, however, from the Tower of London through the courage and devotion of his wife Winifred (d. 1749), daughter of William Herbert, 1st marquess of Powis. He was attainted in 1716 and his titles became extinct, but his estates passed to his son William (d. 1776), whose descendant, William Constable-Maxwell, regained the title of Lord Herries in 1858. The countess of Nithsdale wrote an account of her husband's escape, which is published in vol. i. of the *Transactions of the Society of Antiquaries of Scotland*.

A few words may be added about other prominent members of the Maxwell family. John Maxwell (*c.* 1590–1647), archbishop of Tuam, was a Scottish ecclesiastic who took a leading part in helping Archbishop Laud in his futile attempt to restore the liturgy in Scotland. He was bishop of Ross from 1633 until 1638, when he was deposed by the General Assembly; then crossing over to Ireland he was bishop of Killala and Achonry from 1640 to 1645, and archbishop of Tuam from 1645 until his death. James Maxwell of Kirkconnell (*c.* 1708–1762), the Jacobite, wrote the *Narrative of Charles Prince of Wales's Expedition to Scotland in 1745*, which was printed for the Maitland Club in 1841. Robert Maxwell (1695–1765) was the author of *Select Transactions of the Society of Improvers* and was a great benefactor to Scottish agriculture. Sir Murray Maxwell (1775–1831), a naval officer, gained much fame by his conduct when his ship the "Alceste" was wrecked in Gaspar Strait in 1817. William Hamilton Maxwell (1792–1850), the Irish novelist, wrote, in addition to several novels, a *Life of the Duke of Wellington* (1839–1841 and again 1883), and a *History of the Irish Rebellion in 1798* (1845 and 1891). Sir Herbert Maxwell, 7th bart. (b. 1845), member of parliament for Wigtownshire from 1880 to 1906, and president of the Society of Antiquaries of Scotland, became well known as a writer, his works including *Life and Times of the Right Hon. W. H. Smith* (1893); *Life of the Duke of Wellington* (1899); *The House of Douglas* (1902); *Robert the Bruce* (1897) and *A Duke of Britain* (1895).

MAXWELL, JAMES CLERK (1831–1879), British physicist, was the last representative of a younger branch of the well-known Scottish family of Clerk of Penicuik, and was born at Edinburgh on the 13th of November 1831. He was educated at the Edinburgh Academy (1840–1847) and the university of Edinburgh (1847–1850). Entering at Cambridge in 1850, he spent a term or two at Peterhouse, but afterwards migrated to Trinity. In 1854 he took his degree as second wrangler, and was declared equal with the senior wrangler of his year (E. J. Routh, *q.v.*) in the higher ordeal of the Smith's prize examination. He held the chair of Natural Philosophy in Marischal College, Aberdeen, from 1856 till the fusion of the two colleges there in 1860. For eight years subsequently he held the chair of Physics and Astronomy in King's College, London, but resigned in 1868 and retired to his estate of Glenlair in Kirkcudbrightshire. He was summoned from his seclusion in 1871 to become the first holder of the newly founded professorship of Experimental Physics in Cambridge; and it was under his direction that the plans of the Cavendish Laboratory were prepared. He superintended every step of the progress of the building and of the purchase of the very valuable collection of apparatus with which it was equipped at the expense of its munificent founder the seventh duke of Devonshire (chancellor of the university, and one of its most distinguished alumni). He died at Cambridge on the 5th of November 1879.

For more than half of his brief life he held a prominent position in the very foremost rank of natural philosophers. His contributions to scientific societies began in his fifteenth year, when Professor J. D. Forbes communicated to the Royal Society of Edinburgh a short paper of his on a mechanical method of racing Cartesian ovals. In his eighteenth year, while still a student in Edinburgh, he contributed two valuable papers o the *Transactions* of the same society—one of which, "On he Equilibrium of Elastic Solids," is remarkable, not only on account of its intrinsic power and the youth of its author, but also because in it he laid the foundation of one of the most ingular discoveries of his later life, the temporary double efraction produced in viscous liquids by shearing stress. Immediately after taking his degree, he read to the Cambridge Philosophical Society a very novel memoir, "On the Transformation of Surfaces by Bending." This is one of the few urely mathematical papers he published, and it exhibited at nce to experts the full genius of its author. About the same time appeared his elaborate memoir, "On Faraday's Lines of Force," in which he gave the first indication of some of those extraordinary electrical investigations which culminated in the greatest work of his life. He obtained in 1859 the Adams prize in Cambridge for a very original and powerful essay, "On the Stability of Saturn's Rings." From 1855 to 1872 he published at intervals a series of valuable investigations connected with the "Perception of Colour" and "Colour-Blindness," for the earlier of which he received the Rumford medal from the Royal Society in 1860. The instruments which he devised for these investigations were simple and convenient, but could not have been thought of for the purpose except by a man whose knowledge was co-extensive with his ingenuity. One of his greatest investigations bore on the "Kinetic Theory of Gases." Originating with D. Bernoulli, this theory was advanced by the successive labours of John Herapath, J. P. Joule, and particularly R. Clausius, to such an extent as to put its general accuracy beyond a doubt; but it received enormous developments from Maxwell, who in this field appeared as an experimenter (on the laws of gaseous friction) as well as a mathematician. He wrote an admirable textbook of the *Theory of Heat* (1871), and a very excellent elementary treatise on *Matter and Motion* (1876).

But the great work of his life was devoted to electricity. He began by reading, with the most profound admiration and attention, the whole of Faraday's extraordinary self-revelations, and proceeded to translate the ideas of that master into the succinct and expressive notation of the mathematicians. A considerable part of this translation was accomplished during his career as an undergraduate in Cambridge. The writer had the opportunity of perusing the MS. of "On Faraday's Lines of Force," in a form little different from the final one, a year before Maxwell took his degree. His great object, as it was also the great object of Faraday, was to overturn the idea of action at a distance. The splendid researches of S. D. Poisson and K. F. Gauss had shown how to reduce all the phenomena of statical electricity to mere attractions and repulsions exerted at a distance by particles of an imponderable on one another. Lord Kelvin (Sir W. Thomson) had, in 1846, shown that a totally different assumption, based upon other analogies, led (by its own special mathematical methods) to precisely the same results. He treated the resultant electric force at any point as analogous to the *flux of heat* from sources distributed in the same manner as the supposed electric particles. This paper of Thomson's, whose ideas Maxwell afterwards developed in an extraordinary manner, seems to have given the first hint that there are at least two perfectly distinct methods of arriving at the known formulae of statical electricity. The step to magnetic phenomena was comparatively simple; but it was otherwise as regards electromagnetic phenomena, where current electricity is essentially involved. An exceedingly ingenious, but highly artificial, theory had been devised by W. E. Weber, which was found capable of explaining all the phenomena investigated by Ampère as well as the induction currents of Faraday. But this was based upon the assumption of a distance-action between electric particles, the intensity of which depended on their relative motion as well as on their position. This was, of course, even more repugnant to Maxwell's mind than the statical distance-action developed by Poisson. The first paper of Maxwell's in which an attempt at an admissible physical theory of electromagnetism was made was communicated to the Royal Society in 1867. But the theory, in a fully developed form, first appeared in 1873 in his great treatise on *Electricity and Magnetism*. This work was one of the most splendid monuments ever raised by the genius of a single individual. Availing himself of the admirable generalized co-ordinate system of Lagrange, Maxwell showed how to reduce all electric and magnetic phenomena to stresses and motions of a material medium, and, as one preliminary, but excessively severe, test of the truth of his theory, he pointed out that (if the electromagnetic medium be that which is required for the explanation of the phenomena of light) the velocity of light in vacuo should be numerically the same as the ratio of the electromagnetic and electrostatic units. In fact, the means of the best determinations of each of these quantities separately agree with one another more closely than do the various values of either.

One of Maxwell's last great contributions to science was the editing (with copious original notes) of the *Electrical Researches of the Hon. Henry Cavendish*, from which it appeared that Cavendish, already famous by many other researches (such as the mean density of the earth, the composition of water, &c.), must be looked on as, in his day, a man of Maxwell's own stamp as a theorist and an experimenter of the very first rank.

In private life Clerk Maxwell was one of the most lovable of men, a sincere and unostentatious Christian. Though perfectly free from any trace of envy or ill-will, he yet showed on fit occasion his contempt for that pseudo-science which seeks for the applause of the ignorant by professing to reduce the whole system of the universe to a fortuitous sequence of uncaused events.

His collected works, including the series of articles on the properties of matter, such as "Atom," "Attraction," "Capillary Action," "Diffusion," "Ether," &c., which he contributed to the 9th edition of this encyclopaedia, were issued in two volumes by the Cambridge University Press in 1890; and an extended biography, by his former schoolfellow and lifelong friend Professor Lewis Campbell, was published in 1882. (P. G. T.)

MAXWELLTOWN, a burgh of barony and police burgh of Kirkcudbrightshire, Scotland. Pop. (1901), 5796. It lies on the Nith, opposite to Dumfries, with which it is connected by three bridges, being united with it for parliamentary purposes. It has a station on the Glasgow & South-Western line from Dumfries to Kirkcudbright. Its public buildings include a court-house, the prison for the south-west of Scotland, and an observatory and museum, housed in a disused windmill. The chief manufactures are woollens and hosiery, besides dyeworks and sawmills. It was a hamlet known as Bridgend up till 1810, in which year it was erected into a burgh of barony under its present name. To the north-west lies the parish of Terregles, said to be a corruption of Tir-eglwys (*terra ecclesia*, that is, "Kirk land"). The parish contains the beautiful ruin of Lincluden Abbey (see DUMFRIES), and Terregles House, once the seat of William Maxwell, last earl of Nithsdale. In the parish of Lochrutton, a few miles south-west of Maxwelltown, there is a good example of a stone circle, the "Seven Grey Sisters," and an old peel-tower in the Mains of Hills.

MAY, PHIL (1864–1903), English caricaturist, was born at Wortley, near Leeds, on the 22nd of April 1864, the son of an engineer. His father died when the child was nine years old, and at twelve he had begun to earn his living. Before he was fifteen he had acted as time-keeper at a foundry, had tried to become a jockey, and had been on the stage at Scarborough and Leeds. When he was about seventeen he went to London with a sovereign in his pocket. He suffered extreme want, sleeping out in the parks and streets, until he obtained employment as designer to a theatrical costumier. He also drew posters and cartoons, and for about two years worked for the *St Stephen's Review*, until he was advised to go to Australia for his health. During the three years he spent there he was attached to the *Sydney Bulletin*, for which many of his best drawings were made. On his return to Europe he went to Paris by way of Rome, where he worked hard for some time before he appeared in 1892 in London to resume his interrupted connexion with the *St Stephen's Review*. His studies of the London "guttersnipe" and the coster-girl rapidly made him famous. His overflowing sense of fun, his genuine sympathy with his subjects, and his kindly wit were on a par with his artistic ability. It was often said that the extraordinary economy of line which was a characteristic feature of his drawings had been forced upon him by the deficiencies of the printing machines of the *Sydney Bulletin*. It was in fact the result of a laborious process which involved a number of preliminary sketches, and of a carefully considered system of elimination. His later work included some excellent political portraits. He became a regular member of the staff of *Punch* in 1896, and in his later years his services were retained exclusively for *Punch* and the *Graphic*. He died on the 5th of August 1903.

There was an exhibition of his drawings at the Fine Arts Society in 1895, and another at the Leicester Galleries in 1903. A selection of his drawings contributed to the periodical press and from *Phil May's Annual* and *Phil May's Sketch Books*, with a portrait and biography of the artist, entitled *The Phil May Folio*, appeared in 1903.

MAY, THOMAS (1595–1650), English poet and historian, son of Sir Thomas May of Mayfield, Sussex, was born in 1595. He entered Sidney Sussex College, Cambridge, in 1609, and took his B.A. degree three years later. His father having lost his fortune and sold the family estate, Thomas May, who was hampered by an impediment in his speech, made literature his profession. In 1620 he produced *The Heir*, an ingeniously constructed comedy, and, probably about the same time, *The Old Couple*, which was not printed until 1658. His other dramatic works are classical tragedies on the subjects of Antigone, Cleopatra, and Agrippina. F. G. Fleay has suggested that the more famous anonymous tragedy of *Nero* (printed 1624, reprints in A. H. Bullen's *Old English Plays* and the *Mermaid Series*) should also be assigned to May. But his most important work in the department of pure literature was his translation (1627) into heroic couplets of the *Pharsalia* of Lucan. Its success led May to write a continuation of Lucan's narrative down to the death of Caesar. Charles I. became his patron, and commanded him to write metrical histories of Henry II. and Edward III., which were completed in 1635. When the earl of Pembroke, then lord chamberlain, broke his staff across May's shoulders at a masque, the king took him under his protection as "my poet," and Pembroke made him an apology accompanied with a gift of £50. These marks of the royal favour seem to have led May to expect the posts of poet-laureate and city chronologer when they fell vacant on the death of Ben Jonson in 1637, but he was disappointed, and he forsook the court and attached himself to the party of the Parliament. In 1646 he is styled one of the "secretaries" of the Parliament, and in 1647 he published his best known work, *The History of the Long Parliament*. In this official apology for the moderate or Presbyterian party, he professes to give an impartial statement of facts, unaccompanied by any expression of party or personal opinion. If he refrained from actual invective, he accomplished his purpose, according to Guizot, by "omission, palliation and dissimulation." Accusations of this kind were foreseen by May, who says in his preface that if he gives more information about the Parliament men than their opponents it is that he was more conversant with them and their affairs. In 1650 he followed this with another work written with a more definite bias, a *Breviary of the History of the Parliament of England*, in Latin and English, in which he defended the position of the Independents. He stopped short of the catastrophe of the king's execution, and it seems likely that his subservience to Cromwell was not quite voluntary. In February 1650 he was brought to London from Weymouth under a strong guard for having spread false reports of the Parliament and of Cromwell. He died on the 13th of November in the same year, and was buried in Westminster Abbey, but after the Restoration his remains were exhumed and buried in a pit in the yard of St Margaret's, Westminster. May's change of side made him many bitter enemies, and he is the object of scathing condemnation from many of his contemporaries.

There is a long notice of May in the *Biographia Britannica*. See also W. J. Courthope, *Hist. of Eng. Poetry*, vol. 3; and Guizot, *Études biographiques sur la révolution d'Angleterre* (pp. 403–426, ed. 1851).

MAY, or **MEY(E), WILLIAM** (d. 1560), English divine, was the brother of John May, bishop of Carlisle. He was educated at Cambridge, where he was a fellow of Trinity Hall, and in 1537, president of Queen's College. May heartily supported the Reformation, signed the Ten Articles in 1536, and helped in the production of *The Institution of a Christian Man*. He had close connexion with the diocese of Ely, being successively chancellor, vicar-general and prebendary. In 1545 he was made a prebendary of St Paul's, and in the following year dean. His favourable report on the Cambridge colleges saved them from dissolution. He was dispossessed during the reign of Mary, but restored to the deanery on Elizabeth's accession. He died on the day of his election to the archbishopric of York.

MAY, the fifth month of our modern year, the third of the old Roman calendar. The origin of the name is disputed; the derivation from Maia, the mother of Mercury, to whom the Romans were accustomed to sacrifice on the first day of this month, is usually accepted. The ancient Romans used on May Day to go in procession to the grotto of Egeria. From the 28th of April to the 2nd of May was kept the festival in honour of Flora, goddess of flowers. By the Romans the month was regarded as unlucky for marriages, owing to the celebration on the 9th, 11th and 13th of the Lemuria, the festival of the unhappy dead. This superstition has survived to the present day.

In medieval and Tudor England, May Day was a great public holiday. All classes of the people, young and old alike, were up with the dawn, and went "a-Maying" in the woods. Branches of trees and flowers were borne back in triumph to the towns and villages, the centre of the procession being occupied by those who shouldered the maypole, glorious with ribbons and wreaths. The maypole was usually of birch, and set up for the day only; but in London and the larger towns the poles were of durable wood and permanently erected. They were special eyesores to the Puritans. John Stubbes in his *Anatomy of Abuses* (1583) speaks of them as those "stinckyng idols," about which the people "leape and daunce, as the heathen did." Maypoles were forbidden by the parliament in 1644, but came once more into favour at the Restoration, the last to be erected in London being that set up in 1661. This pole, which was of cedar, 134 ft. high, was set up by twelve British sailors under the personal supervision of James II., then duke of York and lord high admiral, in the Strand on or about the site of the present church of St Mary's-in-the-Strand. Taken down in 1717, it was conveyed to Wanstead Park in Essex, where it was fixed by Sir Isaac Newton as part of the support of a large telescope, presented to the Royal Society by a French astronomer.

For an account of the May Day survivals in rural England see P. H. Ditchfield, *Old English Customs extant at Present Times* (1897).

MAY, ISLE OF, an island belonging to Fifeshire, Scotland, at the entrance to the Firth of Forth, 5 m. S.E. of Crail and Anstruther. It has a N.W. to S.E. trend, is more than 1 m. long, and measures at its widest about ¼ m. St Adrian, who had settled here, was martyred by the Danes about the middle of the 9th century. The ruins of the small chapel dedicated to him, which was a favourite place of pilgrimage, still exist. The place where the pilgrims—of whom James IV. was often one—landed is yet known as Pilgrims' Haven, and traces may yet be seen of the various wells of St Andrew, St John, Our Lady, and the Pilgrims, though their waters have become brackish. In 1499 Sir Andrew Wood of Largo, with the "Yellow Carvel" and "Mayflower," captured the English seaman Stephen Bull, and three ships, after a fierce fight which took place between the island and the Bass Rock. In 1636 a coal beacon was lighted on the May and maintained by Alexander Cunningham of Barns. The oil light substituted for it in 1816 was replaced in 1888 by an electric light.

MAYA, an important tribe and stock of American Indians, the dominant race of Yucatan and other states of Mexico and part of Central America at the time of the Spanish conquest. They were then divided into many nations, chief among them being the Maya proper, the Huastecs, the Tzental, the Pokom, the Mame and the Cakchiquel and Quiché. They were spread over Yucatan, Vera Cruz, Tabasco, Campeche, and Chiapas in Mexico, and over the greater part of Guatemala and Salvador. In civilization the Mayan peoples rivalled the Aztecs. Their traditions give as their place of origin the extreme north; thence a migration took place, perhaps at the beginning of the Christian era. They appear to have reached Yucatan as early as the 5th century. From the evidence of the Quiché chronicles, which are said to date back to about A.D. 700, Guatemala was shortly afterwards overrun. Physically the Mayans are a dark-skinned, round-headed, short and sturdy type. Although they were already decadent when the Spaniards arrived they made a fierce resistance. They still form the bulk of the inhabitants of Yucatan. For their culture, ruined cities, &c. see Central America and Mexico.

MAYAGUEZ, the third largest city of Porto Rico, a seaport, and the seat of government of the department of Mayaguez, on the west coast, at the mouth of Río Yaguez, about 72 m. W. by S. of San Juan. Pop. of the city (1899), 15,187, including 1381 negroes and 4711 of mixed races; (1910), 16,591; of the municipal district, 35,700 (1899), of whom 2687 were negroes and 9933 were of mixed races. Mayaguez is connected by the American railroad of Porto Rico with San Juan and Ponce, and it is served regularly by steamboats from San Juan, Ponce and New York, although its harbour is not accessible to vessels drawing more than 16 ft. of water. It is situated at the foot of Las Mesas mountains and commands picturesque views. The climate is healthy and good water is obtained from the mountain region. From the shipping district along the water-front a thoroughfare leads to the main portion of the city, about 1 m. distant. There are four public squares, in one of which is a statue of Columbus. Prominent among the public buildings are the City Hall (containing a public library), San Antonio Hospital, Roman Catholic churches, a Presbyterian church, the court-house and a theatre. The United States has an agricultural experiment station here, and the Insular Reform School is 1 m. south of the city. Coffee, sugar-cane and tropical fruits are grown in the surrounding country; and the business of the city consists chiefly in their export and the import of flour. Among the manufactures are sugar, tobacco and chocolate. Mayaguez was founded about the middle of the 18th century on the site of a hamlet which was first settled about 1680. It was incorporated as a town in 1836, and became a city in 1873. In 1841 it was nearly all destroyed by fire.

MAYAVARAM, a town of British India, in the Tanjore district of Madras, on the Cauvery river; junction on the South Indian railway, 174 m. S.W. of Madras. Pop. (1901), 24,276. It possesses a speciality of fine cotton and silk cloth, known as Kornad from the suburb in which the weavers live. During October and November the town is the scene of a great pilgrimage to the holy waters of the Cauvery.

MAYBOLE, a burgh of barony and police burgh of Ayrshire, Scotland. Pop. (1901), 5892. It is situated 9 m. S. of Ayr and 50¾ m. S.W. of Glasgow by the Glasgow & South-Western railway. It is an ancient place, having received a charter from Duncan II. in 1193. In 1516 it was made a burgh of regality, but for generations it remained under the subjection of the Kennedys, afterwards earls of Cassillis and marquesses of Ailsa, the most powerful family in Ayrshire. Of old Maybole was the capital of the district of Carrick, and for long its characteristic feature was the family mansions of the barons of Carrick. The castle of the earls of Cassillis still remains. The public buildings include the town-hall, the Ashgrove and the Lumsden fresh-air fortnightly homes, and the Maybole combination poorhouse. The leading manufactures are of boots and shoes and agricultural implements. Two miles to the south-west are the ruins of Crossraguel (Cross of St Regulus) Abbey, founded about 1240. Kirkoswald, where Burns spent his seventeenth year, learning land-surveying, lies a little farther west. In the parish churchyard lie "Tam o' Shanter" (Douglas Graham) and "Souter Johnnie" (John Davidson). Four miles to the west of Maybole on the coast is Culzean Castle, the chief seat of the marquess of Ailsa, dating from 1777; it stands on a basaltic cliff, beneath which are the Coves of Culzean, once the retreat of outlaws and a resort of the fairies. Farther south are the ruins of Turnberry Castle, where Robert Bruce is said to have been born. A few miles to the north of Culzean are the ruins of Dunure Castle, an ancient stronghold of the Kennedys.

MAYEN, a town of Germany, in the Prussian Rhine province, on the northern declivity of the Eifel range, 16 m. W. from Coblenz, on the railway Andernach-Gerolstein. Pop. (1905), 13,435. It is still partly surrounded by medieval walls, and the ruins of a castle rise above the town. There are some small industries, embracing textile manufactures, oil mills and tanneries, and a trade in wine, while near the town are extensive quarries of basalt. Having been a Roman settlement, Mayen became a town in 1291. In 1689 it was destroyed by the French.

MAYENNE, CHARLES OF LORRAINE, Duke of (1554–1611), second son of Francis of Lorraine, second duke of Guise, was born on the 26th of March 1554. He was absent from France at the time of the massacre of Saint Bartholomew, but took part in the siege of La Rochelle in the following year, when he was created duke and peer of France. He went with Henry of Valois, duke of Anjou (afterwards Henry III.), on his election as king of Poland, but soon returned to France to become the energetic supporter and lieutenant of his brother, the 3rd duke of Guise. In 1577 he gained conspicuous successes over the Huguenot forces in Poitou. As governor of Burgundy he raised his province in the cause of the League in 1585. The assassination of his brothers at Blois on the 23rd and 24th of December 1588 left him at the head of the Catholic party. The Venetian ambassador, Mocenigo, states that Mayenne had warned Henry III. that there was a plot afoot to seize his person and to send him by force to Paris. At the time of the murder he was at Lyons, where he received a letter from the king saying that he had acted on his warning, and ordering him to retire to his government. Mayenne professed obedience, but immediately made preparations for marching on Paris. After a vain attempt to recover the persons of those of his relatives who had been arrested at Blois he proceeded to recruit troops in his government of Burgundy and in Champagne. Paris was devoted to the house of Guise and had been roused to fury by the news of the murder. When Mayenne entered the city in February 1589 he found it dominated by representatives of the sixteen quarters of Paris, all fanatics of the League. He formed a council general to direct the affairs of the city and to maintain relations with the other towns faithful to the League. To this council each quarter sent four representatives, and Mayenne added representatives of the various trades and professions of Paris in order to counterbalance this revolutionary element. He constituted himself "lieutenant-general of the state and crown of France," taking his oath before the parlement of Paris. In April he advanced on Tours. Henry III. in his extremity sought an alliance with Henry of Navarre, and the allied forces drove the leaguers back, and had laid siege to Paris, when the murder of Henry III. by a Dominican fanatic changed the face of affairs and gave new strength to the Catholic party.

Mayenne was urged to claim the crown for himself, but he was faithful to the official programme of the League and proclaimed Charles, cardinal of Bourbon, at that time a prisoner in the hands of Henry IV., as Charles X. Henry IV. retired to Dieppe, followed by Mayenne, who joined his forces with those of his cousin Charles, duke of Aumale, and Charles de Cossé, comte de Brissac, and engaged the royal forces in a succession of fights in the neighbourhood of Arques (September 1589). He was defeated and out-marched by Henry IV., who moved on Paris, but retreated before Mayenne's forces. In 1590 Mayenne received additions to his army from the Spanish Netherlands, and took the field again, only to suffer complete defeat at Ivry (March 14, 1590). He then escaped to Mantes, and in September collected a fresh army at Meaux, and with the assistance of Alexander Farnese, prince of Parma, sent by Philip II., raised the siege of Paris, which was about to surrender to Henry IV. Mayenne feared with reason the designs of Philip II., and his difficulties were increased by the death of Charles X., the "king of the league." The extreme section of the party, represented by the Sixteen, urged him to proceed to the election of a Catholic king and to accept the help and the claims of their Spanish allies. But Mayenne, who had not the popular gifts of his brother, the duke of Guise, had no sympathy with the demagogues, and himself inclined to the moderate side of his party, which began to urge reconciliation with Henry IV. He maintained the ancient forms of the constitution against the revolutionary policy of the Sixteen, who during his absence from Paris took the law into their own hands and in November 1591 executed one of the leaders of the more moderate party, Barnabé Brisson, president of the parlement. He returned to Paris and executed four of the chief malcontents. The power of the Sixteen diminished from that time, but with it the strength of the League.[1]

Mayenne entered into negotiations with Henry IV. while he was still appearing to consider with Philip II. the succession to the French crown of the Infanta Elizabeth, granddaughter, through her mother Elizabeth of Valois, of Henry II. He demanded that Henry IV. should accomplish his conversion to Catholicism before he was recognized by the leaguers. He also desired the continuation to himself of the high offices which had accumulated in his family and the reservation of their provinces to his relatives among the leaguers. In 1593 he summoned the States General to Paris and placed before them the claims of the Infanta, but they protested against foreign intervention. Mayenne signed a truce at La Villette on the 31st of July 1593. The internal dissensions of the league continued to increase, and the principal chiefs submitted. Mayenne finally made his peace only in October 1595. Henry IV. allowed him the possession of Chalon-sur-Saône, of Seurre and Soissons for three years, made him governor of the Isle of France and paid a large indemnity. Mayenne died at Soissons on the 3rd of October 1611.

A *Histoire de la vie et de la mort du duc de Mayenne* appeared at Lyons in 1618. See also J. B. H. Capefigue, *Hist. de la Réforme, de la ligue et du règne de Henri IV.* (8 vols., 1834–1835) and the literature dealing with the house of Guise (*q.v.*).

MAYENNE, a department of north-western France, three-fourths of which formerly belonged to Lower Maine and the remainder to Anjou, bounded on the N. by Manche and Orne, E. by Sarthe, S. by Maine-et-Loire and W. by Ille-et-Vilaine. Area, 2012 sq. m. Pop. (1906), 305,457. Its ancient geological formations connect it with Brittany. The surface is agreeably undulating; forests are numerous, and the beauty of the cultivated portions is enhanced by the hedgerows and lines of trees by which the farms are divided. The highest point of the department, and indeed of the whole north-west of France, is the Mont des Avaloirs (1368 ft.). Hydrographically Mayenne belongs to the basins of the Loire, the Vilaine and the Sélune, the first mentioned draining by far the larger part of the entire area. The principal stream is the Mayenne, which passes successively from north to south through Mayenne, Laval and Château-Gontier; by means of weirs and sluices it is navigable below Mayenne, but traffic is inconsiderable. The chief affluents are the Jouanne on the left, and on the right the Colmont, the Ernée and the Oudon. A small area in the east of the department drains by the Erve into the Sarthe; the Vilaine rises in the west, and in the north-west two small rivers flow into the Sélune. The climate of Mayenne is generally healthy except in the neighbourhood of the numerous marshes. The temperature is lower and the moisture of the atmosphere greater than in the neighbouring departments; the rainfall (about 32 in. annually) is above the average for France.

Agriculture and stock-raising are prosperous. A large number of horned cattle are reared, and in no other French department are so many horses found within the same area; the breed, that of Craon, is famed for its strength. Craon has also given its name to the most prized breed of pigs in western France. Mayenne produces excellent butter and poultry and a large quantity of honey. The cultivation of the vine is very limited, and the most common beverage is cider. Wheat, oats, barley and buckwheat, in the order named, are the most important crops, and a large quantity of flax and hemp is produced. Game is abundant. The timber grown is chiefly beech, oak, birch, elm and chestnut. The department produces antimony, auriferous quartz and coal. Marble, slate and other stone are quarried. There are several chalybeate springs. The industries include flour-milling, brick and tile making, brewing, cotton and wool spinning, and the production of various textile fabrics (especially ticking) for which Laval and Château-Gontier are the centres, agricultural implement making, wood and marble sawing, tanning and dyeing. The exports include agricultural produce, live-stock, stone and textiles; the chief imports are coal, brandy, wine, furniture and clothing. The department is served by the Western railway. It forms part of the circumscriptions of the IV. army corps, the académie (educational division) of Rennes, and the court of appeal of Angers. It comprises three arrondissements (Laval, Château-Gontier and Mayenne), with 27 cantons and 276 communes. Laval, the capital, is the seat of a bishopric of the province of Tours. The other principal towns are Château-Gontier and Mayenne, which are treated under separate headings. The following places are also of interest: Evron, which has a church of the 12th and 13th centuries; Jublains, with a Roman fort and other Roman remains; Lassay, with a fine château of the 14th and 16th centuries; and Ste Suzanne, which has remains of medieval ramparts and a fortress with a keep of the Romanesque period.

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[1] The estates of the League in 1593 were the occasion of the famous *Satire Ménippée*, circulated in MS. in that year, but only printed at Tours in 1594. It was the work of a circle of men of letters who belonged to the *politiques* or party of the centre and ridiculed the League. The authors were Pierre Le Roy, Jean Passerat, Florent Chrestien, Nicolas Rapin and Pierre Pithou. It opened with "La vertu du catholicon," in which a Spanish quack (the cardinal of Plaisance) vaunts the virtues of his drug "catholicon composé," manufactured in the Escurial, while a Lorrainer rival (the cardinal of Pellevé) tries to sell a rival cure. A mock account of the estates, with harangues delivered by Mayenne and the other chiefs of the League, followed. Mayenne's discourse is said to have been written by the jurist Pithou.

MAYENNE, a town of north-western France, capital of an arrondissement in the department of Mayenne, 19 m. N.N.E. of Laval by rail. Pop., town 7003, commune 10,020. Mayenne is an old feudal town, irregularly built on hills on both sides of the river Mayenne. Of the old castle overlooking the river several towers remain, one of which has retained its conical roof; the vaulted chambers and chapel are ornamented in the style of the 13th century; the building is now used as a prison. The church of Notre-Dame, beside which there is a statue of Joan of Arc, dates partly from the 12th century; the choir was rebuilt in the 19th century. In the Place de Cheverus is a statue, by David of Angers, to Cardinal Jean de Cheverus (1768–1836), who was born in Mayenne. Mayenne has a subprefecture, tribunals of first instance and of commerce, a chamber of arts and manufactures, and a board of trade-arbitration. There is a school of agriculture in the vicinity. The chief industry of the place is the manufacture of tickings, linen, handkerchiefs and calicoes.

Mayenne had its origin in the castle built here by Juhel, baron of Mayenne, the son of Geoffrey of Maine, in the beginning of the 11th century. It was taken by the English in 1424, and several times suffered capture by the opposing parties in the wars of religion and the Vendée. At the beginning of the 16th century the territory passed to the family of Guise, and in 1573 was made a duchy in favour of Charles of Mayenne, leader of the League.

MAYER, JOHANN TOBIAS (1723–1762), German astronomer, was born at Marbach, in Würtemberg, on the 17th of February 1723, and brought up at Esslingen in poor circumstances. A self-taught mathematician, he had already published two original geometrical works when, in 1746, he entered J. B. Homann's cartographic establishment at Nuremberg. Here he introduced many improvements in map-making, and gained a scientific reputation which led (in 1751) to his election to the chair of economy and mathematics in the university of Göttingen. In 1754 he became superintendent of the observatory, where he laboured with great zeal and success until his death, on the 20th of February 1762. His first important astronomical work was a careful investigation of the libration of the moon (*Kosmographische Nachrichten*, Nuremberg, 1750), and his chart of the full moon (published in 1775) was unsurpassed for half a century. But his fame rests chiefly on his lunar tables, communicated in 1752, with new solar tables, to the Royal Society of Göttingen, and published in their *Transactions* (vol. ii.). In 1755 he submitted to the English government an amended body of MS. tables, which James Bradley compared with the Greenwich observations, and found to be sufficiently accurate to determine the moon's place to 75″, and consequently the longitude at sea to about half a degree. An improved set was afterwards published in London (1770), as also the theory (*Theoria lunae juxta systema Newtonianum*, 1767) upon which the tables are based. His widow, by whom they were sent to England, received in consideration from the British government a grant of £3000. Appended to the London edition of the solar and lunar tables are two short tracts—the one on determining longitude by lunar distances, together with a description of the repeating circle (invented by Mayer in 1752), the other on a formula for atmospheric refraction, which applies a remarkably accurate correction for temperature.

Mayer left behind him a considerable quantity of manuscript, part of which was collected by G. C. Lichtenberg and published in one volume (*Opera inedita*, Göttingen, 1775). It contains an easy and accurate method for calculating eclipses: an essay on colour, in which three primary colours are recognized; a catalogue of 998 zodiacal stars; and a memoir, the earliest of any real value, on the proper motion of eighty stars, originally communicated to the Göttingen Royal Society in 1760. The manuscript residue includes papers on atmospheric refraction (dated 1755), on the motion of Mars as affected by the perturbations of Jupiter and the Earth (1756), and on terrestrial magnetism (1760 and 1762). In these last Mayer sought to explain the magnetic action of the earth by a modification of Euler's hypothesis, and made the first really definite attempt to establish a mathematical theory of magnetic action (C. Hansteen, *Magnetismus der Erde*, i. 283). E. Klinkerfuss published in 1881 photo-lithographic reproductions of Mayer's local charts and general map of the moon; and his star-catalogue was re-edited by F. Baily in 1830 (*Memoirs Roy. Astr. Soc.* iv. 391) and by G. F. J. A. Auvers in 1894.

AUTHORITIES.—A. G. Kästner, *Elogium Tobiae Mayeri* (Göttingen, 1762); *Connaissance des temps, 1767*, p. 187 (J. Lalande); *Monatliche Correspondenz* viii. 257, ix. 45, 415, 487, xi. 462; *Allg. Geographische Ephemeriden* iii. 116, 1799 (portrait); *Berliner Astr. Jahrbuch*, Suppl. Bd. iii. 209, 1797 (A. G. Kästner); J. B. J. Delambre, *Hist. de l'Astr. au XVIII^e^ siècle*, p. 429; R. Grant, *Hist. of Phys. Astr.* pp. 46, 488, 555; A. Berry, *Short Hist. of Astr.* p. 282; J. S. Pütter, *Geschichte von der Universität zu Göttingen*, i. 68; J. Gehler, *Physik. Wörterbuch neu bearbeitet*. vi. 746, 1039; *Allg. Deutsche Biographie* (S. Günther). (A. M. C.)

MAYER, JULIUS ROBERT (1814–1878), German physicist, was born at Heilbronn on the 25th of November 1814, studied medicine at Tübingen, Munich and Paris, and after a journey to Java in 1840 as surgeon of a Dutch vessel obtained a medical post in his native town. He claims recognition as an independent a priori propounder of the "First Law of Thermodynamics," but more especially as having early and ably applied that law to the explanation of many remarkable phenomena, both cosmical and terrestrial. His first little paper on the subject, "*Bemerkungen über die Kräfte der unbelebten Natur*," appeared in 1842 in Liebig's *Annalen*, five years after the republication, in the same journal, of an extract from K. F. Mohr's paper on the nature of heat, and three years later he published *Die organische Bewegung in ihren Zusammenhange mit dem Stoffwechsel*.

It has been repeatedly claimed for Mayer that he calculated the value of the dynamical equivalent of heat, indirectly, no doubt, but in a manner altogether free from error, and with a result according almost exactly with that obtained by J. P. Joule after years of patient labour in direct experimenting. This claim on Mayer's behalf was first shown to be baseless by W. Thomson (Lord Kelvin) and P. G. Tait in an article on "Energy," published in *Good Words* in 1862, which gave rise to a long but lively discussion. A calm and judicial annihilation of the claim is to be found in a brief article by Sir G. G. Stokes, *Proc. Roy. Soc.*, 1871, p. 54. See also Maxwell's *Theory of Heat*, chap. xiii. Mayer entirely ignored the grand fundamental principle laid down by Sadi Carnot—that nothing can be concluded as to the relation between heat and work from an experiment in which the working substance is left at the end of an operation in a different physical state from that in which it was at the commencement. Mayer has also been styled the discoverer of the fact that heat consists in (the energy of) motion, a matter settled at the very end of the 18th century by Count Rumford and Sir H. Davy; but in the teeth of this statement we have Mayer's own words, "We might much rather assume the contrary—that in order to become heat motion must cease to be motion."

Mayer's real merit consists in the fact that, having for himself made out, on inadequate and even questionable grounds, the conservation of energy, and having obtained (though by inaccurate reasoning) a numerical result correct so far as his data permitted, he applied the principle with great power and insight to the explanation of numerous physical phenomena. His papers, which were republished in a single volume with the title *Die Mechanik der Wärme* (3rd ed., 1893), are of unequal merit. But some, especially those on *Celestial Dynamics* and *Organic Motion*, are admirable examples of what really valuable work may be effected by a man of high intellectual powers, in spite of imperfect information and defective logic.

Different, and it would appear exaggerated, estimates of Mayer are given in John Tyndall's papers in the *Phil. Mag.*, 1863–1864 (whose avowed object was "to raise a noble and a suffering man to the position which his labours entitled him to occupy"), and in E. Dühring's *Robert Mayer, der Galilei des neunzehnten Jahrhunderts*, Chemnitz, 1880. Some of the simpler facts of the case are summarized by Tait in the *Phil. Mag.*, 1864, ii. 289.

MAYFLOWER, the vessel which carried from Southampton, England, to Plymouth, Massachusetts, the Pilgrims who established the first permanent colony in New England. It was of about 180 tons burden, and in company with the "Speedwell" sailed from Southampton on the 5th of August 1620, the two having on board 120 Pilgrims. After two trials the "Speedwell" was pronounced unseaworthy, and the "Mayflower" sailed alone from Plymouth, England, on the 6th of September with the 100 (or 102) passengers, some 41 of whom on the 11th of November (O.S.) signed the famous "Mayflower Compact" in Provincetown Harbor, and a small party of whom, including William Bradford, sent to choose a place for settlement, landed at what is now Plymouth, Massachusetts, on the 11th of December (21st N.S.), an event which is celebrated, as Forefathers' Day, on the 22nd of December. A "General Society of Mayflower Descendants" was organized in 1894 by lineal descendants of passengers of the "Mayflower" to "preserve their memory, their records, their history, and all facts relating to them, their ancestors and their posterity." Every lineal descendant, over eighteen years of age, of any passenger of the "Mayflower" is eligible to membership. Branch societies have since been organized in several of the states and in the District of Columbia, and a triennial congress is held in Plymouth.

See Azel Ames, *The May-Flower and Her Log* (Boston, 1901); Blanche McManus, *The Voyage of the Mayflower* (New York, 1897); *The General Society of Mayflower: Meetings, Officers and Members, arranged in State Societies, Ancestors and their Descendants* (New York, 1901). Also the articles Plymouth, Mass.; Massachusetts, § *History*; Pilgrim; and Provincetown, Mass.

MAY-FLY. The Mayflies belong to the Ephemeridae, a remarkable family of winged insects, included by Linnaeus in his order Neuroptera, which derive their scientific name from ἐφήμερος, in allusion to their very short lives. In some species it is possible that they have scarcely more than one day's existence, but others are far longer lived, though the extreme limit is probably rarely more than a week. The family has very sharply defined characters, which separate its members at once from all other neuropterous (or pseudo-neuropterous) groups.

These insects are universally aquatic in their preparatory states. The eggs are dropped into the water by the female in large masses, resembling, in some species, bunches of grapes in miniature. Probably several months elapse before the young larvae are excluded. The sub-aquatic condition lasts a considerable time: in *Cloeon*, a genus of small and delicate species, Sir J. Lubbock (Lord Avebury) proved it to extend over more than six months; but in larger and more robust genera (*e.g. Palingenia*) there appears reason to believe that the greater part of three years is occupied in preparatory conditions.

The larva is elongate and campodeiform. The head is rather large, and is furnished at first with five simple eyes of nearly equal size; but as it increases in size the homologues of the facetted eyes of the imago become larger, whereas those equivalent to the ocelli remain small. The antennae are long and thread-like, composed at first of few joints, but the number of these latter apparently increases at each moult. The mouth parts are well developed, consisting of an upper lip, powerful mandibles, maxillae with three-jointed palpi, and a deeply quadrifid labium or lower lip with three-jointed labial palpi. Distinct and conspicuous maxillulae are associated with the tongue or hypopharynx. There are three distinct and large thoracic segments, whereof the prothorax is narrower than the others; the legs are much shorter and stouter than in the winged insect, with monomerous tarsi terminated by a single claw. The abdomen consists of ten segments, the tenth furnished with long and slender multi-articulate tails, which appear to be only two in number at first, but an intermediate one gradually develops itself (though this latter is often lost in the winged insect). Respiration is effected by means of external gills placed along both sides of the dorsum of the abdomen and hinder segments of the thorax. These vary in form: in some species they are entire plates, in others they are cut up into numerous divisions, in all cases traversed by numerous tracheal ramifications. According to the researches of Lubbock and of E. Joly, the very young larvae have no breathing organs, and respiration is effected through the skin. Lubbock traced at least twenty moults in *Cloeon*; at about the tenth rudiments of the wing-cases began to appear. These gradually become larger, and when so the creature may be said to have entered its "nymph" stage; but there is no condition analogous to the pupa-stage of insects with complete metamorphoses.

There may be said to be three or four different modes of life in these larvae: some are fossorial, and form tubes in the mud or clay in which they live; others are found on or beneath stones; while others again swim and crawl freely among water plants. It is probable that some are carnivorous, either attacking other larvae or subsisting on more minute forms of animal life; but others perhaps feed more exclusively on vegetable matters of a low type, such as diatoms.

The most aberrant type of larva is that of the genus *Prosopistoma*, which was originally described as an entomostracous crustacean on account of the presence of a large carapace overlapping the greater part of the body. The dorsal skeletal elements of the thorax and of the anterior six abdominal segments unite with the wing-cases to form a large respiratory chamber, containing five pairs of tracheal gills, with lateral slits for the inflow and a posterior orifice for the outflow of water. Species of this genus occur in Europe, Africa and Madagascar.

When the aquatic insect has reached its full growth it emerges from the water or seeks its surface; the thorax splits down the back and the winged form appears. But this is not yet perfect, although it has all the form of a perfect insect and is capable of flight; it is what is variously termed a "pseudimago," "sub-imago" or "pro-imago." Contrary to the habits of all other insects, there yet remains a pellicle that has to be shed, covering every part of the body. This final moult is effected soon after the insect's appearance in the winged form; the creature seeks a temporary resting-place, the pellicle splits down the back, and the now perfect insect comes forth, often differing very greatly in colours and markings from the condition in which it was only a few moments before. If the observer takes up a suitable position near water, his coat is often seen to be covered with the cast sub-imaginal skins of these insects, which had chosen him as a convenient object upon which to undergo their final change. In some few genera of very low type it appears probable that, at any rate in the female, this final change is never effected and that the creature dies a sub-imago.

The winged insect differs considerably in form from its sub-aquatic condition. The head is smaller, often occupied almost entirely above in the male by the very large eyes, which in some species are curiously double in that sex, one portion being pillared, and forming what is termed a "turban," the mouth parts are aborted, for the creature is now incapable of taking nutriment either solid or fluid; the antennae are mere short bristles, consisting of two rather large basal joints and a multi-articulate thread. The prothorax is much narrowed, whereas the other segments (especially the mesothorax) are greatly enlarged; the legs long and slender, the anterior pair often very much longer in the male than in the female; the tarsi four- or five-jointed; but in some genera (*e.g. Oligoneuria* and allies) the legs are aborted, and the creatures are driven helplessly about by the wind. The wings are carried erect: the anterior pair large, with numerous longitudinal nervures, and usually abundant transverse reticulation; the posterior pair very much smaller, often lanceolate, and frequently wanting absolutely. The abdomen consists of ten segments; at the end are either two or three long multi-articulate tails; in the male the ninth joint bears forcipated appendages; in the female the oviducts terminate at the junction of the seventh and eighth ventral segments. The independent opening of the genital ducts and the absence of an ectodermal vagina and ejaculatory duct are remarkable archaic features of these insects, as has been pointed out by J. A. Palmén. The sexual act takes place in the air, and is of very short duration, but is apparently repeated several times, at any rate in some cases.

Ephemeridae are found all over the world, even up to high northern latitudes. F. J. Pictet, A. E. Eaton and others have given us valuable works or monographs on the family; but the subject still remains little understood, partly owing to the great difficulty of preserving such delicate insects; and it appears probable they can only be satisfactorily investigated as moist preparations. The number of described species is less than 200, spread over many genera.

From the earliest times attention has been drawn to the enormous abundance of species of the family in certain localities. Johann Anton Scopoli, writing in the 18th century, speaks of them as so abundant in one place in Carniola that in June twenty cart-loads were carried away for manure! *Polymitarcys virgo*, which, though not found in England, occurs in many parts of Europe (and is common at Paris), emerges from the water soon after sunset, and continues for several hours in such myriads as to resemble snow showers, putting out lights, and causing inconvenience to man, and annoyance to horses by entering their nostrils. In other parts of the world they have been recorded in multitudes that obscured passers-by on the other side of the street. And similar records might be multiplied almost to any extent. In Britain, although they are often very abundant, we have scarcely anything analogous.

Fish, as is well known, devour them greedily, and enjoy a veritable feast during the short period in which any particular species appears. By anglers the common English species of *Ephemera* (*vulgata* and *danica*, but more especially the latter, which is more abundant) is known as the "may-fly," but the terms "green drake" and "bastard drake" are applied to conditions of the same species. Useful information on this point will be found in Ronalds's *Fly-Fisher's Entomology*, edited by Westwood.

Ephemeridae belong to a very ancient type of insects, and fossil imprints of allied forms occur even in the Devonian and Carboniferous formations.

There is much to be said in favour of the view entertained by some entomologists that the structural and developmental characteristics of may-flies are sufficiently peculiar to warrant the formation for them of a special order of insects, for which the names Agnatha, Plectoptera and Ephemeroptera have been proposed. (See HEXAPODA, NEUROPTERA.)

BIBLIOGRAPHY.—Of especial value to students of these insects are A. E. Eaton's monograph (*Trans. Linn. Soc.* (2) iii. 1883–1885) and A. Vayssière's "Recherches sur l'organisation des larves" (*Ann. Sci. Nat. Zool.* (6) xiii. 1882 (7) ix. 1890). J. A. Palmén's memoirs *Zur Morphologie des Tracheensystems* (Leipzig, 1877) and *Über paarige Ausführungsgänge der Geschlechtsorgane bei Insekten* (Helsingfors, 1884), contain important observations on may-flies. See also L. C. Miall, *Nat. Hist. Aquatic Insects* (London, 1895); J. G. Needham and others (New York State Museum, Bull. 86, 1905).

(R. M'L.; G. H. C.)

MAYHEM (for derivation see MAIMING), an old Anglo-French term of the law signifying an assault whereby the injured person is deprived of a member proper for his defence in fight, *e.g.* an arm, a leg, a fore tooth, &c. The loss of an ear, jaw tooth, &c., was not mayhem. The most ancient punishment in English law was rotaliative—*membrum pro membro*, but ultimately at common law fine and imprisonment. Various statutes were passed aimed at the offence of maiming and disfiguring, which is now dealt with by section 18 of the Offences against the Person Act 1861. Mayhem may also be the ground of a civil action, which had this peculiarity that the court on sight of the wound might increase the damages awarded by the jury.

MAYHEW, HENRY (1812–1887), English author and journalist, son of a London solicitor, was born in 1812. He was sent to Westminster school, but ran away to sea. He sailed to India, and on his return studied law for a short time under his father. He began his journalistic career by founding, with Gilbert à Beckett, in 1831, a weekly paper, *Figaro in London*. This was followed in 1832 by a short-lived paper called *The Thief*; and he produced one or two successful farces. His brothers Horace (1816–1872) and Augustus Septimus (1826–1875) were also journalists, and with them Henry occasionally collaborated, notably with the younger in *The Greatest Plague of Life* (1847) and in *Acting Charades* (1850). In 1841 Henry Mayhew was one of the leading spirits in the foundation of *Punch*, of which he was for the first two years joint-editor with Mark Lemon. He afterwards wrote on all kinds of subjects, and published a number of volumes of no permanent reputation—humorous stories, travel and practical handbooks. He is credited with being the first to "write up" the poverty side of London life from a philanthropic point of view; with the collaboration of John Binny and others he published *London Labour and London Poor* (1851; completed 1864) and other works on social and economic questions. He died in London, on the 25th of July 1887. Horace Mayhew was for some years sub-editor of *Punch*, and was the author of several humorous publications and plays. The books of Horace and Augustus Mayhew owe their survival chiefly to Cruikshank's illustrations.

MAYHEW, JONATHAN (1720–1766), American clergyman, was born at Martha's Vineyard on the 8th of October 1720, being fifth in descent from Thomas Mayhew (1592–1682), an early settler and the grantee (1641) of Martha's Vineyard. Thomas Mayhew (*c.* 1616–1657), the younger, his son John (d. 1689) and John's son, Experience (1673–1758), were active missionaries among the Indians of Martha's Vineyard and the vicinity. Jonathan, the son of Experience, graduated at Harvard in 1744. So liberal were his theological views that when he was to be ordained minister of the West Church in Boston in 1747 only two ministers attended the first council called for the ordination, and it was necessary to summon a second council. Mayhew's preaching made his church practically the first "Unitarian" Congregational church in New England, though it was never officially Unitarian. In 1763 he published *Observations on the Charter and Conduct of the Society for Propagating the Gospel in Foreign Parts*, an attack on the policy of the society in sending missionaries to New England contrary to its original purpose of "Maintaining Ministers of the Gospel" in places "wholly destitute and unprovided with means for the maintenance of ministers and for the public worship of God;" the *Observations* marked him as a leader among those in New England who feared, as Mayhew said (1762), "that there is a scheme forming for sending a bishop into this part of the country, and that our Governor,[1] a true churchman, is deeply in the plot." To an American reply to the *Observations*, entitled *A Candid Examination* (1763), Mayhew wrote a *Defense*; and after the publication of an *Answer*, anonymously published in London in 1764 and written by Thomas Secker, archbishop of Canterbury, he wrote a *Second Defense*. He bitterly opposed the Stamp Act, and urged the necessity of colonial union (or "communion") to secure colonial liberties. He died on the 9th of July 1766. Mayhew was Dudleian lecturer at Harvard in 1765, and in 1749 had received the degree of D.D. from the University of Aberdeen.

See Alden Bradford, *Memoir of the Life and Writings of Rev. Jonathan Mayhew* (Boston, 1838), and "An Early Pulpit Champion of Colonial Rights," chapter vi., in vol. i. of M. C. Tyler's *Literary History of the American Revolution* (2 vols., New York, 1897).

MAYHEW, THOMAS, English 18th century cabinet-maker. Mayhew was the less distinguished partner of William Ince (*q.v.*). The chief source of information as to his work is supplied by his own drawings in the volume of designs, *The universal system of household furniture*, which he published in collaboration with his partner. The name of the firm appears to have been Mayhew and Ince, but on the title page of this book the names are reversed, perhaps as an indication that Ince was the more extensive contributor. In the main Mayhew's designs are heavy and clumsy, and often downright extravagant, but he had a certain lightness of accomplishment in his applications of the bizarre Chinese style. Of original talent he possessed little, yet it is certain that much of his Chinese work has been attributed to Chippendale. It is indeed often only by reference to books of design that the respective work of the English cabinet-makers of the second half of the 18th century can be correctly attributed.

MAYMYO, a hill sanatorium in India, in the Mandalay district of Upper Burma, 3500 ft. above the sea, with a station on the

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[1] Francis Bernard, whose project for a college at Northampton seemed to Mayhew and others a move to strengthen Anglicanism.

Mandalay-Lashio railway 422 m. from Rangoon. Pop. (1901), 6223. It consists of an undulating plateau, surrounded by hills, which are covered with thin oak forest and bracken. Though not entirely free from malaria, it has been chosen for the summer residence of the lieutenant-governor; and it is also the permanent headquarters of the lieutenant-general commanding the Burma division, and of other officials.

MAYNARD, FRANÇOIS DE (1582–1646), French poet, was born at Toulouse in 1582. His father was *conseiller* in the parlement of the town, and François was also trained for the law, becoming eventually president of Aurillac. He became secretary to Margaret of Valois, wife of Henry IV., for whom his early poems are written. He was a disciple of Malherbe, who said that in the workmanship of his lines he excelled Racan, but lacked his rival's energy. In 1634 he accompanied the Cardinal de Noailles to Rome and spent about two years in Italy. On his return to France he made many unsuccessful efforts to obtain the favour of Richelieu, but was obliged to retire to Toulouse. He never ceased to lament his exile from Paris and his inability to be present at the meetings of the Academy, of which he was one of the earliest members. The best of his poems is in imitation of Horace, "Alcippe, reviens dans nos bois." He died at Toulouse on the 23rd of December 1646.

His works consist of odes, epigrams, songs and letters, and were published in 1646 by Marin le Roy de Gomberville.

MAYNE, JASPER (1604–1672), English author, was baptized at Hatherleigh, Devonshire, on the 23rd of November 1604. He was educated at Westminster School and at Christ Church, Oxford, where he had a distinguished career. He was presented to two college livings in Oxfordshire, and was made D.D. in 1646. During the Commonwealth he was dispossessed, and became chaplain to the duke of Devonshire. At the Restoration he was made canon of Christ Church, archdeacon of Chichester and chaplain in ordinary to the king. He wrote a farcical domestic comedy, *The City Match* (1639), which is reprinted in vol. xiii. of Hazlitt's edition of Dodsley's *Old Plays*, and a fantastic tragi-comedy entitled *The Amorous War* (printed 1648). After receiving ecclesiastical preferment he gave up poetry as unbefitting his profession. His other works comprise some occasional gems, a translation of Lucian's *Dialogues* (printed 1664) and a number of sermons. He died on the 6th of December 1672 at Oxford.

MAYNOOTH, a small town of county Kildare, Ireland, on the Midland Great Western railway and the Royal Canal, 15 m. W. by N. of Dublin. Pop. (1901), 948. The Royal Catholic College of Maynooth, founded by an Act of the Irish parliament in 1795, is the chief seminary for the education of the Roman Catholic clergy of Ireland. The building is a fine Gothic structure by A. W. Pugin, erected by a parliamentary grant obtained in 1846. The chapel, with fine oak choir-stalls, mosaic pavements, marble altars and stained glass, and with adjoining cloisters, was dedicated in 1890. The average number of students is about 500—the number specified under the act of 1845—and the full course of instruction is eight years. Near the college stand the ruins of Maynooth Castle, probably built in 1176, but subsequently extended, and formerly the residence of the Fitzgerald family. It was besieged in the reigns of Henry VIII. and Edward VI., and during the Cromwellian Wars, when it was demolished. The beautiful mansion of Carton is about a mile from the town.

MAYO, RICHARD SOUTHWELL BOURKE, 6TH EARL OF (1822–1872), British statesman, son of Robert Bourke, the 5th earl (1797–1867), was born in Dublin on the 21st of February, 1822, and was educated at Trinity College, Dublin. After travelling in Russia he entered parliament, and sat successively for Kildare, Coleraine and Cockermouth. He was chief secretary for Ireland in three administrations, in 1852, 1858 and 1866, and was appointed viceroy of India in January 1869. He consolidated the frontiers of India and met Shere Ali, amir of Afghanistan, in durbar at Umballa in March 1869. His reorganization of the finances of the country put India on a paying basis; and he did much to promote irrigation, railways, forests and other useful public works. Visiting the convict settlement at Port Blair in the Andaman Islands, for the purpose of inspection, the viceroy was assassinated by a convict on the 8th of February 1872. His successor was his son, Dermot Robert Wyndham Bourke (b. 1851) who became 7th earl of Mayo.

See Sir W. W. Hunter, *Life of the Earl of Mayo*, (1876), and *The Earl of Mayo* in the Rulers of India Series (1891).

MAYO, a western county of Ireland, in the province of Connaught, bounded N. and W. by the Atlantic Ocean, N.E. by Sligo, E. by Roscommon, S.E. and S. by Galway. The area is 1,380,390 acres, or about 2157 sq. m., the county being the largest in Ireland after Cork and Galway. About two-thirds of the boundary of Mayo is formed by sea, and the coast is very much indented, and abounds in picturesque scenery. The principal inlets are Killary Harbour between Mayo and Galway; Clew Bay, in which are the harbours of Westport and Newport; Blacksod Bay and Broad Haven, which form the peninsula of the Mullet; and Killala Bay between Mayo and Sligo. The islands are very numerous, the principal being Inishturk, near Killary Harbour; Clare Island, at the mouth of Clew Bay, where there are many islets, all formed of drift; and Achill, the largest island off Ireland. The coast scenery is not surpassed by that of Donegal northward and Connemara southward, and there are several small coast-towns, among which may be named Killala on the north coast, Belmullet on the isthmus between Blacksod Bay and Broad Haven, Newport and Westport on Clew Bay, with the watering-place of Mallaranny. The majestic cliffs of the north coast, however, which reach an extreme height in Benwee Head (892 ft.), are difficult of access and rarely visited. In the eastern half of the county the surface is comparatively level, with occasional hills; the western half is mountainous. Mweelrea (2688 ft.) is included in a mountain range lying between Killary Harbour and Lough Mask. The next highest summits are Nephin (2646 ft.), to the west of Lough Conn, and Croagh Patrick (2510 ft.), to the south of Clew Bay. The river Moy flows northwards, forming part of the boundary of the county with Sligo, and falls into Killala Bay. The courses of the other streams are short, and except when swollen by rains their volume is small. The principal lakes are Lough Mask and Lough Corrib, on the borders of the county with Galway, and Loughs Conn in the east, Carrowmore in the north-west, Beltra in the west, and Carra adjoining Lough Mask. These loughs and the smaller loughs, with the streams generally, afford admirable sport with salmon, sea-trout and brown trout, and Ballina is a favourite centre.

Geology.—The wild and barren west of this county, including the great hills on Achill Island, is formed of "Dalradian" rocks, schists and quartzites, highly folded and metamorphosed, with intrusions of granite near Belmullet. At Blacksod Bay the granite has been quarried as an ornamental stone. Nephin Beg, Nephin and Croagh Patrick are typical quartzite summits, the last named belonging possibly to a Silurian horizon but rising from a metamorphosed area on the south side of Clew Bay. The schists and gneisses of the Ox Mountain axis also enter the county north of Castlebar. The Muilrea and Ben Gorm range, bounding the fine fjord of Killary Harbour, is formed of terraced Silurian rocks, from Bala to Ludlow age. These beds, with intercalated lavas, form the mountainous west shore of Lough Mask, the east, like that of Lough Corrib, being formed of low Carboniferous Limestone ground. Silurian rocks, with Old Red Sandstone over them, come out at the west end of the Curlew range at Ballaghaderreen. Clew Bay, with its islets capped by glacial drift, is a submerged part of a synclinal of Carboniferous strata, and Old Red Sandstone comes out on the north side of this, from near Achill to Lough Conn. The country from Lough Conn northward to the sea is a lowland of Carboniferous Limestone, with L. Carboniferous Sandstone against the Dalradian on the west.

Industries.—There are some very fertile regions in the level portions of the county, but in the mountainous districts the soil is poor, the holdings are subdivided beyond the possibility of affording proper sustenance to their occupiers, and, except where fishing is combined with agricultural operations, the circumstances of the peasantry are among the most wretched of any district of Ireland. The proportion of tillage to pasturage is roughly as 1 to 3⅓. Oats and potatoes are the principal crops. Cattle, sheep, pigs and poultry are reared. Coarse linen and woollen cloths are manufactured to a small extent. At Foxford woollen-mills are established at a nunnery, in connexion with a scheme of technical instruction. Keel, Belmullet and Ballycastle are the headquarters of sea and coast fishing districts, and Ballina of a salmon-fishing district, and these fisheries are of some value to the poor inhabitants. A branch of the Midland Great Western railway enters the county from Athlone, in the south-east, and runs north to Ballina and Killala on the coast, branches diverging from Claremorris to Ballinrobe, and from Manulla to Westport and Achill on the west coast. The Limerick and Sligo line of the Great Southern and Western passes from south to north-east by way of Claremorris.

Population and Administration.—The population was 218,698 in 1891, and 199,166 in 1901. The decrease of population and the number of emigrants are slightly below the average of the Irish counties. Of the total population about 97% are rural, and about the same percentage are Roman Catholics. The chief towns are Ballina (pop. 4505), Westport (3892) and Castlebar (3585), the county town. Ballaghaderreen, Claremorris (Clare), Crossmolina and Swineford are lesser market towns; and Newport and Westport are small seaports on Clew Bay. The county includes nine baronies. Assizes are held at Castlebar, and quarter sessions at Ballina, Ballinrobe, Belmullet, Castlebar, Claremorris, Swineford and Westport. In the Irish parliament two members were returned for the county, and two for the borough of Castlebar, but at the union Castlebar was disfranchised. The division since 1885 is into north, south, east and west parliamentary divisions, each returning one member. The county is in the Protestant diocese of Tuam and the Roman Catholic dioceses of Taum, Achonry, Galway and Kilmacduagh, and Killala.

History and Antiquities.—Erris in Mayo was the scene of the landing of the chief colony of the Firbolgs, and the battle which is said to have resulted in the overthrow and almost annihilation of this tribe took place also in this county, at Moytura near Cong. At the close of the 12th century what is now the county of Mayo was granted, with other lands, by king John to William, brother of Hubert de Burgh. After the murder of William de Burgh, 3rd earl of Ulster (1333), the Bourkes (de Burghs) of the collateral male line, rejecting the claim of William's heiress (the wife of Lionel, son of King Edward III.) to the succession, succeeded in holding the bulk of the De Burgh possessions, what is now Mayo falling to the branch known by the name of "MacWilliam Oughter," who maintained their virtual independence till the time of Elizabeth. Sir Henry Sydney, during his first viceroyalty, after making efforts to improve communications between Dublin and Connaught in 1566, arranged for the shiring of that province, and Mayo was made shire ground, taking its name from the monastery of Maio or Mageo, which was the seat of a bishop. Even after this period the MacWilliams continued to exercise very great authority, which was regularized in 1603, when "the MacWilliam Oughter," Theobald Bourke, surrendered his lands and received them back, to hold them by English tenure, with the title of Viscount Mayo (see BURGH, DE). Large confiscations of the estates in the county were made in 1586, and on the termination of the wars of 1641; and in 1666 the restoration of his estates to the 4th Viscount Mayo involved another confiscation, at the expense of Cromwell's settlers. Killala was the scene of the landing of a French squadron in connexion with the rebellion of 1798. In 1879 the village of Knock in the south-east acquired notoriety from a story that the Virgin Mary had appeared in the church, which became the resort of many pilgrims.

There are round towers at Killala, Turlough, Meelick and Balla, and an imperfect one at Aughagower. Killala was formerly a bishopric. The monasteries were numerous, and many of them of considerable importance: the principal being those at Mayo, Ballyhaunis, Cong, Ballinrobe, Ballintober, Burrishoole, Cross or Holycross in the peninsula of Mullet, Moyne, Roserk or Rosserick and Templemore or Strade. Of the old castles the most notable are Carrigahooly near Newport, said to have been built by the celebrated Grace O'Malley, and Deel Castle near Ballina, at one time the residence of the earls of Arran.

See Hubert Thomas Knox, *History of the County of Mayo* (1908).

MAYOR, JOHN EYTON BICKERSTETH (1825-), English classical scholar, was born at Baddegama, Ceylon, on the 28th of January 1825, and educated in England at Shrewsbury School and St John's College, Cambridge. From 1863 to 1867 he was librarian of the university, and in 1872 succeeded H. A. J. Munro in the professorship of Latin. His best-known work, an edition of thirteen satires of Juvenal, is marked by an extraordinary wealth of illustrative quotations. His *Bibliographical Clue to Latin Literature* (1873), based on E. Hübner's *Grundriss zu Vorlesungen über die römische Litteraturgeschichte* is a valuable aid to the student, and his edition of Cicero's *Second Philippic* is widely used. He also edited the English works of J. Fisher, bishop of Rochester, i. (1876); Thomas Baker's *History of St John's College, Cambridge* (1869); Richard of Cirencester's *Speculum historiale de gestis regum Angliae 447-1066* (1863-1869); Roger Ascham's *Schoolmaster* (new ed., 1883); the *Latin Heptateuch* (1889); and the *Journal of Philology*.

His brother, JOSEPH BICKERSTETH MAYOR (1828-), classical scholar and theologian, was educated at Rugby and St John's College, Cambridge, and from 1870 to 1879 was professor of classics at King's College, London. His most important classical works are an edition of Cicero's *De natura deorum* (3 vols., 1880-1885) and *Guide to the Choice of Classical Books* (3rd ed., 1885, with supplement, 1896). He also devoted attention to theological literature and edited the epistles of St James (2nd ed., 1892), St Jude and St Peter (1907), and the *Miscellanies* of Clement of Alexandria (with F. J. A. Hort, 1902). From 1887 to 1893 he was editor of the *Classical Review*. His *Chapters on English Metre* (1886) reached a second edition in 1901.

MAYOR (Lat. *major*, greater), in modern times the title of a municipal officer who discharges judicial and administrative functions. The French form of the word is *maire*. In Germany the corresponding title is *Bürgermeister*, in Italy *sindico*, and in Spain *alcalde*. "Mayor" had originally a much wider significance. Among the nations which arose on the ruins of the Roman empire of the West, and which made use of the Latin spoken by their "Roman" subjects as their official and legal language, *major* and the Low Latin feminine *majorissa* were found to be very convenient terms to describe important officials of both sexes who had the superintendence of others. Any female servant or slave in the houselold of a barbarian, whose business it was to overlook other female servants or slaves, would be quite naturally called a *majorissa*. So the male officer who governed the king's household would be the *major domus*. In the households of the Frankish kings of the Merovingian line, the *major domus*, who was also variously known as the *gubernator*, *rector*, *moderator* or *praefectus palatii*, was so great an officer that he ended by evicting his master. He was the "mayor of the palace" (*q.v.*). The fact that his office became hereditary in the family of Pippin of Heristal made the fortune of the Carolingian line. But besides the *major domus* (the major-domo), there were other officers who were *majores*, the *major cubiculi*, mayor of the bedchamber, and *major equorum*, mayor of the horse. In fact a word which could be applied so easily and with accuracy in so many circumstances was certain to be widely used by itself, or in its derivatives. The post-Augustine *majorinus*, "one of the larger kind," was the origin of the medieval Spanish *merinus*, who in Castillian is the *merino*, and sometimes the *merino mayor*, or chief merino. He was a judicial and administrative officer of the king's. The *gregum merinus* was the superintendent of the flocks of the corporation of sheep-owners called the *mesta*. From him the sheep, and then the wool, have come to be known as *merinos*—a word identical in origin with the municipal title of mayor. The latter came directly from the heads of gilds, and other associations of freemen, who had their banner and formed a group on the populations of the towns, the *majores baneriae* or *vexilli*.

In England the major is the modern representative of the lord's bailiff or reeve (see BOROUGH). We find the chief magistrate of London bearing the title of portreeve for considerably more than a century after the Conquest. This official was elected by popular choice, a privilege secured from king John. By the beginning of the 11th century the title of portreeve[1] gave way to that of mayor as the designation of the chief officer of

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[1] If a place was of mercantile importance it was called a port (from *porta*, the city gate), and the reeve or bailiff, a "portreeve."

London,[1] and the adoption of the title by other boroughs followed at various intervals.

A mayor is now in England and America the official head of a municipal government. In the United Kingdom the Municipal Corporations Act, 1882, s. 15, regulates the election of mayors. He is to be a fit person elected annually on the 9th of November by the council of the borough from among the aldermen or councillors or persons qualified to be such. His term of office is one year, but he is eligible for re-election. He may appoint a deputy to act during illness or absence, and such deputy must be either an alderman or councillor. A mayor who is absent from the borough for more than two months becomes disqualified and vacates his office. A mayor is *ex officio* during his year of office and the next year a justice of the peace for the borough. He receives such remuneration as the council thinks reasonable. The office of mayor in an English borough does not entail any important administrative duties. It is generally regarded as an honour conferred for past services. The mayor is expected to devote much of his time to ornamental functions and to preside over meetings which have for their object the advancement of the public welfare. His administrative duties are merely to act as returning officer at municipal elections, and as chairman of the meetings of the council.

The position and power of an English mayor contrast very strongly with those of the similar official in the United States. The latter is elected directly by the voters within the city, usually for several years; and he has extensive administrative powers.

The English method of selecting a mayor by the council is followed for the corresponding functionaries in France (except Paris), the more important cities of Italy, and in Germany, where, however, the central government must confirm the choice of the council. Direct appointment by the central government exists in Belgium, Holland, Denmark, Norway, Sweden and the smaller towns of Italy and Spain. As a rule, too, the term of office is longer in other countries than in the United Kingdom. In France election is for four years, in Holland for six, in Belgium for an indefinite period, and in Germany usually for twelve years, but in some cases for life. In Germany the post may be said to be a professional one, the burgomaster being the head of the city magistracy, and requiring, in order to be eligible, a training in administration. German burgomasters are most frequently elected by promotion from another city. In France the *maire*, and a number of experienced members termed "adjuncts," who assist him as an executive committee, are elected directly by the municipal council from among their own number. Most of the administrative work is left in the hands of the *maire* and his adjuncts, the full council meeting comparatively seldom. The *maire* and the adjuncts receive no salary.

Further information will be found in the sections on local government in the articles on the various countries; see also A. Shaw, *Municipal Government in Continental Europe*; J. A. Fairlie, *Municipal Administration*; S. and B. Webb, *English Local Government*; Redlich and Hirst, *Local Government in England*; A. L. Lowell, *The Government of England*.

MAYOR OF THE PALACE.—The office of mayor of the palace was an institution peculiar to the Franks of the Merovingian period. A landowner who did not manage his own estate placed it in the hands of a steward (*major*), who superintended the working of the estate and collected its revenues. If he had several estates, he appointed a chief steward, who managed the whole of the estates and was called the *major domus*. Each great personage had a *major domus*—the queen had hers, the king his; and since the royal house was called the palace, this officer took the name of "mayor of the palace." The mayor of the palace, however, did not remain restricted to domestic functions; he had the discipline of the palace and tried persons who resided there. Soon his functions expanded. If the king were a minor, the mayor of the palace supervised his education in the capacity of guardian (*nutricius*), and often also occupied himself with affairs of state. When the king came of age, the mayor exerted himself to keep this power, and succeeded. In the 7th century he became the head of the administration and a veritable prime minister. He took part in the nomination of the counts and dukes; in the king's absence he presided over the royal tribunal; and he often commanded the armies. When the custom of commendation developed, the king charged the mayor of the palace to protect those who had commended themselves to him and to intervene at law on their behalf. The mayor of the palace thus found himself at the head of the *commendati*, just as he was at the head of the functionaries.

It is difficult to trace the names of some of the mayors of the palace, the post being of almost no significance in the time of Gregory of Tours. When the office increased in importance the mayors of the palace did not, as has been thought, pursue an identical policy. Some—for instance, Otto, the mayor of the palace of Austrasia towards 640—were devoted to the Crown. On the other hand, mayors like Flaochat (in Burgundy) and Erkinoald (in Neustria) stirred up the great nobles, who claimed the right to take part in their nomination, against the king. Others again, sought to exercise the power in their own name both against the king and against the great nobles—such as Ebroïn (in Neustria), and, later, the Carolingians Pippin II., Charles Martel, and Pippin III., who, after making use of the great nobles, kept the authority for themselves. In 751 Pippin III., fortified by his consultation with Pope Zacharias, could quite naturally exchange the title of mayor for that of king; and when he became king, he suppressed the title of mayor of the palace. It must be observed that from 639 there were generally separate mayors of Neustria, Austrasia and Burgundy, even when Austrasia and Burgundy formed a single kingdom; the mayor was a sign of the independence of the region. Each mayor, however, sought to supplant the others; the Pippins and Charles Martel succeeded, and their victory was at the same time the victory of Austrasia over Neustria and Burgundy.

See G. H. Pertz, *Geschichte der merowingischen Hausmeier* (Hanover, 1819); H. Bonnell, *De dignitate majoris domus* (Berlin, 1858); E. Hermann, *Das Hausmeieramt, ein echt germanisches Amt*, vol. ix. of *Untersuchungen zur deutschen Staats- und Rechtsgeschichte*, ed. by O. Gierke (Breslau, 1878, seq.); G. Waitz, *Deutsche Verfassungsgeschichte*, 3rd ed., revised by K. Zeumer; and Fustel de Coulanges, *Histoire des institutions politiques de l' ancienne France: La monarchie franque* (Paris, 1888). (C. Pf.)

MAYORUNA, a tribe of South American Indians of Panoan stock. Their country is between the Ucayali and Javari rivers, north-eastern Peru. They are a fine race, roaming the forests and living by hunting. They cut their hair in a line across the forehead and let it hang down their backs. Many have fair skins and beards, a peculiarity sometimes explained by their alleged descent from Ursua's soldiers, but this theory is improbable. They are famous for the potency of their blow-gun poison.

MAYO-SMITH, RICHMOND (1854-1901), American economist, was born in Troy, Ohio, on the 9th of February 1854. Educated at Amherst, and at Berlin and Heidelberg, he became assistant professor of economics at Columbia University in 1877. He was an adjunct professor from 1878 to 1883, when he was appointed professor of political economy and social science, a post which he held until his death on the 11th of November 1901. He devoted himself especially to the study of statistics, and was recognized as one of the foremost authorities on the subject. His works include *Emigration and Immigration* (1890); *Sociology and Statistics* (1895), and *Statistics and Economics* (1899).

MAYOTTE, one of the Comoro Islands, in the Mozambique Channel between Madagascar and the African mainland. It has belonged to France since 1843 (see Comoro Islands).

MAYOW, JOHN (1643-1679), English chemist and physiologist, was born in London in May 1643. At the age of fifteen he went up to Wadham College, Oxford, of which he became a scholar a year later, and in 1660 he was elected to a fellowship at All Souls. He graduated in law (bachelor, 1665, doctor, 1670), but made medicine his profession, and "became noted for his practice therein, especially in the summer time, in the city of Bath." In 1678, on the proposal of R. Hooke, he was chosen a fellow of the Royal Society. The following year, after a marriage which was "not altogether to his content," he died in London in September 1679. He published at Oxford in 1668 two tracts, on respiration and rickets, and in 1674 these were reprinted, the former in an enlarged and corrected form, with three others "De sal-nitro et spiritu nitro-aereo," "De respiratione foetus in utero et ovo," and "De motu musculari et spiritibus animalibus" as *Tractatus quinque medico-physici*. The contents of this work, which was several times republished and translated into Dutch, German and French, show him to have been an investigator much in advance of his time.

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[1] The mayors of certain cities in the United Kingdom (London, York, Dublin) have acquired by prescription the prefix of "lord." In the case of London it seems to date from 1540. It has also been conferred during the closing years of the 19th century by letters patent on other cities—Birmingham, Liverpool, Manchester, Bristol, Sheffield, Leeds, Cardiff, Bradford, Newcastle-on-Tyne, Belfast, Cork. In 1910 it was granted to Norwich. Lord mayors are entitled to be addressed as "right honourable."

Accepting as proved by Boyle's experiments that air is necessary for combustion, he showed that fire is supported not by the air as a whole but by a "more active and subtle part of it." This part he called *spiritus igneo-aereus*, or sometimes *nitro-aereus*; for he identified it with one of the constituents of the acid portion of nitre which he regarded as formed by the union of fixed alkali with a *spiritus acidus*. In combustion the *particulae nitro-aereae*—either pre-existent in the thing consumed or supplied by the air—combined with the material burnt; as he inferred from his observation that antimony, strongly heated with a burning glass, undergoes an increase of weight which can be attributed to nothing else but these particles. In respiration he argued that the same particles are consumed, because he found that when a small animal and a lighted candle were placed in a closed vessel full of air the candle first went out and soon afterwards the animal died, but if there was no candle present it lived twice as long. He concluded that this constituent of the air is absolutely necessary for life, and supposed that the lungs separate it from the atmosphere and pass it into the blood. It is also necessary, he inferred, for all muscular movements, and he thought there was reason to believe that the sudden contraction of muscle is produced by its combination with other combustible (salino-sulphureous) particles in the body; hence the heart, being a muscle, ceases to beat when respiration is stopped. Animal heat also is due to the union of nitro-aerial particles, breathed in from the air, with the combustible particles in the blood, and is further formed by the combination of these two sets of particles in muscle during violent exertion. In effect, therefore, Mayow—who also gives a remarkably correct anatomical description of the mechanism of respiration—preceded Priestley and Lavoisier by a century in recognizing the existence of oxygen, under the guise of his *spiritus nitro-aereus*, as a separate entity distinct from the general mass of the air; he perceived the part it plays in combustion and in increasing the weight of the calces of metals as compared with metals themselves; and, rejecting the common notions of his time that the use of breathing is to cool the heart, or assist the passage of the blood from the right to the left side of the heart, or merely to agitate it, he saw in inspiration a mechanism for introducing oxygen into the body, where it is consumed for the production of heat and muscular activity, and even vaguely conceived of expiration as an excretory process.

MAYSVILLE, a city and the county-seat of Mason county, Kentucky, U.S.A., on the Ohio river, 60 m. by rail S.E. of Cincinnati. Pop. (1890) 5358; (1900) 6423 (1155 negroes); (1910) 6141. It is served by the Louisville & Nashville, and the Chesapeake & Ohio railways, and by steamboats on the Ohio river. Among its principal buildings are the Mason county public library (1878), the Federal building and Masonic and Odd Fellows' temples. The city lies between the river and a range of hills; at the back of the hills is a fine farming country, of which tobacco of excellent quality is a leading product. There is a large plant of the American Tobacco Company at Maysville, and among the city's manufactures are pulleys, ploughs, whisky, flour, lumber, furniture, carriages, cigars, foundry and machine-shop products, bricks and cotton goods. The city is a distributing point for coal and other products brought to it by Ohio river boats. Formerly it was one of the principal hemp markets of the country. The place early became a landing point for immigrants to Kentucky, and in 1784 a double log cabin and a blockhouse were erected here. It was then called Limestone, from the creek which flows into the Ohio here, but several years later the present name was adopted in honour of John May, who with Simon Kenton laid out the town in 1787, and who in 1790 was killed by the Indians. Maysville was incorporated as a town in 1787, was chartered as a city in 1833, and became the county-seat in 1848.

In 1830, when the question of "internal improvements" by the National government was an important political issue, Congress passed a bill directing the government to aid in building a turnpike road from Maysville to Lexington. President Andrew Jackson vetoed the bill on the ground that the proposed improvement was a local rather than a national one; but one-half the capital was then furnished privately, the other half was furnished through several state appropriations, and the road was completed in 1835 and marked the beginning of a system of turnpike roads built with state aid.

MAZAGAN (*El Jadîda*), a port on the Atlantic coast of Morocco in 33° 16′ N. 8° 26′ W. Pop. (1908), about 12,000, of whom a fourth are Jews and some 400 Europeans. It is the port for Marrákesh, from which it is 110 m. nearly due north, and also for the fertile province of Dukálla. Mazagan presents from the sea a very un-Moorish appearance; it has massive Portuguese walls of hewn stone. The exports, which include beans, almonds, maize, chick-peas, wool, hides, wax, eggs, &c., were valued at £360,000 in 1900, £364,000 in 1904, and £248,000 in 1906. The imports (cotton goods, sugar, tea, rice, &c.) were valued at £280.000 in 1900, £286,000 in 1904, and £320,000 in 1906. About 46% of the trade is with Great Britain and 34% with France. Mazagan was built in 1506 by the Portuguese, who abandoned it to the Moors in 1769 and established a colony, New Mazagan, on the shores of Para in Brazil.

See A. H. Dyé, "Les ports du Maroc" in *Bull. Soc. Geog. Comm. Paris*, xxx. 325–332 (1908), and British consular reports.

MAZAMET, an industrial town of south-western France in the department of Tarn, 41 m. S.S.E. of Albi by rail. Pop. (1906), town, 11,370; commune, 14,386. Mazamet is situated on the northern slope of the Montagnes Noires and on the Arnette, a small sub-tributary of the Agout. Numerous establishments are employed in wool-spinning and in the manufacture of "swan-skins" and flannels, and clothing for troops, and hosiery, and there are important tanneries and leather-dressing, glove and dye works. Extensive commerce is carried on in wool and raw hides from Argentina, Australia and Cape Colony.

MAZANDARAN, a province of northern Persia, lying between the Caspian Sea and the Elburz range, and bounded E. and W. by the provinces of Astarabad and Gilan respectively, 220 m. in length and 60 m. in (mean) breadth, with an area of about 10,000 sq. m. and a population estimated at from 150,000 to 200,000. Mazandaran comprises two distinct natural regions presenting the sharpest contrasts in their relief, climate and products. In the north the Caspian is encircled by the level and swampy lowlands, varying in breadth from 10 to 30 m., partly under impenetrable jungle, partly under rice, cotton, sugar and other crops. This section is fringed northwards by the sandy beach of the Caspian, here almost destitute of natural harbours, and rises somewhat abruptly inland to the second section, comprising the northern slopes and spurs of the Elburz, which approach at some points within 1 or 2 m. of the sea, and are almost everywhere covered with dense forest. The lowlands, rising but a few feet above the Caspian, and subject to frequent floodings, are extremely malarious, while the highlands, culminating with the magnificent Demavend (19,400 ft.), enjoy a tolerably healthy climate. But the climate, generally hot and moist in summer, is everywhere capricious and liable to sudden changes of temperature, whence the prevalence of rheumatism, dropsy and especially ophthalmia, noticed by all travellers. Snow falls heavily in the uplands, where it often lies for weeks on the ground. The direction of the long sandbanks at the river mouths, which project with remarkable uniformity from west to east, shows that the prevailing winds blow from the west and north-west. The rivers themselves, of which there are as many as fifty, are little more than mountain torrents, all rising on the northern slopes of Elburz, flowing mostly in independent channels to the Caspian, and subject to sudden freshets and inundations along their lower course. The chief are the Sardab-rud, Chalus, Herhaz (Lar in its upper course), Babul, Tejen and Nika, and all are well stocked with trout, salmon (*azad-mahi*), perch (*safid-mahi*), carp (*kupur*), bream (*subulu*), sturgeon (*sag-mahi*) and other fish, which with rice form the staple food of the inhabitants; the sturgeon supplies the caviare for the Russian market. Near their mouths the rivers, running counter to the prevailing winds and waves of the Caspian, form long sand-hills 20 to 30 ft. high and about 200 yds. broad, behind which are developed the so-called *múrd-áb*, or "dead waters," stagnant pools and swamps characteristic of this coast, and a main cause of its unhealthiness.

The chief products are rice, cotton, sugar, a little silk, and fruits in great variety, including several kinds of the orange, lemon and citron. Some of the slopes are covered with extensive thickets of the pomegranate, and the wild vine climbs to a great height round the trunks of the forest trees. These woodlands are haunted by the tiger, panther, bear, wolf and wild boar in considerable numbers. Of the domestic animals, all remarkable for their small size, the chief are the black, humped cattle somewhat resembling the Indian variety, and sheep and goats.

Kinneir, Fraser and other observers speak unfavourably of the Mazandarani people, whom they describe as very ignorant and bigoted, arrogant, rudely inquisitive and almost insolent towards strangers. The peasantry, however, are far from dull, and betray much shrewdness where their interests are concerned. In the healthy districts they are stout and well made, and are considered a warlike race, furnishing some cavalry (800 men) and eight battalions of infantry (5600 men) to government. They speak a marked Persian dialect, but a Tūrki idion closely akin to the Turkoman is still current amongst the tribes, although they have mostly already passed from the nomad to the settled state. Of these tribes the most numerous are the Modaunlū, Khojehvand and Abdul Maleki, originally of Lek or Kurd stock, besides branches of the royal Afshār and Kājār tribes of Tūrki descent. All these are exempt from taxes in consideration of their military service.

The export trade is chiefly with Russia from Meshed-i-Sar, the principal port of the province, to Baku, where European goods are taken in exchange for the white and coloured calicoes, caviare, rice, fruits and raw cotton of Mazandarān. Great quantities of rice are also exported to the interior of Persia, principally to Teheran and Kazvin. Owing to the almost impenetrable character of the country there are scarcely any roads accessible to wheeled carriages, and the great causeway of Shah Abbas along the coast has in many places even disappeared under the jungle. Two routes, however, lead to Teheran, one by Firuz Kuh, 180 m. long, the other by Larijan, 144 m. long, both in tolerably good repair. Except where crossed by these routes the Elburz forms an almost impassable barrier to the south.

The administration is in the hands of a governor, who appoints the sub-governors of the nine districts of Amol, Barfarush, Meshed-i-Sar, Sari, Ashref, Farah-abad, Tunakabun, Kelarrustak and Kujur into which the province is divided. There is fair security for life and property; and, although otherwise indifferently administered, the country is quite free from marauders; but local disturbances have latterly been frequent in the two last-named districts. The revenue is about £30,000, of which little goes to the state treasury, most being required for the governors, troops and pensions. The capital is Sari, the other chief towns being Barfarush, Meshed-i-Sar, Ashref and Farah-abad. (A. H.-S.)

MAZARIN, JULES (1602–1661), French cardinal and statesman, elder son of a Sicilian, Pietro Mazarini, the intendant of the household of Philip Colonna, and of his wife Ortensia Buffalini, a connexion of the Colonnas, was born at Piscina in the Abruzzi on the 14th of July 1602. He was educated by the Jesuits at Rome till his seventeenth year, when he accompanied Jerome Colonna as chamberlain to the university of Alcala in Spain. There he distinguished himself more by his love of gambling and his gallant adventures than by study, but made himself a thorough master, not only of the Spanish language and character, but also of that romantic fashion of Spanish love-making which was to help him greatly in after life, when he became the servant of a Spanish queen. On his return to Rome, about 1622, he took his degree as Doctor *utriusque juris*, and then became captain of infantry in the regiment of Colonna, which took part in the war in the Valtelline. During this war he gave proofs of much diplomatic ability, and Pope Urban VIII. entrusted him, in 1629, with the difficult task of putting an end to the war of the Mantuan succession. His success marked him out for further distinction. He was presented to two canonries in the churches of St John Lateran and Sta Maria Maggiore, although he had only taken the minor orders, and had never been consecrated priest; he negotiated the treaty of Turin between France and Savoy in 1632, became vice-legate at Avignon in 1634, and nuncio at the court of France from 1634 to 1636. But he began to wish for a wider shpere than papal negotiations, and, seeing that he had no chance of becoming a cardinal except by the aid of some great power, he accepted Richelieu's offer of entering the service of the king of France, and in 1639 became a naturalized Frenchman.

In 1640 Richelieu sent him to Savoy, where the regency of Christine, the duchess of Savoy, and sister of Louis XIII., was disputed by her brothers-in-law, the princes Maurice and Thomas of Savoy, and he succeeded not only in firmly establishing Christine but in winning over the princes to France. This great service was rewarded by his promotion to the rank of cardinal on the presentation of the king of France in December 1641. On the 4th of December 1642 Cardinal Richelieu died, and on the very next day the king sent a circular letter to all officials ordering them to send in their reports to Cardinal Mazarin, as they had formerly done to Cardinal Richelieu. Mazarin was thus acknowledged supreme minister, but he still had a difficult part to play. The king evidently could not live long, and to preserve power he must make himself necessary to the queen, who would then be regent, and do this without arousing the suspicions of the king or the distrust of the queen. His measures were ably taken, and when the king died, on the 14th of May 1643, to everyone's surprise her husband's minister remained the queen's. The king had by a royal edict cumbered the queen-regent with a council and other restrictions, and it was necessary to get the parlement of Paris to overrule the edict and make the queen absolute regent, which was done with the greatest complaisance. Now that the queen was all-powerful, it was expected she would at once dismiss Mazarin and summon her own friends to power. One of them, Potier, bishop of Beauvais, already gave himself airs as prime minister, but Mazarin had had the address to touch both the queen's heart by his Spanish gallantry and her desire for her son's glory by his skilful policy abroad, and he found himself able easily to overthrow the clique of Importants, as they were called. That skilful policy was shown in every arena on which the great Thirty Years' War was being fought out. Mazarin had inherited the policy of France during the Thirty Years' War from Richelieu. He had inherited his desire for the humiliation of the house of Austria in both its branches, his desire to push the French frontier to the Rhine and maintain a counterpoise of German states against Austria, his alliances with the Netherlands and with Sweden, and his four theatres of war—on the Rhine, in Flanders, in Italy and in Catalonia.

During the last five years of the great war it was Mazarin alone who directed the French diplomacy of the period. He it was who made the peace of Brömsebro between the Danes and the Swedes, and turned the latter once again against the empire; he it was who sent Lionne to make the peace of Castro, and combine the princes of North Italy against the Spaniards, and who made the peace of Ulm between France and Bavaria, thus detaching the emperor's best ally. He made one fatal mistake—he dreamt of the French frontier being the Rhine and the Scheldt, and that a Spanish princess might bring the Spanish Netherlands as dowry to Louis XIV. This roused the jealousy of the United Provinces, and they made a separate peace with Spain in January 1648; but the valour of the French generals made the skill of the Spanish diplomatists of no avail, for Turenne's victory at Zusmarshausen, and Condé's at Lens, caused the peace of Westphalia to be definitely signed in October 1648. This celebrated treaty belongs rather to the history of Germany than to a life of Mazarin; but two questions have been often asked, whether Mazarin did not delay the peace as long as possible in order to more completely ruin Germany, and whether Richelieu would have made a similar peace. To the first question Mazarin's letters, published by M. Chéruel, prove a complete negative, for in them appears the zeal of Mazarin for the peace. On the second point, Richelieu's letters in many places indicate that his treatment of the great question of frontier would have been more thorough, but then he would not have been hampered in France itself.

At home Mazarin's policy lacked the strength of Richelieu's. The Frondes were largely due to his own fault. The arrest of Broussel threw the people on the side of the parlement. His avarice and unscrupulous plundering of the revenues of the realm, the enormous fortune which he thus amassed, his supple ways, his nepotism, and the general lack of public interest in the great foreign policy of Richelieu, made Mazarin the especial object of hatred both by bourgeois and nobles. The irritation of the latter was greatly Mazarin's own fault; he had tried consistently to play off the king's brother Gaston of Orleans against Condé, and their respective followers against each other, and had also, as his *carnets* prove, jealously kept any courtier from getting into the good graces of the queen-regent except by his means, so that it was not unnatural that the nobility should hate him, while the queen found herself surrounded by his creatures alone. Events followed each other quickly; the day of the barricades was followed by the peace of Ruel, the peace of Ruel by the arrest of the princes, by the battle of Rethel, and Mazarin's exile to Brühl before the union of the two Frondes. It was while in exile at Brühl that Mazarin saw the mistake he had made in isolating himself and the queen, and that his policy of balancing every party in the state against each other had made every party distrust him. So by his counsel the queen, while nominally in league with De Retz and the parliamentary Fronde, laboured to form a purely royal party, wearied by civil dissensions, who should act for her and her son's interest alone, under the leadership of Mathieu Molé, the famous premier president of the parlement of Paris. The new party grew in strength, and in January 1652, after exactly a year's absence, Mazarin returned to the court. Turenne had now become the royal general, and out-manœuvred Condé, while the royal party at last grew to such strength in Paris that Condé had to leave the capital and France. In order to promote a reconciliation with the parlement of Paris Mazarin had again retired from court, this time to Sedan, in August 1652, but he returned finally in February 1653. Long had been the trial, and greatly had Mazarin been to blame in allowing the Frondes to come into existence, but he had retrieved his position by founding that great royal party which steadily grew until Louis XIV. could fairly have said "L'État, c'est moi." As the war had progressed, Mazarin had steadily followed Richelieu's policy of weakening the nobles on their country estates. Whenever he had an opportunity he destroyed a feudal castle, and by destroying the towers which commanded nearly every town in France, he freed such towns as Bourges, for instance, from their long practical subjection to the neighbouring great lord.

The Fronde over, Mazarin had to build up afresh the power of France at home and abroad. It is to his shame that he did so little at home. Beyond destroying the brick-and-mortar remains of feudalism, he did nothing for the people. But abroad his policy was everywhere successful, and opened the way for the policy of Louis XIV. He at first, by means of an alliance with Cromwell, recovered the north-western cities of France, though at the price of yielding Dunkirk to the Protector. On the Baltic, France guaranteed the Treaty of Oliva between her old allies Sweden, Poland and Brandenburg, which preserved her influence in that quarter. In Germany he, through Hugues de Lionne, formed the league of the Rhine, by which the states along the Rhine bound themselves under the headship of France to be on their guard against the house of Austria. By such measures Spain was induced to sue for peace, which was finally signed in the Isle of Pheasants on the Bidassoa, and is known as the Treaty of the Pyrenees. By it Spain recovered Franche Comté, but ceded to France Roussillon, and much of French Flanders; and, what was of greater ultimate importance to Europe, Louis XIV. was to marry a Spanish princess, who was to renounce her claims to the Spanish succession if her dowry was paid, which Mazarin knew could not happen at present from the emptiness of the Spanish exchequer. He returned to Paris in declining health, and did not long survive the unhealthy sojourn on the Bidassoa; after some political instruction to his young master he passed away at Vincennes on the 9th of March 1661, leaving a fortune estimated at from 18 to 40 million livres behind him, and his nieces married into the greatest families of France and Italy.

The man who could have had such success, who could have made the Treaties of Westphalia and the Pyrenees, who could have weathered the storm of the Fronde, and left France at peace with itself and with Europe to Louis XIV., must have been a great man; and historians, relying too much on the brilliant memoirs of his adversaries, like De Retz, are apt to rank him too low. That he had many a petty fault there can be no doubt; that he was avaricious and double-dealing was also undoubted; and his *carnets* show to what unworthy means he had recourse to maintain his influence over the queen. What that influence was will be always debated, but both his *carnets* and the Brühl letters show that a real personal affection, amounting to passion on the queen's part, existed. Whether they were ever married may be doubted; but that hypothesis is made more possible by M. Chéruel's having been able to prove from Mazarin's letters that the cardinal himself had never taken more than the minor orders, which could always be thrown off. With regard to France he played a more patriotic part than Condé or Turenne, for he never treated with the Spaniards, and his letters show that in the midst of his difficulties he followed with intense eagerness every movement on the frontiers. It is that immense mass of letters that prove the real greatness of the statesman, and disprove De Retz's portrait, which is carefully arranged to show off his enemy against the might of Richelieu. To concede that the master was the greater man and the greater statesman does not imply that Mazarin was but a foil to his predecessor. It is true that we find none of those deep plans for the internal prosperity of France which shine through Richelieu's policy. Mazarin was not a Frenchman, but a citizen of the world, and always paid most attention to foreign affairs; in his letters all that could teach a diplomatist is to be found, broad general views of policy, minute details carefully elaborated, keen insight into men's characters, cunning directions when to dissimulate or when to be frank. Italian though he was by birth, education and nature, France owed him a great debt for his skilful management during the early years of Louis XIV., and the king owed him yet more, for he had not only transmitted to him a nation at peace, but had educated for him his great servants Le Tellier, Lionne and Colbert. Literary men owed him also much; not only did he throw his famous library open to them, but he pensioned all their leaders, including Descartes, Vincent Voiture (1598–1648), Jean Louis Guez de Balzac (1597–1654) and Pierre Corneille. The last-named applied, with an adroit allusion to his birthplace, in the dedication of his *Pompée*, the line of Virgil:—

> "Tu regere imperio populos, Romane, memento."

(H. M. S.)

AUTHORITIES.—All the earlier works on Mazarin, and early accounts of his administration, of which the best were Bazin's *Histoire de France sous Louis XIII. et sous le Cardinal Mazarin*, 4 vols. (1846), and Saint-Aulaire's *Histoire de la Fronde*, have been superseded by P. A. Chéruel's admirable *Histoire de France pendant la minorité de Louis XIV.*, 4 vols. (1879–1880), which covers from 1643–1651, and its sequel *Histoire de France sous le ministère de Cardinal Mazarin*, 2 vols. (1881–1882), which is the first account of the period written by one able to sift the statements of De Retz and the memoir writers, and rest upon such documents as Mazarin's letters and *carnets*. Mazarin's *Lettres*, which must be carefully studied by any student of the history of France, have appeared in the *Collection des documents inédits*, 9 vols. For his *carnets* reference must be made to V. Cousin's articles in the *Journal des Savants*, and Chéruel in *Revue historique* (1877), see also Chéruel's *Histoire de France pendant la minorité*, &c., app. to vol. iii.; for his early life to Cousin's *Jeunesse de Mazarin* (1865), and for the careers of his nieces to Renée's *Les Nièces de Mazarin* (1856). For the Mazarinades or squibs written against him in Paris during the Fronde, see C. Moreau's *Bibliographie des mazarinades* (1850), containing an account of 4082 Mazarinades. See also A. Hassall, *Mazarin* (1903).

MAZAR-I-SHARIF, a town of Afghanistan, the capital of the province of Afghan Turkestan. Owing to the importance of the military cantonment of Takhtapul, and its religious sanctity, it has long ago supplanted the more ancient capital of Balkh. It is situated in a malarious, almost desert plain, 9 m. E. of Balkh, and 30 m. S. of the Pata Kesar ferry on the Oxus river. In this neighbourhood is concentrated most of the Afghan army north of the Hindu Kush mountains, the fortified cantonment of Dehdadi having been completed by Sirdar Ghulam Ali Khan and incorporated with Mazar. Mazar-i-Sharif also contains a celebrated mosque, from which the town takes its name. It is a huge ornate building with minarets and a lofty cupola faced with shining blue tiles. It was built by Sultan Ali Mirza about A.D. 1420, and is held in great veneration by all Mussulmans, and especially by Shiites, because it is supposed to be the tomb of Ali, the son-in-law of Mahomet.

MAZARRÓN, a town of eastern Spain, in the province of Murcia, 19 m. W. of Cartagena. Pop. (1900), 23,284. There are soap and flour mills and metallurgic factories in the town, and iron, copper and lead mines in the neighbouring Sierra de Almenara. A railway 5 m. long unites Mazarrón to its port on the Mediterranean, where there is a suburb with 2500 inhabitants (mostly engaged in fisheries and coasting trade), containing barracks, a custom-house, and important leadworks. Outside of the suburb there are saltpans, most of the proceeds of which are exported to Galicia.

MAZATLÁN, a city and port of the state of Sinaloa, Mexico, 120 m. (direct) W.S.W. of the city of Durango, in lat. 23° 12′ N., long. 106° 24′ W. Pop. (1895), 15,852; (1900), 17,852. It is the Pacific coast terminus of the International railway which crosses northern Mexico from Ciudad Porfirio Diaz, and a port of call for the principal steamship lines on this coast. The harbour is spacious, but the entrance is obstructed by a bar. The city is built on a small peninsula. Its public buildings include a fine town-hall, chamber of commerce, a custom-house and two hospitals, besides which there is a nautical school and a meteorological station, one of the first established in Mexico. The harbour is provided with a sea-wall at Olas Altas. A government wireless telegraph service is maintained between Mazatlán and La Paz, Lower California. Among the manufactures are saw-mills, foundries, cotton factories and ropeworks, and the exports are chiefly hides, ixtle, dried and salted fish, gold, silver and copper (bars and ores), fruit, rubber, tortoise-shell, and gums and resins.

MAZE, a network of winding paths, a labyrinth (*q.v.*). The word means properly a state of confusion or wonder, and is probably of Scandinavian origin; cf. Norw. *mas*, exhausting labour, also chatter, *masa*, to be busy, also to worry, annoy; Swed. *masa*, to lounge, move slowly and lazily, to dream, muse. Skeat (*Etym.* Dict.) takes the original sense to be probably "to be lost in thought," "to dream," and connects with the root *ma-man-*, to think, cf. "mind," "man," &c. The word "maze" represents the addition of an intensive suffix.

MAZEPA-KOLEDINSKY, IVAN STEPANOVICH (1644?–1709), hetman of the Cossacks, belonging to a noble Orthodox family, was born possibly at Mazeptsina, either in 1629 or 1644, the latter being the more probable date. He was educated at the court of the Polish king, John Casimir, and completed his studies abroad. An intrigue with a Polish married lady forced him to fly into the Ukraine. There is a trustworthy tradition that the infuriated husband tied the naked youth to the back of a wild horse and sent him forth into the steppe. He was rescued and cared for by the Dnieperian Cossacks, and speedily became one of their ablest leaders. In 1687, during a visit to Moscow, he won the favour of the then all-powerful Vasily Golitsuin, from whom he virtually purchased the hetmanship of the Cossacks (July 25). He took a very active part in the Azov campaigns of Peter the Great and won the entire confidence of the young tsar by his zeal and energy. He was also very serviceable to Peter at the beginning of the Great Northern War, especially in 1705 and 1706, when he took part in the Volhynian campaign and helped to construct the fortress of Pechersk. The power and influence of Mazepa were fully recognized by Peter the Great. No other Cossack hetman had ever been treated with such deference at Moscow. He ranked with the highest dignitaries in the state; he sat at the tsar's own table. He had been made one of the first cavaliers of the newly established order of St Andrew, and Augustus of Poland had bestowed upon him, at Peter's earnest solicitation, the universally coveted order of the White Eagle. Mazepa had no temptations to be anything but loyal, and loyal he would doubtless have remained had not Charles XII. crossed the Russian frontier. Then it was that Mazepa, who had had doubts of the issue of the struggle all along, made up his mind that Charles, not Peter, was going to win, and that it was high time he looked after his own interests. Besides, he had his personal grievances against the tsar. He did not like the new ways because they interfered with his old ones. He was very jealous of the favourite (Menshikov), whom he suspected of a design to supplant him. But he proceeded very cautiously. Indeed, he would have preferred to remain neutral, but he was not strong enough to stand alone. The crisis came when Peter ordered him to co-operate actively with the Russian forces in the Ukraine. At this very time he was in communication with Charles's first minister, Count Piper, and had agreed to harbour the Swedes in the Ukraine and close it against the Russians (Oct. 1708). The last doubt disappeared when Menshikov was sent to supervise Mazepa. At the approach of his rival the old hetman hastened to the Swedish outposts at Horki, in Severia. Mazepa's treason took Peter completely by surprise. He instantly commanded Menshikov to get a new hetman elected and raze Baturin, Mazepa's chief stronghold in the Ukraine, to the ground. When Charles, a week later, passed Baturin by, all that remained of the Cossack capital was a heap of smouldering mills and ruined houses. The total destruction of Baturin, almost in sight of the Swedes, overawed the bulk of the Cossacks into obedience, and Mazepa's ancient prestige was ruined in a day when the metropolitan of Kiev solemnly excommunicated him from the high altar, and his effigy, after being dragged with contumely through the mud at Kiev, was publicly burnt by the common hangman. Henceforth Mazepa, perforce, attached himself to Charles. What part he took at the battle of Poltava is not quite clear. After the catastrophe he accompanied Charles to Turkey with some 1500 horsemen (the miserable remnant of his 80,000 warriors). The sultan refused to surrender him to the tsar, though Peter offered 300,000 ducats for his head. He died at Bender on the 22nd of August 1709.

See N. I. Kostomarov, *Mazepa and the Mazepanites* (Russ.) (St Petersburg), 1885, R. Nisbet Bain, *The First Romanovs* (London, 1905); S. M. Solovev, *History of Russia* (Russ.), vol. xv. (St Petersburg, 1895). (R. N. B.)

MAZER, the name of a special type of drinking vessel, properly made of maple-wood, and so-called from the spotted or "birds-eye" marking on the wood (Ger. *Maser*, spot, marking, especially on wood; cf. "measles"). These drinking vessels are shallow bowls without handles, with a broad flat foot and a knob or boss in the centre of the inside, known technically as the "print." They were made from the 13th to the 16th centuries, and were the most prized of the various wooden cups in use, and so were ornamented with a rim of precious metal, generally of silver or silver gilt; the foot and the "print" being also of metal. The depth of the mazers seems to have decreased in course of time, those of the 16th century that survive being much shallower than the earlier examples. There are examples with wooden covers with a metal handle, such as the Flemish and German mazers in the Franks Bequest in the British Museum. On the metal rim is usually an inscription, religious or bacchanalian, and the "print" was also often decorated. The later mazers sometimes had metal straps between the rim and the foot.

A very fine mazer with silver gilt ornamentation 3 in. deep and 9½ in. in diameter was sold in the Braikenridge collection in 1908 for £2300. It bears the London hall-mark of 1534. This example is illustrated in the article PLATE: see also DRINKING VESSELS.

MAZURKA (Polish for a woman of the province of Mazovia), a lively dance, originating in Poland, somewhat resembling the polka. It is danced in couples, the music being in $\frac{3}{4}$ or $\frac{3}{8}$ time.

MAZZARA DEL VALLO, a town of Sicily, in the province of Trapani, on the south-west coast of the island, 32 m. by rail S. of Trapani. Pop. (1901), 20,130. It is the seat of a bishop; the cathedral, founded in 1093, was rebuilt in the 17th century. The castle, at the south-eastern angle of the town walls, was erected in 1073. The mouth of the river, which bears the same name, serves as a port for small ships only. Mazzara was in origin a colony of Selinus: it was destroyed in 409, but it is mentioned again as a Carthaginian fortress in the First Punic War and as a post station on the Roman coast road, though whether it had municipal rights is doubtful.[1] A few inscriptions of the imperial period exist, but no other remains of importance. On the west bank of the river are grottoes cut in the rock, of uncertain date: and there are quarries in the neighbourhood resembling those of Syracuse, but on a smaller scale.

See A. Castiglione, *Sulle cose antiche della città di Mazzara* (Alcamo, 1878).

MAZZINI, GIUSEPPE (1805–1872), Italian patriot, was born on the 22nd of June 1805 at Genoa, where his father, Giacomo Mazzini, was a physician in good practice, and a professor in the university. His mother is described as having been a woman of great personal beauty, as well as of active intellect and strong affections. During infancy and childhood his health was extremely delicate, and it appears that he was nearly six years of age before he was quite able to walk; but he had already begun to devour books of all kinds and to show other signs of great intellectual precocity. He studied Latin with his first tutor, an old priest, but no one directed his extensive course of reading. He became a student at the university of Genoa at an unusually early age, and intended to follow his father's profession, but being unable to conquer his horror of practical anatomy, he decided to graduate in law (1826). His exceptional abilities, together with his remarkable generosity, kindness and loftiness of character, endeared him to his fellow students. As to his inner life during this period, we have only one brief but significant sentence; "for a short time," he says, "my mind was somewhat tainted by the doctrines of the foreign materialistic school; but the study of history and the intuitions of conscience—the only tests of truth—soon led me back to the spiritualism of our Italian fathers."

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[1] Th. Mommsen in *Corpus inscr. lat.* (Berlin, 1883), x. 739.

The natural bent of his genius was towards literature, and, in the course of the four years of his nominal connexion with the legal profession, he wrote a considerable number of essays and reviews, some of which have been wholly or partially reproduced in the critical and literary volumes of his *Life and Writings*. His first essay, characteristically enough on "Dante's Love of Country," was sent to the editor of the *Antologia fiorentina* in 1826, but did not appear until some years afterwards in the *Subalpino*. He was an ardent supporter of romanticism as against what he called "literary servitude under the name of classicism"; and in this interest all his critiques (as, for example, that of Giannoni's "Exile" in the *Indicatore Livornese*, 1829) were penned. But in the meantime the "republican instincts" which he tells us he had inherited from his mother had been developing, and his sense of the evils under which Italy was groaning had been intensified; and at the same time he became possessed with the idea that Italians, and he himself in particular, "*could* and therefore *ought* to struggle for liberty of country." Therefore, he at once put aside his dearest ambition, that of producing a complete history of religion, developing his scheme of a new theology uniting the spiritual with the practical life, and devoted himself to political thought. His literary articles accordingly became more and more suggestive of advanced liberalism in politics, and led to the suppression by government of the *Indicatore Genovese* and the *Indicatore Livornese* successively. Having joined the Carbonari, he soon rose to one of the higher grades in their hierarchy, and was entrusted with a special secret mission into Tuscany; but, as his acquaintance grew, his dissatisfaction with the organization of the society increased, and he was already meditating the formation of a new association stripped of foolish mysterious and theatrical formulae, which instead of merely combating existing authorities should have a definite and purely patriotic aim, when shortly after the French revolution of 1830 he was betrayed, while initiating a new member, to the Piedmontese authorities. He was imprisoned in the fortress of Savona on the western Riviera for about six months, when, a conviction having been found impracticable through deficiency of evidence, he was released, but upon conditions involving so many restrictions of his liberty that he preferred the alternative of leaving the country. He withdrew accordingly into France, living chiefly in Marseilles.

While in his lonely cell at Savona, in presence of "those symbols of the infinite, the sky and the sea," with a greenfinch for his sole companion, and having access to no books but "a Tacitus, a Byron, and a Bible," he had finally become aware of the great mission or "apostolate" (as he himself called it) of his life; and soon after his release his prison meditations took shape in the programme of the organization which was destined soon to become so famous throughout Europe, that of *La Giovine Italia*, or Young Italy. Its publicly avowed aims were to be the liberation of Italy both from foreign and domestic tyranny, and its unification under a republican form of government; the means to be used were education, and, where advisable, insurrection by guerrilla bands; the motto was to be "God and the people," and the banner was to bear on one side the words "Unity" and "Independence" and on the other "Liberty," "Equality," and "Humanity," to describe respectively the national and the international aims. In April 1831 Charles Albert, "the ex-Carbonaro conspirator of 1821," succeeded Charles Felix on the Sardinian throne, and towards the close of that year Mazzini, making himself, as he afterwards confessed, "the interpreter of a hope which he did not share," wrote the new king a letter, published at Marseilles, urging him to take the lead in the impending struggle for Italian independence. Clandestinely reprinted, and rapidly circulated all over Italy, its bold and outspoken words produced a great sensation, but so deep was the offence it gave to the Sardinian government that orders were issued for the immediate arrest and imprisonment of the author should he attempt to cross the frontier. Towards the end of the same year appeared the important Young Italy "Manifesto," the substance of which is given in the first volume of the *Life and Writings* of Mazzini; and this was followed soon afterwards by the society's *Journal*, which, smuggled across the Italian frontier, had great success in the objects for which it was written, numerous "congregations" being formed at Genoa, Leghorn, and elsewhere. Representations were consequently made by the Sardinian to the French government, which issued in an order for Mazzini's withdrawal from Marseilles (Aug. 1832); he lingered for a few months in concealment, but ultimately found it necessary to retire into Switzerland.

From this point it is somewhat difficult to follow the career of the mysterious and terrible conspirator who for twenty years out of the next thirty led a life of voluntary imprisonment (as he himself tells us) "within the four walls of a room," and "kept no record of dates, made no biographical notes, and preserved no copies of letters." In 1833, however, he is known to have been concerned in an abortive revolutionary movement which took place in the Sardinian army; several executions took place, and he himself was laid under sentence of death. Before the close of the same year a similar movement in Genoa had been planned, but failed through the youth and inexperience of the leaders. At Geneva, also in 1833, Mazzini set on foot *L'Europe Centrale*, a journal of which one of the main objects was the emancipation of Savoy; but he did not confine himself to a merely literary agitation for this end. Chiefly through his agency a considerable body of German, Polish and Italian exiles was organized, and an armed invasion of the duchy planned. The frontier was actually crossed on the 1st of February 1834, but the attack ignominiously broke down without a shot having been fired. Mazzini, who personally accompanied the expedition, is no doubt correct in attributing the failure to dissensions with the Carbonari leaders in Paris, and to want of a cordial understanding between himself and the Savoyard Ramorino, who had been chosen as military leader.

In April 1834 the "Young Europe" association "of men believing in a future of liberty, equality and fraternity for all mankind, and desirous of consecrating their thoughts and actions to the realization of that future" was formed also under the influence of Mazzini's enthusiasm; it was followed soon afterwards by a "Young Switzerland" society, having for its leading idea the formation of an Alpine confederation, to include Switzerland, Tyrol, Savoy and the rest of the Alpine chain as well. But *La Jeune Suisse* newspaper was compelled to stop within a year, and in other respects the affairs of the struggling patriot became embarrassed. He was permitted to remain at Grenchen in Solothurn for a while, but at last the Swiss diet, yielding to strong and persistent pressure from abroad, exiled him about the end of 1836. In January 1837 he arrived in London, where for many months he had to carry on a hard fight with poverty and the sense of spiritual loneliness, so touchingly described by himself in the first volume of the *Life and Writings*. Ultimately, as he gained command of the English language, he began to earn a livelihood by writing review articles, some of which have since been reprinted, and are of a high order of literary merit; they include papers on "Italian Literature since 1830" and "Paolo Sarpi" in the *Westminster Review*, articles on "Lamennais," "George Sand," "Byron and Goethe" in the *Monthly Chronicle*, and on "Lamartine," "Carlyle," and "The Minor Works of Dante" in the *British and Foreign Review*. In 1839 he entered into relations with the revolutionary committees sitting in Malta and Paris, and in 1840 he originated a working men's association, and the weekly journal entitled *Apostolato Popolare*, in which the admirable popular treatise "On the Duties of Man" was commenced. Among the patriotic and philanthropic labours undertaken by Mazzini during this period of retirement in London may be mentioned a free evening school conducted by himself and a few others for some years, at which several hundreds of Italian children received at least the rudiments of secular and religious education. He also exposed and combated the infamous traffic carried on in southern Italy, where scoundrels bought small boys from poverty-stricken parents and carried them off to England and elsewhere to grind organs and suffer martyrdom at the hands of cruel taskmasters.

The most memorable episode in his life during the same period was perhaps that which arose out of the conduct of Sir James Graham, the home secretary, in systematically, for some months, opening Mazzini's letters as they passed through the British post office, and communicating their contents to the Neapolitan government—a proceeding which was believed at the time to have led to the arrest and execution of the brothers Bandiera, Austrian subjects, who had been planning an expedition against Naples, although the recent publication of Sir James Graham's life seems to exonerate him from the charge. The prolonged discussions in parliament, and the report of the committee appointed to inquire into the matter, did not, however, lead to any practical result, unless indeed the incidental vindication of Mazzini's character, which had been recklessly assailed in the course of debate. In this connexion Thomas Carlyle wrote to *The Times*: "I have had the honour to know Mr Mazzini for a series of years, and, whatever I may think of his practical insight and skill in worldly affairs, I can with great freedom testify that he, if I have ever seen one such, is a man of genius and virtue, one of those rare men, numerable unfortunately but as units in this world, who are worthy to be called martyr souls; who in silence, piously in their daily life, practise what is meant by that."

Mazzini did not share the enthusiastic hopes everywhere raised in the ranks of the Liberal party throughout Europe by the first acts of Pius IX., in 1846, but at the same time he availed himself, towards the end of 1847, of the opportunity to publish a letter addressed to the new pope, indicating the nature of the religious and national mission which the Liberals expected him to undertake. The leaders of the revolutionary outbreaks in Milan and Messina in the beginning of 1848 had long been in secret correspondence with Mazzini; and their action, along with the revolution in Paris, brought him early in the same year to Italy, where he took a great and active interest in the events which dragged Charles Albert into an unprofitable war with Austria; he actually for a short time bore arms under Garibaldi immediately before the reoccupation of Milan, but ultimately, after vain attempts to maintain the insurrection in the mountain districts, found it necessary to retire to Lugano. In the beginning of the following year he was nominated a member of the short-lived provisional government of Tuscany formed after the flight of the grand-duke, and almost simultaneously, when Rome had, in consequence of the withdrawal of Pius IX., been proclaimed a republic, he was declared a member of the constituent assembly there. A month afterwards, the battle of Novara having again decided against Charles Albert in the brief struggle with Austria, into which he had once more been drawn, Mazzini was appointed a member of the Roman triumvirate, with supreme executive power (March 23, 1849). The opportunity he now had for showing the administrative and political ability which he was believed to possess was more apparent than real, for the approach of the professedly friendly French troops soon led to hostilities, and resulted in a siege which terminated, towards the end of June, with the assembly's resolution to discontinue the defence, and Mazzini's indignant resignation. That he succeeded, however, for so long a time, and in circumstances so adverse, in maintaining a high degree of order within the turbulent city is a fact that speaks for itself. His diplomacy, backed as it was by no adequate physical force, naturally showed at the time to very great disadvantage, but his official correspondence and proclamations can still be read with admiration and intellectual pleasure, as well as his eloquent vindication of the revolution in his published "Letter to MM. de Tocqueville and de Falloux." The surrender of the city on the 30th of June was followed by Mazzini's not too precipitate flight by way of Marseilles into Switzerland, whence he once more found his way to London. Here in 1850 he became president of the National Italian Committee, and at the same time entered into close relations with Ledru-Rollin and Kossuth. He had a firm belief in the value of revolutionary attempts, however hopeless they might seem; he had a hand in the abortive rising at Mantua in 1852, and again, in February 1853, a considerable share in the ill-planned insurrection at Milan on the 6th of February 1853, the failure of which greatly weakened his influence; once more, in 1854, he had gone far with preparations for renewed action when his plans were completely disconcerted by the withdrawal of professed supporters, and by the action of the French and English governments in sending ships of war to Naples.

The year 1857 found him yet once more in Italy, where, for complicity in short-lived émeutes which took place at Genoa, Leghorn and Naples, he was again laid under sentence of death. Undiscouraged in the pursuit of the one great aim of his life by any such incidents as these, he returned to London, where he edited his new journal *Pensiero ed Azione*, in which the constant burden of his message to the overcautious practical politicians of Italy was: "I am but a voice crying *Action*; but the state of Italy cries for it also. So do the best men and people of her cities. Do you wish to destroy my influence? *Act*." The same tone was at a somewhat later date assumed in the letter he wrote to Victor Emmanuel, urging him to put himself at the head of the movement for Italian unity, and promising republican support. As regards the events of 1859–1860, however, it may be questioned whether, through his characteristic inability to distinguish between the ideally perfect and the practically possible, he did not actually hinder more than he helped the course of events by which the realization of so much of the great dream of his life was at last brought about. If Mazzini was the prophet of Italian unity, and Garibaldi its knight errant, to Cavour alone belongs the honour of having been the statesman by whom it was finally accomplished. After the irresistible pressure of the popular movement had led to the establishment not of an Italian republic but of an Italian kingdom, Mazzini could honestly enough write, "I too have striven to realize unity under a monarchical flag." but candour compelled him to add, "The Italian people are led astray by a delusion at the present day, a delusion which has induced them to substitute material for moral unity and their own reorganization. Not so I. I bow my head sorrowfully to the sovereignty of the national will; but monarchy will never number me amongst its servants or followers." In 1865, by way of protest against the still uncancelled sentence of death under which he lay, Mazzini was elected by Messina as delegate to the Italian parliament, but, feeling himself unable to take the oath of allegiance to the monarchy, he never took his seat. In the following year, when a general amnesty was granted after the cession of Venice to Italy, the sentence of death was at last removed, but he declined to accept such an "offer of oblivion and pardon for having loved Italy above all earthly things." In May 1869 he was again expelled from Switzerland at the instance of the Italian government for having conspired with Garibaldi; after a few months spent in England he set out (1870) for Sicily, but was promptly arrested at sea and carried to Gaeta, where he was imprisoned for two months. Events soon made it evident that there was little danger to fear from the contemplated rising, and the occasion of the birth of a prince was seized for restoring him to liberty. The remainder of his life, spent partly in London and partly at Lugano, presents no noteworthy incidents. For some time his health had been far from satisfactory, but the immediate cause of his death was an attack of pleurisy with which he was seized at Pisa, and which terminated fatally on the 10th of March 1872. The Italian parliament by a unanimous vote expressed the national sorrow with which the tidings of his death had been received, the president pronouncing an eloquent eulogy on the departed patriot as a model of disinterestedness and self-denial, and one who had dedicated his whole life ungrudgingly to the cause of his country's freedom. A public funeral took place at Pisa on the 14th of March, and the remains were afterwards conveyed to Genoa. (J. S. Bl.)

The published writings of Mazzini, mostly occasional, are very voluminous. An edition was begun by himself and continued by A. Saffi, *Scritti editi e inediti di Giuseppe Mazzini*, in 18 vols. (Milan and Rome, 1861–1891); many of the most important are found in the partially autobiographical *Life and Writings of Joseph Mazzini* (1864–1870) and the two most systematic—*Thoughts upon Democracy in Europe*, a remarkable series of criticisms on Benthamism, St Simonianism, Fourierism, and other economic and socialistic schools of the day, and the treatise *On the Duties of Man*, an admirable primer of ethics, dedicated to the Italian working class—will be found in *Joseph Mazzini: a Memoir*, by Mrs E. A. Venturi (London, 1875). Mazzini's "first great sacrifice," he tells us, was "the renunciation of the career of literature for the more direct path of political action," and as late as 1861 we find him still recurring to the long-cherished hope of being able to leave the stormy arena of politics and consecrate the last years of his life to the dream of his youth. He had specially contemplated three considerable literary undertakings—a volume of *Thoughts on Religion*, a popular *History of Italy*, to enable the working classes to apprehend what he conceived to be the "mission" of Italy in God's providential ordering of the world, and a comprehensive collection of translations of ancient and modern classics into Italian. None of these was actually achieved. No one, however, can read even the briefest and most occasional writing of Mazzini without gaining some impression of the simple grandeur of the man, the lofty elevation of his moral tone, his unwavering faith in the living God, who is ever revealing Himself in the progressive development of humanity. His last public utterance is to be found in a highly characteristic article on Renan's *Réforme Morale et Intellectuelle*, finished on the 3rd of March 1872, and published in the *Fortnightly Review* for February 1874. Of the 40,000 letters of Mazzini only a small part have been published. In 1887 two hundred unpublished letters were printed at Turin (*Duecento lettere inedite di Giuseppe Mazzini*), in 1895 the *Lettres intimes* were published in Paris, and in 1905 Francesco Rosso published *Lettre inedite di Giuseppe Mazzini* (Turin, 1905). A popular edition of Mazzini's writings has been undertaken by order of the Italian government.

For Mazzini's biography see Jessie White Mario, *Della vita di Giuseppe Mazzini* (Milan, 1886), a useful if somewhat too enthusiastic work; Bolton King, *Mazzini* (London, 1903); Count von Schack, *Joseph Mazzini und die italienische Einheit* (Stuttgart, 1891). A. Luzio's *Giuseppe Mazzini* (Milan, 1905) contains a great deal of valuable information, bibliographical and other, and Dora Melegari in *La giovine Italia e Giuseppe Mazzini* (Milan, 1906) publishes the correspondence between Mazzini and Luigi A. Melegari during the early days of "Young Italy." For the literary side of Mazzini's life see Peretti, *Gli scritti letterarii di Giuseppe Mazzini* (Turin, 1904). (L. V.*)

MAZZONI, GIACOMO (1548–1598), Italian philosopher, was born at Cesena and died at Ferrara. A member of a noble family and highly educated, he was one of the most eminent savants of the period. He occupied chairs in the universities of Pisa and Rome, was one of the founders of the Della Crusca Academy, and had the distinction, it is said, of thrice vanquishing the Admirable Crichton in dialectic. His chief work in philosophy was an attempt to reconcile Plato and Aristotle, and in this spirit he published in 1597 a treatise *In universam Platonis et Aristotelis philosophiam praecludia*. He wrote also *De triplici hominum vita*, wherein he outlined a theory of the infinite perfection and development of nature. Apart from philosophy, he was prominent in literature as the champion of Dante, and produced two works in the poet's defence: *Discorso composto in difesa della comedia di Dante* (1572), and *Della difesa della comedia di Dante* (1587, reprinted 1688). He was an authority on ancient languages and philology, and gave a great impetus to the scientific study of the Italian language.

MAZZONI, GUIDO (1859–), Italian poet, was born at Florence, and educated at Pisa and Bologna. In 1887 he became professor of Italian at Padua, and in 1894 at Florence. He was much influenced by Carducci, and became prominent both as a prolific and well-read critic and as a poet of individual distinction. His chief volumes of verse are *Versi* (1880), *Nuove poesie* (1886), *Poesie* (1891), *Voci della vita* (1893).

MEAD, LARKIN GOLDSMITH (1835–), American sculptor, was born at Chesterfield, New Hampshire, on the 3rd of January 1835. He was a pupil (1853–1855) of Henry Kirke Brown. During the early part of the Civil War he was at the front for six months, with the army of the Potomac, as an artist for *Harper's Weekly*; and in 1862–1865 he was in Italy, being for part of the time attached to the United States consulate at Venice, while William D. Howells, his brother-in-law, was consul. He returned to America in 1865, but subsequently went back to Italy and lived at Florence. His first important work was a statue of Ethan Allen, now at the State House, Montpelier, Vermont. His principal works are: the monument to President Lincoln, Springfield, Illinois; "Ethan Allen" (1876), National Hall of Statuary, Capitol, Washington; an heroic marble statue, "The Father of Waters," New Orleans; and "Triumph of Ceres," made for the Columbian Exposition, Chicago.

His brother, **William Rutherford Mead** (1846– , graduated at Amherst College in 1867, and studied architecture in New York under Russell Sturgis, and also abroad. In 1879 he and J. F. McKim, with whom he had been in partnership for two years as architects, were joined by Stanford White, and formed the well-known firm of McKim, Mead & White.

MEAD, RICHARD (1673–1754), English physician, eleventh child of Matthew Mead (1630–1699), Independent divine, was born on the 11th of August 1673 at Stepney, London. He studied at Utrecht for three years under J. G. Graevius; having decided to follow the medical profession, he then went to Leiden and attended the lectures of Paul Hermann and Archibald Pitcairne. In 1695 he graduated in philosophy and physic at Padua, and in 1696 he returned to London, entering at once on a successful practice. His *Mechanical Account of Poisons* appeared in 1702, and in 1703 he was admitted to the Royal Society, to whose *Transactions* he contributed in that year a paper on the parasitic nature of scabies. In the same year he was elected physician to St Thomas's Hospital, and appointed to read anatomical lectures at the Surgeons' Hall. On the death of John Radcliffe in 1714 Mead became the recognized head of his profession; he attended Queen Anne on her deathbed, and in 1727 was appointed physician to George II., having previously served him in that capacity when he was prince of Wales. He died in London on the 16th of February 1754.

Besides the *Mechanical Account of Poisons* (2nd ed., 1708), Mead published a treatise *De imperio solis et lunae in corpora humana et morbis inde oriundis* (1704), *A Short Discourse concerning Pestilential Contagion, and the Method to be used to prevent it* (1720), *De variolis et morbillis dissertatio* (1747), *Medica sacra, sive de morbis insignioribus qui in bibliis memorantur commentarius* (1748), *On the Scurvy* (1749), and *Monita et praecepta medica* (1751). A *Life* of Mead by Dr Matthew Maty appeared in 1755.

MEAD. (1) A word now only used more or less poetically for the commoner form "meadow," properly land laid down for grass and cut for hay, but often extended in meaning to include pasture-land. "Meadow" represents the oblique case, *mǣdwe*, of O. Eng. *mǣd*, which comes from the root seen in "mow"; the word, therefore, means "mowed land." Cognate words appear in other Teutonic languages, a familiar instance being Ger. *matt*, seen in place-names such as Zermatt, Andermatt, &c. (See Grass.) (2) The name of a drink made by the fermentation of honey mixed with water. Alcoholic drinks made from honey were common in ancient times, and during the middle ages throughout Europe. The Greeks and Romans knew of such under the names of ὑδρόμελι and *hydromel*; *mulsum* was a form of mead with the addition of wine. The word is common to Teutonic languages (cf. Du. *mede*, Ger. *Met* or *Meth*), and is cognate with Gr. *μέθυ*, wine, and Sansk. *mádhu*, sweet drink. "Metheglin," another word for mead, properly a medicated or spiced form of the drink, is an adaptation of the Welsh *meddyglyn*, which is derived from *meddyg*, healing (Lat. *medicus*) and *llyn*, liquor. It therefore means "spiced or medicated drink," and is not etymologically connected with "mead."

MEADE, GEORGE GORDON (1815–1872), American soldier, was born of American parentage at Cadiz, Spain, on the 31st of December 1815. On graduation at the United States Military Academy in 1835, he served in Florida with the 3rd Artillery against the Seminoles. Resigning from the army in 1836, he became a civil engineer and constructor of railways, and was engaged under the war department in survey work. In 1842 he was appointed a second lieutenant in the corps of the topographical engineers. In the war with Mexico he was on the staffs successively of Generals Taylor, J. Worth and Robert Patterson, and was brevetted for gallant conduct at Monterey. Until the Civil War he was engaged in various engineering works, mainly in connexion with lighthouses, and later as a captain of topographical engineers in the survey of the northern lakes. In 1861 he was appointed brigadier-general of volunteers, and had command of the 2nd brigade of the Pennsylvania Reserves in the Army of the Potomac under General M'Call. He served in the Seven Days, receiving a severe wound at the action of Frazier's Farm. He was absent from his command until the second battle of Bull Run, after which he obtained the command of his division. He distinguished himself greatly at the battles of South Mountain and Antietam. At Fredericksburg he and his division won great distinction by their attack on the position held by Jackson's corps, and Meade was promoted major-general of volunteers, to date from the 29th of November. Soon afterwards he was placed in command of the V. corps. At Chancellorsville he displayed great intrepidity and energy, and on the eve of the battle of Gettysburg was appointed to succeed Hooker. The choice was unexpected, but Meade justified it by his conduct of the operations, and in the famous three days' battle he inflicted a complete defeat on General Lee's army. His reward was the commission of brigadier-general in the regular army. In the autumn of 1863 a war of manœuvre was fought between the two commanders, on the whole favourably to the Union arms. Grant, commanding all the armies of the United States, joined the Army of the Potomac in the spring of 1864, and remained with it until the end of the war; but he continued Meade in his command, and successfully urged his appointment as major-general in the regular army (Aug. 18, 1864), eulogizing him as the commander who had successfully met and defeated the best general and the strongest army on the Confederate side. After the war Meade commanded successively the military division of the Atlantic, the department of the east, the third military district (Georgia and Alabama) and the department of the south. He died at Philadelphia on the 6th of November, 1872. The degree of LL.D. was conferred upon him by Harvard University, and his scientific attainments were recognized by the American Philosophical Society and the Philadelphia Academy of Natural Sciences. There are statues of General Meade in Philadelphia and at Gettysburg.

See I. R. Pennypacker, *General Meade* ("Great Commanders" series, New York, 1901).

MEADE, WILLIAM (1789–1862), American Protestant Episcopal bishop, the son of Richard Kidder Meade (1746–1805), one of General Washington's aides during the War of Independence, was born on the 11th of November 1789, near Millwood, in that part of Frederick county which is now Clarke county, Virginia. He graduated as valedictorian in 1808 at the college of New Jersey (Princeton); studied theology under the Rev. Walter Addison of Maryland, and in Princeton; was ordained deacon in 1811 and priest in 1814; and preached both in the Stone Chapel, Millwood, and in Christ Church, Alexandria, for some time. He became assistant bishop of Virginia in 1829; was pastor of Christ Church, Norfolk, in 1834–1836; in 1841 became bishop of Virginia; and in 1842–1862 was president of the Protestant Episcopal Theological Seminary in Virginia, near Alexandria, delivering an annual course of lectures on pastoral theology. In 1819 he had acted as the agent of the American Colonization Society to purchase slaves, illegally brought into Georgia, which had become the property of that state and were sold publicly at Milledgeville. He had been prominent in the work of the Education Society, which was organized in 1818 to advance funds to needy students for the ministry of the American Episcopal Church, and in the establishment of the Theological Seminary near Alexandria, as he was afterwards in the work of the American Tract Society, and the Bible Society. He was a founder and president of the Evangelical Knowledge Society (1847), which, opposing what it considered the heterodoxy of many of the books published by the Sunday School Union, attempted to displace them by issuing works of a more evangelical type. A low Churchman, he strongly opposed Tractarianism. He was active in the case against Bishop Henry Ustick Onderdonk (1789–1858) of Pennsylvania, who because of intemperance was forced to resign and was suspended from the ministry in 1844; in that against Bishop Benjamin Tredwell Onderdonk (1791–1861) of New York, who in 1845 was suspended from the ministry on the charge of intoxication and improper conduct; and in that against Bishop G. W. Doane of New Jersey. He fought against the threatening secession of Virginia, but acquiesced in the decision of the state and became presiding bishop of the Southern Church. He died in Richmond, Virginia, on the 14th of March 1862.

Among his publications, besides many sermons, were *A Brief Review of the Episcopal Church in Virginia* (1845); *Wilberforce, Cranmer, Jewell and the Prayer Book on the Incarnation* (1850); *Reasons for Loving the Episcopal Church* (1852); and *Old Churches, Ministers and Families of Virginia* (1857); a storehouse of material on the ecclesiastical history of the state.

See the *Life* by John Johns (Baltimore, 1867).

MEADVILLE, a city and the county-seat of Crawford county, Pennsylvania, U.S.A., on French Creek, 36 m. S. of Erie. Pop. (1900), 10,291, of whom 912 were foreign-born and 173 were negroes; (1910 census) 12,780. It is served by the Erie, and the Bessemer & Lake Erie railways. Meadville has three public parks, two general hospitals and a public library, and is the seat of the Pennsylvania College of Music, of a commercial college, of the Meadville Theological School (1844, Unitarian), and of Allegheny College (co-educational), which was opened in 1815, came under the general patronage of the Methodist Episcopal Church in 1833, and in 1909 had 322 students (200 men and 122 women). Meadville is the commercial centre of a good agricultural region, which also abounds in oil and natural gas. The Erie Railroad has extensive shops here, which in 1905 employed 46·7% of the total number of wage-earners, and there are various manufactures. The factory product in 1905 was valued at $2,074,600, being 24·4% more than that of 1900. Meadville, the oldest settlement in N.W. Pennsylvania, was founded as a fortified post by David Mead in 1793, laid out as a town in 1795, incorporated as a borough in 1823 and chartered as a city in 1866.

MEAGHER, THOMAS FRANCIS (1823–1867), Irish nationalist and American soldier, was born in Waterford, Ireland, on the 3rd of August 1823. He graduated at Stonyhurst College, Lancashire, in 1843, and in 1844 began the study of law at Dublin. He became a member of the Young Ireland Party in 1845, and in 1847 was one of the founders of the Irish Confederation. In March 1848 he made a speech before the Confederation which led to his arrest for sedition, but at his trial the jury failed to agree and he was discharged. In the following July the Confederation created a "war directory" of five, of which Meagher was a member, and he and William Smith O'Brien travelled through Ireland for the purpose of starting a revolution. The attempt proved abortive; Meagher was arrested in August, and in October was tried for high treason before a special commission at Clonmel. He was found guilty and was condemned to death, but his sentence was commuted to life imprisonment in Van Diemen's Land, whither he was transported in the summer of 1849. Early in 1852 he escaped, and in May reached New York City. He made a tour of the cities of the United States as a popular lecturer, and then studied law and was admitted to the New York bar in 1855. He made two unsuccessful ventures in journalism, and in 1857 went to Central America, where he acquired material for another series of lectures. In 1861 he was captain of a company (which he had raised) in the 69th regiment of New York volunteers and fought at the first battle of Bull Run; he then organized an Irish brigade, of whose first regiment he was colonel until the 3rd of February 1862, when he was appointed to the command of this organization with the rank of brigadier-general. He took part in the siege of Yorktown, the battle of Fair Oaks, the seven days' battle before

Richmond, and the battles of Antietam, Fredericksburg, where he was wounded, and Chancellorsville, where his brigade was reduced in numbers to less than a regiment, and General Meagher resigned his commission. On the 23rd of December 1863 his resignation was cancelled, and he was assigned to the command of the military district of Etowah, with headquarters at Chattanooga. At the close of the war he was appointed by President Johnson secretary of Montana Territory, and there, in the absence of the territorial governor, he acted as governor from September 1866 until his death from accidental drowning in the Missouri River near Fort Benton, Montana, on the 1st of July 1867. He published *Speeches on the Legislative Independence of Ireland* (1852).

W. F. Lyons, in *Brigadier-General Thomas Francis Meagher* (New York, 1870), gives a eulogistic account of his career.

MEAL. (1) (A word common to Teutonic languages, cf. Ger. *Mehl*, Du. meel; the ultimate source is the root seen in various Teutonic words meaning "to grind," and in Eng. "mill," Lat. *mola*, *molĕre*, Gr. μύλη), a powder made from the edible part of any grain or pulse, with the exception of wheat, which is known as "flour." In America the word is specifically applied to the meal produced from Indian corn or maize, as in Scotland and Ireland to that produced from oats, while in South Africa the ears of the Indian corn itself are called "mealies." (2) Properly, eating and drinking at regular stated times of the day, as breakfast, dinner, &c., hence taking of food at any time and also the food provided. The word was in O.E. *mael*, which also had the meanings (now lost) of time, mark, measure, &c., which still appear in many forms of the word in Teutonic languages; thus Ger. *mal*, time, mark, cf. *Denkmal*, monument, *Mahl*, meal, repast, or Du. *maal*, Swed. *mal*, also with both meanings. The ultimate source is the pre-Teutonic root *me- ma-*, to measure, and the word thus stood for a marked-out point of time.

MEALIE, the South African name for Indian corn or maize. The word as spelled represents the pronunciation of the Cape Dutch *milje*, an adaptation of *milho* (*da India*), the millet of India, the Portuguese name for millet, used in South Africa for maize.

MEAN, an homonymous word, the chief uses of which may be divided thus. (1) A verb with two principal applications, to intend, purpose or design, and to signify. This word is in O.E. *maenan*, and cognate forms appear in other Teutonic languages, cf. Du. *meenen*, Ger. *meinen*. The ultimate origin is usually taken to be the root *men-*, to think, the root of "mind." (2) An adjective and substantive meaning "that which is in the middle." This is derived through the O. Fr. *men*, *meien* or *moien*, modern *moyen*, from the late Lat. adjective *medianus*, from *medius*, middle. The law French form *mesne* is still preserved in certain legal phrases (see Mesne). The adjective "mean" is chiefly used in the sense of "average," as in mean temperature, mean birth or death rate, &c.

"Mean" as a substantive has the following principal applications; it is used of that quality, course of action, condition, state, &c., which is equally distant from two extremes, as in such phrases as the "golden (or happy) mean." For the philosophic application see Aristotle and Ethics.

In mathematics, the term "mean," in its most general sense, is given to some function of two or more quantities which (1) becomes equal to each of the quantities when they themselves are made equal, and (2) is unaffected in value when the quantities suffer any transpositions. The three commonest means are the arithmetical, geometrical, and harmonic; of less importance are the contraharmonical, arithmetico-geometrical, and quadratic.

From the sense of that which stands between two things, "mean," or the plural "means," often with a singular construction, takes the further significance of agency, instrument, &c., of which that produces some result, hence resources capable of producing a result, particularly the pecuniary or other resources by which a person is enabled to live, and so used either of employment or of property, wealth, &c. There are many adverbial phrases, such as "by all means," "by no means," &c., which are extensions of "means" in the sense of agency.

The word "mean" (like the French *moyen*) had also the sense of middling, moderate, and this considerably influenced the uses of "mean" (3). This, which is now chiefly used in the sense of inferior, low, ignoble, or of avaricious, penurious, "stingy," meant originally that which is common to more persons or things than one. The word in O. E. is *gemaéne*, and is represented in the modern Ger. *gemein*, common. It is cognate with Lat. *communis*, from which "common" is derived. The descent in meaning from that which is shared alike by several to that which is inferior, vulgar or low, is paralleled by the uses of "common."

In astronomy the "mean sun" is a fictitious sun which moves uniformly in the celestial equator and has its right ascension always equal to the sun's mean longitude. The time recorded by the mean sun is termed mean-solar or clock time; it is regular as distinct from the non-uniform solar or sun-dial time. The "mean moon" is a fictitious moon which moves around the earth with a uniform velocity and in the same time as the real moon. The "mean longitude" of a planet is the longitude of the "mean" planet, *i.e.* a fictitious planet performing uniform revolutions in the same time as the real planet.

The arithmetical mean of n quantities is the sum of the quantities divided by their number n. The geometrical mean of n quantities is the nth root of their product. The harmonic mean of n quantities is the arithmetical mean of their reciprocals. The significance of the word "mean," *i.e.*, middle, is seen by considering 3 instead of n quantities; these will be denoted by a, b, c. The arithmetic mean b, is seen to be such that the terms a, b, c are in arithmetical progression, *i.e.* $b=\frac{1}{2}(a+c)$; the geometrical mean b places a, b, c in geometrical progression, *i.e.* in the proportion $a : b :: b : c$ or $b^2=ac$; and the harmonic mean places the quantities in harmonic proportion, *i.e.* $a : c :: a-b : b-c$, or $b=2ac/(a+c)$. The contraharmonical mean is the quantity b given by the proportion $a : c :: b-c : a-b$, *i.e.* $b=(a^2+c^2)/(a+c)$. The arithmetico-geometrical mean of two quantities is obtained by first forming the geometrical and arithmetical means, then forming the means of these means, and repeating the process until the numbers become equal. They were invented by Gauss to facilitate the computation of elliptic integrals. The quadratic mean of n quantities is the square root of the arithmetical mean of their squares.

MEASLES, (*Morbilli*, *Rubeola*; the M. E. word is *maseles*, properly a diminutive of a word meaning "spot," O.H.G. *mâsa*, cf. "mazer"; the equivalent is Ger. *Masern*; Fr. *Rougeole*), an acute infectious disease occurring mostly in children. It is mentioned in the writings of Rhazes and others of the Arabian physicians in the 10th century For long, however, it was held to be a variety of small-pox. After the non-identity of these two diseases had been established, measles and scarlet-fever continued to be confounded with each other; and in the account given by Thomas Sydenham of epidemics of measles in London in 1670 and 1674 it is evident that even that accurate observer had not as yet clearly perceived their pathological distinction, although it would seem to have been made a century earlier by Giovanni Filippo Ingrassias (1510–1580), a physician of Palermo. The specific micro-organism responsible for measles has not been definitely isolated.

Its progress is marked by several stages more or less sharply defined. After the reception of the contagion into the system, there follows a period of incubation or latency during which scarcely any disturbance of the health is perceptible. This period generally lasts for from ten to fourteen days, when it is followed by the invasion of the symptoms specially characteristic of measles. These consist in the somewhat sudden onset of acute catarrh of the mucous membranes. At this stage minute white spots in the buccal mucous membrane frequently occur; when they do, they are diagnostic of the disease. Sneezing, accompanied with a watery discharge, sometimes bleeding, from the nose, redness and watering of the eyes, cough of a short, frequent, and noisy character, with little or no expectoration, hoarseness of the voice, and occasionally sickness and diarrhoea, are the chief local phenomena of this stage. With these there is well-marked febrile disturbance, the temperature being elevated (102°–104° F.), and the pulse rapid, while headache, thirst, and restlessness are usually present. In some instances, these initial symptoms are slight, and the child is allowed to associate with others at a time when, as will be afterwards seen, the contagion of the disease is most active. In rare cases, especially in young children, convulsions usher in, or occur in the course of, this stage of invasion, which lasts as a rule for four or five days, the febrile symptoms, however, showing some tendency to undergo abatement after the second day. On the fourth or fifth day after the invasion, sometimes later, rarely earlier, the characteristic eruption appears on the skin, being first noticed on the brow, cheeks, chin, also behind the ears, and on the neck. It consists of small spots of a dusky red or crimson colour, just like flea-bites, slightly elevated above the surface, at first isolated, but tending to become grouped into patches of irregular, occasionally crescentic, outline, with portions of skin free from the eruption intervening. The face acquires a swollen and bloated appearance, which, taken with the catarrh of the nostrils and eyes, is almost characteristic, and renders the diagnosis at this stage a matter of no difficulty. The eruption spreads downwards over the body and limbs, which are soon thickly studded with the red spots or patches. Sometimes these become confluent over a considerable surface. The rash continues to come out for two or three days, and then begins to fade in the order in which it first showed itself, namely from above downwards. By the end of about a week after its first appearance scarcely any trace of the eruption remains beyond a faint staining of the skin. Usually during convalescence slight peeling of the epidermis takes place, but much less distinctly than is the case in scarlet fever. At the commencement of the eruptive stage the fever, catarrh, and other constitutional disturbance, which were present from the beginning, become aggravated, the temperature often rising to 105° or more, and there is headache, thirst, furred tongue, and soreness of the throat, upon which red patches similar to those on the surface of the body may be observed. These symptoms usually decline as soon as the rash has attained its maximum, and often there occurs a sudden and extensive fall of temperature, indicating that the crisis of the disease has been reached. In favourable cases convalescence proceeds rapidly, the patient feeling perfectly well even before the rash has faded from the skin.

Measles may, however, occur in a very malignant form, in which the symptoms throughout are of urgent character, the rash but feebly developed, and of dark purple hue, while there is great prostration, accompanied with intense catarrh of the respiratory or gastro-intestinal mucous membrane. Such cases are rare, occurring mostly in circumstances of bad hygiene, both as regards the individual and his surroundings. On the other hand, cases of measles are often of so mild a form throughout that the patient can scarcely be persuaded to submit to treatment.

Measles as a disease derives its chief importance from the risk, by no means slight, of certain complications which are apt to arise during its course, more especially inflammatory affections of the respiratory organs. These are most liable to occur in the colder seasons of the year and in very young and delicate children. It has been already stated that irritation of the respiratory passages is one of the symptoms characteristic of measles, but that this subsides with the decline of the eruption. Not unfrequently, however, these symptoms, instead of abating, become aggravated, and bronchitis of the capillary form (see **Bronchitis**), or pneumonia, generally of the diffuse or lobular variety (see **Pneumonia**), supervene. By far the greater proportion of the mortality in measles is due to its complications, of which those just mentioned are the most common, but which also include inflammatory affections of the larynx, with attacks resembling croup, and also diarrhoea assuming a dysenteric character Or there may remain as direct results of the disease chronic ophthalmia, or discharge from the ears with deafness, and occasionally a form of gangrene affecting the tissues of the mouth or cheeks and other parts of the body, leading to disfigurement and gravely endangering life.

Apart from those immediate risks there appears to be a tendency in many cases for the disease to leave behind a weakened and vulnerable condition of the general health, which may render children, previously robust, delicate and liable to chest complaints, and is in not a few instances the precursor of some of those tubercular affections to which the period of childhood and youth is liable. These various effects or sequelae of measles indicate that although in itself a comparatively mild ailment, it should not be regarded with indifference. Indeed it is doubtful whether any other disease of early life demands more careful watching as to its influence on the health. Happily many of those attending evils may by proper management be averted.

Measles is a disease of the earlier years of childhood. Like other infectious maladies, it is admittedly rare, though not unknown, in nurslings or infants under six months old. It is comparatively seldom met with in adults, but this is due to the fact that most persons have undergone an attack in early life. Where this has not been the case, the old suffer equally with the young. All races of men appear liable to this disease, provided that which constitutes the essential factor in its origin and spread exists, namely, contagion. Some countries enjoy long immunity from outbreaks of measles, but it has frequently been found in such cases that when the contagion has once been introduced the disease extends with great rapidity and virulence. This was shown by the epidemic in the Faroe Islands in 1846, where, within six months after the arrival of a single case of measles, more than three-fourths of the entire population were attacked and many perished; and the similarly produced and still more destructive outbreak in Fiji in 1875, in which it was estimated that about one-fourth of the inhabitants died from the disease in about three months. In both these cases the great mortality was due to the complications of the malady, specially induced by overcrowding, insanitary surroundings, the absence of proper nourishment and nursing for the sick, and the utter prostration and terror of the people, and to the disease being specially malignant, occurring on what might be termed virgin soil.[1] It may be regarded as an invariable rule that the first epidemic of any disease in a community is specially virulent, each successive attack conferring a certain immunity.

In many lands, such as the United Kingdom, measles is rarely absent, especially from large centres of population, where sporadic cases are found at all seasons. Every now and then epidemics arise from the extension of the disease among those members of a community who have not been in some measure protected by a previous attack. There are few diseases so contagious as measles, and its rapid spread in epidemic outbreaks is no doubt due to the well-ascertained fact that contagion is most potent in the earlier stages, even before its real nature has been evinced by the characteristic appearances on the skin. Hence the difficulty of timely isolation, and the readiness with which the disease is spread in schools and families. The contagion is present in the skin and the various secretions. While the contagion is generally direct, it can also be conveyed by the particles from the nose and mouth which, after being expelled, become dry and are conveyed as dust on clothes, toys, &c Fortunately the germs of measles do not retain their virulence long under such conditions, comparing favourably with those of some other diseases.

Treatment.—The treatment embraces the preventive measures to be adopted by the isolation of the sick at as early a period as possible. Epidemics have often, especially in limited localities, been curtailed by such a precaution. In families with little house accommodation this measure is frequently, for the reason given regarding the communicable period of the disease, ineffectual, nevertheless where practicable it ought to be tried. The unaffected children should be kept from school for a time (probably about three weeks from the outbreak in the family would suffice if no other case occur in the interval), and all clothing in contact with the patient or nurses should be disinfected. In extensive epidemics it is often desirable to close the schools for a time. As regards special treatment, in an ordinary case of measles little is required beyond what is necessary in febrile conditions generally. Confinement to bed in a somewhat darkened room, into which, however, air is freely admitted; light, nourishing, liquid diet (soups, milk, &c.), water almost *ad lib.* to drink, and mild diaphoretic remedies such as the acetate of ammonia or ipecacuanha, are all that is necessary in the febrile stage. When the fever is very severe, sponging the body generally or the chest and arms affords relief. The serious chest complications of measles are to be dealt with by those measures applicable for the relief of the particular symptoms (see BRONCHITIS; PNEUMONIA). The preparations of ammonia are of special efficacy. During convalescence the patient must be guarded from exposure to cold, and for a time after recovery the state of the health ought to be watched with a view of averting the evils, both local and constitutional, which too often follow this disease.

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[1] *Transactions of the Epidemiological Society* (London, 1877).

"German measles" (*Rötheln*, or *Epidemic Roseola*) is a term applied to a contagious eruptive disorder having certain points of resemblance to measles, and also to scarlet fever, but exhibiting its distinct individuality in the fact that it protects from neither of these diseases. It occurs most commonly in children, but frequently in adults also, and is occasionally seen in extensive epidemics. Beyond confinement to the house in the eruptive stage, which, from the slight symptoms experienced, is often difficult of accomplishment, no special treatment is called for. There is little doubt that the disease is often mistaken for true measles, and many of the alleged second attacks of the latter malady are probably cases of rötheln. The chief points of difference are the following: (1) The absence of distinct premonitory symptoms, the stage of invasion, which in measles is usually of four days' duration, and accompanied with well-marked fever and catarrh, being in rötheln either wholly absent or exceedingly slight, enduring only for one day. (2) The eruption of rötheln, which, although as regards its locality and manner of progress similar to measles, differs somewhat in its appearance, the spots being of smaller size, paler colour, and with less tendency to grouping in crescentic patches. The rash attains its maximum in about one day, and quickly disappears. There is not the same increase of temperature in this stage as in measles. (3) The presence of white spots on the buccal mucous membrane, in the case of measles. (4) The milder character of the symptoms of rötheln throughout its whole course, and the absence of complications and of liability to subsequent impairment of health such as have been seen to appertain to measles.

MEAT, a word originally applied to food in general, and so still used in such phrases as "meat and drink"; but now, except as an archaism, generally used of the flesh of certain domestic animals, slaughtered for human food by butchers, "butcher's meat," as opposed to "game," that of wild animals, "fish" or "poultry." Cognate forms of the O. Eng. *mete* are found in certain Teutonic languages, *e.g.* Swed. *mat*, Dan. *mad* and O. H. Ger. *Maz*. The ultimate origin has been disputed; the *New English Dictionary* considers probable a connexion with the root *med-*, "to be fat," seen in Sansk. *mēda*, Lat. *madere*, "to be wet," and Eng. "mast," the fruit of the beech as food for pigs.

See DIETETICS; FOOD PRESERVATION; PUBLIC HEALTH; AGRICULTURE; and the sections dealing with agricultural statistics under the names of the various countries.

MEATH (pronounced with *th* soft, as in *the*), a county of Ireland in the province of Leinster, bounded E. by the Irish Sea, S.E. by Dublin, S. by Kildare and King's County, W. by Westmeath, N.W. by Cavan and Monaghan, and N.E. by Louth. Area 579,320 acres, or about 905 sq. m. In some districts the surface is varied by hills and swells, which to the west reach a considerable elevation, although the general features of a fine champain country are never lost. The coast, low and shelving, extends about 10 m., but there is no harbour of importance. Laytown is a small seaside resort, 5 m. S.E. of Drogheda. The Boyne enters the county at its south-western extremity, and flowing north-east to Drogheda divides it into two almost equal parts. At Navan it receives the Blackwater, which flows south-west from Cavan. Both these rivers are noted for their trout, and salmon are taken in the Boyne. The Boyne is navigable for barges as far as Navan whence a canal is carried to Trim. The Royal Canal passes along the southern boundary of the county from Dublin.

In the north is a broken country of Silurian rocks with much igneous material, partly contemporaneous, partly intrusive, near Slane. Carboniferous Limestone stretches from the Boyne valley to the Dublin border, giving rise to a flat plain especially suitable for grazing. Outliers of higher Carboniferous strata occur on the surface; but the Coal Measures have all been removed by denudation.

The climate is genial and favourable for all kinds of crops, there being less rain than even in the neighbouring counties. Except a small portion occupied by the Bog of Allen, the county is verdant and fertile. The soil is principally a rich deep loam resting on limestone gravel, but varies from a strong clayey loam to a light sandy gravel. The proportion of tillage to pasturage is roughly as 1 to 3½. Oats potatoes and turnips are the principal crops, but all decrease. The numbers of cattle, sheep and poultry, however, are increasing or well maintained. Agriculture is almost the sole industry, but coarse linen is woven by hand-looms, and there are a few woollen manufactories. The main line of the Midland Great Western railway skirts the southern boundary, with a branch line north from Clonsilla to Navan and Kingscourt (county Cavan). From Kilmessan on this line a branch serves Trim and Athboy. From Drogheda (county Louth) a branch of the Great Northern railway crosses the county from east to West by Navan and Kells to Oldcastle.

The population (76,111 in 1891; 67,497 in 1901) suffers a large decrease, considerably above the average of Irish counties, and emigration is heavy. Nearly 93% are Roman Catholics. The chief towns are Navan (pop. 3839), Kells (2428) and Trim (1513), the county town. Lesser market towns are Oldcastle and Athboy, an ancient town which received a charter from Henry IV. The county includes eighteen baronies. Assizes are held at Trim, and quarter sessions at Kells, Navan and Trim. The county is in the Protestant dioceses of Armagh, Kilmore and Meath, and in the Roman Catholic dioceses of Armagh and Meath. Before the Union in 1800 it sent fourteen members to parliament, but now only two members are returned, for the north and south divisions of the county respectively.

History and Antiquities.—A district known as Meath (Midhe), and including the present county of Meath as well as Westmeath and Longford, with parts of Cavan, Kildare and King's County, was formed by Tuathal (*c.* 130) into a kingdom to serve as mensal land or personal estate of the Ard Ri or over-king of Ireland. Kings of Meath reigned until 1173, and the title was claimed as late as the 15th century by their descendants, but at the date mentioned Hugh de Lacy obtained the lordship of the country and was confirmed in it by Henry II. Meath thus came into the English "Pale." But though it was declared a county in the reign of Edward I. (1296), and though it came by descent into the possession of the Crown in the person of Edward IV., it was long before it was fully subdued and its boundaries clearly defined. In 1543 Westmeath was created a county apart from that of Meath, but as late as 1598 Meath was still regarded as a province by some, who included in it the counties Westmeath, East Meath, Longford and Cavan. In the early part of the 17th century it was at last established as a county, and no longer considered as a fifth province of Ireland.

There are two ancient round towers, the one at Kells and the other in the churchyard of Donaghmore, near Navan. By the river Boyne near Slane there is an extensive ancient burial-place called Brugh. Here are some twenty burial mounds, the largest of which is that of New Grange, a domed tumulus erected above a circular chamber, which is entered by a narrow passage enclosed by great upright blocks of stone, covered with carvings. The mound is surrounded by remains of a stone circle, and the whole forms one of the most remarkable extant erections of its kind. Tara (*q.v.*) is famous in history, especially as the seat of a royal palace referred to in the well-known lines of Thomas Moore. Monastic buildings were very numerous in Meath, among the more important ruins being those of Duleek, which is said to have been the first ecclesiastical building in Ireland of stone and mortar; the extensive remains of Bective Abbey; and those of Clonard, where also were a cathedral and a famous college. Of the old fortresses, the castle of Trim still presents an imposing appearance. There are many fine old mansions.

MEAUX, a town of northern France, capital of an arrondissement in the department of Seine-et-Marne, and chief town of the agricultural region of Brie, 28 m. E.N.E. of Paris by rail. Pop. (1906), 11,989. The town proper stands on an eminence on the right bank of the Marne; on the left bank lies the old suburb of Le Marché, with which it is united by a bridge of the 16th century. Two rows of picturesque mills of the same period are built across the river. The cathedral of St Stephen dates from the 12th to the 16th centuries, and was restored in the 19th century. Of the two western towers, the completed one is that to the north of the façade, the other being disfigured by an unsightly slate roof. The building, which is 275 ft. long and 105 ft. high, consists of a short nave, with aisles, a fine transept, a choir and a sanctury. The choir contains the statue and the tomb of Bossuet, bishop from 1681 to 1704, and the pulpit of the cathedral has been reconstructed with the panels of that from which the "eagle of Meaux" used to preach. The transept terminates at each end in a fine portal surmounted by a rose-window. The episcopal palace (17th century) has several curious old rooms; the buildings of the choir school are likewise of some archaeological interest. A statue of General Raoult (1870) stands in one of the squares.

Meaux is the centre of a considerable trade in cereals, wool, Brie cheeses, and other farm-produce, while its mills provide much of the flour with which Paris is supplied. Other industries are saw-milling, metal-founding, distilling, the preparation of vermicelli and preserved vegetables, and the manufacture of mustard, hosiery, plaster and machinery. There are nursery-gardens in the vicinity. The Canal de l'Ourcq, which surrounds the town, and the Marne furnish the means of transport. Meaux is the seat of a bishopric dating from the 4th century, and has among its public institutions a sub-prefecture, and tribunals of first instance and of commerce.

In the Roman period Meaux was the capital of the Meldi, a small Gallic tribe, and in the middle ages of the Brie. It formed part of the kingdom of Austrasia, and afterwards belonged to the counts of Vermandois and Champagne, the latter of whom established important markets on the left bank of the Marne. Its communal charter, received from them, is dated 1179. A treaty signed at Meaux in 1229 after the Albigensian War sealed the submission of Raymond VII., count of Toulouse. The town suffered much during the Jacquerie, the peasants receiving a severe check there in 1358; during the Hundred Years' War; and also during the Religious Wars, in which it was an important Protestant centre. It was the first town which opened its gates to Henry IV. in 1594. On the high-road for invaders marching on Paris from the east of France, Meaux saw its environs ravaged by the army of Lorraine in 1652, and was laid under heavy requisitions in 1814, 1815 and 1870. In September 1567 Meaux was the scene of an attempt made by the Protestants to seize the French king Charles IX., and his mother Catherine de' Medici. The plot, which is sometimes called the "enterprise of Meaux," failed, the king and queen with their courtiers escaping to Paris. This conduct, however, on the part of the Huguenots had doubtless some share in influencing Charles to assent to the massacre of St Bartholomew.

MECCA (Arab. *Makkah*),[1] the chief town of the Hejaz in Arabia, and the great holy city of Islām. It is situated two camel marches (the resting-place being Bahra or Hadda), or about 45 m. almost due E., from Jidda on the Red Sea. Thus on a rough estimate Mecca lies in 21° 25′ N., 39° 50′ E. It is said in the Koran (*Sur.* xiv. 40) that Mecca lies in a sterile valley, and the old geographers observe that the whole Haram or sacred territory round the city is almost without cultivation or date palms, while fruit trees, springs, wells, gardens and green valleys are found immediately beyond. Mecca in fact lies in the heart of a mass of rough hills, intersected by a labyrinth of narrow valleys and passes, and projecting into the Tehāma or low country on the Red Sea, in front of the great mountain wall that divides the coast-lands from the central plateau, though in turn they are themselves separated from the sea by a second curtain of hills forming the western wall of the great Wādi Marr. The inner mountain wall is pierced by only two great passes, and the valleys descending from these embrace on both sides the Mecca hills.

Holding this position commanding two great routes between the lowlands and inner Arabia, and situated in a narrow and barren valley incapable of supporting an urban population, Mecca must have been from the first a commercial centre.[2] In the palmy days of South Arabia it was probably a station on the great incense route, and thus Ptolemy may have learned the name, which he writes Makoraba. At all events, long before Mahomet we find Mecca established in the twofold quality of a commercial centre and a privileged holy place, surrounded by an inviolable territory (the Haram), which was not the sanctuary of a single tribe but a place of pilgrimage, where religious observances were associated with a series of annual fairs at different points in the vicinity. Indeed in the unsettled state of the country commerce was possible only under the sanctions of religion, and through the provisions of the sacred truce which prohibited war for four months of the year, three of these being the month of pilgrimage, with those immediately preceding and following. The first of the series of fairs in which the Meccans had an interest was at Okaz on the easier road between Mecca and Taif, where there was also a sanctuary, and from it the visitors moved on to points still nearer Mecca (Majanna, and finally Dhul-Majāz, on the flank of Jebel Kabkab behind Arafa) where further fairs were held,[3] culminating in the special religious ceremonies of the great feast at 'Arafa, Quzaḥ (Mozdalifa), and Mecca itself. The system of intercalation in the lunar calendar of the heathen Arabs was designed to secure that the feast should always fall at the time when the hides, fruits and other merchandise were ready for market,[4] and the Meccans, who knew how to attract the Bedouins by hospitality, bought up these wares in exchange for imported goods, and so became the leaders of the international trade of Arabia. Their caravans traversed the length and breadth of the peninsula. Syria, and especially Gaza, was their chief goal. The Syrian caravan intercepted, on its return, at Badr (see MAHOMET) represented capital to the value of £20,000, an enormous sum for those days.[5]

The victory of Mahommedanism made a vast change in the position of Mecca. The merchant aristocracy became satraps or pensioners of a great empire; but the seat of dominion was removed beyond the desert, and though Mecca and the Hejāz strove for a time to maintain political as well as religious predominance, the struggle was vain, and terminated on the death of Ibn Zubair, the Meccan pretendant to the caliphate, when the city was taken by Hajjāj (A.D. 692). The sanctuary and feast of Mecca received, however, a new prestige from the victory of Islām. Purged of elements obviously heathen, the Ka'ba became the holiest site, and the pilgrimage the most sacred ritual observance of Mahommedanism, drawing worshippers from so wide a circle that the confluence of the petty traders of the desert was no longer the main feature of the holy season. The pilgrimage retained its importance for the commercial well-being of Mecca; to this day the Meccans live by the Hajj—letting rooms, acting as guides and directors in the sacred ceremonies, as contractors and touts for land and sea transport, as well as exploiting the many benefactions that flow to the holy city; while the surrounding Bedouins derive support from the camel-transport it demands and from the subsidies by which they are engaged to protect or abstain from molesting the pilgrim caravans. But the ancient "fairs of heathenism" were given up, and the traffic of the pilgrim season, sanctioned by the Prophet in *Sur.* ii. 194, was concentrated at Minā and Mecca, where most of the pilgrims still have something to buy or sell, so that Minā, after the sacrifice of the feast day, presents the aspect of a huge international fancy fair.[1] In the middle ages this trade was much more important than it is now. Ibn Jubair (ed. Wright, p. 118 seq.) in the 12th century describes the mart of Mecca in the eight days following the feast as full of gems, unguents, precious drugs, and all rare merchandise from India, Irāk, Khorāsān, and every part of the Moslem world.

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[1] A variant of the name Makkah is Bakkah (*Sur.* iii. 90; Bakri, 155 seq.). For other names and honorific epithets of the city see Bakri, *ut supra*, Azraqi, p. 197, Yāqūt iv. 617 seq. The lists are in part corrupt, and some of the names (Kūthā and 'Arsh or 'Ursh, "the huts") are not properly names of the town as a whole.

[2] Mecca, says one of its citizens, in Wāqidī (Kremer's ed., p. 196, or *Muh. in Med*, p. 100), is a settlement formed for trade with Syria in summer and Abyssinia in winter, and cannot continue to exist if the trade is interrupted.

[3] The details are variously related. See Bīrūnī, p. 328 (E. T., p. 324); Asma'i in Yāqūt, iii. 705, iv. 416, 421; Azraqi, p. 129 seq.; Bakri, p. 661. Jebel Kabkab is a great mountain occupying the angle between W. Namān and the plain of Arafa. The peak is due north of Sheddād, the hamlet which Burckhardt (i. 115) calls Shedad. According to Azraqi, p. 80, the last shrine visited was that of the three trees of Uzzā in W. Nakhla.

[4] So we are told by Bīrūnī, p. 62 (E. T., 73).

[5] Wāqidī, ed. Kremer, pp. 20, 21; *Muh. in Med.* p. 39.

The hills east and west of Mecca, which are partly built over and rise several hundred feet above the valley, so enclose the city that the ancient walls only barred the valley at three points, where three gates led into the town. In the time of Ibn Jubair the gates still stood though the walls were ruined, but now the gates have only left their names to quarters of the town. At the northern or upper end was the Bāb el Mā'lā, or gate of the upper quarter, whence the road continues up the valley towards Minā and Arafa as well as towards Zeima and the Nejd. Beyond the gate, in a place called the Hajūn, is the chief cemetery, commonly called el Mā'lā, and said to be the resting-place of many of the companions of Mahomet. Here a cross-road, running over the hill to join the main Medina road from the western gate, turns off to the west by the pass of Kadā, the point from which the troops of the Prophet stormed the city (A.H. 8).[2] Here too the body of Ibn Zubair was hung on a cross by Ḥajjāj. The lower or southern gate, at the Masfala quarter, opened on the Yemen road, where the rain-water from Mecca flows off into an open valley. Beyond, there are mountains on both sides; on that to the east, commanding the town, is the great castle, a fortress of considerable strength. The third or western gate, Bāb el-Omra (formerly also Bāb el-Zāhir, from a village of that name), lay almost opposite the great mosque, and opened on a road leading westwards round the southern spurs of the Red Mountain. This is the way to Wādi Fātima and Medīna, the Jidda road branching off from it to the left. Considerable suburbs now lie outside the quarter named after this gate; in the middle ages a pleasant country road led for some miles through partly cultivated land with good wells, as far as the boundary of the sacred territory and gathering place of the pilgrims at Tanīm, near the mosque of Ayesha. This is the spot on the Medīna road now called the Omra, from a ceremonial connected with it which will be mentioned below.

The length of the sinuous main axis of the city from the farthest suburbs on the Medina road to the suburbs in the extreme north, now frequented by Bedouins, is, according to Burckhardt, 3500 paces.[3] About the middle of this line the longitudinal thoroughfares are pushed aside by the vast courtyard and colonnades composing the great mosque, which, with its spacious arcades surrounding the Ka'ba and other holy places, and its seven minarets, forms the only prominent architectural feature of the city. The mosque is enclosed by houses with windows opening on the arcades and commanding a view of the Ka'ba. Immediately beyond these, on the side facing Jebel Abu Kobais, a broad street runs south-east and north-west across the valley. This is the Mas'ā (sacred course) between the eminences of Safā and Merwa, and has been from very early times one of the most lively bazaars and the centre of Meccan life. The other chief bazaars are also near the mosque in smaller streets. The general aspect of the town is picturesque; the streets are fairly spacious, though ill-kept and filthy; the houses are all of stone, many of them well-built and four or five storeys high, with terraced roofs and large projecting windows as in Jidda—a style of building which has not varied materially since the 10th century (Mukaddasī, p. 71), and gains in effect from the way in which the dwellings run up the sides and spurs of the mountains. Of public institutions there are baths, ribāṭs, or hospices, for poor pilgrims from India, Java, &c., a hospital and a public kitchen for the poor. The mosque is at the same time the university hall, where between two pilgrim seasons lectures are delivered on Mahommedan law, doctrine and connected branches of science. A poorly provided public library is open to the use of students. The madrassehs or buildings around the mosque, originally intended as lodgings for students and professors, have long been let out to rich pilgrims. The minor places of visitation for pilgrims, such as the birthplaces of the prophet and his chief followers, are not notable.[4] Both these and the court of the great mosque lie beneath the general level of the city, the site having been gradually raised by accumulated rubbish. The town in fact has little air of antiquity; genuine Arab buildings do not last long, especially in a valley periodically ravaged by tremendous floods when the tropical rains burst on the surrounding hills. The history of Mecca is full of the record of these inundations, unsuccessfully combated by the great dam drawn across the valley by the caliph Omar (*Kutbeddin*, p. 76), and later works of Mahdī.[5]

The fixed population of Mecca in 1878 was estimated by Assistant-Surgeon 'Abd el-Razzāq at 50,000 to 60,000; there is a large floating population—and that not merely at the proper season of pilgrimage, the pilgrims of one season often beginning to arrive before those of the former season have all dispersed. At the height of the season the town is much overcrowded, and the entire want of a drainage system is severely felt. Fortunately good water is tolerably plentiful; for, though the wells are mostly undrinkable, and even the famous Zamzam water only available for medicinal or religious purposes, the underground conduit from beyond Arafa, completed by Sultan Selim II. in 1571, supplies to the public fountains a sweet and light water, containing, according to 'Abd el-Razzāq, a large amount of chlorides. The water is said to be free to townsmen, but is sold to the pilgrims at a rather high rate.[6]

Medieval writers celebrate the copious supplies, especially of fine fruits, brought to the city from Tāif and other fertile parts of Arabia. These fruits are still famous; rice and other foreign products are brought by sea to Jidda; mutton, milk and butter are plentifully supplied from the desert.[7] The industries all centre in the pilgrimage; the chief object of every Meccan—from the notables and sheikhs, who use their influence to gain custom for the Jidda speculators in the pilgrim traffic, down to the cicerones, pilgrim brokers, lodging-house keepers, and mendicants at the holy places—being to pillage the visitor in every possible way. The fanaticism of the Meccan is an affair of the purse; the mongrel population (for the town is by no means purely Arab) has exchanged the virtues of the Bedouin for the worst corruptions of Eastern town life, without casting off the ferocity of the desert, and it is hardly possible to find a worse certificate of character than the three parallel gashes on each cheek, called Tashrīṭ, which are the customary mark of birth in the holy city. The unspeakable vices of Mecca are a scandal to all Islām, and a constant source of wonder to pious pilgrims.[8] The slave trade has connexions with the pilgrimage which are not thoroughly clear; but under cover of the pilgrimage a great deal of importation and exportation of slaves goes on.

Since the fall of Ibn Zubair the political position of Mecca has always been dependent on the movements of the greater Mahommedan world. In the splendid times of the caliphs immense sums were lavished upon the pilgrimage and the holy city; and conversely the decay of the central authority of Islām brought with it a long period of faction, wars and misery, in which the most notable episode was the sack of Mecca by the Carmathians at the pilgrimage season of A.D. 930. The victors carried off the "black stone," which was not restored for twenty-two years, and then only for a great ransom, when it was plain that even the loss of its palladium could not destroy the sacred character of the city. Under the Fatimites Egyptian influence began to be strong in Mecca; it was opposed by the sultans of Yemen, while native princes claiming descent from the Prophet—the Hāshimite amīrs of Mecca, and after them the amīrs of the house of Qatāda (since 1202)—attained to great authority and aimed at independence; but soon after the final fall of the Abbasids the Egyptian overlordship was definitely established by sultan Bībars (A.D. 1269). The Turkish conquest of Egypt transferred the supremacy to the Ottoman sultans (1517), who treated Mecca with much favour, and during the 16th century executed great works in the sanctuary and temple. The Ottoman power, however, became gradually almost nominal, and that of the amīrs or sherīfs increased in proportion, culminating under Ghālib, whose accession dates from 1786. Then followed the wars of the Wahhābīs (see ARABIA and WAHHĀBĪS) and the restoration of Turkish rule by the troops of Mehemet 'Ali. By him the dignity of sherīf was deprived of much of its weight, and in 1827 a change of dynasty was effected by the appointment of Ibn 'Aun. Afterwards Turkish authority again decayed. Mecca is, however, officially the capital of a Turkish province, and has a governor-general and a Turkish garrison, while Mahommedan law is administered by a judge sent from Constantinople. But the real sovereign of Mecca and the Hejāz is the sherīf, who, as head of a princely family claiming descent from the Prophet, holds a sort of feudal position. The dignity of sherīf (or grand sherīf, as Europeans usually say for the sake of distinction, since all the kin of the princely houses reckoning descent from the Prophet are also named sherīfs), although by no means a religious pontificate, is highly respected owing to its traditional descent in the line of Hasan, son of the fourth caliph 'Ali. From a political point of view the sherīf is the modern counterpart of the ancient amīrs of Mecca, who were named in the public prayers immediately after the reigning caliph. When the great Mahommedan sultanates had become too much occupied in internecine wars to maintain order in the distant Hejāz, those branches of the Hassanids which from the beginning of Islām had retained rural property in Arabia usurped power in the holy cities and the adjacent Bedouin territories. About A.D. 960 they established a sort of kingdom with Mecca as capital. The influence of the princes of Mecca has varied from time to time, according to the strength of the foreign protectorate in the Hejāz or in consequence of feuds among the branches of the house; until about 1882 it was for most purposes much greater than that of the Turks. The latter were strong enough to hold the garrisoned towns, and thus the sultan was able within certain limits—playing off one against the other the two rival branches of the aristocracy, viz. the kin of Ghālib and the house of Ibn'Aun—to assert the right of designating or removing the sherīf, to whom in turn he owed the possibility of maintaining, with the aid of considerable pensions, the semblance of his much-prized lordship over the holy cities. The grand sherīf can muster a considerable force of freedmen and clients, and his kin, holding wells and lands in various places through the Hejāz, act as his deputies and administer the old Arabic customary law to the Bedouin. To this influence the Hejāz owes what little of law and order it enjoys. During the last quarter of the 19th century Turkish influence became preponderant in western Arabia, and the railway from Syria to the Hejāz tended to consolidate the sultan's supremacy. After the sherīfs, the principal family of Mecca is the house of Shaibah, which holds the hereditary custodianship of the Ka'ba.

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[1] The older fairs were not entirely deserted till the troubles of the last days of the Omayyads (Azraqī, p. 131).

[2] This is the cross-road traversed by Burckhardt (i. 109), and described by him as cut through the rocks with much labour.

[3] Iṣṭakhri gives the length of the city proper from north to south as 2 m., and the greatest breadth from the Jiyād quarter east of the great mosque across the valley and up the western slopes as two-thirds of the length.

[4] For details as to the ancient quarters of Mecca, where the several families or septs lived apart, see Azraqī, 455 pp. seq., and compare Ya'qūbī, ed. Juynboll, p. 100. The minor sacred places are described at length by Azraqī and Ibn Jubair. They are either connected with genuine memories of the Prophet and his times, or have spurious legends to conceal the fact that they were originally holy stones, wells, or the like, of heathen sanctity.

[5] Balādhurī, in his chapter on the floods of Mecca (pp. 53 seq.), says that 'Omar built two dams.

[6] The aqueduct is the successor of an older one associated with the names of Zobaida, wife of Harūn al-Rashīd, and other benefactors. But the old aqueduct was frequently out of repair, and seems to have played but a secondary part in the medieval water supply. Even the new aqueduct gave no adequate supply in Burckhardt's time.

[7] In Ibn Jubair's time large supplies were brought from the Yemen mountains.

[8] The corruption of manners in Mecca is no new thing. See the letter of the caliph Mahdi on the subject; Wüstenfeld, *Chron. Mek.*, iv. 168.

The Great Mosque and the Ḳa'ba.—Long before Mahomet the chief sanctuary of Mecca was the Ka'ba, a rude stone building without windows, and having a door 7 ft. from the ground; and so named from its resemblance to a monstrous *astragalus* (die) of about 40 ft. cube, though the shapeless structure is not really an exact cube nor even exactly rectangular.[1] The Ka'ba has been rebuilt more than once since Mahomet purged it of idols and adopted it as the chief sanctuary of Islām, but the old form has been preserved, except in secondary details;[2] so that the "Ancient House," as it is titled, is still essentially a heathen temple, adapted to the worship of Islām by the clumsy fiction that it was built by Abraham and Ishmael by divine revelation as a temple of pure monotheism; and that it was only temporarily perverted to idol worship from the time when 'Amr ibn Lohai introduced the statue of Hobal from Syria[3] till the victory of Islām. This fiction has involved the superinduction of a new mythology over the old heathen ritual, which remains practically unchanged. Thus the chief object of veneration is the black stone, which is fixed in the external angle facing Safā. The building is not exactly oriented, but it may be called the south-east corner. Its technical name is the black corner, the others being named the Yemen (south-west), Syrian (north-west), and Irāk (north-east) corners, from the lands to which they approximately point. The black stone is a small dark mass a span long, with an aspect suggesting volcanic or meteoric origin, fixed at such a height that it can be conveniently kissed by a person of middle size. It was broken by fire in the siege of A.D. 683 (not, as many authors relate, by the Carmathians), and the pieces are kept together by a silver setting. The history of this heavenly stone, given by Gabriel to Abraham, does not conceal the fact that it was originally a fetish, the most venerated of a multitude of idols and sacred stones which stood all round the sanctuary in the time of Mahomet. The Prophet destroyed the idols, but he left the characteristic form of worship—the *ṭawāf*, or sevenfold circuit of the sanctuary, the worshipper kissing or touching the objects of his veneration—and besides the black stone he recognized the so-called "southern" stone, the same presumably as that which is still touched in the ṭawāf at the Yemen corner (*Muh. in Med.* pp. 336, 425). The ceremony of the ṭawāf and the worship of stone fetishes was common to Mecca with other ancient Arabian sanctuaries.[4] It was, as it still is, a frequent religious exercise of the Meccans, and the first duty of one who returned to the city or arrived there under a vow of pilgrimage; and thus the outside of the Ka'ba was and is more important than the inside. Islām did away with the worship of idols; what was lost in interest by their suppression has been supplied by the invention of spots consecrated by recollections of Abraham, Ishmael and Hagar, or held to be acceptable places of prayer. Thus the space of ten spans between the black stone and the door, which is on the east side, between the black and Irāk corners, and a man's height from the ground, is called the *Multazam*, and here prayer should be offered after the ṭawāf with outstretched arms and breast pressed against the house. On the other side of the door, against the same wall, is a shallow trough, which is said to mark the original site of the stone on which Abraham stood to build the Ka'ba. Here the growth of the legend can be traced, for the place is now called the "kneading-place" (Ma'jan), where the cement for the Ka'ba was prepared. This name and story do not appear in the older accounts. Once more, on the north side of the Ka'ba, there projects a low semicircular wall of marble, with an opening at each end between it and the walls of the house. The space within is paved with mosaic, and is called the Ḥijr. It is included in the ṭawāf, and two slabs of *verde antico* within it are called the graves of Ishmael and Hagar, and are places of acceptable prayer. Even the golden or gilded *mīzāb* (water-spout) that projects into the Ḥijr marks a place where prayer is heard, and another such place is the part of the west wall close to the Yemen corner.

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[1] The exact measurements (which, however, vary according to different authorities) are stated to be: sides 37 ft. 2 in. and 38 ft. 4 in.; ends 31 ft. 7 in. and 29 ft.; height 35 ft.

[2] The Ka'ba of Mahomet's time was the successor of an older building, said to have been destroyed by fire. It was constructed in the still usual rude style of Arabic masonry, with string courses of timber between the stones (like Solomon's Temple). The roof rested on six pillars; the door was raised above the ground and approached by a stair (probably on account of the floods which often swept the valley); and worshippers left their shoes under the stair before entering. During the first siege of Mecca (A.D. 683), the building was burned down, the Ibn Zubair reconstructed it on an enlarged scale and in better style of solid ashlar-work. After his death his most glaring innovations (the introduction of two doors on a level with the ground, and the extension of the building lengthwise to include the Ḥijr) were corrected by Ḥajjāj, under orders from the caliph, but the building retained its more solid structure. The roof now rested on three pillars, and the height was raised one-half. The Ka'ba was again entirely rebuilt after the flood of A.D. 1626, but since Hajjāj there seem to have been no structural changes.

[3] Hobal was set up within the Temple over the pit that contained the sacred treasures. His chief function was connected with the sacred lot to which the Meccans were accustomed to betake themselves in all matters of difficulty.

[4] See Ibn Hishām i. 54, Azraki p. 80 ('Uzzā in Baṭn Marr); Yāḳūt iii. 705 (Otheydā); Bar Hebraeus on Psalm xii. 9. Stones worshipped by circling round them bore the name *dawār* or *duwār* (Krehl, *Rel. d. Araber*, p. 69). The later Arabs not unnaturally viewed such cultus as imitated from that of Mecca (Yāqūt iv. 622, cf. Dozy, *Israeliten te Mekka*, p. 125, who draws very perverse inferences).

The feeling of religious conservatism which has preserved the structural rudeness of the Ka'ba did not prohibit costly surface decoration. In Mahomet's time the outer walls were covered by a veil (or *kiswa*) of striped Yemen cloth. The caliphs substituted a covering of figured brocade, and the Egyptian government still sends with each pilgrim caravan from Cairo a new kiswa of black brocade, adorned with a broad band embroidered with golden inscriptions from the Korān, as well as a richer curtain for the door.[1] The door of two leaves, with its posts and lintel, is of silver gilt.

The interior of the Ka'ba is now opened but a few times every year for the general public, which ascends by the portable staircase brought forward for the purpose. Foreigners can obtain admission at any time for a special fee. The modern descriptions, from observations made under difficulties, are not very complete. Little change, however, seems to have been made since the time of Ibn Jubair, who describes the floor and walls as overlaid with richly variegated marbles, and the upper half of the walls as plated with silver thickly gilt, while the roof was veiled with coloured silk. Modern writers describe the place as windowless, but Ibn Jubair mentions five windows of rich stained glass from Irāk. Between the three pillars of teak hung thirteen silver lamps. A chest in the corner to the left of one entering contained Korans, and at the Irāk corner a space was cut off enclosing the stair that leads to the roof. The door to this stair (called the door of mercy—Bāb el-Raḥma) was plated with silver by the caliph Motawakkil. Here, in the time of Ibn Jubair, the *Maqām* or standing stone of Abraham was usually placed for better security, but brought out on great occasions.[2]

The houses of ancient Mecca pressed close upon the Ka'ba, the noblest families, who traced their descent from Ḳoṣai, the reputed founder of the city, having their dwellings immediately round the sanctuary. To the north of the Ka'ba was the Dār el-Nadwa, or place of assembly of the Koreish. The multiplication of pilgrims after Islām soon made it necessary to clear away the nearest dwellings and enlarge the place of prayer around the Ancient House. Omar, Othmān and Ibn Jubair had all a share in this work, but the great founder of the mosque in its present form, with its spacious area and deep colonnades, was the caliph Mahdī, who spent enormous sums in bringing costly pillars from Egypt and Syria. The work was still incomplete at his death in A.D. 785, and was finished in less sumptuous style by his successor. Subsequent repairs and additions, extending down to Turkish times, have left little of Mahdī's work untouched, though a few of the pillars probably date from his days. There are more than five hundred pillars in all, of very various style and workmanship, and the enclosure—250 paces in length and 200 in breadth, according to Burckhardt's measurement—is entered by nineteen archways irregularly disposed.

After the Ka'ba the principal points of interest in the mosque are the well Zamzam and the Maqām Ibrāhīm. The former is a deep shaft enclosed in a massive vaulted building paved with marble, and, according to Mahommedan tradition, is the source (corresponding to the Beer-lahai-roi of Gen. xvi. 14) from which Hagar drew water for her son Ishmael. The legend tells that the well was long covered up and rediscovered by 'Abd al-Moṭṭalib, the grandfather of the Prophet. Sacred wells are familiar features of Semitic sanctuaries, and Islām, retaining the well, made a quasi-biblical story for it, and endowed its tepid waters with miraculous curative virtues. They are eagerly drunk by the pilgrims, or when poured over the body are held to give a miraculous refreshment after the fatigues of religious exercise; and the manufacture of bottles or jars for carrying the water to distant countries is quite a trade. Ibn Jubair mentions a curious superstition of the Meccans, who believed that the water rose in the shaft at the full moon of the month Shaban. On this occasion a great crowd, especially of young people, thronged round the well with shouts of religious enthusiasm, while the servants of the well dashed buckets of water over their heads. The Maqām of Abraham is also connected with a relic of heathenism, the ancient holy stone which once stood on the Ma'jan, and is said to bear the prints of the patriarch's feet. The whole legend of this stone, which is full of miraculous incidents, seems to have arisen from a misconception, the Maqām Ibrāhīm in the Korān meaning the sanctuary itself; but the stone, which is a block about 3 spans in height and 2 in breadth, and in shape "like a potter's furnace" (Ibn Jubair), is certainly very ancient. No one is now allowed to see it, though the box in which it lies can be seen or touched through a grating in the little chapel that surrounds it. In the middle ages it was sometimes shown, and Ibn Jubair describes the pious enthusiasm with which he drank Zamzam water poured on the footprints. It was covered with inscriptions in an unknown character, one of which was copied by Fākihī in his history of Mecca. To judge by the facsimile in Dozy's *Israeliten te Mekka*, the character is probably essentially one with that of the Syrian Safā inscriptions, which extended through the Nejd and into the Ḥejāz.[3]

Safā and Merwa.—In religious importance these two points or "hills," connected by the Mas'ā, stand second only to the Ka'ba. Safā is an elevated platform surmounted by a triple arch, and approached by a flight of steps.[4] It lies south-east of the Ka'ba, facing the black corner, and 76 paces from the "Gate of Safā," which is architecturally the chief gate of the mosque. Merwa is a similar platform, formerly covered with a single arch, on the opposite side of the valley. It stands on a spur of the Red Mountain called Jebel Kuayḳian. The course between these two sacred points is 493 paces long, and the religious ceremony called the "sa'y" consists in traversing it seven times, beginning and ending at Safā. The lowest part of the course, between the so-called green milestones, is done at a run. This ceremony, which, as we shall presently see, is part of the omra, is generally said to be performed in memory of Hagar, who ran to and fro between the two eminences vainly seeking water for her son. The observance, however, is certainly of pagan origin; and at one time there were idols on both the so-called hills (see especially Azraqī, pp. 74, 78).

The Ceremonies and the Pilgrimage.—Before Islām the Ka'ba was the local sanctuary of the Meccans, where they prayed and did sacrifice, where oaths were administered and hard cases submitted to divine sentence according to the immemorial custom of Semitic shrines. But, besides this, Mecca was already a place of pilgrimage. Pilgrimage with the ancient Arabs was the fulfilment of a vow, which appears to have generally terminated—at least on the part of the well-to-do—in a sacrificial feast. A vow of pilgrimage might be directed to other sanctuaries than Mecca—the technical word for it (*ihlāl*) is applied, for example, to the pilgrimage to Manāt (*Bakri*, p. 519). He who was under such a vow was bound by ceremonial observances of abstinence from certain acts (*e.g.* hunting) and sensual pleasures, and in particular was forbidden to shear or comb his hair till the fulfilment of the vow. This old Semitic usage has its close parallel in the vow of the Nazarite. It was not peculiarly connected with Mecca; at Tāif, for example, it was customary on return to the city after an absence to present oneself at the sanctuary, and there shear the hair (*Muh. in Med.*, p. 381). Pilgrimages to Mecca were not tied to a single time, but they were naturally associated with festive occasions, and especially with the great annual feast and market. The pilgrimage was so intimately connected with the wellbeing of Mecca, and had already such a hold on the Arabs round about, that Mahomet could not afford to sacrifice it to an abstract purity of religion, and thus the old usages were transplanted into Islām in the double form of the omra or vow of pilgrimage to Mecca, which can be discharged at any time, and the ḥajj or pilgrimage at the great annual feast. The latter closes with a visit to the Ka'ba, but its essential ceremonies lie outside Mecca, at the neighbouring shrines where the old Arabs gathered before the Meccan fair.

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[1] The old *kiswa* is removed on the 25th day of the month before the pilgrimage, and fragments of it are bought by the pilgrims as charms. Till the 10th day of the pilgrimage month the Ka'ba is bare.

[2] Before Islām the Ka'ba was opened every Monday and Thursday; in the time of Ibn Jubair it was opened with considerable ceremony every Monday and Friday, and daily in the month Rajab. But, though prayer within the building is favoured by the example of the Prophet, it is not compulsory on the Moslem, and even in the time of Ibn Baṭūṭa the opportunities of entrance were reduced to Friday and the birthday of the Prophet.

[3] See De Vogüé, *Syrie centrale: inscr. sem.*; Lady Anne Blunt *Pilgrimage of Nejd*, ii., and W. R. Smith, in the *Athenaeum*, March 20, 1880.

[4] Ibn Jubair speaks of fourteen steps, Ali Bey of four, Burckhardt of three. The surrounding ground no doubt has risen so that the old name "hill of Safā" is now inapplicable.

The omra begins at some point outside the Ḥaram (or holy territory), generally at Tanim, both for convenience sake and because Ayesha began the omra there in the year 10 of the Hegira. The pilgrim enters the Ḥaram in the antique and scanty pilgrimage dress (iḥrām), consisting of two cloths wound round his person in a way prescribed by ritual. His devotion is expressed in shouts of "Labbeyka" (a word of obscure origin and meaning; he enters the great mosque, performs the ṭawāf and the sa'y[1] and then has his head shaved and resumes his common dress. This ceremony is now generally combined with the ḥajj, or is performed by every stranger or traveller when he enters Mecca, and the iḥrām (which involves the acts of abstinence already referred to) is assumed at a considerable distance from the city. But it is also proper during one's residence in the holy city to perform at least one omra from Tanim in connexion with a visit to the mosque of Ayesha there. The triviality of these rites is ill concealed by the legends of the sa'y of Hagar and of the ṭawāf being first performed by Adam in imitation of the circuit of the angels about the throne of God; the meaning of their ceremonies seems to have been almost a blank to the Arabs before Islām, whose religion had become a mere formal tradition. We do not even know to what deity the worship expressed in the ṭawāf was properly addressed. There is a tradition that the Ka'ba was a temple of Saturn (Shahrastāni, p. 431); perhaps the most distinctive feature of the shrine may be sought in the sacred doves which still enjoy the protection of the sanctuary. These recall the sacred doves of Ascalon (Philo vi. 200 of Richter's ed.), and suggests Venus-worship as at least one element (cf. Herod i. 131, iii. 8; Ephr. Syr., *Op. Syr.* ii. 457).

To the ordinary pilgrim the omra has become so much an episode of the ḥajj that it is described by some European pilgrims as a mere visit to the mosque of Ayesha; a better conception of its original significance is got from the Meccan feast of the seventh month (Rajab), graphically described by Ibn Jubair from his observations in A.D. 1184. Rajab was one of the ancient sacred months, and the feast, which extended through the whole month and was a joyful season of hospitality and thanksgiving, no doubt represents the ancient feasts of Mecca more exactly than the ceremonies of the ḥajj, in which old usage has been overlaid by traditions and glosses of Islām. The omra was performed by crowds from day to day, especially at new and full moon.[2] The new moon celebration was nocturnal; the road to Tanim, the Mas'ā, and the mosque were brilliantly illuminated; and the appearing of the moon was greeted with noisy music. A genuine old Arab market was held, for the wild Bedouins of the Yemen mountains came in thousands to barter their cattle and fruits for clothing, and deemed that to absent themselves would bring drought and cattle plague in their homes. Though ignorant of the legal ritual and prayers, they performed the ṭawāf with enthusiasm, throwing themselves against the Ka'ba and clinging to its curtains as a child clings to its mother. They also made a point of entering the Ka'ba. The 29th of the month was the feast day of the Meccan women, when they and their little ones had the Ka'ba to themselves without the presence even of the Sheybās.

The central and essential ceremonies of the ḥajj or greater pilgrimage are those of the day of Arafa, the 9th of the "pilgrimage month" (Dhu'l Ḥijja), the last of the Arab year; and every Moslem who is his own master, and can command the necessary means, is bound to join in these once in his life, or to have them fulfilled by a substitute on his behalf and at his expense. By them the pilgrim becomes as pure from sin as when he was born, and gains for the rest of his life the honourable title of ḥajj. Neglect of many other parts of the pilgrim ceremonial may be compensated by offerings, but to miss the "stand" (*woqūf*) at Arafa is to miss the pilgrimage. Arafa or Arafat is a space, artificially limited, round a small isolated hill called the Hill of Mercy, a little way outside the holy territory, on the road from Mecca to Taif. One leaving Mecca after midday can easily reach the place on foot the same evening. The road is first northwards along the Mecca valley and then turns eastward. It leads through the straggling village of Mina, occupying a long narrow valley (Wādi Mina), two to three hours from Mecca, and thence by the mosque of Mozdalifa over a narrow pass opening out into the plain of Arafa, which is an expansion of the great Wādi Naman, through which the Taif road descends from Mount Kara. The lofty and rugged mountains of the Hodheyl tower over the plain on the north side and overshadow the little Hill of Mercy, which is one of those bosses of weathered granite so common in the Hejāz. Arafa lay quite near Dhul-Majaz, where, according to Arabian tradition, a great fair was held from the 1st to the 8th of the pilgrimage month; and the ceremonies from which the ḥajj was derived were originally an appendix to this fair. Now, on the contrary, the pilgrim is expected to follow as closely as may be the movements of the prophet at his "farewell pilgrimage" in the year 10 of the Hegira (A.D. 632). He therefore leaves Mecca in pilgrim garb on the 8th of Dhu'l Ḥijja, called the day of *tarwīya* (an obscure and pre-Islamic name), and, strictly speaking, should spend the night at Mina. It is now, however, customary to go right on and encamp at once at Arafa. The night should be spent in devotion, but the coffee booths do a lively trade, and songs are as common as prayers. Next forenoon the pilgrim is free to move about, and towards midday he may if he please hear a sermon. In the afternoon the essential ceremony begins; it consists simply in "standing" on Arafa shouting "Labbeyka" and reciting prayers and texts till sunset. After the sun is down the vast assemblage breaks up, and a rush (technically *ifāḍa*, *daf*', *nafr* is made in the utmost confusion to Mozdalifa, where the night prayer is said and the night spent. Before sunrise next morning (the 10th) a second "stand" like that on Arafa is made for a short time by torchlight round the mosque of Mozdalifa, but before the sun is fairly up all must be in motion in the second *ifāḍa* towards Mina. The day thus begun is the "day of sacrifice," and has four ceremonies—(1) to pelt with seven stones a cairn (*jamrat al 'aqaba*) at the eastern end of W. Mina, (2) to slay a victim at Mina and hold a sacrificial meal, part of the flesh being also dried and so preserved, or given to the poor,[3] (3) to be shaved and so terminate the *iḥrām*, (4) to make the third *ifāḍa*, *i.e.* go to Mecca and perform the ṭawāf and sa'y (*'omrat al-ifāḍa*), returning thereafter to Mina. The sacrifice and visit to Mecca may, however, be delayed till the 11th, 12th or 13th. These are the days of Mina, a fair and joyous feast, with no special ceremony except that each day the pilgrim is expected to throw seven stones at the *jamrat al 'aqaba*, and also at each of two similar cairns in the valley. The stones are thrown in the name of Allah, and are generally thought to be directed at the devil. This is, however, a custom older than Islām, and a tradition in Azraqī, p. 412, represents it as an act of worship to idols at Mina. As the stones are thrown on the days of the fair, it is not unlikely that they have something to do with the old Arab mode of closing a sale by the purchaser throwing a stone (Bīrūni, p. 328).[4] The pilgrims leave Mina on the 12th or 13th, and the ḥajj is then over. (See further MAHOMMEDAN RELIGION.)

The colourless character of these ceremonies is plainly due to the fact that they are nothing more than expurgated heathen rites. In Islām proper they have no *raison d'être*; the legends about Adam and Eve on Arafa, about Abraham's sacrifice of the ram at Thabū by Mina, imitated in the sacrifices of the pilgrimage, are clumsy afterthoughts, as appears from their variations and only partial acceptance. It is not so easy to get at the nature of the original rites, which Islām was careful to suppress. But we find mention of practices condemned by the orthodox, or forming no part of the Moslem ritual, which may be regarded as traces of an older ceremonial. Such are nocturnal illuminations at Mina (Ibn Baṭūta i. 396), Arafa and Mozdalifa (Ibn Jubair, 179), and ṭawāfs performed by the ignorant at holy spots at Arafa not recognized by law (Snouck-Hurgronje p. 149 sqq.). We know that the rites at Mozdalifa were originally connected with a holy hill bearing the name of the god Quzah (the Edomite Kozē) whose bow is the rainbow, and there is reason to think that the *ifāḍas* from Arafa and Quzah, which were not made as now after sunset and before sunrise, but when the sun rested on the tops of the mountains, were ceremonies of farewell and salutation to the sun-god.

The statistics of the pilgrimage cannot be given with certainty and vary much from year to year. The quarantine office keeps a record of arrivals by sea at Jidda (66,000 for 1904); but to these must be added those travelling by land from Cairo, Damascus and Irák, the pilgrims who reach Medina from Yanbu and go on to Mecca, and those from all parts of the peninsula. Burckhardt in 1814 estimated the crowd at Arafa at 70,000, Burton in 1853 at 50,000, 'Abd el-Razzāk in 1858 at 60,000. This great assemblage is always a dangerous centre of infection, and the days of Mina especially, spent under circumstances originally adapted only for a Bedouin fair, with no provisions for proper cleanliness, and with the air full of the smell of putrefying offal and flesh drying in the sun, produce much sickness.

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[1] The latter perhaps was no part of the ancient omra; see Snouck-Hurgronje, *Het Mekkaansche Feest* (1880) p. 115 sqq.

[2] The 27th was also a great day, but this day was in commemoration of the rebuilding of the Ka'ba by Ibn Jubair.

[3] The sacrifice is not indispensable except for those who can afford it and are combining the hajj with the omra.

[4] On the similar pelting of the supposed graves of Abū Lahab and his wife (Ibn Jubair, p. 110) and of Abū Righāl at Mughammas, see Nöldeke's translation of Tabari, p. 208.

LITERATURE.—Besides the Arabic geographers and cosmographers, we have Ibn 'Abd Rabbih's description of the mosque, early in the 10th century (*'Iḳd Farīd*, Cairo ed., iii. 362 sqq.), but above all the admirable record of Ibn Jubair (A.D. 1184), by far the best account extant of Mecca and the pilgrimage. It has been much pillaged by Ibn Baṭūta. The Arabic historians are largely occupied with fabulous matter as to Mecca before Islām; for these legends the reader may refer to C. de Perceval's *Essai*. How little confidence can be placed in the pre-Islamic history appears very clearly from the distorted accounts of Abraha's excursion against the Hejāz, which fell but a few years before the birth of the Prophet, and is the first event in Meccan history which has confirmation from other sources. See Nöldeke's version of Ṭabarī, p. 204 sqq. For the period of the Prophet, Ibn Hishām and Wāḳidī are valuable sources in topography as well as history. Of the special histories and descriptions of Mecca published by Wüstenfeld (*Chroniken der Stadt Mekka*, 3 vols., 1857–1859, with an abstract in German, 1861), the most valuable is that of Azraqi It has passed through the hands of several editors, but the oldest part goes back to the beginning of the 9th Christian century. Kutbeddin's history (vol. iii. of the *Chroniken*) goes down with the additions of his nephew to A.D. 1592.

Of European descriptions of Mecca from personal observation the best is Burckhardt's *Travels in Arabia* (cited above from the 8vo ed., 1829). *The Travels of Aly Bey* (Badia, London, 1816) describe a visit in 1807; Burton's *Pilgrimage* (3rd ed., 1879) often supplements Burckhardt; Von Maltzan's *Wallfahrt nach Mekka* (1865) is lively but very slight. 'Abd el-Razzāq's report to the government of India on the pilgrimage of 1858 is specially directed to sanitary questions; C. Snouck-Hurgronje, *Mekka* (2 vols., and a collection of photographs, The Hague, 1888–1889), gives a description of the Meccan sanctuary and of the public and private life of the Meccans as observed by the author during a sojourn in the holy city in 1884–1885 and a political history of Mecca from native sources from the Hegira till 1884. For the pilgrimage see particularly Snouck-Hurgronje, *Het Mekkaansche Feest* (Leiden, 1880). (W. R. S.)

MECHANICS. The subject of mechanics may be divided into two parts: (1) theoretical or abstract mechanics, and (2) applied mechanics.

I. THEORETICAL MECHANICS

Historically theoretical mechanics began with the study of practical contrivances such as the lever, and the name *mechanics* Gr. τὰ μηχανικά), which might more properly be restricted to the theory of mechanisms, and which was indeed used in this narrower sense by Newton, has clung to it, although the subject has long attained a far wider scope. In recent times it has been proposed to adopt the term *dynamics* (from Gr. δύναμις force,) as including the whole science of the action of force on bodies, whether at rest or in motion. The subject is usually expounded under the two divisions of *statics* and *kinetics*, the former dealing with the conditions of rest or equilibrium and the latter with the phenomena of motion as affected by force. To this latter division the old name of *dynamics* (in a restricted sense) is still often applied. The mere geometrical description and analysis of various types of motion, apart from the consideration of the forces concerned, belongs to *kinematics*. This is sometimes discussed as a separate theory, but for our present purposes it is more convenient to introduce kinematical motions as they are required. We follow also the traditional practice of dealing first with statics and then with kinetics. This is, in the main, the historical order of development, and for purposes of exposition it has many advantages. The laws of equilibrium are, it is true, necessarily included as a particular case under those of motion; but there is no real inconvenience in formulating as the basis of statics a few provisional postulates which are afterwards seen to be comprehended in a more general scheme.

The whole subject rests ultimately on the Newtonian laws of motion and on some natural extensions of them. As these laws are discussed under a separate heading (MOTION, LAWS OF), it is here only necessary to indicate the standpoint from which the present article is written. It is a purely empirical one. Guided by experience, we are able to frame rules which enable us to say with more or less accuracy what will be the consequences, or what were the antecedents, of a given state of things. These rules are sometimes dignified by the name of "laws of nature," but they have relation to our present state of knowledge and to the degree of skill with which we have succeeded in giving more or less compact expression to it. They are therefore liable to be modified from time to time, or to be superseded by more convenient or more comprehensive modes of statement. Again, we do not aim at anything so hopeless, or indeed so useless, as a *complete* description of any phenomenon. Some features are naturally more important or more interesting to us than others; by their relative simplicity and evident constancy they have the first hold on our attention, whilst those which are apparently accidental and vary from one occasion to another are ignored, or postponed for later examination. It follows that for the purposes of such description as is possible some process of abstraction is inevitable if our statements are to be simple and definite. Thus in studying the flight of a stone through the air we replace the body in imagination by a mathematical point endowed with a mass-coefficient. The size and shape, the complicated spinning motion which it is seen to execute, the internal strains and vibrations which doubtless take place, are all sacrificed in the mental picture in order that attention may be concentrated on those features of the phenomenon which are in the first place most interesting to us. At a later stage in our subject the conception of the ideal rigid body is introduced; this enables us to fill in some details which were previously wanting, but others are still omitted. Again, the conception of a force as concentrated in a mathematical line is as unreal as that of a mass concentrated in a point, but it is a convenient fiction for our purpose, owing to the simplicity which it lends to our statements.

The laws which are to be imposed on these ideal representations are in the first instance largely at our choice. Any scheme of abstract dynamics constructed in this way, provided it be self-consistent, is mathematically legitimate; but from the physical point of view we require that it should help us to picture the sequence of phenomena as they actually occur. Its success or failure in this respect can only be judged a posteriori by comparison of the results to which it leads with the facts. It is to be noticed, moreover, that all available tests apply only to the scheme as a whole; owing to the complexity of phenomena we cannot submit any one of its postulates to verification apart from the rest.

It is from this point of view that the question of relativity of motion, which is often felt to be a stumbling-block on the very threshold of the subject, is to be judged. By "motion" we mean of necessity motion relative to some frame of reference which is conventionally spoken of as "fixed." In the earlier stages of our subject this may be any rigid, or apparently rigid, structure fixed relatively to the earth. If we meet with phenomena which do not fit easily into this view, we have the alternatives either to modify our assumed laws of motion, or to call to our aid adventitious forces, or to examine whether the discrepancy can be reconciled by the simpler expedient of a new basis of reference. It is hardly necessary to say that the latter procedure has hitherto been found to be adequate. As a first step we adopt a system of rectangular axes whose origin is fixed in the earth, but whose directions are fixed by relation to the stars; in the planetary theory the origin is transferred to the sun, and afterwards to the mass-centre of the solar system; and so on. At each step there is a gain in accuracy and comprehensiveness; and the conviction is cherished that *some* system of rectangular axes exists with respect to which the Newtonian scheme holds with all imaginable accuracy.

A similar account might be given of the conception of time as a measurable quantity, but the remarks which it is necessary to make under this head will find a place later.

The following synopsis shows the scheme on which the treatment is based:—

Part 1.—Statics.

1. Statics of a particle.
2. Statics of a system of particles.
3. Plane kinematics of a rigid body.
4. Plane statics.
5. Graphical statics.
6. Theory of frames.
7. Three-dimensional kinematics of a rigid body.
8. Three-dimensional statics.
9. Work.
10. Statics of inextensible chains.
11. Theory of mass-systems.

Part 2.—Kinetics.

12. Rectilinear motion.
13. General motion of a particle.
14. Central forces. Hodograph.
15. Kinetics of a system of discrete particles.
16. Kinetics of a rigid body. Fundamental principles.
17. Two-dimensional problems.
18. Equations of motion in three dimensions.
19. Free motion of a solid.
20. Motion of a solid of revolution.
21. Moving axes of reference.
22. Equations of motion in generalized co-ordinates.
23. Stability of equilibrium. Theory of vibrations.

PART I.—STATICS

§ 1. *Statics of a Particle.*—By a *particle* is meant a body whose position can for the purpose in hand be sufficiently specified by a mathematical point. It need not be "infinitely small," or even small compared with ordinary standards; thus in astronomy such vast bodies as the sun, the earth, and the other planets can for many purposes be treated merely as points endowed with mass.

A *force* is conceived as an effort having a certain direction and a certain magnitude. It is therefore adequately represented, for mathematical purposes, by a straight line AB drawn in the direction in question, of length proportional (on any convenient scale) to the magnitude of the force. In other words, a force is mathematically of the nature of a "vector" (see VECTOR ANALYSIS, QUATERNIONS). In most questions of pure statics we are concerned only with the *ratios* of the various forces which enter into the problem, so that it is indifferent what *unit* of force is adopted. For many purposes a gravitational system of measurement is most natural; thus we speak of a force of so many pounds or so many kilogrammes. The "absolute" system of measurement will be referred to below in PART II., KINETICS. It is to be remembered that all "force" is of the nature of a push or a pull, and that according to the accepted terminology of modern mechanics such phrases as "force of inertia," "accelerating force," "moving force," once classical, are proscribed. This rigorous limitation of the meaning of the word is of comparatively recent origin, and it is perhaps to be regretted that some more technical term has not been devised, but the convention must now be regarded as established.

The fundamental postulate of this part of our subject is that the two forces acting on a particle may be compounded by the "parallelogram rule." Thus, if the two forces P,Q be represented by the lines OA, OB, they can be replaced by a single force R represented by the diagonal OC of the parallelogram determined by OA, OB. This is of course a physical assumption whose propriety is justified solely by experience. We shall see later that it is implied in Newton's statement of his Second Law of motion. In modern language, forces are compounded by "vector-addition"; thus, if we draw in succession vectors $\overrightarrow{HK}$, $\overrightarrow{KL}$ to represent P, Q, the force R is represented by the vector $\overrightarrow{HL}$ which is the "geometric sum" of $\overrightarrow{HK}$, $\overrightarrow{KL}$.

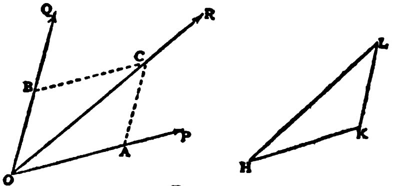


FIG. 1.

By successive applications of the above rule any number of forces acting on a particle may be replaced by a single force which is the vector-sum of the given forces; this single force is called the *resultant.* Thus if $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$ . . . , $\overrightarrow{HK}$ be vectors representing the given forces, the resultant will be given by $\overrightarrow{AK}$. It will be understood that the figure ABCD . . . K need not be confined to one plane.

If, in particular, the point K coincides with A, so that the resultant vanishes, the given system of forces is said to be *in equilibrium*—*i.e.* the particle could remain permanently at rest under its action. This is the proposition known as the *polygon of forces.* In the particular case of three forces it reduces to the *triangle of forces,* viz. "If three forces acting on a particle are represented as to magnitude and direction by the sides of a triangle taken in order, they are in equilibrium."

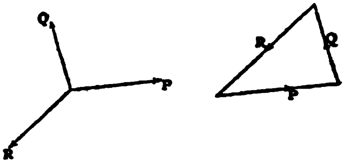


FIG. 2.

A sort of converse proposition is frequently useful, viz. if three forces acting on a particle be in equilibrium, and any triangle be constructed whose sides are respectively parallel to the forces, the magnitudes of the forces will be to one another as the corresponding sides of the triangle. This follows from the fact that all such triangles are necessarily similar.

As a simple example of the geometrical method of treating statical problems we may consider the equilibrium of a particle on a "rough" inclined plane. The usual empirical law of sliding friction is that the mutual action between two plane surfaces in contact, or between a particle and a curve or surface, cannot make with the normal an angle exceeding a certain limit λ called the *angle of friction.* If the conditions of equilibrium require an obliquity greater than this, sliding will take place. The precise value of λ will vary with the nature and condition of the surfaces in contact. In the case of a body simply resting on an inclined plane, the reaction must of course be vertical, for equilibrium, and the slope α of the plane must therefore not exceed λ. For this reason λ is also known as the *angle of repose.* If $\alpha > \lambda$, a force P must be applied in order to maintain equilibrium; let θ be the inclination of P to the plane, as shown in the left-hand diagram. The relations between this force P, the gravity W of the body, and the reaction S of the plane are then determined by a triangle of forces HKL. Since the inclination of S to the normal cannot exceed λ on either side, the value of P must lie between two limits which are represented by L_1H, L_2H, in the right-hand diagram. Denoting these limits by P_1, P_2, we have

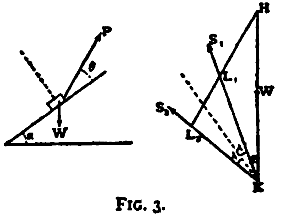


FIG. 3.

$$P_1/W = L_1H/HK = \sin(\alpha-\lambda)/\cos(\theta+\lambda),$$
$$P_2/W = L_2H/HK = \sin(\alpha+\lambda)/\cos(\theta-\lambda).$$

It appears, moreover, that if θ be varied P will be least when L_1H is at right angles to KL_1, in which case $P_1 = W \sin(\alpha-\lambda)$, corresponding to $\theta = -\lambda$.

Just as two or more forces can be combined into a single resultant, so a single force may be *resolved* into *components* acting in assigned directions. Thus a force can be uniquely resolved into two components acting in two assigned directions in the same plane with it by an inversion of the parallelogram construction of fig. 1. If, as is usually most convenient, the two assigned directions are at right angles, the two components of a force P will be P cos θ, P sin θ, where θ is the inclination of P to the direction of the former component. This leads to formulae for the analytical reduction of a system of coplanar forces acting on a particle. Adopting rectangular axes Ox, Oy, in the plane of the forces, and distinguishing the various forces of the system by suffixes, we can replace the system by two forces X, Y, in the direction of co-ordinate axes; viz.—

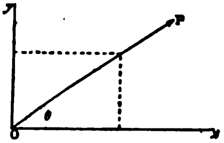


FIG. 4.

$$\left.\begin{aligned} X &= P_1 \cos\theta_1 + P_2 \cos\theta_2 + \ldots = \Sigma\,(P\cos\theta), \\ Y &= P_1 \sin\theta_1 + P_2 \sin\theta_2 + \ldots = \Sigma\,(P\sin\theta). \end{aligned}\right\} \tag{1}$$

These two forces X, Y, may be combined into a single resultant R making an angle ϕ with Ox, provided

$$X = R\cos\phi, \quad Y = R\sin\phi, \tag{2}$$

whence

$$R^2 = X^2 + Y^2, \quad \tan\phi = Y/X. \tag{3}$$

For equilibrium we must have $R=0$, which requires $X=0$, $Y=0$; in words, the sum of the components of the system must be zero for each of two perpendicular directions in the plane.

A similar procedure applies to a three-dimensional system. Thus if, O being the origin, $\overrightarrow{OH}$ represent any force P of the system, the planes drawn through H parallel to the co-ordinate planes will enclose with the latter a parallelepiped, and it is evident that $\overrightarrow{OH}$ is the geometric sum of $\overrightarrow{OA}$, $\overrightarrow{AN}$, $\overrightarrow{NH}$, or $\overrightarrow{OA}$, $\overrightarrow{OB}$, $\overrightarrow{OC}$, in the figure. Hence P is equivalent to three forces Pl, Pm, Pn acting along Ox, Oy, Oz, respectively, where l, m, n, are the "direction-ratios" of $\overrightarrow{OH}$. The whole system can be reduced in this way to three forces

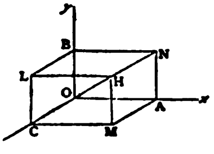


FIG. 5.

$$X = \Sigma\,(Pl), \quad Y = \Sigma\,(Pm), \quad Z = \Sigma\,(Pn), \tag{4}$$

acting along the co-ordinate axes. These can again be combined into a single resultant R acting in the direction (λ, μ, ν), provided

$$X = R\lambda,\ Y = R\mu,\ Z = R\nu. \tag{5}$$

If the axes are rectangular, the direction-ratios become direction-cosines, so that $\lambda^2 + \mu^2 + \nu^2 = 1$, whence

$$R^2 = X^2 + Y^2 + Z^2. \tag{6}$$

The conditions of equilibrium are $X=0$, $Y=0$, $Z=0$.

§ 2. *Statics of a System of Particles.*—We assume that the mutual forces between the pairs of particles, whatever their nature, are subject to the "Law of Action and Reaction" (Newton's Third Law); *i.e.* the force exerted by a particle A on a particle B, and the force exerted by B on A, are equal and opposite in the line AB. The problem of determining the possible configurations of equilibrium of a system of particles subject to extraneous forces which are known functions of the positions of the particles, and to internal forces which are known functions of the distances of the pairs of particles between which they act, is in general determinate For if n be the number of particles, the $3n$ conditions of equilibrium (three for each particle) are equal in number to the $3n$ Cartesian (or other) co-ordinates of the particles, which are to be found. If the system be subject to frictionless constraints, *e.g.* if some of the particles be constrained to lie on smooth surfaces, or if pairs of particles be connected by inextensible strings, then for each geometrical relation thus introduced we have an unknown reaction (*e.g.* the pressure of the smooth surface, or the tension of the string), so that the problem is still determinate.

The case of the *funicular polygon* will be of use to us later. A number of particles attached at various points of a string are acted on by given extraneous forces P_1, P_2, P_3 . . . respectively. The relation between the three forces acting on any particle, viz. the extraneous force and the tensions in the two adjacent portions of the string can be exhibited by means of a triangle of forces; and if the successive triangles be drawn to the same scale they can be fitted together so as to constitute a single *force-diagram*, as shown in fig. 6. This diagram consists of a polygon whose successive sides represent the given forces P_1, P_2, P_3 . . . , and of a series of lines connecting the vertices with a point O. These latter lines measure the tensions in the successive portions of string. As a special, but very important case, the forces P_1, P_2, P_3 . . . may be parallel, *e.g.* they may be the weights of the several particles. The polygon of forces is then made up of segments of a vertical line. We note that the tensions have now the same horizontal projection (represented by the dotted line in fig. 7). It is further of interest to note that if the weights be all equal, and at equal horizontal intervals, the vertices of the funicular will lie on a parabola whose axis is vertical. To prove this statement, let A, B, C, D . . . be successive vertices, and let H, K . . . be the middle points of AC, BD . . . ; then BH, CK . . . will be vertical by the hypothesis, and since the geometric sum of $\overrightarrow{BA}$, $\overrightarrow{BC}$ is represented by $2\overrightarrow{BH}$, the tension in BA : tension in BC : weight at B as BA : BC : 2BH. The tensions in the successive portions of the string are therefore proportional to the respective lengths, and the lines BH, CK . . . are all equal. Hence AD, BC are parallel and are bisected by the same vertical line; and a parabola with vertical axis can therefore be described through A, B, C, D. The same holds for the four points B, C, D, E and so on; but since a parabola is uniquely determined by the direction of its axis and by three points on the curve, the successive parabolas ABCD, BCDE, CDEF . . . must be coincident.

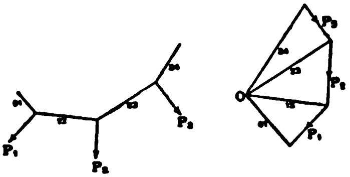


FIG. 6.

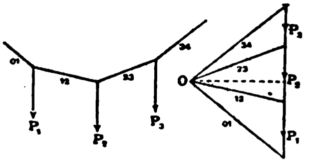


FIG. 7.

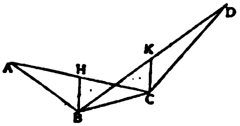


FIG. 8.

§ 3. *Plane Kinematics of a Rigid Body.*—The ideal *rigid body* is one in which the distance between any two points is invariable. For the present we confine ourselves to the consideration of displacements in two dimensions, so that the body is adequately represented by a thin lamina or plate.

The position of a lamina movable in its own plane is determinate when we know the positions of any two points A, B of it. Since the four co-ordinates (Cartesian or other) of these two points are connected by the relation which expresses the invariability of the length AB, it is plain that virtually three independent elements are required and suffice to specify the position of the lamina. For instance, the lamina may in general be fixed by connecting any three points of it by rigid links to three fixed points in its plane. The three independent elements may be chosen in a variety of ways (*e.g.* they may be the lengths

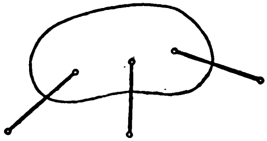


FIG. 9.

of the three links in the above example). They may be called (in a generalized sense) the *co-ordinates* of the lamina. The lamina when perfectly free to move in its own plane is said to have *three degrees of freedom*.

By a theorem due to M. Chasles any displacement whatever of the lamina in its own plane is equivalent to a rotation about some finite or infinitely distant point J. For suppose that in consequence of the displacement a point of the lamina is brought from A to B, whilst the point of the lamina which was originally at B is brought to C. Since AB, BC, are two different positions of the same line in the lamina they are equal, and it is evident that the rotation could have been effected by a rotation about J, the centre of the circle ABC, through an angle AJB. As a special case the three points A, B, C may be in a straight line; J is then at infinity and the displacement is equivalent to a pure *translation*, since every point of the lamina is now displaced parallel to AB through a space equal to AB.

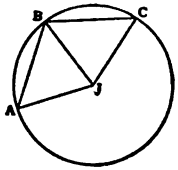


FIG. 10.

Next, consider any continuous motion of the lamina. The latter may be brought from any one of its positions to a neighbouring one by a rotation about the proper centre. The limiting position J of this centre, when the two positions are taken infinitely close to one another, is called the *instantaneous centre*. If P, P′ be consecutive positions of the same point, and $\delta\theta$ the corresponding angle of rotation, then ultimately PP′ is at right angles to JP and equal to JP . $\delta\theta$. The instantaneous centre will have a certain locus in space, and a certain locus in the lamina. These two loci are called *pole-curves* or *centrodes*, and are sometimes distinguished as the *space-centrode* and the *body-centrode*, respectively. In the continuous motion in question the latter curve rolls without slipping on the former (M. Chasles). Consider in fact any series of successive positions 1, 2, 3 . . . of the lamina (fig. 11); and let J_{12}, J_{23}, J_{34} . . . be the positions in space of the centres of the rotations by which the lamina can be brought from the first position to the second, from the second to the third, and so on. Further, in the position 1, let J_{12}, J'_{23}, J'_{34} . . . be the points of the lamina which have become the successive centres of rotation. The given series of positions will be assumed in succession if we imagine the lamina to rotate first about J_{12} until J'_{23} comes into coincidence with J_{23}, then about J_{23} until J'_{34} comes into coincidence with J_{34}, and so on. This is equivalent to imagining the polygon $J_{12}\,J'_{23}\,J'_{34}\ldots$, supposed fixed in the lamina, to roll on the polygon $J_{12}\,J_{23}\,J_{34}\ldots$, which is supposed fixed in space. By imagining the successive positions to be taken infinitely close to one another we derive the theorem stated. The particular case where both centrodes are circles is specially important in mechanism.

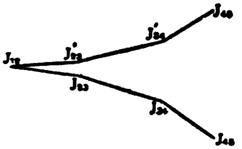


FIG. 11.

The theory may be illustrated by the case of "three-bar motion." Let ABCD be any quadrilateral formed of jointed links. If, AB being held fixed, the quadrilateral be slightly deformed, it is obvious that the instantaneous centre J will be at the intersection of the straight lines AD, BC, since the displacements of the points D, C are necessarily at right angles to AD, BC, respectively. Hence these displacements are proportional to JD, JC, and therefore to DD′, CC′, where C′D′ is any line drawn parallel to CD, meeting BC, AD in C′, D′, respectively. The determination of the centrodes in three-bar motion is in general complicated, but in one case, that of the "crossed parallelogram" (fig. 13), they assume simple forms. We then have AB = DC and AD = BC, and from the symmetries of the figure it is plain that

$$AJ + JB = CJ + JD = AD.$$

Hence the locus of J relative to AB, and the locus relative to CD are equal ellipses of which A, B and C, D are respectively the foci. It may be noticed that the lamina in fig. 9 is not, strictly speaking, fixed, but admits of infinitesimal displacement, whenever the directions of the three links are concurrent (or parallel).

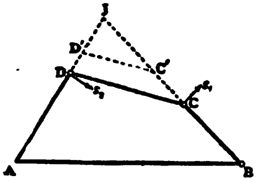


FIG. 12.

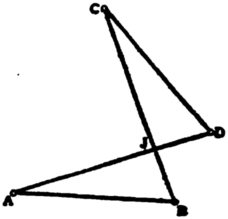


FIG. 13.

The matter may of course be treated analytically, but we shall only require the formula for infinitely small displacements. If the origin of rectangular axes fixed in the lamina be shifted through a space whose projections on the original directions of the axes are λ, μ, and if the axes are simultaneously turned through an angle ϵ, the co-ordinates of a point of the lamina, relative to the original axes, are changed from x, y to $\lambda + x\cos\epsilon - y\sin\epsilon$, $\mu + x\sin\epsilon + y\cos\epsilon$, or $\lambda + x - y\epsilon$, $\mu + x\epsilon + y$, ultimately. Hence the component displacements are ultimately

$$\delta x = \lambda - y\epsilon,\ \delta y = \mu + x\epsilon \tag{1}$$

If we equate these to zero we get the co-ordinates of the instantaneous centre.

§ 4. *Plane Statics.*—The statics of a rigid body rests on the following two assumptions:—

(i) A force may be supposed to be applied indifferently at any point in its line of action. In other words, a force is of the nature of a "bound" or "localized" vector; it is regarded as resident in a certain line, but has no special reference to any particular point of the line.

(ii) Two forces in intersecting lines may be replaced by a force which is their geometric sum, acting through the intersection. The theory of parallel forces is included as a limiting case. For if O, A, B be any three points, and m, n any scalar quantities, we have in vectors

$$m\,.\,\overrightarrow{OA} + n\,.\,\overrightarrow{OB} = (m+n)\,\overrightarrow{OC}, \tag{1}$$

provided

$$m\,.\,\overrightarrow{CA} + n\,.\,\overrightarrow{CB} = 0. \tag{2}$$

Hence if forces P, Q act in OA, OB, the resultant R will pass through C, provided

$$m = P/OA,\quad n = Q/OB:$$

also

$$R = P\,.\,OC/OA + Q\,.\,OC/OB, \tag{3}$$

and

$$P\,.\,AC : Q\,.\,CB = OA : OB. \tag{4}$$

These formulae give a means of constructing the resultant by means of any transversal AB cutting the lines of action. If we now imagine the point O to recede to infinity, the forces P, Q and the resultant R are parallel, and we have

$$R = P + Q,\quad P\,.\,AC = Q\,.\,CB. \tag{5}$$

When P, Q have opposite signs the point C divides AB externally on the side of the greater force. The investigation fails when P+Q = 0, since it leads to an infinitely small resultant acting in an infinitely distant line. A combination of two equal, parallel, but oppositely directed forces cannot in fact be replaced by anything simpler, and must therefore be recognized as an independent entity in statics. It was called by L. Poinsot, who first systematically investigated its properties, a *couple*.

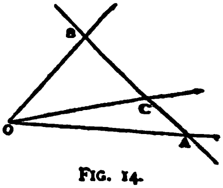


FIG. 14.

We now restrict ourselves for the present to the systems of forces in one plane. By successive applications of (ii) any such coplanar system can in general be reduced to a *single resultant* acting in a definite line. As exceptional cases the system may reduce to a couple, or it may be in equilibrium.

The *moment* of a force about a point O is the product of the force into the perpendicular drawn to its line of action from O, this perpendicular being reckoned positive or negative according as O lies on one side or other of the line of action. If we mark off a segment AB along the line of action so as to represent the force completely, the moment is represented as to magnitude by twice the area of the triangle OAB, and the usual convention as to sign is that the area is to be reckoned positive or negative according as the letters O, A, B, occur in "counter-clockwise" or "clockwise" order.

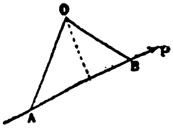


FIG. 15.

The sum of the moments of two forces about any point O is equal to the moment of their resultant (P. Varignon, 1687). Let AB, AC (fig. 16) represent the two forces, AD their resultant; we have to prove that the sum of the triangles OAB, OAC is equal to the triangle OAD, regard being had to signs. Since the side OA is common, we have to prove that the sum of the perpendiculars from B and C on OA is equal to the perpendicular from D on OA, these perpendiculars being reckoned positive or negative according as they lie to the right or left of AO. Regarded as a statement concerning the orthogonal projections of the vectors $\overrightarrow{AB}$ and $\overrightarrow{AC}$ (or $\overrightarrow{BD}$), and of their sum $\overrightarrow{AD}$, on a line perpendicular to AO, this is obvious.

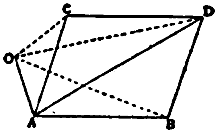


FIG. 16.

It is now evident that in the process of reduction of a coplanar system no change is made at any stage either in the sum of the projections of the forces on any line or in the sum of their moments about any point. It follows that the single resultant to which the system in general reduces is uniquely determinate, *i.e.* it acts in a definite line and has a definite magnitude and sense. Again it is necessary and sufficient for equilibrium that the sum of the projections of the forces on each of two perpendicular directions should vanish, and (moreover) that the sum of the moments about some one point should be zero. The fact that three independent conditions must hold for equilibrium is important. The conditions may of course be expressed in different (but equivalent) forms; *e.g.* the sum of the moments of the forces about each of the three points which are not collinear must be zero.

The particular case of three forces is of interest. If they are not all parallel they must be concurrent, and their vector-sum must be zero. Thus three forces acting perpendicular o the sides of a triangle at the middle points will be in equi- brium provided they are proportional to the respective sides, nd act all inwards or all outwards. This result is easily xtended to the case of a polygon of any number of sides; it as an important application in hydrostatics.

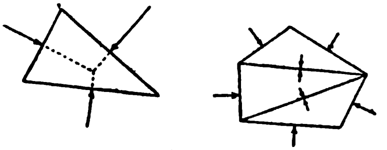


FIG. 17.

Again, suppose we have a bar AB resting with its ends on two nooth inclined planes which face each other. Let G be the centre gravity (§ 11), and let AG = *a*, GB = *b*. Let α, β be the inclina- ons of the planes, and θ the angle which the bar makes with the rtical. The position of equilibrium is determined by the considera- on that the reactions at A and B, which are by hypothesis normal to the planes, must meet at a point J on the vertical through G. Hence

$$JG/a = \sin(\theta-\alpha)/\sin\alpha,\quad JG/b = \sin(\theta+\beta)/\sin\beta,$$

whence

$$\cot\theta = \frac{a\cot\alpha - b\cot\beta}{a+b}. \tag{6}$$

If the bar is uniform we have $a = b$, and

$$\cot\theta = \tfrac{1}{2}(\cot\alpha - \cot\beta). \tag{7}$$

The problem of a rod suspended by strings attached to two points of it is virtually identical, the tensions of the strings taking the place of the reactions of the planes.

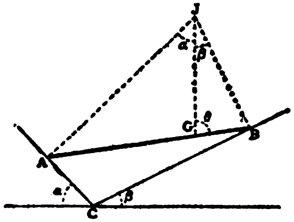


FIG. 18.

Just as a system of forces is in general equivalent to a single force, so a given force can conversely be replaced by combinations of other forces, in various ways. For instance, a given force (and consequently a system of forces) can be replaced in one and only one way by three forces acting in three assigned straight lines, provided these lines be not concurrent or parallel. Thus if the three lines form a triangle ABC, and if the given force F meet BC in H, then F can be resolved into two components acting in HA, BC, respectively. And the force in HA can be resolved into two components acting in BC, CA, respectively. A simple graphical construction is indicated in fig. 19, where the dotted lines are parallel. As an example, any system of forces acting on the lamina in fig. 9 is balanced by three determinate tensions (or thrusts) in the three links, provided the directions of the latter are not concurrent.

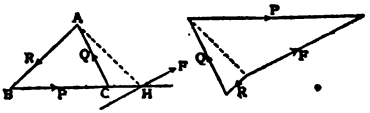


FIG. 19.

If P, Q, R, be any three forces acting along BC, CA, AB, respectively, the line of action of the resultant is determined by the consideration that the sum of the moments about any point on it must vanish. Hence in "trilinear" co-ordinates, with ABC as fundamental triangle, its equation is $P\alpha + Q\beta + R\gamma = 0$. If $P : Q : R = a : b : c$, where a, b, c are the lengths of the sides, this becomes the "line at infinity," and the forces reduce to a couple.

The sum of the moments of the two forces of a couple is the same about any point in the plane. Thus in the figure the sum of the moments about O is P . OA − P . OB or P . AB, which is independent of the position of O. This sum is called the *moment of the couple*; it must of course have the proper sign attributed to it. It easily follows that any two couples of the same moment are equivalent, and that any number of couples can be replaced by a single couple whose moment is the sum of their moments. Since a couple is for our purposes sufficiently represented by its moment, it has been proposed to substitute the name *torque* (or twisting effort), as free from the suggestion of any special pair of forces.

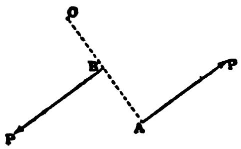


FIG. 20.

A system of forces represented completely by the sides of a plane polygon taken in order is equivalent to a couple whose moment is represented by twice the area of the polygon; this is proved by taking moments about any point. If the polygon intersects itself, care must be taken to attribute to the different parts of the area their proper signs.

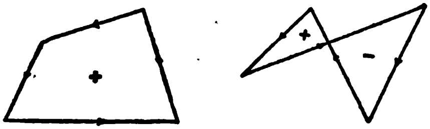


FIG. 21.

Again, any coplanar system of forces can be replaced by a single force R acting at any assigned point O, together with a couple G. The force R is the geometric sum of the given forces, and the moment (G) of the couple is equal to the sum of the moments of the given forces about O. The value of G will in general vary with the position of O, and will vanish when O lies on the line of action of the single resultant.

The formal analytical reduction of a system of coplanar forces is as follows. Let (x_1, y_1), (x_2, y_2), . . . be the rectangular co-ordinates of any points A_1, A_2, . . . on the lines of action of the respective forces. The force at A_1 may be replaced by its components X_1, Y_1, paraller to the co-ordinate axes; that at A_2 by its components X_2, Y_2, and so on. Introducing at O two equal and opposite forces $\pm X_1$ in Ox, we see that X_1 at A_1 may be replaced by an equal and parallel force at O together with a couple $-y_1X_1$. Similarly the force Y_1 at A_1 may be replaced by a force Y_1 at O together with a couple x_1Y_1. The forces X_1, Y_1, at O can thus be transferred to O provided we introduce a couple $x_1Y_1-y_1X_1$. Treating the remaining forces in the same way we get a force $X_1+X_2+\ldots$, or $\Sigma(X)$ along Ox, a force $Y_1+Y_2+\ldots$ or $\Sigma(Y)$ along Oy, and a couple $(x_1Y_1-y_1X_1)+(x_2Y_2-y_2X_2)+\ldots$ or $\Sigma(xY-yX)$. The three conditions of equilibrium are therefore

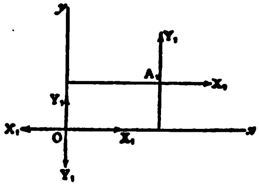


FIG. 22.

$$\Sigma(X)=0, \quad \Sigma(Y)=0, \quad \Sigma(xY-yX)=0. \tag{8}$$

If O′ be a point whose co-ordinates are (ξ, η), the moment of the couple when the forces are transferred to O′ as a new origin will be $\Sigma\{(x-\xi)\,Y-(y-\eta)\,X\}$. This vanishes, *i.e.* the system reduces to a single resultant through O′, provided

$$-\xi.\Sigma(Y)+\eta.\Sigma(X)+\Sigma(xY-yX)=0. \tag{9}$$

If ξ, η be regarded as current co-ordinates, this is the equation of the line of action of the single resultant to which the system is in general reducible.

If the forces are all parallel, making say an angle θ with Ox, we may write $X_1=P_1\cos\theta$, $Y_1=P_1\sin\theta$, $X_2=P_2\cos\theta$, $Y_2=P_2\sin\theta$, . . . The equation (9) then becomes

$$\{\Sigma(xP)-\xi.\Sigma(P)\}\sin\theta-\{\Sigma(yP)-\eta.\Sigma(P)\}\cos\theta=0. \tag{10}$$

If the forces P_1, P_2, . . . be turned in the same sense through the same angle about the respective points A_1, A_2, . . . so as to remain parallel, the value of θ is alone altered, and the resultant $\Sigma(P)$ passes always through the point

$$x=\frac{\Sigma(xP)}{\Sigma(P)},\ y=\frac{\Sigma(yP)}{\Sigma(P)}, \tag{11}$$

which is determined solely by the configuration of the points A_1, A_2, . . . and by the ratios $P_1:P_2:$ . . . of the forces acting at them respectively. This point is called the *centre* of the given system of parallel forces; it is finite and determinate unless $\Sigma(P)=0$. A geometrical proof of this theorem, which is not restricted to a two-dimensional system, is given later (§ 11). It contains the theory of the *centre of gravity* as ordinarily understood. For if we have an assemblage of particles whose mutual distances are small compared with the dimensions of the earth, the forces of gravity on them constitute a system of sensibly parallel forces, sensibly proportional to the respective masses. If now the assemblage be brought into any other position relative to the earth, without alteration of the mutual distances, this is equivalent to a rotation of the directions of the forces relatively to the assemblage, the ratios of the forces remaining unaltered. Hence there is a certain point, fixed relatively to the assemblage, through which the resultant of gravitational action always passes; this resultant is moreover equal to the sum of the forces on the several particles.

The theorem that any coplanar system of forces can be reduced to a force acting through any assigned point, together with a couple, has an important illustration in the theory of the distribution of shearing stress and bending moment in a horizontal beam, or other structure, subject to vertical extraneous forces. If we consider any vertical section P, the forces exerted across the section by the portion of the structure on one side on the portion on the other may be reduced to a vertical force F at P and a couple M. The force measures the *shearing stress*, and the couple the *bending moment* at P; we will reckon these quantities positive when the senses are as indicated in the figure.

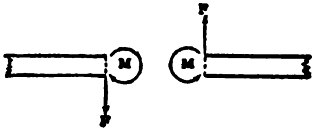


FIG. 23.

If the remaining forces acting on the portion of the structure on either side of P are known, then resolving vertically we find F, and taking moments about P we find M. Again if PQ be any segment of the beam which is free from load, Q lying to the right of P, we find

$$F_P=F_Q, \quad M_P-M_Q=-F.PQ; \tag{12}$$

hence F is constant between the loads, whilst M decreases as we travel to the right, with a constant gradient $-F$. If PQ be a short segment containing an isolated load W, we have

$$F_Q-F_P=-W, \quad M_Q=M_P; \tag{13}$$

hence F is discontinuous at a concentrated load, diminishing by an amount equal to the load as we pass the loaded point to the right, whilst M is continuous. Accordingly the graph of F for any system of isolated loads will consist of a series of horizontal lines, whilst that of M will be a continuous polygon.

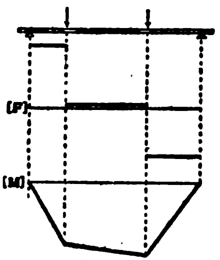


FIG. 24.

To pass to the case of continuous loads, let x be measured horizontally along the beam to the right. The load on an element δx of the beam may be represented by $w\delta x$, where w is in general a function of x. The equations (12) are now replaced by

$$\delta F=-w\delta x, \quad \delta M=-F\delta x,$$

whence

$$F_Q-F_P=-\int_P^Q w\,dx, \quad M_Q-M_P=-\int_P^Q F\,dx. \tag{14}$$

The latter relation shows that the bending moment varies as the area cut off by the ordinate in the graph of F. In the case of uniform load we have

$$F=-wx+A, \quad M=\tfrac{1}{2}wx^2-Ax+B, \tag{15}$$

where the arbitrary constants A,B are to be determined by the conditions of the special problem, *e.g.* the conditions at the ends of the beam. The graph of F is a straight line; that of M is a parabola with vertical axis. In all cases the graphs due to different distributions of load may be superposed. The figure shows the case of a uniform heavy beam supported at its ends.

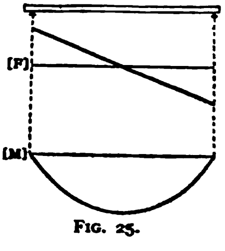


FIG. 25.

§ 5. *Graphical Statics.*—A graphical method of reducing a plane system of forces was introduced by C. Culmann (1864). It involves the construction of two figures, a *force-diagram* and a *funicular polygon*. The force-diagram is constructed by placing end to end a series of vectors representing the given forces in magnitude and direction, and joining the vertices of the polygon thus formed to an arbitrary *pole* O. The funicular or link polygon has its vertices on the lines of action of the given forces, and its sides respectively parallel to the lines drawn from O in the force-diagram; in particular, the two sides meeting in any vertex are respectively parallel to the lines drawn from O to the ends of that side of the force-polygon which represents the corresponding force. The relations will be understood from the annexed diagram, where corresponding lines in the force-diagram (to the right) and the funicular (to the left) are numbered similarly. The sides of the force-polygon may in the first instance be arranged in any order; the force-diagram can then be completed in a doubly infinite number of ways, owing to the arbitrary position of O; and for each force-diagram a simply infinite number of funiculars can be drawn. The two diagrams being supposed constructed, it is seen that each of the given systems of forces can be replaced by two components acting in the sides of the funicular which meet at the corresponding vertex, and that the magnitudes of these components will be given by the corresponding triangle of forces in the force-diagram; thus the force 1 in the figure is equivalent to two forces represented by O1 and 12. When this process of replacement is complete, each terminated side of the funicular is the seat of two forces which neutralize one another, and there remain only two uncompensated forces, viz., those resident in the first and last sides of the funicular. If these sides intersect, the resultant acts through the intersection, and its magnitude and direction are given by the line joining the first and last sides of the force-polygon (see fig. 26, where the resultant of the four given forces is denoted by R). As a special case it may happen that the force-polygon is closed, *i.e.* its first and last points coincide, the first and last sides of the funicular will then be parallel (unless they coincide), and the two uncompensated forces form a couple. If, however, the first and last sides of the funicular coincide, the two outstanding forces neutralize one another, and we have equilibrium. Hence the necessary and sufficient conditions of equilibrium are that the force-polygon and the funicular should both be closed. This is illustrated by fig. 26 if we imagine the force R, reversed, to be included in the system of given forces.

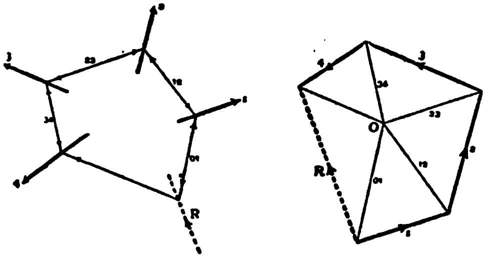


FIG. 26.

It is evident that a system of jointed bars having the shape of the funicular polygon would be in equilibrium under the action of the given forces, supposed applied to the joints; moreover any bar in which the stress is of the nature of a tension (as distinguished from a thrust) might be replaced by a string. This is the origin of the names "link-polygon" and "funicular" (cf. § 2).

If funiculars be drawn for two positions O,O′ of the pole in the force-diagram, their corresponding sides will intersect on a straight line parallel to OO′. This is essentially a theorem of projective geometry, but the following statical proof is interesting. Let AB (fig. 27) be any side of the force-polygon, and construct the corresponding portions of the two diagrams, first with O and then with O′ as pole. The force corresponding to AB may be replaced by the two components marked x, y; and a force corresponding to BA may be represented by the two components marked x', y'. Hence the forces x, y, x', y' are in equilibrium. Now x, x' have a resultant through H, represented in magnitude and direction by OO′, whilst y, y' have a resultant through K represented in magnitude and direction by O′O. Hence HK must be parallel to OO′. This theorem enables us, when one funicular has been drawn, to construct any other without further reference to the force-diagram.

The complete figures obtained by drawing first the force-diagrams of a system of forces in equilibrium with two distinct poles O, O′, and secondly the corresponding funiculars, have various interesting relations. In the first place, each of these figures may be conceived as an orthogonal projection of a closed plane-faced polyhedron.

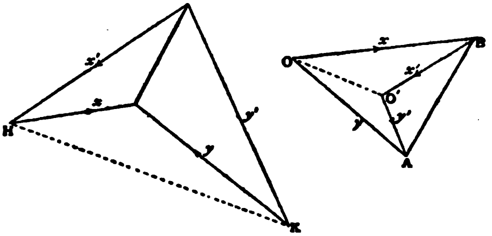


FIG. 27.

As regards the former figure this is evident at once; viz. the polyhedron consists of two pyramids with vertices represented by O, O′, and a common base whose perimeter is represented by the force-polygon (only one of these is shown in fig. 28). As regards the funicular diagram, let LM be the line on which the pairs of corresponding sides of the two polygons meet, and through it draw any two planes ω, ω′. Through the vertices A, B, C, . . . and A′, B′, C′, . . of the two funiculars draw normals to the plane of the diagram, to meet ω and ω′ respectively. The points thus obtained are evidently the vertices of a polyhedron with plane faces.

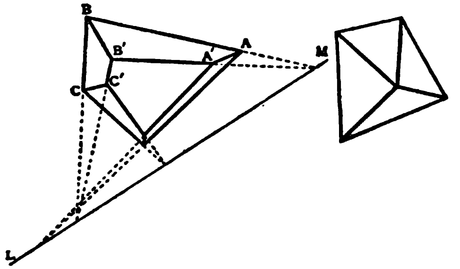


FIG. 28.

To every line in either of the original figures corresponds of course a parallel line in the other; moreover, it is seen that concurrent lines in either figure correspond to lines forming a closed polygon in the other. Two plane figures so related are called *reciprocal*, since the properties of the first figure in relation to the second are the same as those of the second with respect to the first. A still simpler instance of reciprocal figures is supplied by the case of concurrent forces in equilibrium (fig. 29). The theory of these reciprocal figures was first studied by J. Clerk Maxwell, who showed amongst other things that a reciprocal can always be drawn to any figure which is the orthogonal projection of a plane-faced polyhedron. If in fact we take the pole of each face of such a polyhedron with respect to a paraboloid of revolution, these poles will be the vertices of a second polyhedron whose edges are the "conjugate lines" of those of the former. If we project both polyhedra orthogonally on a plane perpendicular to the axis of the paraboloid, we obtain two figures which are reciprocal, except that corresponding lines are orthogonal instead of parallel. Another proof will be indicated later (§ 8) in connexion with the properties of the linear complex. It is

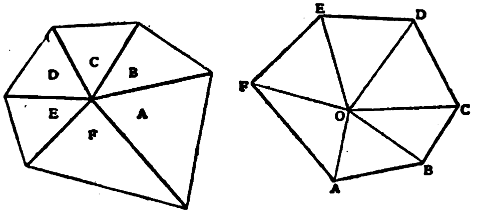


FIG. 29.

convenient to have a notation which shall put in evidence the reciprocal character. For this purpose we may designate the points in one figure by letters A, B, C, . . . and the corresponding polygons in the other figure by the same letters; a line joining two points A, B in one figure will then correspond to the side common to the two polygons A, B in the other. This notation was employed by R. H. Bow in connexion with the theory of frames (§ 6, and see also APPLIED MECHANICS below) where reciprocal diagrams are frequently of use (cf. DIAGRAM).

When the given forces are all parallel, the force-polygon consists of a series of segments of a straight line. This case has important practical applications; for instance we may use the method to find the pressures on the supports of a beam loaded in any given manner. Thus if AB, BC, CD represent the given loads, in the force-diagram, we construct the sides corresponding to OA, OB, OC, OD in the funicular; we then draw the *closing line* of the funicular polygon, and a parallel OE to it in the force diagram. The segments DE, EA then represent the upward pressures of the two supports on the beam, which pressures together with the given loads constitute a system of forces in equilibrium. The pressures of the beam on the supports are of course represented by ED, AE. The two diagrams are portions of reciprocal figures, so that Bow's notation is applicable.

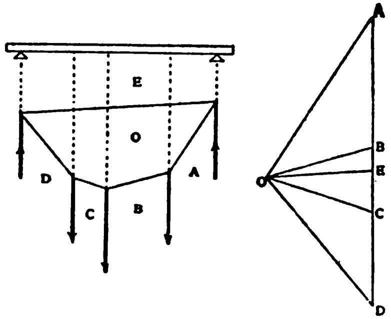


FIG. 30.

A graphical method can also be applied to find the moment of a force, or of a system of forces, about any assigned point P. Let F be a force represented by AB in the force-diagram. Draw a parallel through P to meet the sides of the funicular which correspond to OA, OB in the points H, K. If R be the intersection of these sides, the triangles OAB, RHK are similar, and if the perpendiculars OM, RN be drawn we have

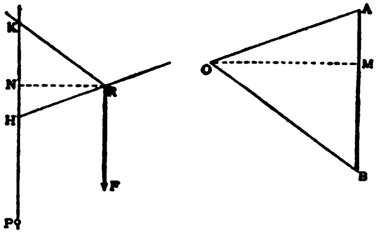


FIG. 31.

$$HK\,.\,OM = AB\,.\,RN = F\,.\,RN,$$

which is the moment of F about P. If the given forces are all parallel (say vertical) OM is the same for all, and the moments of the several forces about P are represented on a certain scale by the lengths intercepted by the successive pairs of sides on the vertical through P. Moreover, the moments are compounded by adding (geometrically) the corresponding lengths HK. Hence if a system of vertical forces be in equilibrium, so that the funicular polygon is closed, the length which this polygon intercepts on the vertical through any point P gives the sum of the moments about P of all the forces on one side of this vertical. For instance, in the case of a beam in equilibrium under any given loads and the reactions at the supports, we get a graphical representation of the distribution of bending moment over the beam. The construction in fig. 30 can easily be adjusted so that the closing line shall be horizontal; and the figure then becomes identical with the bending-moment diagram of § 4. If we wish to study the effects of a movable load, or system of loads, in different positions on the beam, it is only necessary to shift the lines of action of the pressures of the supports relatively to the funicular, keeping them at the same distance apart; the only change is then in the position of the closing line of the funicular. It may be remarked that since this line joins homologous points of two "similar" rows it will envelope a parabola.

The "centre" (§ 4) of a system of parallel forces of given magnitudes, acting at given points, is easily determined graphically. We have only to construct the line of action of the resultant for each of two arbitrary directions of the forces, the intersection of the two lines gives the point required. The construction is neatest if the two arbitrary directions are taken at right angles to one another.

§ 6. *Theory of Frames.*—A *frame* is a structure made up of pieces, or *members*, each of which has two *joints* connecting it with other members. In a two-dimensional frame, each joint may be conceived as consisting of a small cylindrical pin fitting accurately and smoothly into holes drilled through the members which it connects. This supposition is a somewhat ideal one, and is often only roughly approximated to in practice. We shall suppose, in the first instance, that extraneous forces act on the frame at the joints only, *i.e.* on the pins.

On this assumption, the reactions on any member at its two joints must be equal and opposite. This combination of equal and opposite forces is called the *stress* in the member; it may be a *tension* or a *thrust*. For diagrammatic purposes each member is sufficiently represented by a straight line terminating at the two joints; these lines will be referred to as the *bars* of the frame.

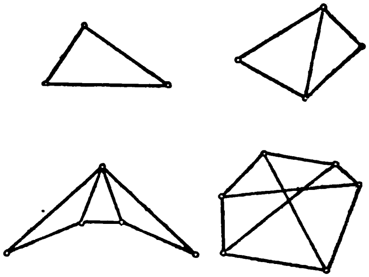


FIG. 32.

In structural applications a frame must be *stiff*, or *rigid*, *i.e.* it must be incapable of deformation without alteration of length in at least one of its bars. It is said to be *just rigid* if it ceases to be rigid when any one of its bars is removed. A frame which has more bars than are essential for rigidity may be called *over-rigid*; such a frame is in general self-stressed, *i.e.* it is in a state of stress independently of the action of extraneous forces. A plane frame of n joints which is just rigid (as regards deformation in its own plane) has $2n-3$ bars, for if one bar be held fixed the $2(n-2)$ co-ordinates of the remaining $n-2$ joints must just be determined by the lengths of the remaining bars. The total number of bars is therefore $2(n-2)+1$. When a plane frame which is just rigid is subject to a given system of equilibrating extraneous forces (in its own plane) acting on the joints, the stresses in the bars are in general uniquely determinate. For the conditions of equilibrium of the forces on each pin furnish $2n$ equations, viz. two for each point, which are linear in respect of the stresses and the extraneous forces. This system of equations must involve the three conditions of equilibrium of the extraneous forces which are already identically satisfied, by hypothesis; there remain therefore $2n-3$ independent relations to determine the $2n-3$ unknown stresses. A frame of n joints and $2n-3$ bars may of course fail to be rigid owing to some parts being over-stiff whilst others are deformable; in such a case it will be found that the statical equations, apart from the three identical relations imposed by the equilibrium of the extraneous forces, are not all independent but are equivalent to less than $2n-3$ relations. Another exceptional case, known as the *critical case*, will be noticed later (§ 9).

A plane frame which can be built up from a single bar by successive steps, at each of which a new joint is introduced by two new bars meeting there, is called a *simple* frame; it is obviously just rigid. The stresses produced by extraneous forces in a simple frame can be found by considering the equilibrium of the various joints in a proper succession; and if the graphical method be employed the various polygons of force can be combined into a single force-diagram. This procedure was introduced by W. J. M. Rankine and J. Clerk Maxwell (1864). It may be noticed that if we take an arbitrary pole in the force-diagram, and draw a corresponding funicular in the skeleton diagram which represents the frame together with the lines of action of the extraneous forces, we obtain two complete reciprocal figures, in Maxwell's sense. It is accordingly convenient to use Bow's notation (§ 5), and to distinguish the several compartments of the frame-diagram by letters. See fig. 33, where the successive triangles in the diagram of forces may be constructed in the order XYZ, ZXA, AZB. The class of "simple" frames includes many of the frameworks used in the construction of roofs, lattice girders and suspension bridges; a number of examples will be found in the article BRIDGES. By examining the senses in which the respective forces act at each joint we can ascertain which members are in tension and which are in thrust; in fig. 33 this is indicated by the directions of the arrowheads.

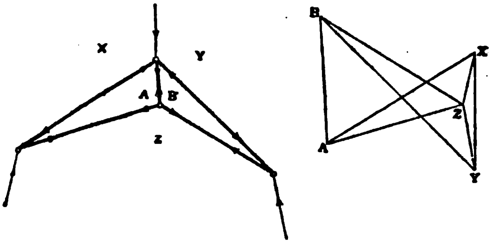


FIG. 33.

When a frame, though just rigid, is not "simple" in the above sense, the preceding method must be replaced, or supplemented, by one or other of various artifices. In some cases the *method of sections* is sufficient for the purpose. If an ideal section be drawn across the frame, the extraneous forces on either side must be in equilibrium with the forces in the bars cut across; and if the section can be drawn so as to cut only three bars, the forces in these can be found, since the problem reduces to that of resolving a given force into three components acting in three given lines (§ 4). The "critical case" where the directions of the three bars are concurrent is of course excluded. Another method, always available, will be explained nder "Work" (§ 9).

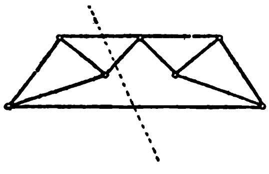


FIG. 34.

When extraneous forces act on the bars themselves the stress in ach bar no longer consists of a simple longitudinal tension or thrust. o find the reactions at the joints we may proceed as follows. ach extraneous force W acting on a bar may be replaced (in an finite number of ways) by two components P, Q in lines through e centres of the pins at the extremities. In practice the forces W re usually vertical, and the components P, Q are then conveniently ken to be vertical also. We first alter the problem by transferring e forces P, Q to the pins. The stresses in the bars, in the problem thus modified, may be supposed found by the preceding methods; remains to infer from the results thus obtained the reactions in the iginal form of the problem. To find the pressure exerted by a bar B on the pin A we compound with the force in AB given by the agram a force equal to P. Conversely, to find the pressure of c pin A on the bar AB we must compound with the force given the diagram a force equal and opposite to P. This question ises in practice in the theory of "three-jointed" structures; for e purpose in hand such a structure is sufficiently represented by o bars AB, BC. The right-hand figure represents a portion of the rce-diagram; in particular $\overrightarrow{ZX}$ represents the pressure of AB on B in the modified problem where the loads W_1 and W_2 on the two bars are replaced by loads P_1, Q_1, and P_2, Q_2 respectively, acting on the pins. Compounding with this $\overrightarrow{XV}$, which represents Q_1, we get the actual pressure $\overrightarrow{ZV}$ exerted by AB on B. The directions and magnitudes of the reactions at A and C are then easily ascertained. On account of its practical importance several other graphical solutions of this problem have been devised.

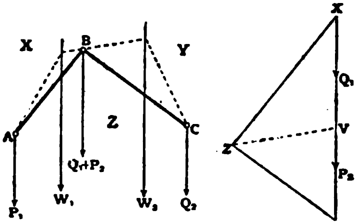


FIG. 35.

§ 7. *Three-dimensional Kinematics of a Rigid Body.*—The position of a rigid body is determined when we know the positions of three points A, B, C of it which are not collinear, for the position of any other point P is then determined by the three distances PA, PB, PC. The nine co-ordinates (Cartesian or other) of A, B, C are subject to the three relations which express the invariability of the distances BC, CA, AB, and are therefore equivalent to six independent quantities. Hence a rigid body not constrained in any way is said to have six degrees of freedom. Conversely, any six geometrical relations restrict the body in general to one or other of a series of definite positions, none of which can be departed from without violating the conditions in question. For instance, the position of a theodolite is fixed by the fact that its rounded feet rest in contact with six given plane surfaces. Again, a rigid three-dimensional frame can be rigidly fixed relatively to the earth by means of six links.

The six independent quantities, or "co-ordinates," which serve to specify the position of a rigid body in space may of course be chosen in an endless variety of ways. We may, for instance, employ the three Cartesian co-ordinates of a particular point O of the body, and three angular co-ordinates which express the orientation of the body with respect to O. Thus in fig. 36, if OA, OB, OC be three mutually perpendicular lines in the solid, we may denote by θ the angle which OC makes with a fixed direction OZ, by ψ the azimuth of the plane ZOC measured from some fixed plane through OZ, and by ϕ the inclination of the plane COA to the plane ZOC. In fig. 36 these various lines and planes are represented by their intersections with a unit sphere having O as centre. This very useful, although unsymmetrical, system of angular co-ordinates was introduced by L. Euler. It is exemplified in "Cardan's suspension," as used in connexion with a compass-bowl or a gyroscope. Thus in the gyroscope the "flywheel" (represented by the globe in fig. 37) can turn about a diameter OC of a ring which is itself free to turn about a diametral axis OX at right angles to the former; this axis is carried by a second ring which is free to turn about a fixed diameter OZ, which is at right angles to OX.

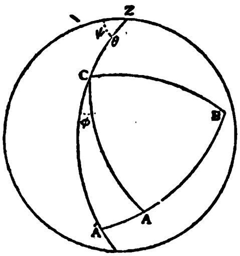


FIG. 36.

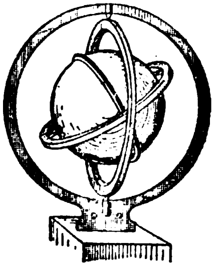


FIG. 37.

We proceed to sketch the theory of the finite displacements of a rigid body. It was shown by Euler (1776) that any displacement in which one point O of the body is fixed is equivalent to a pure *rotation* about some axis through O. Imagine two spheres of equal radius with O as their common centre, one fixed in the body and moving with it, the other fixed in space. In any displacement about O as a fixed point, the former sphere slides over the latter, as in a "ball-and-socket" joint. Suppose that as the result of the displacement a point of the moving sphere is brought from A to B, whilst the point which was at B is brought to C (cf. fig. 10). Let J be the pole of the circle ABC (usually a "small circle" of the fixed sphere), and join JA, JB, JC, AB, BC by great-circle arcs. The spherical isosceles triangles AJB, BJC are congruent, and we see that AB can be brought into the position BC by a rotation about the axis OJ through an angle AJB.

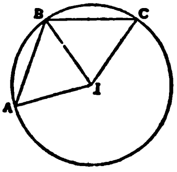


FIG. 10.

It is convenient to distinguish the two senses in which rotation may take place about an axis OA by opposite signs. We shall reckon a rotation as positive when it is related to the direction from O to A as the direction of rotation is related to that of translation in a right-handed screw. Thus a negative rotation about OA may be regarded as a positive rotation about OA′, the prolongation of AO. Now suppose that a body receives first a positive rotation α about OA, and secondly a positive rotation β about OB; and let A, B be the intersections of these axes with a sphere described about O as centre. If we construct the spherical triangles ABC, ABC′ (fig. 38), having in each case the angles at A and B equal to $\frac{1}{2}\alpha$ and $\frac{1}{2}\beta$ respectively, it is evident that the first rotation will bring a point from C to C′ and that the second will bring it back to C; the result is therefore equivalent to a rotation about OC. We note also that if the given rotations had been effected in the inverse order, the axis of the resultant rotation would have been OC′, so that finite rotations do not obey the "commutative law." To find the angle of the equivalent rotation, in the actual case, suppose that the second rotation (about OB) brings a point from A to A′. The spherical triangles ABC, A′BC (fig. 39) are "symmetrically equal," and the angle of the resultant rotation, viz. ACA′, is $2\pi-2\text{C}$. This is equivalent to a negative rotation 2C about OC, whence the theorem that the effect of three successive positive rotations 2A, 2B, 2C about OA, OB, OC, respectively, is to leave the body in its original position, provided the circuit ABC is left-handed as seen from O. This theorem is due to O. Rodrigues (1840). The composition of finite rotations about parallel axes is a particular case of the preceding; the radius of the sphere is now infinite, and the triangles are plane.

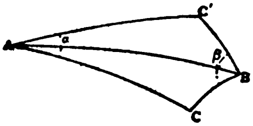


FIG. 38.

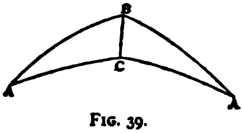


FIG. 39.

In any continuous motion of a solid about a fixed point O, the limiting position of the axis of the rotation by which the body can be brought from any one of its positions to a consecutive one is called the *instantaneous axis*. This axis traces out a certain cone in the body, and a certain cone in space, and the continuous motion in question may be represented as consisting in a rolling of the former cone on the latter. The proof is similar to that of the corresponding theorem of plane kinematics (§ 3).

It follows from Euler's theorem that the most general displacement of a rigid body may be effected by a pure translation which brings any one point of it to its final position O, followed by a pure rotation about some axis through O Those planes in the body which are perpendicular to this axis obviously remain parallel to their original positions. Hence, if σ, σ' denote the initial and final positions of any figure in one of these planes, the displacement could evidently have been effected by (1) a translation perpendicular to the planes in question, bringing σ into some position σ'' in the plane of σ', and (2) a rotation about a normal to the planes, bringing σ'' into coincidence with σ (§ 3). In other words, the most general displacement is equivalent to a translation parallel to a certain axis combined with a rotation about that axis; *i.e.* it may be described as a *twist* about a certain *screw*. In particular cases, of course, the translation, or the rotation, may vanish.

The preceding theorem, which is due to Michel Chasles (1830), may be proved in various other interesting ways. Thus if a point of the body be displaced from A to B, whilst the point which was at B is displaced to C, and that which was at C to D, the four points A, B, C, D lie on a helix whose axis is the common perpendicular to the bisectors of the angles ABC, BCD. This is the axis of the required screw; the amount of the translation is measured by the projection of AB or BC or CD on the axis; and the angle of rotation is given by the inclination of the aforesaid bisectors. This construction was given by M. W. Crofton. Again, H. Wiener and W. Burnside have employed the *half-turn* (*i.e.* a rotation through two right angles) as the fundamental operation. This has the advantage that it is completely specified by the axis of the rotation, the sense being immaterial. Successive half-turns about parallel axes a, b are equivalent to a translation measured by double the distance between these axes in the direction from a to b. Successive half-turns about intersecting axes a, b are equivalent to a rotation about the common perpendicular to a, b at their intersection, of amount equal to twice the acute angle between them, in the direction from a to b. Successive half-turns about two skew axes a, b are equivalent to a twist about a screw whose axis is the common perpendicular to a, b, the translation being double the shortest distance, and the angle of rotation being twice the acute angle between a, b, in the direction from a to b. It is easily shown that any displacement whatever is equivalent to two half-turns and therefore to a screw.

In mechanics we are specially concerned with the theory of infinitesimal displacements. This is included in the preceding, but it is simpler in that the various operations are commutative. An infinitely small rotation about any axis is conveniently represented geometrically by a length AB measures along the axis and proportional to the angle of rotation, with the convention that the direction from A to B shall be related to the rotation as is the direction of translation to that of rotation in a right-handed screw. The consequent displacement of any point P will then be at right angles to the plane PAB, its amount will be represented by double the area of the triangle PAB, and its sense will depend on the cyclical order of the letters P, A, B. If AB, AC represent infinitesimal rotations about intersecting axes, the consequent displacement of any point O in the plane BAC will be at right angles to this plane, and will be represented by twice the sum of the areas OAB, OAC, taken with proper signs. It follows by analogy with the theory of moments (§ 4) that the resultant rotation will be represented by AD, the vector-sum of AB, AC (see fig. 16). It is easily inferred as a limiting case, or proved directly, that two infinitesimal rotations α, β about parallel axes are equivalent to a rotation $\alpha+\beta$ about a parallel axis in the same plane with the two former, and dividing a common perpendicular AB in a point C so that $\text{AC}/\text{CB}=\beta/\alpha$. If the rotations are equal and opposite, so that $\alpha+\beta=0$, the point C is at infinity, and the effect is a translation perpendicular to the plane of the two given axes, of amount $\alpha.\text{AB}$. It thus appears that an infinitesimal rotation is of the nature of a "localized vector," and is subject in all respects to the same mathematical laws as a force, conceived as acting on a rigid body. Moreover, that an infinitesimal translation is analogous to a couple and follows the same laws. These results are due to Poinsot.

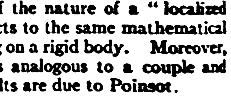


FIG. 16.

The analytical treatment of small displacements is as follows. We first suppose that one point O of the body is fixed, and take this as the origin of a "right-handed" system of rectangular co-ordinates; *i.e.* the positive directions of the axes are assumed to be so arranged that a positive rotation of 90° about Ox would bring Oy into the position of Oz, and so on. The displacement will consist of an infinitesimal rotation ϵ about some axis through O, whose direction-cosines are, say, l, m, n. From the equivalence of a small rotation to a localized vector it follows that the rotation ϵ will be equivalent to rotations ξ, η, ζ about Ox, Oy, Oz, respectively, provided

$$\xi = l\epsilon, \quad \eta = m\epsilon, \quad \zeta = n\epsilon, \tag{1}$$

and we note that

$$\xi^2 + \eta^2 + \zeta^2 = \epsilon^2 \tag{2}$$

Thus in the case of fig. 36 it may be required to connect the infinitesimal rotations ξ, η, ζ about OA, OB, OC with the variations of the angular co-ordinates θ, ψ, ϕ. The displacement of the point C of the body is made up of $\delta\theta$ tangential to the meridian ZC and $\sin\theta\,\delta\psi$ perpendicular to the plane of this meridian. Hence, resolving along the tangents to the arcs BC, CA, respectively, we have

$$\xi = \delta\theta \sin\phi - \sin\theta\,\delta\psi\cos\phi, \quad \eta = \delta\theta\cos\phi + \sin\theta\,\delta\psi\sin\phi. \tag{3}$$

Again, consider the point of the solid which was initially at A′ in the figure. This is displaced relatively to A′ through a space $\delta\phi$ perpendicular to the plane of the meridian, whilst A′ itself is displaced through a space $\cos\theta\,\delta\psi$ in the same direction. Hence

$$\zeta = \delta\phi + \cos\theta\,\delta\psi. \tag{4}$$

To find the component displacements of a point P of the body, whose co-ordinates are x, y, z, we draw PL normal to the plane yOz, and LH, LK perpendicular to Oy, Oz, respectively. The displacement of P parallel to Ox is the same as that of L, which is made up of ηz and $-\zeta y$. In this way we obtain the formulae

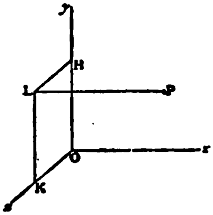


FIG. 40.

$$\delta x = \eta z - \zeta y, \quad \delta y = \zeta x - \xi z, \quad \delta z = \xi y - \eta x. \tag{5}$$

The most general case is derived from this by adding the component displacements λ, μ, ν (say) of the point which was at O; thus

$$\left.\begin{aligned} \delta x &= \lambda + \eta z - \zeta y, \\ \delta y &= \mu + \zeta x - \xi z, \\ \delta z &= \nu + \xi y - \eta x. \end{aligned}\right\} \tag{6}$$

The displacement is thus expressed in terms of the six independent quantities $\xi, \eta, \zeta, \lambda, \mu, \nu$. The points whose displacements are in the direction of the resultant axis of rotation are determined by $\delta x : \delta y : \delta z = \xi : \eta : \zeta$, or

$$(\lambda + \eta z - \zeta y)/\xi = (\mu + \zeta x - \xi z)/\eta = (\nu + \xi y - \eta x)/\zeta. \tag{7}$$

These are the equations of a straight line, and the displacement is in fact equivalent to a twist about a screw having this line as axis. The translation parallel to this axis is

$$l\delta x + m\delta y + n\delta z = (\lambda\xi + \mu\eta + \nu\zeta)/\epsilon. \tag{8}$$

The linear magnitude which measures the ratio of translation to rotation in a screw is called the *pitch*. In the present case the pitch is

$$(\lambda\xi + \mu\eta + \nu\zeta)/(\xi^2 + \eta^2 + \zeta^2). \tag{9}$$

Since $\xi^2 + \eta^2 + \zeta^2$, or ϵ^2, is necessarily an absolute invariant for all transformations of the (rectangular) co-ordinate axes, we infer that $\lambda\xi + \mu\eta + \nu\zeta$ is also an absolute invariant. When the latter invariant, but not the former, vanishes, the displacement is equivalent to a pure rotation.

If the small displacements of a rigid body be subject to one constraint, *e.g.* if a point of the body be restricted to lie on a given surface, the mathematical expression of this fact leads to a homogeneous linear equation between the infinitesimals $\xi, \eta, \zeta, \lambda, \mu, \nu$, say

$$A\xi + B\eta + C\zeta + F\lambda + G\mu + H\nu = 0. \tag{10}$$

The quantities $\xi, \eta, \zeta, \lambda, \mu, \nu$ are no longer independent, and the body has now only five degrees of freedom. Every additional constraint introduces an additional equation of the type (10) and reduces the number of degrees of freedom by one. In Sir R. S. Ball's *Theory of Screws* an analysis is made of the possible displacements of a body which has respectively two, three, four, five degrees of freedom. We will briefly notice the case of two degrees, which involves an interesting generalization of the method (already explained) of compounding rotations about intersecting axes. We assume that the body receives arbitrary twists about two given screws, and it is required to determine the character of the resultant displacement. We examine first the case where the axes of the two screws are at right angles and intersect. We take these as axes of x and y; then if ξ, η be the component rotations about them, we have

$$\lambda = h\xi, \quad \mu = k\eta, \quad \nu = 0, \tag{11}$$

where h, k, are the pitches of the two given screws. The equations (7) of the axis of the resultant screw then reduce to

$$x/\xi = y/\eta, \quad z(\xi^2 + \eta^2) = (k - h)\xi\eta \tag{12}$$

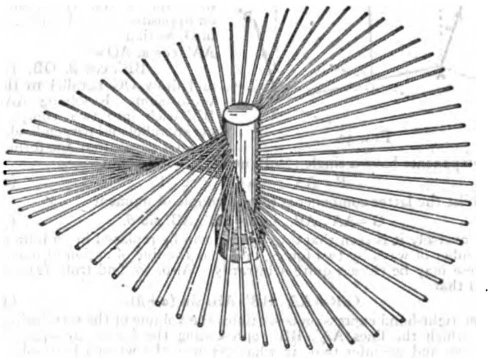
Hence, whatever the ratio $\xi : \eta$, the axis of the resultant screw lies on the conoidal surface

$$z(x^2 + y^2) = cxy \tag{13}$$

where $c = \frac{1}{2}(k - h)$. The co-ordinates of any point on (13) may be written

$$x = r\cos\theta, \quad y = r\sin\theta, \quad z = c\sin 2\theta; \tag{14}$$

hence if we imagine a curve of sines to be traced on a circular cylinder so that the circumference just includes two complete undulations, a straight line cutting the axis of the cylinder at right angles and meeting this curve will generate the surface. This is called a *cylindroid*. Again, the pitch of the resultant screw is



From Sir Robert S. Ball's *Theory of Screws*.

FIG. 41.

$$p = (\lambda\xi + \mu\eta)/(\xi^2 + \eta^2) = h\cos^2\theta + k\sin^2\theta. \tag{15}$$

The distribution of pitch among the various screws has therefore a simple relation to the *pitch-conic*

$$hx^2 + ky^2 = \text{const}; \tag{16}$$

viz. the pitch of any screw varies inversely as the square of that diameter of the conic which is parallel to its axis. It is to be noticed that the parameter c of the cylindroid is unaltered if the two pitches h, k be increased by equal amounts; the only change is that all the pitches are increased by the same amount. It remains to show that a system of screws of the above type can be constructed so as to contain any two given screws whatever. In the first place, a cylindroid can be constructed so as to have its axis coincident with the common perpendicular to the axes of the two given screws and to satisfy three other conditions, for the position of the centre, the parameter, and the orientation about the axis are still at our disposal. Hence we can adjust these so that the surface shall contain the axes of the two given screws as generators, and that the difference of the corresponding pitches shall have the proper value. It follows that when a body has two degrees of freedom it can twist about any one of a singly infinite system of screws whose axes lie on a certain cylindroid. In particular cases the cylindroid may degenerate into a plane, the pitches being then all equal.

§ 8. *Three-dimensional Statics.*—A system of parallel forces can be combined two and two until they are replaced by a single resultant equal to their sum, acting in a certain line. As special cases, the system may reduce to a couple, or it may be in equilibrium.

In general, however, a three-dimensional system of forces cannot be replaced by a single resultant force. But it may be reduced to simpler elements in a variety of ways. For example, it may be reduced to two forces in perpendicular skew lines. For consider any plane, and let each force, at its intersection with the plane, be resolved into two components, one (P) normal to the plane, the other (Q) in the plane. The assemblage of parallel forces P can be replaced in general by a single force, and the coplanar system of forces Q by another single force.

If the plane in question be chosen perpendicular to the direction of the vector-sum of the given forces, the vector-sum of the components Q is zero, and these components are therefore equivalent to a couple (§ 4). Hence any three-dimensional system can be reduced to a single force R acting in a certain line, together with a couple G in a plane perpendicular to the line. This theorem was first given by L. Poinsot, and the line of action of R was called by him the *central axis* of the system. The combination of a force and a couple in a perpendicular plane is termed by Sir R. S. Ball a *wrench*. Its type, as distinguished from its absolute magnitude, may be specified by a screw whose axis is the line of action of R, and whose pitch is the ratio G/R.

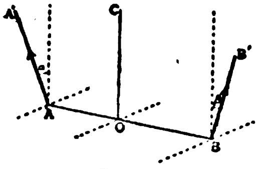


FIG. 42.

The case of two forces may be specially noticed. Let AB be the shortest distance between the lines of action, and let AA′, BB′ (fig. 42) represent the forces. Let α, β be the angles which AA′, BB′ make with the direction of the vector-sum, on opposite sides. Divide AB in O, so that

$$AA'.\cos\alpha.\ AO = BB'.\cos\beta.\ OB, \tag{1}$$

and draw OC parallel to the vector-sum. Resolving AA′, BB′ each into two components parallel and perpendicular to OC, we see that the former components have a single resultant in OC, of amount

$$R = AA'\cos\alpha + BB'\cos\beta, \tag{2}$$

whilst the latter components form a couple of moment

$$G = AA'.\ AB.\ \sin\alpha = BB'.\ AB.\ \sin\beta. \tag{3}$$

Conversely it is seen that any wrench can be replaced in an infinite number of ways by two forces, and that the line of action of one of these may be chosen quite arbitrarily. Also, we find from (2) and (3) that

$$G.R = AA'.\ BB'.\ AB.\ \sin(\alpha+\beta). \tag{4}$$

The right-hand expression is six times the volume of the tetrahedron of which the lines AA′, BB′ representing the forces are opposite edges; and we infer that, in whatever way the wrench be resolved into two forces, the volume of this tetrahedron is invariable.

To define the *moment* of a force *about an axis* HK, we project the force orthogonally on a plane perpendicular to HK and take the moment of the projection about the intersection of HK with the plane (see § 4). Some convention as to sign is necessary; we shall reckon the moment to be positive when the tendency of the force is right-handed as regards the direction from H to K. Since two concurrent forces and their resultant obviously project into two concurrent forces and their resultant, we see that the sum of the moments of two concurrent forces about any axis HK is equal to the moment of their resultant. Parallel forces may be included in this statement as a limiting case. Hence, in whatever way one system of forces is by successive steps replaced by another, no change is made in the sum of the moments about any assigned axis. By means of this theorem we can show that the previous reduction of any system to a wrench is unique.

From the analogy of couples to translations which was pointed out in § 7, we may infer that a couple is sufficiently represented by a "free" (or non-localized) vector perpendicular to its plane. The length of the vector must be proportional to the moment of the couple, and its sense must be such that the sum of the moments of the two forces of the couple about it is positive. In particular, we infer that couples of the same moment in parallel planes are equivalent; and that couples in any two planes may be compounded by geometrical addition of the corresponding vectors. Independent statical proofs are of course easily given. Thus, let the plane of the paper be perpendicular to the planes of two couples, and therefore perpendicular to the line of intersection of these planes. By § 4, each couple can be replaced by two forces ± P (fig. 43) perpendicular to the plane of the paper, and so that one force of each couple is in the line of intersection (B); the arms (AB, BC) will then be proportional to the respective moments. The two forces at B will cancel, and we are left with a couple of moment P.AC in the plane AC. If we draw three vectors to represent these three couples, they will be perpendicular and proportional to the respective sides of the triangle ABC; hence the third vector is the geometric sum of the other two. Since, in this proof the magnitude of P is arbitrary, it follows incidentally that couples of the same moment in parallel planes, *e.g.* planes parallel to AC, are equivalent.

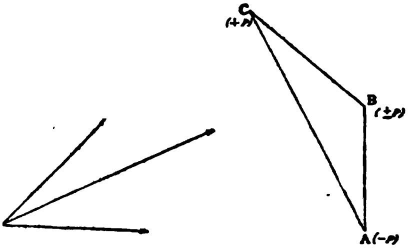


FIG. 43.

Hence a couple of moment G, whose axis has the direction (l, m, n) relative to a right-handed system of rectangular axes, is equivalent to three couples lG, mG, nG in the co-ordinate planes. The analytical reduction of a three-dimensional system can now be conducted as follows. Let (x_1, y_1, z_1) be the co-ordinates of a point P_1 on the line of action of one of the forces, whose components are (say) X_1, Y_1, Z_1. Draw P_1H normal to the plane zOx, and HK perpendicular to Oz. In KH introduce two equal and opposite forces $\pm X_1$. The force X_1 at P_1 with $-X_1$ in KH forms a couple about Oz, of moment $-y_1X_1$. Next, introduce along Ox two equal and opposite forces $\pm X_1$. The force X_1 in KH with $-X_1$ in Ox forms a couple about Oy, of moment z_1X_1. Hence the force X_1 can be transferred from P_1 to O, provided we introduce couples of moments z_1X_1 about Oy and $-y_1X_1$, about Oz. Dealing in the same way with the forces Y_1, Z_1 at P_1, we find that all three components of the force at P_1 can be transferred to O, provided we introduce three couples L_1, M_1, N_1 about Ox, Oy, Oz respectively, viz.

$$L_1 = y_1Z_1 - z_1Y_1,\quad M_1 = z_1X_1 - x_1Z_1,\quad N_1 = x_1Y_1 - y_1X_1. \tag{5}$$

It is seen that L_1, M_1, N_1 are the moments of the original force at P_1 about the co-ordinate axes. Summing up for all the forces of the given system, we obtain a force R at O, whose components are

$$X = \Sigma(X_r),\quad Y = \Sigma(Y_r),\quad Z = \Sigma(Z_r), \tag{6}$$

and a couple G whose components are

$$L = \Sigma(L_r),\quad M = \Sigma(M_r),\quad N = \Sigma(N_r), \tag{7}$$

where $r = 1, 2, 3\ldots$ Since $R^2 = X^2+Y^2+Z^2$, $G^2 = L^2+M^2+N^2$, it is necessary and sufficient for equilibrium that the six quantities X, Y, Z, L, M, N, should all vanish. In words: the sum of the projections of the forces on each of the co-ordinate axes must vanish; and, the sum of the moments of the forces about each of these axes must vanish.

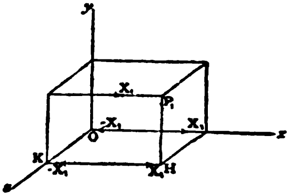


FIG. 44.

If any other point O′, whose co-ordinates are x, y, z, be chosen in place of O, as the point to which the forces are transferred, we have to write x_1-x, y_1-y, z_1-z for x_1, y_1, z_1, and so on, in the preceding process. The components of the resultant force R are unaltered, but the new components of couple are found to be

$$\left.\begin{aligned} L' &= L - yZ + zY,\\ M' &= M - zX + xZ,\\ N' &= N - xY + yX. \end{aligned}\right\} \tag{8}$$

By properly choosing O′ we can make the plane of the couple perpendicular to the resultant force. The conditions for this are L′ : M′ : N′ = X : Y : Z, or

$$\frac{L-yZ+zY}{X} = \frac{M-zX+xZ}{Y} = \frac{N-xY+yX}{Z} \tag{9}$$

These are the equations of the central axis. Since the moment of the resultant couple is now

$$G' = \frac{X}{R}L' + \frac{Y}{R}M' + \frac{Z}{R}N' = \frac{LX + MY + NZ}{R}, \qquad (10)$$

the pitch of the equivalent wrench is

$$(LX + MY + NZ)/(X^2 + Y^2 + Z^2).$$

It appears that $X^2+Y^2+Z^2$ and $LX+MY+NZ$ are absolute invariants (cf. § 7). When the latter invariant, but not the former, vanishes, the system reduces to a single force.

The analogy between the mathematical relations of infinitely small displacements on the one hand and those of force-systems on the other enables us immediately to convert any theorem in the one subject into a theorem in the other. For example, we can assert without further proof that any infinitely small displacement may be resolved into two rotations, and that the axis of one of these can be chosen arbitrarily. Again, that wrenches of arbitrary amounts about two given screws compound into a wrench the locus of whose axis is a cylindroid.

The mathematical properties of a twist or of a wrench have been the subject of many remarkable investigations, which are, however, of secondary importance from a physical point of view. In the "Null-System" of A. F. Möbius (1790–1868), a line such that the moment of a given wrench about it is zero is called a *null-line*. The triply infinite system of null-lines form what is called in line-geometry a "complex." As regards the configuration of this complex, consider a line whose shortest distance from the central axis is r, and whose inclination to the central axis is θ. The moment of the resultant force R of the wrench about this line is $-Rr \sin\theta$, and that of the couple G is $G\cos\theta$. Hence the line will be a null-ine provided

$$\tan\theta = k/r, \qquad (11)$$

where k is the pitch of the wrench. The null-lines which are at a given distance r from a point O of the central axis will therefore orm one system of generators of a hyperboloid of revolution; and by varying r we get a series of such hyperboloids with a common centre and axis. By moving O along the central axis we obtain he whole complex of null-lines. It appears also from (11) that the null-lines whose distance from the central axis is r are tangent ines to a system of helices of slope $\tan^{-1}(r/k)$; and it is to be noticed hat these helices are left-handed if the given wrench is right-handed, and vice versa.

Since the given wrench can be replaced by a force acting through any assigned point P, and a couple, the locus of the null-lines hrough P is a plane, viz. a plane perpendicular to the vector which represents the couple. The complex is therefore of the ype called "linear" (in relation to the degree of this locus). The plane in question is called the *null-plane* of P. If the null-plane of P pass through Q, the null-plane of Q will pass through P, since PQ is a null-line. Again, any plane ω is the locus of a system of null-lines meeting in a point, called the *null-point* of ω. If a plane evolve about a fixed straight line p in it, its null-point describes another straight line p', which is called the *conjugate line* of p. We have seen that the wrench may be replaced by two forces, one of which may act in any arbitrary line p. It is now evident hat the second force must act in the conjugate line p', since every line meeting p, p' is a null-line. Again, since the shortest distance between any two conjugate lines cuts the central axis at right ngles, the orthogonal projections of two conjugate lines on a plane perpendicular to the central axis will be parallel (fig. 42). This property was employed by L. Cremona to prove the existence under certain conditions of "reciprocal figures" in a plane (§ 5). f we take any polyhedron with plane faces, the null-planes of its vertices with respect to a given wrench will form another polyhedron, and the edges of the latter will be conjugate (in the above ense) to those of the former. Projecting orthogonally on a plane erpendicular to the central axis we obtain two reciprocal figures.

In the analogous theory of infinitely small displacements of a solid, a "null-line" is a line such that the lengthwise displacement of any point on it is zero.

Since a wrench is defined by six independent quantities, it can in eneral be replaced by any system of forces which involves six djustable elements. For instance, it can in general be replaced y six forces acting in six given lines, *e.g.* in the six edges of a given etrahedron. An exception to the general statement occurs when he six lines are such that they are possible lines of action of a system f six forces in equilibrium; they are then said to be *in involution*. The theory of forces in involution has been studied by A. Cayley, . J. Sylvester and others. We have seen that a rigid structure may in general be rigidly connected with the earth by six links, nd it now appears that any system of forces acting on the structure an in general be balanced by six determinate forces exerted by the nks. If, however, the links are in involution, these forces become infinite or indeterminate. There is a corresponding kinematic eculiarity, in that the connexion is now not strictly rigid, an infinitely small relative displacement being possible. See § 9.

When parallel forces of given magnitudes act at given points, the resultant acts through a definite point, or *centre of parallel forces*, which is independent of the special direction of the forces. If P_r be the force at (x_r, y_r, z_r), acting in the direction (l, m, n), the formulae (6) and (7) reduce to

$$X = \Sigma(P).l, \quad Y = \Sigma(P).m, \quad Z = \Sigma(P).n, \qquad (12)$$

and

$$L = \Sigma(P).(n\bar{y} - m\bar{z}), \quad M = \Sigma(P).(l\bar{z} - n\bar{x}), \quad N = \Sigma(P).(m\bar{x} - l\bar{y}), \qquad (13)$$

provided

$$\bar{x} = \frac{\Sigma(Px)}{\Sigma(P)}, \quad \bar{y} = \frac{\Sigma(Py)}{\Sigma(P)}, \quad \bar{z} = \frac{\Sigma(Pz)}{\Sigma(P)}. \qquad (14)$$

These are the same as if we had a single force $\Sigma(P)$ acting at the point $(\bar{x}, \bar{y}, \bar{z})$, which is the same for all directions (l, m, n). We can hence derive the theory of the centre of gravity, as in § 4. An exceptional case occurs when $\Sigma(P) = 0$.

If we imagine a rigid body to be acted on at given points by forces of given magnitudes in directions (not all parallel) which are fixed in space, then as the body is turned about the resultant wrench will assume different configurations in the body, and will in certain positions reduce to a single force. The investigation of such questions forms the subject of "Astatics," which has been cultivated by Möbius, Minding, G. Darboux and others. As it has no physical bearing it is passed over here.

§ 9. *Work.*—The *work* done by a force acting on a particle, in any infinitely small displacement, is defined as the product of the force into the orthogonal projection of the displacement on the direction of the force; *i.e.* it is equal to $F.\delta s \cos\theta$, where F is the force, δs the displacement, and θ is the angle between the directions of F and δs. In the language of vector analysis (*q.v.*) it is the "scalar product" of the vector representing the force and the displacement. In the same way, the work done by a force acting on a rigid body in any infinitely small displacement of the body is the scalar product of the force into the displacement of any point on the line of action. This product is the same whatever point on the line of action be taken, since the lengthwise components of the displacements of any two points A, B on a line AB are equal, to the first order of small quantities. To see this, let A′, B′ be the displaced positions of A, B, and let ϕ be the infinitely small angle between AB and A′B′. Then if α, β be the orthogonal projections of A′, B′ on AB, we have

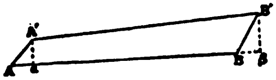


FIG. 45.

$$A\alpha - B\beta = AB - \alpha\beta = AB(1 - \cos\phi) = \tfrac{1}{2}AB.\phi^2,$$

ultimately. Since this is of the second order, the products $F.A\alpha$ and $F.B\beta$ are ultimately equal.

The total work done by two concurrent forces acting on a particle, or on a rigid body, in any infinitely small displacement, is equal to the work of their resultant. Let AB, AC (fig. 46) represent the forces, AD their resultant, and let AH be the direction of the displacement δs of the point A. The proposition follows at once from the fact that the sum of orthogonal projections of $\overrightarrow{AB}$, $\overrightarrow{AC}$ on AH is equal to the projection of $\overrightarrow{AD}$. It is to be noticed that AH need not be in the same plane with AB, AC.

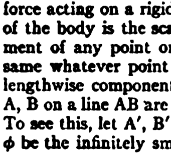


FIG. 46.

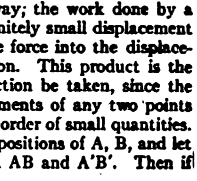


FIG. 47.

It follows from the preceding statements that any two systems of forces which are statically equivalent, according to the principles of §§ 4, 8, will (to the first order of small quantities) do the same amount of work in any infinitely small displacement of a rigid body to which they may be applied. It is also evident that the total work done in two or more successive infinitely small displacements is equal to the work done in the resultant displacement.

The work of a couple in any infinitely small rotation of a rigid body about an axis perpendicular to the plane of the couple is equal to the product of the moment of the couple into the angle of rotation, proper conventions as to sign being observed. Let the couple consist of two forces P, P (fig. 47) in the plane of the paper, and let J be the point where this plane is met by the axis of rotation. Draw JBA perpendicular to the lines of action, and let ϵ be the angle of rotation. The work of the couple is

$$\mathrm{P}\,.\,\mathrm{JA}\,.\,\epsilon-\mathrm{P}\,.\,\mathrm{JB}\,.\,\epsilon=\mathrm{P}\,.\,\mathrm{AB}\,.\,\epsilon=\mathrm{G}\epsilon,$$

if G be the moment of the couple.

The analytical calculation of the work done by a system of forces in any infinitesimal displacement is as follows. For a two-dimensional system we have, in the notation of §§ 3, 4,

$$\begin{aligned}\Sigma(\mathrm{X}\delta x+\mathrm{Y}\delta y)&=\Sigma\{\mathrm{X}(\lambda-y\epsilon)+\mathrm{Y}(\mu+x\epsilon)\}\\&=\Sigma(\mathrm{X})\,.\,\lambda+\Sigma(\mathrm{Y})\,.\,\mu+\Sigma(x\mathrm{Y}-y\mathrm{X})\epsilon\\&=\mathrm{X}\lambda+\mathrm{Y}\mu+\mathrm{N}\epsilon.\end{aligned}\tag{1}$$

Again, for a three-dimensional system, in the notation of §§ 7, 8,

$$\begin{aligned}&\Sigma(\mathrm{X}\delta x+\mathrm{Y}\delta y+\mathrm{Z}\delta z)\\&=\Sigma\{\mathrm{X}(\lambda+\eta z-\zeta y)+\mathrm{Y}(\mu+\zeta x-\xi z)+\mathrm{Z}(\nu+\xi y-\eta x)\}\\&=\Sigma(\mathrm{X})\,.\,\lambda+\Sigma(\mathrm{Y})\,.\,\mu+\Sigma(\mathrm{Z})\,.\,\nu+\Sigma(y\mathrm{Z}-z\mathrm{Y})\,.\,\xi+\Sigma(z\mathrm{X}-x\mathrm{Z})\,.\,\eta\\&\qquad+\Sigma(x\mathrm{Y}-y\mathrm{X})\,.\,\zeta\\&=\mathrm{X}\lambda+\mathrm{Y}\mu+\mathrm{Z}\nu+\mathrm{L}\xi+\mathrm{M}\eta+\mathrm{N}\zeta.\end{aligned}\tag{2}$$

This expression gives the work done by a given wrench when the body receives a given infinitely small twist; it must of course be an absolute invariant for all transformations of rectangular axes. The first three terms express the work done by the components of a force (X, Y, Z) acting at O, and the remaining three terms express the work of a couple (L, M, N).

The work done by a wrench about a given screw, when the body twists about a second given screw, may be calculated directly as follows. In fig. 48 let R, G be the force and couple of the wrench, ϵ, τ the rotation and translation in the twist. Let the axes of the wrench and the twist be inclined at an angle θ, and let h be the shortest distance between them. The displacement of the point H in the figure, resolved in the direction of R, is $\tau\cos\theta-\epsilon h\sin\theta$. The work is therefore

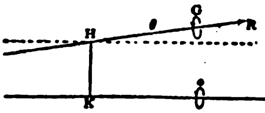


FIG. 48.

$$\begin{aligned}&\mathrm{R}(\tau\cos\theta-\epsilon h\sin\theta)+\mathrm{G}\cos\theta\\&=\mathrm{R}\epsilon\{(p+p')\cos\theta-h\sin\theta\},\end{aligned}\tag{3}$$

if $\mathrm{G}=p\mathrm{R}$, $\tau=p'\epsilon$, *i.e.* p, p' are the pitches of the two screws. The factor $(p+p')\cos\theta-h\sin\theta$ is called the *virtual coefficient* of the two screws which define the types of the wrench and twist, respectively.

A screw is determined by its axis and its pitch, and therefore involves five independent elements. These may be, for instance, the five ratios $\xi:\eta:\zeta:\lambda:\mu:\nu$ of the six quantities which specify an infinitesimal twist about the screw. If the twist is a pure rotation, these quantities are subject to the relation

$$\lambda\xi+\mu\eta+\nu\zeta=0.\tag{4}$$

In the analytical investigations of line geometry, these six quantities, supposed subject to the relation (4), are used to specify a line, and are called the six "co-ordinates" of the line; they are of course equivalent to only four independent quantities. If a line is a null-line with respect to the wrench (X, Y, Z, L, M, N), the work done in an infinitely small rotation about it is zero, and its co-ordinates are accordingly subject to the further relation

$$\mathrm{L}\xi+\mathrm{M}\eta+\mathrm{N}\zeta+\mathrm{X}\lambda+\mathrm{Y}\mu+\mathrm{Z}\nu=0,\tag{5}$$

where the coefficients are constant. This is the equation of a "linear complex" (cf. § 8).

Two screws are *reciprocal* when a wrench about one does no work on a body which twists about the other. The condition for this is

$$\lambda\xi'+\mu\eta'+\nu\zeta'+\lambda'\xi+\mu'\eta+\nu'\zeta=0,\tag{6}$$

if the screws be defined by the ratios $\xi:\eta:\zeta:\lambda:\mu:\nu$ and $\xi':\eta':\zeta':\lambda':\mu':\nu'$, respectively. The theory of the screw-systems which are reciprocal to one, two, three, four given screws respectively has been investigated by Sir R. S. Ball.

Considering a rigid body in any given position, we may contemplate the whole group of infinitesimal displacements which might be given to it. If the extraneous forces are in equilibrium the total work which they would perform in any such displacement would be zero, since they reduce to a zero force and a zero couple. This is (in part) the celebrated principle of *virtual velocities*, now often described as the principle of *virtual work*, enunciated by John Bernoulli (1667–1748). The word "virtual" is used because the displacements in question are not regarded as actually taking place, the body being in fact at rest. The "velocities" referred to are the velocities of the various points of the body in any imagined motion of the body through the position in question; they obviously bear to one another the same ratios as the corresponding infinitesimal displacements. Conversely, we can show that if the virtual work of the extraneous forces be zero for every infinitesimal displacement of the body as rigid, these forces must be in equilibrium. For by giving the body (in imagination) a displacement of translation we learn that the sum of the resolved parts of the forces in any assigned direction is zero, and by giving it a displacement of pure rotation we learn that the sum of the moments about any assigned axis is zero. The same thing follows of course from the analytical expression (2) for the virtual work. If this vanishes for all values of $\lambda, \mu, \nu, \xi, \eta, \zeta$ we must have X, Y, Z, L, M, N = 0, which are the conditions of equilibrium.

The principle can of course be extended to any system of particles or rigid bodies, connected together in any way, provided we take into account the internal stresses, or reactions, between the various parts. Each such reaction consists of two equal and opposite forces, both of which may contribute to the equation of virtual work.

The proper significance of the principle of virtual work, and of its converse, will appear more clearly when we come to kinetics (§ 16); for the present it may be regarded merely as a compact and (for many purposes) highly convenient summary of the laws of equilibrium. Its special value lies in this, that by a suitable adjustment of the hypothetical displacements we are often enabled to eliminate unknown reactions. For example, in the case of a particle lying on a smooth curve, or on a smooth surface, if it be displaced along the curve, or on the surface, the virtual work of the normal component of the pressure may be ignored, since it is of the second order. Again, if two bodies are connected by a string or rod, and if the hypothetical displacements be adjusted so that the distance between the points of attachment is unaltered, the corresponding stress may be ignored. This is evident from fig. 45; if AB, A′B′ represent the two positions of a string, and T be the tension, the virtual work of the two forces ± T at A,B is T(Aα−Bβ), which was shown to be of the second order. Again, the normal pressure between two surfaces disappears from the equation, provided the displacements be such that one of these surfaces merely slides relatively to the other. It is evident, in the first place, that in any displacement common to the two surfaces, the work of the two equal and opposite normal pressures will cancel; moreover if, one of the surfaces being fixed, an infinitely small displacement shifts the point of contact from A to B, and if A′ be the new position of that point of the sliding body which was at A, the projection of AA′ on the normal at A is of the second order. It is to be noticed, in this case, that the tangential reaction (if any) between the two surfaces is not eliminated. Again, if the displacements be such that one curved surface rolls without sliding on another, the reaction, whether normal or tangential, at the point of contact may be ignored. For the virtual work of two equal and opposite forces will cancel in any displacement which is common to the two surfaces; whilst, if one surface be fixed, the displacement of that point of the rolling surface which was in contact with the other is of the second order. We are thus able to imagine a great variety of mechanical systems to which the principle of virtual work can be applied without any regard to the internal stresses, provided the hypothetical displacements be such that none of the connexions of the system are violated.

If the system be subject to gravity, the corresponding part of the virtual work can be calculated from the displacement of the centre of gravity. If $W_1, W_2, \ldots$ be the weights of a system of particles, whose depths below a fixed horizontal plane of reference are $z_1, z_2, \ldots$, respectively, the virtual work of gravity is

$$\begin{aligned} W_1\delta z_1 + W_2\delta z_2 + \ldots &= \delta(W_1 z_1 + W_2 z_2 + \ldots) \\ &= (W_1 + W_2 + \ldots)\delta\bar{z}, \end{aligned} \tag{7}$$

where $\bar{z}$ is the depth of the centre of gravity (see § 8 (14) and § 11 (6)). This expression is the same as if the whole mass were concentrated at the centre of gravity, and displaced with this point. An important conclusion is that in any displacement of a system of bodies in equilibrium, such that the virtual work of all forces except gravity may be ignored, the depth of the centre of gravity is "stationary."

The question as to stability of equilibrium belongs essentially to kinetics; but we may state by anticipation that in cases where gravity is the only force which does work, the equilibrium of a body or system of bodies is stable only if the depth of the centre of gravity be a maximum.

Consider, for instance, the case of a bar resting with its ends on two smooth inclines (fig. 18). If the bar be displaced in a vertical plane so that its ends slide on the two inclines, the instantaneous centre is at the point J. The displacement of G is at right angles to JG; this shows that for equilibrium JG must be vertical. Again, the locus of G is an arc of an ellipse whose centre is in the intersection of the planes; since this arc is convex upwards the equilibrium is unstable. A general criterion for the case of a rigid body movable in two dimensions, with one degree of freedom, can be obtained as follows. We have seen (§ 3) that the sequence of possible positions is obtained if we imagine the "body-centrode" to roll on the "space-centrode." For equilibrium, the altitude of the centre of gravity G must be stationary; hence G must lie in the same vertical line with the point of contact J of the two curves. Further, it is known from the theory of "roulettes" that the locus of G will be concave or convex upwards according as

$$\frac{\cos\phi}{h} \gtrless \frac{1}{\rho} + \frac{1}{\rho'}, \tag{8}$$

where ρ, ρ' are the radii of curvature of the two curves at J, ϕ is the inclination of the common tangent at J to the horizontal, and h is the height of G above J. The signs of ρ, ρ' are to be taken positive when the curvatures are as in the standard case shown in fig. 49. Hence for stability the upper sign must obtain in (8). The same criterion may be arrived at in a more intuitive manner as follows. If the body be supposed to roll (say to the right) until the curves touch at J′, and if $JJ' = \delta s$, the angle through which the upper figure rotates is $\delta s/\rho + \delta s/\rho'$, and the horizontal displacement of G is equal to the product of this expression into h. If this displacement be less than the horizontal projection of JJ′, viz. $\delta s \cos\phi$, the vertical through the new position of G will fall to the left of J′ and gravity will tend to restore the body to its former position. It is here assumed that the remaining forces acting on the body in its displaced position have zero moment about J′; this is evidently the case, for instance, in the problem of "rocking stones."

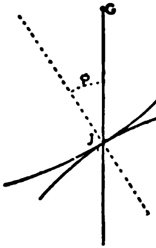


FIG. 49.

The principle of virtual work is specially convenient in the theory of frames (§ 6), since the reactions at smooth joints and the stresses in inextensible bars may be left out of account. In particular, in the case of a frame which is just rigid, the principle enables us to find the stress in any one bar independently of the rest. If we imagine the bar in question to be removed, equilibrium will still persist if we introduce two equal and opposite forces S, of suitable magnitude, at the joints which it connected. In any infinitely small deformation of the frame as thus modified, the virtual work of the forces S, together with that of the original extraneous forces, must vanish; this determines S.

As a simple example, take the case of a light frame, whose bars form the slides of a rhombus ABCD with the diagonal BD, suspended from A and carrying a weight W at C; and let it be required to find the stress in BD. If we remove the bar BD, and apply two equal and opposite forces S at B and D, the equation is

$$W \,.\, \delta(2l\cos\theta) + 2\,S \,.\, \delta(l\sin\theta) = 0,$$

where l is the length of a side of the rhombus, and θ its inclination to the vertical. Hence

$$S = W\tan\theta = W \,.\, BD/AC. \tag{8}$$

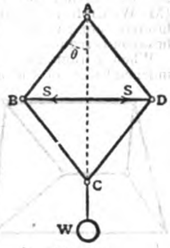


FIG. 50.

The method is specially appropriate when the frame, although just rigid, is not "simple" in the sense of § 6, and when accordingly the method of reciprocal figures is not immediately available. To avoid the intricate trigonometrical calculations which would often be necessary, graphical devices have been introduced by H. Müller-Breslau and others. For this purpose the infinitesimal displacements of the various joints are replaced by finite lengths proportional to them, and therefore proportional to the velocities of the joints in some imagined motion of the deformable frame through its actual configuration; this is really (it may be remarked) a reversion to the original notion of "virtual velocities." Let J be the instantaneous centre for any bar CD (fig. 12), and let s_1, s_2, represent the virtual velocities of C, D. If these lines be turned through a right angle in the same sense, they take up positions such as CC′, DD′, where C′, D′ are on JC, JD, respectively, and C′D′ is parallel to CD. Further, if F_1 (fig. 51) be any force acting on the joint C, its virtual work will be equal to the moment of F_1 about C′; the equation of virtual work is thus transformed into an equation of moments.

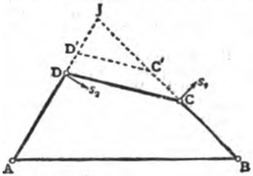


FIG. 12.

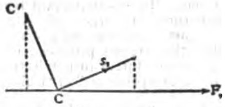


FIG. 51.

Consider, for example, a frame whose sides form the six sides of a hexagon ABCDEF and the three diagonals AD, BE, CF; and suppose that it is required to find the stress in CF due to a given system of extraneous forces in equilibrium, acting on the joints. Imagine the bar CF to be removed, and consider a deformation in which AB is fixed. The instantaneous centre of CD will be at the intersection of AD, BC, and if C′D′ be drawn parallel to CD, the lines CC′, DD′ may be taken to represent the virtual velocities of C, D turned each through a right angle. Moreover, if we draw D′E′ parallel to DE, and E′F′ parallel to EF, the lines CC′, DD′, EE′, FF′ will represent on the same scale the virtual velocities of the points C, D, E, F, respectively, turned each through a right angle. The equation of virtual work is then formed by taking moments about C′, D′, E′, F′ of the extraneous forces which act at C, D, E, F, respectively. Amongst these forces we must include the two equal and opposite forces S which take the place of the stress in the removed bar FC.

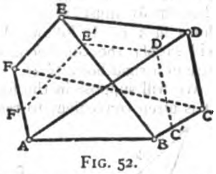


FIG. 52.

The above method lends itself naturally to the investigation of the *critical forms* of a frame whose general structure is given. We have seen that the stresses produced by an equilibrating system of extraneous forces in a frame which is just rigid, according to the criterion of § 6, are in general uniquely determinate; in particular, when there are no extraneous forces the bars are in general free from stress. It may however happen that owing to some special relation between the lengths of the bars the frame admits of an infinitesimal deformation. The simplest case is that of a frame of three bars, when the three joints A, B, C fall into a straight line; a small displacement of the joint B at right angles to AC would involve changes in the lengths of AB, BC which are only of the second order of small quantities. Another example is shown in fig. 53. The graphical method leads at once to the detection of such cases. Thus in the hexagonal frame of fig. 52, if an infinitesimal deformation is possible without removing the bar CF, the instantaneous centre of CF (when AB is fixed) will be at the intersection of AF and BC, and since CC′, FF′ represent the virtual velocities of the points C, F, turned each through a right angle, C′F′ must be parallel to CF. Conversely, if this condition be satisfied, an infinitesimal deformation is possible. The result may be generalized into the statement that a frame has a critical form whenever a frame of the same structure can be designed with corresponding bars parallel, but without complete geometric similarity. In the case of fig. 52 it may be shown that an equivalent condition is that the six points A, B, C, D, E, F should lie on a conic (M. W. Crofton). This is fulfilled when the opposite sides of the hexagon are parallel, and (as a still more special case) when the hexagon is regular.

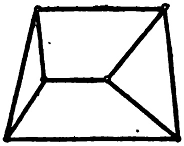


FIG. 53.

When a frame has a critical form it may be in a state of stress independently of the action of extraneous forces; moreover, the stresses due to extraneous forces are indeterminate, and may be infinite. For suppose as before that one of the bars is removed. If there are no extraneous forces the equation of virtual work reduces to $S . \delta s = 0$, where S is the stress in the removed bar, and δs is the change in the distance between the joints which it connected. In a critical form we have $\delta s = 0$, and the equation is satisfied by an arbitrary value of S; a consistent system of stresses in the remaining bars can then be found by preceding rules. Again, when extraneous forces P act on the joints, the equation is

$$\Sigma(P . \delta p) + S . \delta s = 0,$$

where δp is the displacement of any joint in the direction of the corresponding force P. If $\Sigma(P . \delta p) = 0$, the stresses are merely indeterminate as before; but if $\Sigma(P . \delta p)$ does not vanish, the equation cannot be satisfied by any finite value of S, since $\delta s = 0$. This means that, if the material of the frame were absolutely unyielding, no finite stresses in the bars would enable it to withstand the extraneous forces. With actual materials, the frame would yield elastically, until its configuration is no longer "critical." The stresses in the bars would then be comparatively very great, although finite. The use of frames which approximate to a critical form is of course to be avoided in practice.

A brief reference must suffice to the theory of three dimensional frames. This is important from a technical point of view, since all structures are practically three-dimensional. We may note that a frame of n joints which is just rigid must have $3n-6$ bars; and that the stresses produced in such a frame by a given system of extraneous forces in equilibrium are statically determinate, subject to the exception of "critical forms."

§ 10. *Statics of Inextensible Chains.*—The theory of bodies or structures which are deformable in their smallest parts belongs properly to elasticity (*q.v.*). The case of inextensible strings or chains is, however, so simple that it is generally included in expositions of pure statics.

It is assumed that the form can be sufficiently represented by a plane curve, that the stress (tension) at any point P of the curve, between the two portions which meet there, is in the direction of the tangent at P, and that the forces on any linear element δs must satisfy the conditions of equilibrium laid down in § 1. It follows that the forces on any finite portion will satisfy the conditions of equilibrium which apply to the case of a rigid body (§ 4).

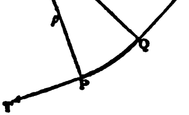


FIG. 54.

We will suppose in the first instance that the curve is plane. It is often convenient to resolve the forces on an element PQ $(= \delta s)$ in the directions of the tangent and normal respectively. If T, $T + \delta T$ be the tensions at P, Q, and $\delta\psi$ be the angle between the directions of the curve at these points, the components of the tensions along the tangent at P give $(T + \delta T) \cos \psi - T$, or δT, ultimately; whilst for the component along the normal at P we have $(T + \delta T) \sin \delta\psi$, or $T\delta\psi$, or $T\delta s/\rho$, where ρ is the radius of curvature.

Suppose, for example, that we have a light string stretched over a smooth curve; and let $R\delta s$ denote the normal pressure (outwards from the centre of curvature) on δs. The two resolutions give $\delta T = 0$, $T\delta\psi = R\delta s$, or

$$T = \text{const.}, \quad R = T/\rho. \tag{1}$$

The tension is constant, and the pressure per unit length varies as the curvature.

Next suppose that the curve is "rough"; and let $F\delta s$ be the tangential force of friction on δs. We have $\delta T \mp F\delta s = 0$, $T\delta\psi = R\delta s$, where the upper or lower sign is to be taken according to the sense in which F acts. We assume that in limiting equilibrium we have $F = \mu R$, everywhere, where μ is the coefficient of friction. If the string be on the point of slipping in the direction in which ψ increases, the lower sign is to be taken; hence $\delta T = F\delta s = \mu T\delta\psi$, whence

$$T = T_0 e^{\mu\psi}, \tag{2}$$

if T_0 be the tension corresponding to $\psi = 0$. This illustrates the resistance to dragging of a rope coiled round a post; *e.g.* if we put $\mu = \cdot 3$, $\psi = 2\pi$, we find for the change of tension in one turn $T/T_0 = 6\cdot 5$. In two turns this ratio is squared, and so on.

Again, take the case of a string under gravity, in contact with a smooth curve in a vertical plane. Let ψ denote the inclination to the horizontal, and $w\delta s$ the weight of an element δs. The tangential and normal components of $w\delta s$ are $-w\delta s \sin \psi$ and $-w\delta s \cos \psi$. Hence

$$\delta T = w\delta s \sin \psi, \quad T\delta\psi = w\delta s \cos \psi + R\delta s. \tag{3}$$

If we take rectangular axes Ox, Oy, of which Oy is drawn vertically upwards, we have $\delta y = \sin \psi \, \delta s$, whence $\delta T = w\delta y$. If the string be uniform, w is constant, and

$$T = wy + \text{const.} = w(y - y_0), \tag{4}$$

say; hence the tension varies as the height above some fixed level (y_0). The pressure is then given by the formula

$$R = T\frac{d\psi}{ds} - w \cos \psi. \tag{5}$$

In the case of a chain hanging freely under gravity it is usually convenient to formulate the conditions of equilibrium of a finite portion PQ. The forces on this reduce to three, viz. the weight of PQ and the tensions at P, Q. Hence these three forces will be concurrent, and their ratios will be given by a triangle of forces. In particular, if we consider a length AP beginning at the lowest point A, then resolving horizontally and vertically we have

$$T \cos \psi = T_0, \quad T \sin \psi = W, \tag{6}$$

where T_0 is the tension at A, and W is the weight of PA. The former equation expresses that the horizontal tension is constant.

If the chain be uniform we have $W = ws$, where s is the arc AP: hence $ws = T_0 \tan \psi$. If we write $T_0 = wa$, so that a is the length of a portion of the chain whose weight would equal the horizontal tension, this becomes

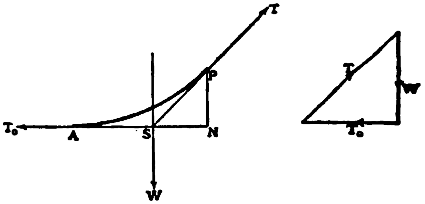


FIG. 55.

$$s = a \tan \psi. \tag{7}$$

This is the "intrinsic" equation of the curve. If the axes of x and y be taken horizontal and vertical (upwards), we derive

$$x = a \log (\sec \psi + \tan \psi), \quad y = a \sec \psi. \tag{8}$$

Eliminating ψ we obtain the Cartesian equation

$$y = a \cosh \frac{x}{a} \tag{9}$$

of the *common catenary*, as it is called (fig. 56). The omission of the additive arbitrary constants of integration in (8) is equivalent to a special choice of the origin O of co-ordinates; viz. O is at a distance a vertically below the lowest point $(\psi = 0)$ of the curve. The horizontal line through O is called the *directrix*. The relations

$$s = a \sinh \frac{x}{a}, \quad y^2 = a^2 + s^2, \quad T = T_0 \sec \psi = wy, \tag{10}$$

which are involved in the preceding formulae are also noteworthy. It is a classical problem in the calculus of variations to deduce the equation (9) from the condition that the depth of the centre of gravity of a chain of given length hanging between fixed points must be stationary (§ 9). The length a is called the *parameter* of the catenary; it determines the scale of the curve, all catenaries being geometrically similar. If weights be suspended from various points of a hanging chain, the intervening portions will form arcs of equal catenaries, since the horizontal tension (wa) is the same for all. Again, if a chain pass over a perfectly smooth peg, the catenaries in which it hangs on the two sides, though usually of different parameters, will have the same directrix, since by (10) y is the same for both at the peg.

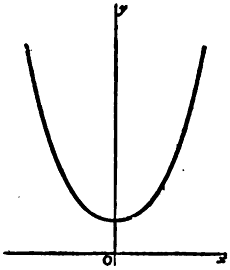


FIG. 56.

As an example of the use of the formulae we may determine the maximum span for a wire of given material. The condition is that the tension must not exceed the weight of a certain length λ of the wire. At the ends we shall have $y = \lambda$, or

$$\lambda = a \cosh \frac{x}{a}, \tag{11}$$

and the problem is to make x a maximum for variations of a. Differentiating (11) we find that, if $dx/da = 0$,

$$\frac{x}{a} \tanh \frac{x}{a} = 1. \tag{12}$$

It is easily seen graphically, or from a table of hyperbolic tangents, that the equation $u \tanh u = 1$ has only one positive root ($u = 1{\cdot}200$); the span is therefore

$$2x = 2au = 2\lambda/ \sinh u = 1{\cdot}326\, \lambda,$$

and the length of wire is

$$2s = 2\lambda/u = 1{\cdot}667\, \lambda.$$

The tangents at the ends meet on the directrix, and their inclination to the horizontal is 56° 30′.

The relation between the sag, the tension, and the span of a wire (*e.g.* a telegraph wire) stretched nearly straight between two points A, B at the same level is determined most simply from first principles. If T be the tension, W the total weight, k the sag in the middle, and ψ the inclination to the horizontal at A or B, we have $2T\psi = W$, $AB = 2\rho\psi$, approximately, where ρ is the radius of curvature. Since $2k\rho = (\tfrac{1}{2}AB)^2$, ultimately, we have

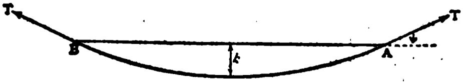


FIG. 57.

$$k = \tfrac{1}{8}W \,.\, AB/T. \tag{13}$$

The same formula applies if A, B be at different levels, provided k be the sag, measured vertically, half way between A and B.

In relation to the theory of suspension bridges the case where the weight of any portion of the chain varies as its horizontal projection is of interest. The vertical through the centre of gravity of the arc AP (see fig. 55) will then bisect its horizontal projection AN; hence if PS be the tangent at P we shall have AS = SN. This property is characteristic of a parabola whose axis is vertical. If we take A as origin and AN as axis of x, the weight of AP may be denoted by wx, where w is the weight per unit length at A. Since PNS is a triangle of forces for the portion AP of the chain, we have $wx/T_0 = PN/NS$, or

$$y = w \,.\, x^2/2T_0, \tag{14}$$

which is the equation of the parabola in question. The result might of course have been inferred from the theory of the parabolic funicular in § 2.

Finally, we may refer to the *catenary of uniform strength*, where the cross-section of the wire (or cable) is supposed to vary as the tension. Hence w, the weight per foot, varies as T, and we may write $T = w\lambda$, where λ is a constant length. Resolving along the normal the forces on an element δs, we find $T\delta\psi = w\delta s \cos \psi$, whence

$$\rho = \frac{ds}{d\psi} = \lambda \sec \psi. \tag{15}$$

From this we derive

$$x = \lambda\psi,\ y = \lambda \log \sec \frac{x}{\lambda}, \tag{16}$$

where the directions of x and y are horizontal and vertical, and the origin is taken at the lowest point. The curve (fig. 58) has two vertical asymptotes $x = \pm\tfrac{1}{2}\pi\lambda$; this shows that however the thickness of a cable be adjusted there is a limit $\pi\lambda$ to the horizontal span, where λ depends on the tensile strength of the material. For a uniform catenary the limit was found above to be $1{\cdot}326\lambda$.

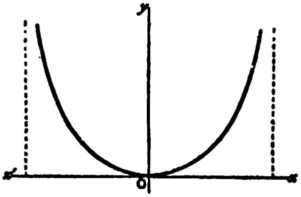


FIG. 58.

For investigations relating to the equilibrium of a string in three dimensions we must refer to the textbooks. In the case of a string stretched over a smooth surface, but in other respects free from extraneous force, the tensions at the ends of a small element δs must be balanced by the normal reaction of the surface. It follows that the osculating plane of the curve formed by the string must contain the normal to the surface, *i.e.* the curve must be a "geodesic," and that the normal pressure per unit length must vary as the principal curvature of the curve.

§ 11. *Theory of Mass-Systems.*—This is a purely geometrical subject. We consider a system of points $P_1, P_2 \ldots, P_n$, with which are associated certain co-efficients $m_1, m_2, \ldots m_n$, respectively. In the application to mechanics these coefficients are the masses of particles situate at the respective points, and are therefore all positive. We shall make this supposition in what follows, but it should be remarked that hardly any difference is made in the theory if some of the coefficients have a different sign from the rest, except in the special case where $\Sigma(m) = 0$. This has a certain interest in magnetism.

In a given mass-system there exists one and only one point G such that

$$\Sigma(m\,.\,\overrightarrow{GP}) = 0. \tag{1}$$

For, take any point O, and construct the vector

$$\overrightarrow{OG} = \frac{\Sigma(m\,.\,\overrightarrow{OP})}{\Sigma(m)}. \tag{2}$$

Then

$$\Sigma(m\,.\overrightarrow{GP}) = \Sigma\{m(\overrightarrow{GO} + \overrightarrow{OP})\} = \Sigma(m)\,.\overrightarrow{GO} + \Sigma(m)\,.\overrightarrow{OP} = 0. \tag{3}$$

Also there cannot be a distinct point G′ such that $\Sigma(m.\ G'P) = 0$, for we should have, by subtraction.

$$\Sigma\{m(\overrightarrow{GP} + \overrightarrow{PG'})\} = 0, \text{ or } \Sigma(m)\,.\,GG' = 0; \tag{4}$$

i.e. G′ must coincide with G. The point G determined by (1) is called the *mass-centre* or *centre of inertia* of the given system. It is easily seen that, in the process of determining the mass-centre, any group of particles may be replaced by a single particle whose mass is equal to that of the group, situate at the mass-centre of the group.

If through $P_1, P_2, \ldots P_n$ we draw any system of parallel planes meeting a straight line OX in the points $M_1, M_2, \ldots M_n$, the collinear vectors $\overrightarrow{OM_1}, \overrightarrow{OM_2} \ldots \overrightarrow{OM_n}$ may be called the "projections" of $\overrightarrow{OP_1}, \overrightarrow{OP_2}, \ldots \overrightarrow{OP_n}$ on OX. Let these projections be denoted algebraically by $x_1, x_2, \ldots x_n$, the sign being positive or negative according as the direction is that of OX or the reverse. Since the projection of a vector-sum is the sum of the projections of the several vectors, the equation (2) gives

$$\bar{x}=\frac{\Sigma(mx)}{\Sigma(m)}, \tag{5}$$

if $\bar{x}$ be the projection of $\overrightarrow{OG}$. Hence if the Cartesian co-ordinates of $P_1, P_2, \dots P_n$ relative to any axes, rectangular or oblique be $(x_1, y_1, z_1), (x_2, y_2, z_2), \dots, (x_n, y_n, z_n)$, the mass-centre $(\bar{x}, \bar{y}, \bar{z})$ is determined by the formulae

$$\bar{x}=\frac{\Sigma(mx)}{\Sigma(m)},\ \bar{y}=\frac{\Sigma(my)}{\Sigma(m)},\ \bar{z}=\frac{\Sigma(mz)}{\Sigma(m)}. \tag{6}$$

If we write $x=\bar{x}+\xi$, $y=\bar{y}+\eta$, $z=\bar{z}+\zeta$, so that ξ, η, ζ denote co-ordinates relative to the mass-centre G, we have from (6)

$$\Sigma(m\xi)=0, \quad \Sigma(m\eta)=0, \quad \Sigma(m\zeta)=0. \tag{7}$$

One or two special cases may be noticed. If three masses α, β, γ be situate at the vertices of a triangle ABC, the mass-centre of β and γ is at a point A′ in BC, such that $\beta . BA'=\gamma . A'C$. The mass-centre (G) of α, β, γ will then divide AA′ so that $\alpha . AG=(\beta+\gamma)\ GA'$. It is easily proved that

$$\alpha : \beta : \gamma=\Delta BGA : \Delta GCA : \Delta GAB;$$

also, by giving suitable values (positive or negative) to the ratios $\alpha : \beta : \gamma$ we can make G assume any assigned position in the plane ABC. We have here the origin of the "barycentric co-ordinates" of Möbius, now usually known as "areal" co-ordinates. If $\alpha+\beta+\gamma=0$, G is at infinity; if $\alpha=\beta=\gamma$, G is at the intersection of the median lines of the triangle; if $\alpha : \beta : \gamma=a : b : c$, G is at the centre of the inscribed circle. Again, if G be the mass-centre of four particles $\alpha, \beta, \gamma, \delta$ situate at the vertices of a tetrahedron ABCD, we find

$$\alpha : \beta : \gamma : \delta=\text{tet}^{n}\ GBCD : \text{tet}^{n}\ GCDA : \text{tet}^{n}\ GDAB : \text{tet}^{n}\ GABC,$$

and by suitable determination of the ratios on the left hand we can make G assume any assigned position in space. If $\alpha+\beta+\gamma+\delta=0$, G is at infinity; if $\alpha=\beta=\gamma=\delta$, G bisects the lines joining the middle points of opposite edges of the tetrahedron ABCD; if $\alpha : \beta : \gamma : \delta=\Delta BCD : \Delta CDA : \Delta DAB : \Delta ABC$, G is at the centre of the inscribed sphere.

If we have a continuous distribution of matter, instead of a system of discrete particles, the summations in (6) are to be replaced by integrations. Examples will be found in textbooks of the calculus and of analytical statics. As particular cases: the mass-centre of a uniform thin triangular plate coincides with that of three equal particles at the corners; and that of a uniform solid tetrahedron coincides with that of four equal particles at the vertices. Again, the mass-centre of a uniform solid right circular cone divides the axis in the ratio 3 : 1; that of a uniform solid hemisphere divides the axial radius in the ratio 3 : 5.

It is easily seen from (6) that if the configuration of a system of particles be altered by "homogeneous strain" (see ELASTICITY) the new position of the mass-centre will be at that point of the strained figure which corresponds to the original mass-centre.

The formula (2) shows that a system of concurrent forces represented by $m_1 . \overrightarrow{OP_1}, m_2 . \overrightarrow{OP_2}, \dots m_n . \overrightarrow{OP_n}$ will have a resultant represented by $\Sigma(m) . \overrightarrow{OG}$. If we imagine O to recede to infinity in any direction we learn that a system of parallel forces proportional to $m_1, m_2, \dots m_n$, acting at $P_1, P_2 \dots P_n$ have a resultant proportional to $\Sigma(m)$ which acts always through a point G fixed relatively to the given mass-system. This contains the theory of the "centre of gravity" (§§ 4, 9). We may note also that if $P_1, P_2, \dots P_n$, and $P_1', P_2', \dots P_n'$ represent two configurations of the series of particles, then

$$\Sigma(m . \overrightarrow{PP'})=\Sigma(m) . \overrightarrow{GG'}, \tag{8}$$

where G,G′ are the two positions of the mass-centre. The forces $m_1 . \overrightarrow{P_1P_1'}, m_2 . \overrightarrow{P_2P_2'}, \dots m_n . \overrightarrow{P_nP_n'}$, considered as localized vectors, do not, however, as a rule reduce to a single resultant.

We proceed to the theory of the *plane*, *axial* and *polar quadratic moments* of the system. The axial moments have alone a dynamical significance, but the others are useful as subsidiary conceptions. If $h_1, h_2, \dots h_n$ be the perpendicular distances of the particles from any fixed plane, the sum $\Sigma(mh^2)$ is the quadratic moment with respect to the plane. If $p_1, p_2, \dots p_n$ be the perpendicular distances from any given axis, the sum $\Sigma(mp^2)$ is the quadratic moment with respect to the axis; it is also called the *moment of inertia* about the axis. If $r_1, r_2, \dots r_n$ be the distances from a fixed point, the sum $\Sigma(mr^2)$ is the quadratic moment with respect to that point (or pole). If we divide any of the above quadratic moments by the total mass $\Sigma(m)$, the result is called the *mean square* of the distances of the particles from the respective plane, axis or pole. In the case of an axial moment, the square root of the resulting mean square is called the *radius of gyration* of the system about the axis in question. If we take rectangular axes through any point O, the quadratic moments with respect to the co-ordinate planes are

$$I_x=\Sigma(mx^2), \quad I_y=\Sigma(my^2), \quad I_z=\Sigma(mz^2); \tag{9}$$

those with respect to the co-ordinate axes are

$$I_{yz}=\Sigma\{m(y^2+z^2)\}, \quad I_{zx}=\Sigma\{m(z^2+x^2)\}, \quad I_{xy}=\Sigma\{m(x^2+y^2)\}; \tag{10}$$

whilst the polar quadratic moment with respect to O is

$$I_o=\Sigma\{m(x^2+y^2+z^2)\}. \tag{11}$$

We note that

$$I_{yz}=I_y+I_z, \quad I_{zx}=I_z+I_x, \quad I_{xy}=I_x+I_y, \tag{12}$$

and

$$I_o=I_x+I_y+I_z=\tfrac{1}{2}(I_{yz}+I_{zx}+I_{xy}). \tag{13}$$

In the case of continuous distributions of matter the summations in (9), (10), (11) are of course to be replaced by integrations. For a uniform thin circular plate, we find, taking the origin at its centre, and the axis of z normal to its plane, $I_o=\tfrac{1}{2}Ma^2$, where M is the mass and a the radius. Since $I_x=I_y$, $I_z=0$, we deduce $I_{zx}=\tfrac{1}{4}Ma^2$, $I_{xy}=\tfrac{1}{2}Ma^2$; hence the value of the squared radius of gyration is for a diameter $\tfrac{1}{4}a^2$, and for the axis of symmetry $\tfrac{1}{2}a^2$. Again, for a uniform solid sphere having its centre at the origin we find $I_o=\tfrac{3}{5}Ma^2$, $I_x=I_y=I_z=\tfrac{1}{5}Ma^2$, $I_{yz}=I_{zx}=I_{xy}=\tfrac{2}{5}Ma^2$; i. e. the square of the radius of gyration with respect to a diameter is $\tfrac{2}{5}a^2$. The method of homogeneous strain can be applied to deduce the corresponding results for an ellipsoid of semi-axes a, b, c. If the co-ordinate axes coincide with the principal axes, we find $I_x=\tfrac{1}{5}Ma^2$, $I_y=\tfrac{1}{5}Mb^2$, $I_z=\tfrac{1}{5}Mc^2$, whence $I_{yz}=\tfrac{1}{5}M(b^2+c^2)$, &c.

If $\phi(x, y, z)$ be any homogeneous quadratic function of x, y, z, we have

$$\begin{aligned}\Sigma\{m\phi(x, y, z)\}&=\Sigma\{m\phi(\bar{x}+\xi, \bar{y}+\eta, \bar{z}+\zeta)\}\\&=\Sigma\{m\phi(\bar{x}, \bar{y}, \bar{z})\}+\Sigma\{m\phi(\xi, \eta, \zeta)\},\end{aligned} \tag{14}$$

since the terms which are bilinear in respect to $\bar{x}, \bar{y}, \bar{z}$, and ξ, η, ζ vanish, in virtue of the relations (7). Thus

$$I_x=I_\xi+\Sigma(m)\bar{x}^2, \tag{15}$$

$$I_{yz}=I_{\eta\zeta}+\Sigma(m) . (\bar{y}^2+\bar{z}^2), \tag{16}$$

with similar relations, and

$$I_O=I_G+\Sigma(m) . OG^2. \tag{17}$$

The formula (16) expresses that the squared radius of gyration about any axis (Ox) exceeds the squared radius of gyration about a parallel axis through G by the square of the distance between the two axes. The formula (17) is due to J. L. Lagrange; it may be written

$$\frac{\Sigma(m . OP^2)}{\Sigma(m)}=\frac{\Sigma(m . GP^2)}{\Sigma(m)}+OG^2, \tag{18}$$

and expresses that the mean square of the distances of the particles from O exceeds the mean square of the distances from G by OG^2. The mass-centre is accordingly that point the mean square of whose distances from the several particles is least. If in (18) we make O coincide with $P_1, P_2, \dots P_n$ in succession, we obtain

$$\left.\begin{array}{l}0 + m_2 . P_1P_2^2 + \dots + m_n . P_1P_n^2=\Sigma(m . GP^2)+\Sigma(m) . GP_1^2,\\ m_1 . P_2P_1^2 + 0 + \dots + m_n . P_2P_n^2=\Sigma(m . GP^2)+\Sigma(m) . GP_2^2,\\ \dots\\ m_1 . P_nP_1^2 + m_2 . P_nP_2^2 + \dots + 0=\Sigma(m . GP^2)+\Sigma(m) . GP_n^2.\end{array}\right\} \tag{19}$$

If we multiply these equations by $m_1, m_2, \dots m_n$, respectively, and add, we find

$$\Sigma\Sigma(m_rm_s . P_rP_s^2)=\Sigma(m) . \Sigma(m . GP^2), \tag{20}$$

provided the summation $\Sigma\Sigma$ on the left hand be understood to include each pair of particles once only. This theorem, also due to Lagrange, enables us to express the mean square of the distances of the particles from the centre of mass in terms of the masses and mutual distances. For instance, considering four equal particles at the vertices of a regular tetrahedron, we can infer that the radius R of the circumscribing sphere is given by $R^2=\tfrac{3}{8}a^2$, if a be the length of an edge.

Another type of quadratic moment is supplied by the *deviation-moments*, or *products of inertia* of a distribution of matter. Thus the sum $\Sigma(m . yz)$ is called the "product of inertia" with respect to the planes $y=0$, $z=0$. This may be expressed in terms of the product of inertia with respect to parallel planes through G by means of the formula (14); viz.:—

$$\Sigma(m . yz)=\Sigma(m . \eta\zeta)+\Sigma(m) . \bar{y}\bar{z} \tag{21}$$

The quadratic moments with respect to different planes through a fixed point O are related to one another as follows. The moment with respect to the plane

$$\lambda x+\mu y+\nu z=0, \tag{22}$$

where λ, μ, ν are direction-cosines, is

$$\begin{aligned}\Sigma\{m(\lambda x+\mu y+\nu z)^2\} = \Sigma(mx^2)\,.\,\lambda^2+\Sigma(my^2)\,.\,\mu^2+\Sigma(mz^2)\,.\,\nu^2\\ +2\Sigma(myz)\,.\,\mu\nu+2\Sigma(mzx)\,.\,\nu\lambda+2\Sigma(mxy)\,.\,\lambda\mu,\end{aligned} \tag{23}$$

and therefore varies as the square of the perpendicular drawn from O to a tangent plane of a certain quadric surface, the tangent plane in question being parallel to (22). If the co-ordinate axes coincide with the principal axes of this quadric, we shall have

$$\Sigma(myz)=0,\quad \Sigma(mzx)=0,\quad \Sigma(mxy)=0; \tag{24}$$

and if we write

$$\Sigma(mx^2)=\mathrm{M}a^2,\quad \Sigma(my^2)=\mathrm{M}b^2,\quad \Sigma(mz^2)=\mathrm{M}c^2, \tag{25}$$

where $\mathrm{M}=\Sigma(m)$, the quadratic moment becomes $\mathrm{M}(a^2\lambda^2+b^2\mu^2+c^2\nu^2)$, or $\mathrm{M}p^2$, where p is the distance of the origin from that tangent plane of the ellipsoid

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1, \tag{26}$$

which is parallel to (22). It appears from (24) that through any assigned point O three rectangular axes can be drawn such that the product of inertia with respect to each pair of co-ordinate planes vanishes; these are called the *principal axes of inertia* at O. The ellipsoid (26) was first employed by J. Binet (1811), and may be called "Binet's Ellipsoid" for the point O. Evidently the quadratic moment for a variable plane through O will have a "stationary" value when, and only when, the plane coincides with a principal plane of (26). It may further be shown that if Binet's ellipsoid be referred to any system of conjugate diameters as co-ordinate axes, its equation will be

$$\frac{x'^2}{a'^2}+\frac{y'^2}{b'^2}+\frac{z'^2}{c'^2}=1, \tag{27}$$

provided

$$\Sigma(mx'^2)=\mathrm{M}a'^2,\quad \Sigma(my'^2)=\mathrm{M}b'^2,\quad \Sigma(mz'^2)=\mathrm{M}c'^2;$$

also that

$$\Sigma(my'z')=0,\ \Sigma(mz'x')=0,\ \Sigma(mx'y')=0. \tag{28}$$

Let us now take as co-ordinate axes the principal axes of inertia at the mass-centre G. If a, b, c be the semi-axes of the Binet's ellipsoid of G, the quadratic moment with respect to the plane $\lambda x+\mu y+\nu z=0$ will be $\mathrm{M}(a^2\lambda^2+b^2\mu^2+c^2\nu^2)$, and that with respect to a parallel plane

$$\lambda x+\mu y+\nu z=p \tag{29}$$

will be $\mathrm{M}(a^2\lambda^2+b^2\mu^2+c^2\nu^2+p^2)$, by (15). This will have a given value $\mathrm{M}k^2$, provided

$$p^2=(k^2-a^2)\lambda^2+(k^2-b^2)\mu^2+(k^2-c^2)\nu^2. \tag{30}$$

Hence the planes of constant quadratic moment $\mathrm{M}k^2$ will envelop the quadric

$$\frac{x^2}{k^2-a^2}+\frac{y^2}{k^2-b^2}+\frac{z^2}{k^2-c^2}=1, \tag{31}$$

and the quadrics corresponding to different values of k^2 will be confocal. If we write

$$\left.\begin{aligned}k^2=a^2+b^2+c^2+\theta,\\ b^2+c^2=\alpha^2,\quad c^2+a^2=\beta^2,\quad a^2+b^2=\gamma^2\end{aligned}\right. \tag{32}$$

the equation (31) becomes

$$\frac{x^2}{\alpha^2+\theta}+\frac{y^2}{\beta^2+\theta}+\frac{z^2}{\gamma^2+\theta}=1; \tag{33}$$

for different values of θ this represents a system of quadrics confocal with the ellipsoid

$$\frac{x^2}{\alpha^2}+\frac{y^2}{\beta^2}+\frac{z^2}{\gamma^2}=1, \tag{34}$$

which we shall meet with presently as the "ellipsoid of gyration" at G. Now consider the tangent plane ω at any point P of a confocal, the tangent plane ω' at an adjacent point N', and a plane ω'' through P parallel to ω'. The distance between the planes ω' and ω'' will be of the second order of small quantities, and the quadratic moments with respect to ω' and ω'' will therefore be equal, to the first order. Since the quadratic moments with respect to ω and ω' are equal, it follows that ω is a plane of stationary quadratic moment at P, and therefore a principal plane of inertia at P. In other words, the principal axes of inertia at P are the normals to the three confocals of the system (33) which pass through P. Moreover if x, y, z be the co-ordinates of P, (33) is an equation to find the corresponding values of θ; and if $\theta_1, \theta_2, \theta_3$ be the roots we find

$$\theta_1+\theta_2+\theta_3=r^2-\alpha^2-\beta^2-\gamma^2, \tag{35}$$

where $r^2=x^2+y^2+z^2$. The squares of the radii of gyration about the principal axes at P may be denoted by $k_2^2+k_3^2$, $k_3^2+k_1^2$, $k_1^2+k_2^2$; hence by (32) and (35) they are $r^2-\theta_1$, $r^2-\theta_2$, $r^2-\theta_3$, respectively.

To find the relations between the moments of inertia about different axes through any assigned point O, we take O as origin. Since the square of the distance of a point (x, y, z) from the axis

$$\frac{x}{\lambda}=\frac{y}{\mu}=\frac{z}{\nu} \tag{36}$$

is $x^2+y^2+z^2-(\lambda x+\mu y+\nu z)^2$, the moment of inertia about this axis is

$$\begin{aligned}\mathrm{I}&=\Sigma[m\{(\lambda^2+\mu^2+\nu^2)(x^2+y^2+z^2)-(\lambda x+\mu y+\nu z)^2\}]\\ &=\mathrm{A}\lambda^2+\mathrm{B}\mu^2+\mathrm{C}\nu^2-2\mathrm{F}\mu\nu-2\mathrm{G}\nu\lambda-2\mathrm{H}\lambda\mu,\end{aligned} \tag{37}$$

provided

$$\left.\begin{aligned}\mathrm{A}=\Sigma\{m(y^2+z^2)\},\quad \mathrm{B}=\Sigma\{m(z^2+x^2)\},\quad \mathrm{C}=\Sigma\{m(x^2+y^2)\},\\ \mathrm{F}=\Sigma(myz),\quad \mathrm{G}=\Sigma(mzx),\quad \mathrm{H}=\Sigma(mxy);\end{aligned}\right\} \tag{38}$$

i.e. A, B, C are the moments of inertia about the co-ordinate axes, and F, G, H are the products of inertia with respect to the pairs of co-ordinate planes. If we construct the quadric

$$\mathrm{A}x^2+\mathrm{B}y^2+\mathrm{C}z^2-2\mathrm{F}yz-2\mathrm{G}zx-2\mathrm{H}xy=\mathrm{M}\epsilon^4, \tag{39}$$

where ϵ is an arbitrary linear magnitude, the intercept r which it makes on a radius drawn in the direction λ, μ, ν is found by putting $x, y, z=\lambda r, \mu r, \nu r$. Hence, by comparison with (37),

$$\mathrm{I}=\mathrm{M}\epsilon^4/r^2. \tag{40}$$

The moment of inertia about any radius of the quadric (39) therefore varies inversely as the square of the length of this radius. When referred to its principal axes, the equation of the quadric takes the form

$$\mathrm{A}x^2+\mathrm{B}y^2+\mathrm{C}z^2=\mathrm{M}\epsilon^4. \tag{41}$$

The directions of these axes are determined by the property (24), and therefore coincide with those of the principal axes of inertia at O, as already defined in connexion with the theory of plane quadratic moments. The new A, B, C are called the *principal moments of inertia* at O. Since they are essentially positive the quadric is an ellipsoid; it is called the *momental ellipsoid* at O. Since, by (12), B+C>A, &c., the sum of the two lesser principal moments must exceed the greatest principal moment. A limitation is thus imposed on the possible forms of the momental ellipsoid; *e.g.* in the case of symmetry about an axis it appears that the ratio of the polar to the equatorial diameter of the ellipsoid cannot be less than $1/\sqrt{2}$.

If we write $\mathrm{A}=\mathrm{M}\alpha^2$, $\mathrm{B}=\mathrm{M}\beta^2$, $\mathrm{C}=\mathrm{M}\gamma^2$, the formula (37), when referred to the principal axes at O, becomes

$$\mathrm{I}=\mathrm{M}(\alpha^2\lambda^2+\beta^2\mu^2+\gamma^2\nu^2=\mathrm{M}p^2, \tag{42}$$

if p denotes the perpendicular drawn from O in the direction (λ, μ, ν) to a tangent plane of the ellipsoid

$$\frac{x^2}{\alpha^2}+\frac{y^2}{\beta^2}+\frac{z^2}{\gamma^2}=1 \tag{43}$$

This is called the *ellipsoid of gyration* at O; it was introduced into the theory by J. MacCullagh. The ellipsoids (41) and (43) are reciprocal polars with respect to a sphere having O as centre.

If A=B=C, the momental ellipsoid becomes a sphere; all axes through O are then principal axes, and the moment of inertia is the same for each. The mass-system is then said to possess kinetic symmetry about O.

If all the masses lie in a plane $(z=0)$ we have, in the notation of (25), $c^2=0$, and therefore $\mathrm{A}=\mathrm{M}b^2$, $\mathrm{B}=\mathrm{M}a^2$, $\mathrm{C}=\mathrm{M}(a^2+b^2)$, so that the equation of the momental ellipsoid takes the form

$$b^2x^2+a^2\ y^2+(a^2+b^2)\ z^2=\epsilon^4. \tag{44}$$

The section of this by the plane $z=0$ is similar to

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1, \tag{45}$$

which may be called the *momental ellipse* at O. It possesses the property that the radius of gyration about any diameter is half the distance between the two tangents which are parallel to that diameter. In the case of a uniform triangular plate it may be shown that the momental ellipse at G is concentric, similar and similarly situated to the ellipse which touches the sides of the triangle at their middle points.

The graphical methods of determining the moment of inertia of a plane system of particles with respect to any line in its plane may be briefly noticed. It appears from § 5 (fig. 31) that the linear moment of each particle about the line may be found by means of a funicular polygon. If we replace the mass of each particle by its moment, as thus found, we can in like manner obtain the quadratic moment of the system with respect to the line. For if the line in question be the axis of y, the first process gives us the values of mx, and the second the value of $\Sigma(mx\,.\,x)$ or $\Sigma(mx^2)$. The construction of a second funicular may be dispensed with by the employment of a planimeter, as follows. In fig. 59 p is the line with respect to which moments are to be taken, and the masses of the respective particles are indicated by the corresponding segments of a line in the force-diagram, drawn parallel to p. The funicular ZABCD ... corresponding to any pole O is constructed for a system of forces acting parallel to p through the positions of the particles and proportional to the respective masses; and its successive sides are produced to meet p in the points H, K, L, M, . . . As explained in § 5, the moment of the first particle is represented on a certain scale by HK, that of the second by KL, and so on. The quadratic moment of the first particle will then be represented by twice the area AHK, that of the second by twice the area BKL, and so on. The quadratic moment of the whole system is therefore represented by twice the area AHEDCBA. Since a quadratic moment is essentially positive, the various areas are to taken positive in all cases. If k be the radius of gyration about p we find

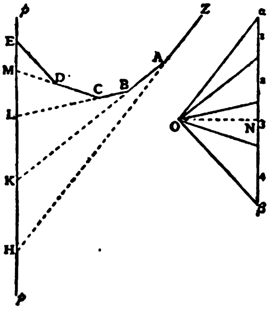


FIG. 59.

$$k^2 = 2 \times \text{area AHEDCBA} \times \text{ON} \div \alpha\beta,$$

where $\alpha\beta$ is the line in the force-diagram which represents the sum of the masses, and ON is the distance of the pole O from this line. If some of the particles lie on one side of p and some on the other, the quadratic moment of each set may be found, and the results added. This is illustrated in fig. 60, where the total quadratic moment is represented by the sum of the shaded areas. It is seen that for a given direction of p this moment is least when p passes through the intersection X of the first and last sides of the funicular; *i.e.* when p goes through the mass-centre of the given system; cf. equation (15).

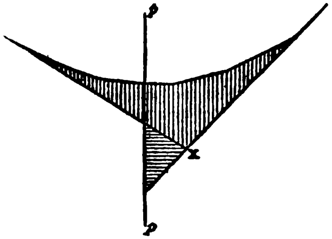


FIG. 60.

PART II.—KINETICS

§ 12. *Rectilinear Motion.*—Let x denote the distance OP of a moving point P at time t from a fixed origin O on the line of motion, this distance being reckoned positive or negative according as it lies to one side or the other of O. At time $t+\delta t$ let the point be at Q, and let $\text{OQ} = x+\delta x$. The *mean velocity* of the point in the interval δt is $\delta x/\delta t$. The limiting value of this when δt is infinitely small, viz. dx/dt, is adopted as the definition of the *velocity* at the instant t. Again, let u be the velocity at time t, $u+\delta u$ that at time $t+\delta t$. The mean rate of increase of velocity, or the *mean acceleration*, in the interval δt is then $\delta u/\delta t$. The limiting value of this when δt is infinitely small, viz., du/dt, is adopted as the definition of the *acceleration* at the instant t. Since $u = dx/dt$, the acceleration is also denoted by d^2x/dt^2. It is often convenient to use the "fluxional" notation for differential coefficients with respect to the time; thus the velocity may be represented by $\dot{x}$ and the acceleration by $\dot{u}$ or $\ddot{x}$. There is another formula for the acceleration, in which u is regarded as a function of the position; thus $\frac{du}{dt} = \frac{du}{dx}\frac{dx}{dt} = u\frac{du}{dx}$. The relation between x and t in any particular case may be illustrated by means of a curve constructed with t as abscissa and x as ordinate. This is called the *curve of positions* or *space-time curve*; its gradient represents the velocity. Such curves are often traced mechanically in acoustical and other experiments. A curve with t as abscissa and u as ordinate is called the *curve of velocities* or *velocity-time curve*. Its gradient represents the acceleration, and the area ($\int u dt$) included between any two ordinates represents the space described in the interval between the corresponding instants (see fig. 62).

So far nothing has been said about the measurement of time. From the purely kinematic point of view, the t of our formulae may be any continuous independent variable, suggested (it may be) by some physical process. But from the dynamical standpoint it is obvious that equations which represent the facts correctly on one system of time-measurement might become seriously defective on another. It is found that for almost all purposes a system of measurement based ultimately on the earth's rotation is perfectly adequate. It is only when we come to consider such delicate questions as the influence of tidal friction that other standards become necessary.

The most important conception in kinetics is that of "inertia." It is a matter of ordinary observation that different bodies acted on by the same force, or what is judged to be the same force, undergo different changes of velocity in equal times. In our ideal representation of natural phenomena this is allowed for by endowing each material particle with a suitable *mass* or *inertia-coefficient* m. The product mu of the mass into the velocity is called the *momentum* or (in Newton's phrase) the *quantity of motion*. On the Newtonian system the motion of a particle entirely uninfluenced by other bodies, when referred to a suitable base, would be rectilinear, with constant velocity. If the velocity changes, this is attributed to the action of force; and if we agree to measure the force (X) by the rate of change of momentum which it produces, we have the equation

$$\frac{d}{dt}(mu) = \text{X}. \qquad (1)$$

From this point of view the equation is a mere truism, its real importance resting on the fact that by attributing suitable values to the masses m, and by making simple assumptions as to the value of X in each case, we are able to frame adequate representations of whole classes of phenomena as they actually occur. The question remains, of course, as to how far the measurement of force here implied is practically consistent with the gravitational method usually adopted in statics; this will be referred to presently.

The practical unit or standard of mass must, from the nature of the case, be the mass of some particular body, *e.g.* the imperial pound, or the kilogramme. In the "C.G.S." system a subdivision of the latter, viz. the gramme, is adopted, and is associated with the centimetre as the unit of length, and the mean solar second as the unit of time. The unit of force implied in (1) is that which produces unit momentum in unit time. On the C.G.S. system it is that force which acting on one gramme for one second produces a velocity of one centimetre per second; this unit is known as the *dyne*. Units of this kind are called *absolute* on account of their fundamental and invariable character as contrasted with gravitational units, which (as we shall see presently) vary somewhat with the locality at which the measurements are supposed to be made.

If we integrate the equation (1) with respect to t between the limits t, t' we obtain

$$mu' - mu = \int_t^{t'} \text{X}\, dt. \qquad 2)$$

The time-integral on the right hand is called the *impulse* of the force on the interval $t'-t$. The statement that the increase of momentum is equal to the impulse is (it may be remarked) equivalent to Newton's own formulation of his Second Law. The form (1) is deduced from it by putting $t'-t=\delta t$, and taking δt to be infinitely small. In problems of impact we have to deal with cases of practically instantaneous impulse, where a very great and rapidly varying force produces an appreciable change of momentum in an exceedingly minute interval of time.

In the case of a constant force, the acceleration $\dot{u}$ or $\ddot{x}$ is, according to (1), constant, and we have

$$\frac{d^2x}{dt^2}=a, \tag{3}$$

say, the general solution of which is

$$x=\tfrac{1}{2}at^2+At+B. \tag{4}$$

The "arbitrary constants" A, B enable us to represent the circumstances of any particular case; thus if the velocity $\dot{x}$ and the position x be given for any one value of t, we have two conditions to determine A, B. The curve of positions corresponding to (4) is a parabola, and that of velocities is a straight line. We may take it as an experimental result, although the best evidence is indirect, that a particle falling freely under gravity experiences a constant acceleration which at the same place is the same for all bodies. This acceleration is denoted by g; its value at Greenwich is about 981 centimetre-second units, or 32·2 feet per second. It increases somewhat with the latitude, the extreme variation from the equator to the pole being about ½%. We infer that on our reckoning the force of gravity on a mass m is to be measured by mg, the momentum produced per second when this force acts alone. Since this is proportional to the mass, the relative masses to be attributed to various bodies can be determined practically by means of the balance. We learn also that on account of the variation of g with the locality a gravitational system of force-measurement is inapplicable when more than a moderate degree of accuracy is desired.

We take next the case of a particle attracted towards a fixed point O in the line of motion with a force varying as the distance from that point. If μ be the acceleration at unit distance, the equation of motion becomes

$$\frac{d^2x}{dt^2}=-\mu x, \tag{5}$$

the solution of which may be written in either of the forms

$$x=A\cos\sigma t+B\sin\sigma t,\quad x=a\cos(\sigma t+\epsilon), \tag{6}$$

where $\sigma=\sqrt{\mu}$, and the two constants A, B or a, ϵ are arbitrary. The particle oscillates between the two positions $x=\pm a$, and the same point is passed through in the same direction with the same velocity at equal intervals of time $2\pi/\sigma$. The type of motion represented by (6) is of fundamental importance in the theory of vibrations (§ 23); it is called a *simple-harmonic* or (shortly) a *simple* vibration. If we imagine a point Q to describe a circle of radius a with the angular velocity σ, its orthogonal projection P on a fixed diameter AA′ will execute a vibration of this character. The angle $\sigma t+\epsilon$ (or AOQ) is called the *phase*; the arbitrary elements a, ϵ are called the *amplitude* and *epoch* (or initial phase), respectively. In the case of very rapid vibrations it is usual to specify, not the *period* ($2\pi/\sigma$), but its reciprocal the *frequency*, *i.e.* the number of complete vibrations per unit time. Fig. 62 shows the curves of position and velocity; they both have the form of the "curve of sines." The numbers correspond to an amplitude of 10 centimetres and a period of two seconds.

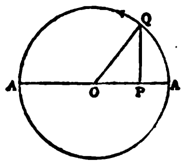


FIG. 61.

The vertical oscillations of a weight which hangs from a fixed point by a spiral spring come under this case. If M be the mass, and x the vertical displacement from the position of equilibrium, the equation of motion is of the form

$$M\frac{d^2x}{dt^2}=-Kx, \tag{7}$$

provided the inertia of the spring itself be neglected. This becomes identical with (5) if we put $\mu=K/M$; and the period is therefore $2\pi\sqrt{(M/K)}$, the same for all amplitudes. The period is increased by an increase of the mass M, and diminished by an increase in the stiffness (K) of the spring. If c be the statical increase of length which is produced by the gravity of the mass M, we have $Kc=Mg$, and the period is $2\pi\sqrt{(c/g)}$.

The small oscillations of a simple pendulum in a vertical plane also come under equation (5). According to the principles of § 13, the horizontal motion of the bob is affected only by the horizontal component of the force acting upon it. If the inclination of the string to the vertical does not exceed a few degrees, the vertical displacement of the particle is of the second order, so that the vertical acceleration may be neglected, and the tension of the string may be equated to the gravity mg of the particle. Hence if l be the length of the string, and x the horizontal displacement of the bob from the equilibrium position, the horizontal component of gravity is mgx/l, whence

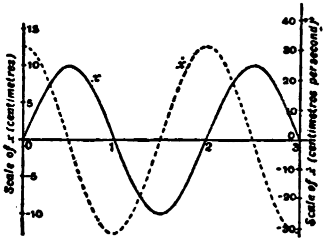


FIG. 62.

$$\frac{d^2x}{dt^2}=-\frac{gx}{l}. \tag{8}$$

The motion is therefore simple-harmonic, of period $\tau=2\pi\sqrt{(l/g)}$. This indicates an experimental method of determining g with considerable accuracy, using the formula $g=4\pi^2l/\tau^2$

In the case of a repulsive force varying as the distance from the origin, the equation of motion is of the type

$$\frac{d^2x}{dt^2}=\mu x, \tag{9}$$

the solution of which is

$$x=Ae^{nt}+Be^{-nt}, \tag{10}$$

where $n=\sqrt{\mu}$. Unless the initial conditions be adjusted so as to make $A=0$ exactly, x will ultimately increase indefinitely with t. The position $x=0$ is one of equilibrium, but it is unstable. This applies to the inverted pendulum, with $\mu=g/l$, but the equation (9) is then only approximate, and the solution therefore only serves to represent the initial stages of a motion in the neighbourhood of the position of unstable equilibrium.

In acoustics we meet with the case where a body is urged towards a fixed point by a force varying as the distance, and is also acted upon by an "extraneous" or "disturbing" force which is a given function of the time. The most important case is where this function is simple-harmonic, so that the equation (5) is replaced by

$$\frac{d^2x}{dt^2}+\mu x=f\cos(\sigma_1t+\alpha), \tag{11}$$

where σ_1 is prescribed. A particular solution is

$$x=\frac{f}{\mu-\sigma_1^2}\cos(\sigma_1t+\alpha). \tag{12}$$

This represents a *forced oscillation* whose period $2\pi/\sigma_1$, coincides with that of the disturbing force; and the phase agrees with that of the force, or is opposed to it, according as σ_1^2 < or > μ; *i.e.* according as the imposed period is greater or less than the natural period $2\pi/\sqrt{\mu}$. The solution fails when the two periods agree exactly; the formula (12) is then replaced by

$$x=\frac{ft}{2\sigma_1}\sin(\sigma_1t+\alpha), \tag{13}$$

which represents a vibration of continually increasing amplitude. Since the equation (12) is in practice generally only an approximation (as in the case of the pendulum), this solution can only be accepted as a representation of the initial stages of the forced oscillation. To obtain the complete solution of (11) we must of course superpose the free vibration (6) with its arbitrary constants in order to obtain a complete representation of the most general motion consequent on arbitrary initial conditions.

A simple mechanical illustration is afforded by the pendulum. If the point of suspension have an imposed simple vibration $\xi = a\cos\sigma t$ in a horizontal line, the equation of small motion of the bob is

$$m\ddot{x} = -mg\frac{x-\xi}{l},$$

or

$$\ddot{x}+\frac{gx}{l} = g\frac{\xi}{l}. \tag{14}$$

This is the same as if the point of suspension were fixed, and a horizontal disturbing force $mg\xi/l$ were to act on the bob. The difference of phase of the forced vibration in the two cases is illustrated and explained in the annexed fig. 63, where the pendulum virtually oscillates about C as a fixed point of suspension. This illustration was given by T. Young in connexion with the kinetic theory of the tides, where the same point arises.

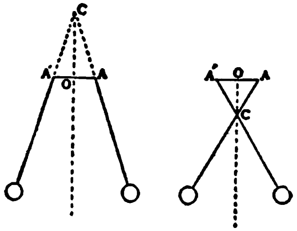


FIG. 63.

We may notice also the case of an attractive force varying inversely as the square of the distance from the origin. If μ be the acceleration at unit distance, we have

$$u\frac{du}{dx} = -\frac{\mu}{x^2} \tag{15}$$

whence

$$u^2 = \frac{2\mu}{x}+C. \tag{16}$$

In the case of a particle falling directly towards the earth from rest at a very great distance we have $C=0$ and, by Newton's Law of Gravitation, $\mu/a^2 = g$, where a is the earth's radius. The deviation of the earth's figure from sphericity, and the variation of g with latitude, are here ignored. We find that the velocity with which the particle would arrive at the earth's surface $(x=a)$ is $\sqrt{(2ga)}$. If we take as rough values $a = 21\times10^6$ feet, $g=32$ foot-second units, we get a velocity of 36,500 feet, or about seven miles, per second. If the particles start from rest at a finite distance c, we have in (16), $C = -2\mu/c$, and therefore

$$\frac{dx}{dt} = u = -\sqrt{\left\{\frac{2\mu(c-x)}{cx}\right\}}, \tag{17}$$

the minus sign indicating motion towards the origin. If we put $x = c\cos^2\frac{1}{2}\phi$, we find

$$t = \frac{c^{\frac{3}{2}}}{\sqrt{(8\mu)}}(\phi+\sin\phi), \tag{18}$$

no additive constant being necessary if t be reckoned from the instant of starting, when $\phi=0$. The time t of reaching the origin $(\phi=\pi)$ is

$$t_1 = \frac{\pi c^{\frac{3}{2}}}{\sqrt{(8\mu)}}. \tag{19}$$

This may be compared with the period of revolution in a circular orbit of radius c about the same centre of force, viz. $2\pi c^{\frac{3}{2}}/\sqrt{\mu}$ (§14). We learn that if the orbital motion of a planet, or a satellite, were arrested, the body would fall into the sun, or into its primary, in the fraction 0·1768 of its actual periodic time. Thus the moon would reach the earth in about five days. It may be noticed that if the scales of x and t be properly adjusted, the curve of positions in the present problem is the portion of a cycloid extending from a vertex to a cusp.

In any case of rectilinear motion, if we integrate both sides of the equation

$$mu\frac{du}{dx} = X, \tag{20}$$

which is equivalent to (1), with respect to x between the limits x_0, x_1, we obtain

$$\tfrac{1}{2}mu_1^2 - \tfrac{1}{2}mu_0^2 = \int_{x_0}^{x_1} X\,dx. \tag{21}$$

We recognize the right-hand member as the *work* done by the force X on the particle as the latter moves from the position x_0 to the position x_1. If we construct a curve with x as abscissa and X as ordinate, this work is represented, as in J. Watt's "indicator-diagram," by the area cut off by the ordinates $x=x_0$, $x=x_1$. The product $\frac{1}{2}mu^2$ is called the *kinetic energy* of the particle, and the equation (21) is therefore equivalent to the statement that the increment of the kinetic energy is equal to the work done on the particle. If the force X be always the same in the same position, the particle may be regarded as moving in a certain invariable "field of force." The work which would have to be supplied by other forces, extraneous to the field, in order to bring the particle from rest in some standard position P_0 to rest in any assigned position P, will depend only on the position of P; it is called the *statical* or *potential energy* of the particle with respect to the field, in the position P. Denoting this by V, we have $\delta V - X\delta x = 0$, whence

$$X = -\frac{dV}{dx}. \tag{22}$$

The equation (21) may now be written

$$\tfrac{1}{2}mu_1^2 + V_1 = \tfrac{1}{2}mu_0^2 + V_0, \tag{23}$$

which asserts that when no extraneous forces act the sum of the kinetic and potential energies is constant. Thus in the case of a weight hanging by a spiral spring the work required to increase the length by x is $V = \int_0^x Kx\,dx = \frac{1}{2}Kx^2$, whence $\frac{1}{2}Mu^2 + \frac{1}{2}Kx^2 = \text{const.}$, as is easily verified from preceding results. It is easily seen that the effect of extraneous forces will be to increase the sum of the kinetic and potential energies by an amount equal to the work done by them. If this amount be negative the sum in question is diminished by a corresponding amount. It appears then that this sum is a measure of the total capacity for doing work against extraneous resistances which the particle possesses in virtue of its motion and its position; this is in fact the origin of the term "energy." The product mv^2 had been called by G. W. Leibnitz the "vis viva"; the name "energy" was substituted by T. Young; finally the name "actual energy" was appropriated to the expression $\frac{1}{2}mv^2$ by W. J. M. Rankine.

The laws which regulate the resistance of a medium such as air to the motion of bodies through it are only imperfectly known. We may briefly notice the case of resistance varying as the square of the velocity, which is mathematically simple. If the positive direction of x be downwards, the equation of motion of a falling particle will be of the form

$$\frac{du}{dt} = g - ku^2; \tag{24}$$

this shows that the velocity u will send asymptotically to a certain limit V (called the *terminal velocity*) such that $kV^2 = g$. The solution is

$$u = V\tanh\frac{gt}{V},\quad x = \frac{V^2}{g}\log\cosh\frac{gt}{V}, \tag{25}$$

if the particle start from rest in the position $x=0$ at the instant $t=0$. In the case of a particle projected vertically upwards we have

$$\frac{du}{dt} = -g-ku^2, \tag{26}$$

the positive direction being now upwards. This leads to

$$\tan^{-1}\frac{u}{V} = \tan^{-1}\frac{u_0}{V} - \frac{gt}{V},\quad x = \frac{V^2}{2g}\log\frac{V^2+u_0^2}{V^2+u^2}, \tag{27}$$

where u_0 is the velocity of projection. The particle comes to rest when

$$t = \frac{V}{g}\tan^{-1}\frac{u_0}{V},\quad x = \frac{V^2}{2g}\log\left(1+\frac{u_0^2}{V^2}\right) \tag{28}$$

For small velocities the resistance of the air is more nearly proportional to the first power of the velocity. The effect of forces of this type on small vibratory motions may be investigated as follows. The equation (5) when modified by the introduction of a frictional term becomes

$$\ddot{x} = -\mu x - k\dot{x}. \tag{29}$$

If $k^2 < 4\mu$ the solution is

$$x = ae^{-t/\tau}\cos(\sigma t+\epsilon), \tag{30}$$

where

$$\tau = 2/k,\quad \sigma = \sqrt{(\mu - \tfrac{1}{4}k^2)}; \tag{31}$$

and the constants a, ϵ are arbitrary. This may be described as a simple harmonic oscillation whose amplitude diminishes asymptotically to zero according to the law $e^{-t/\tau}$. The constant τ is called the *modulus of decay* of the oscillations; if it is large compared with $2\pi/\sigma$ the effect of friction on the period is of the second order of small quantities and may in general be ignored. We have seen that a true simple-harmonic vibration may be regarded as the orthogonal projection of uniform circular motion; it was pointed out by P. G. Tait that a similar representation of the type (30) is obtained if we replace the circle by an equiangular spiral described, with a constant angular velocity about the pole, in the direction of diminishing radius vector. When $k^2 > 4\mu$, the solution of (29) is, in real form,

$$x = a_1 \epsilon^{-t/\tau_1} + a_2 \epsilon^{-t/\tau_2}, \tag{32}$$

where

$$1/\tau_1,\ 1/\tau_2 = \tfrac{1}{2}k \pm \sqrt{(\tfrac{1}{4}k^2 - \mu)}. \tag{33}$$

The body now passes once (at most) through its equilibrium position, and the vibration is therefore styled *aperiodic*.

To find the forced oscillation due to a periodic force we have

$$\ddot{x} + k\dot{x} + \mu x = f \cos(\sigma_1 t + \epsilon). \tag{34}$$

The solution is

$$x = \frac{f}{R} \cos(\sigma_1 t + \epsilon - \epsilon_1), \tag{35}$$

provided

$$R = \{(\mu - \sigma_1^2)^2 + k^2\sigma_1^2\}^{\frac{1}{2}},\quad \tan \epsilon_1 = \frac{k\sigma_1}{\mu - \sigma_1^2}. \tag{36}$$

Hence the phase of the vibration lags behind that of the force by the amount ϵ_1, which lies between 0 and $\tfrac{1}{2}\pi$ or between $\tfrac{1}{2}\pi$ and π, according as $\sigma_1^2 \lesseqgtr \mu$. If the friction be comparatively slight the amplitude is greatest when the imposed period coincides with the free period, being then equal to $f/k\sigma_1$, and therefore very great compared with that due to a slowly varying force of the same average intensity. We have here, in principle, the explanation of the phenomenon of "resonance" in acoustics. The abnormal amplitude is greater, and is restricted to a narrower range of frequency, the smaller the friction. For a complete solution of (34) we must of course superpose the free vibration (30); but owing to the factor $\epsilon^{-t/\tau}$ the influence of the initial conditions gradually disappears.

For purposes of mathematical treatment a force which produces a finite change of velocity in a time too short to be appreciated is regarded as infinitely great, and the time of action as infinitely short. The whole effect is summed up in the value of the instantaneous impulse, which is the time-integral of the force. Thus if an instantaneous impulse ξ changes the velocity of a mass m from u to u' we have

$$mu' - mu = \xi. \tag{37}$$

The effect of ordinary finite forces during the infinitely short duration of this impulse is of course ignored.

We may apply this to the theory of impact. If two masses m_1, m_2 moving in the same straight line impinge, with the result that the velocities are changed from u_1, u_2, to u_1', u_2', then, since the impulses on the two bodies must be equal and opposite, the total momentum is unchanged, *i.e.*

$$m_1u_1' + m_2u_2' = m_1u_1 + m_2u_2. \tag{38}$$

The complete determination of the result of a collision under given circumstances is not a matter of abstract dynamics alone, but requires some auxiliary assumption. If we assume that there is no loss of apparent kinetic energy we have also

$$m_1u_1'^2 + m_2u_2'^2 = m_1u_1^2 + m_2u_2^2. \tag{39}$$

Hence, and from (38),

$$u_2' - u_1' = -(u_2 - u_1), \tag{40}$$

(*i.e.* the relative velocity of the two bodies is reversed in direction, but unaltered in magnitude. This appears to be the case very approximately with steel or glass balls; generally, however, there is some appreciable loss of apparent energy; this is accounted for by vibrations produced in the balls and imperfect elasticity of the materials. The usual empirical assumption is that

$$u_2' - u_1' = -e(u_2 - u_1), \tag{41}$$

where e is a proper fraction which is constant for the same two bodies. It follows from the formula § 15 (10) for the internal kinetic energy of a system of particles that as a result of the impact this energy is diminished by the amount

$$\tfrac{1}{2}(1 - e^2)\frac{m_1m_2}{m_1 + m_2}(u_1 - u_2)^2. \tag{42}$$

The further theoretical discussion of the subject belongs to ELASTICITY.

This is perhaps the most suitable place for a few remarks on the theory of "dimensions." (See also UNITS, DIMENSIONS OF.) In any absolute system of dynamical measurement the fundamental units are those of mass, length and time; we may denote them by the symbols M, L, T, respectively. They may be chosen quite arbitrarily, *e.g.* on the C.G.S. system they are the gramme, centimetre and second. All other units are derived from these. Thus the unit of velocity is that of a point describing the unit of length in the unit of time; it may be denoted by LT^{-1}, this symbol indicating that the magnitude of the unit in question varies directly as the unit of length and inversely as the unit of time. The unit of acceleration is the acceleration of a point which gains unit velocity in unit time; it is accordingly denoted by LT^{-2}. The unit of momentum is MLT^{-1}; the unit force generates unit momentum in unit time and is therefore denoted by MLT^{-2}. The unit of work on the same principles is ML^2T^{-2}, and it is to be noticed that this is identical with the unit of kinetic energy. Some of these derivative units have special names assigned to them; thus on the C.G.S. system the unit of force is called the *dyne*, and the unit of work or energy the *erg*. The number which expresses a physical quantity of any particular kind will of course vary inversely as the magnitude of the corresponding unit. In any general dynamical equation the dimensions of each term in the fundamental units must be the same, for a change of units would otherwise alter the various terms in different ratios. This principle is often useful as a check on the accuracy of an equation.

The theory of dimensions often enables us to forecast, to some extent, the manner in which the magnitudes involved in any particular problem will enter into the result. Thus, assuming that the period of a small oscillation of a given pendulum at a given place is a definite quantity, we see that it must vary as $\sqrt{(l/g)}$. For it can only depend on the mass m of the bob, the length l of the string, and the value of g at the place in question; and the above expression is the only combination of these symbols whose dimensions are those of a time, simply. Again, the time of falling from a distance a into a given centre of force varying inversely as the square of the distance will depend only on a and on the constant μ of equation (15). The dimensions of μ/x^2 are those of an acceleration; hence the dimensions of μ are L^3T^{-2}. Assuming that the time in question varies as $a^x\mu^y$, whose dimensions are $L^{x+3y}T^{-2y}$, we must have $x + 3y = 0$, $-2y = 1$, so that the time of falling will vary as $a^{\frac{3}{2}}/\sqrt{\mu}$, in agreement with (19).

The argument appears in a more demonstrative form in the theory of "similar" systems, or (more precisely) of the similar motion of similar systems. Thus, considering the equations

$$\frac{d^2x}{dt^2} = -\frac{\mu}{x^2},\quad \frac{d^2x'}{dt'^2} = -\frac{\mu'}{x'^2}, \tag{43}$$

which refer to two particles falling independently into two distinct centres of force, it is obvious that it is possible to have x in a constant ratio to x', and t in a constant ratio to t', provided that

$$\frac{x}{t^2} : \frac{x'}{t'^2} = \frac{\mu}{x^2} : \frac{\mu'}{x'^2}, \tag{44}$$

and that there is a suitable correspondence between the initial conditions. The relation (44) is equivalent to

$$t : t' = \frac{x^{\frac{3}{2}}}{\mu^{\frac{1}{2}}} : \frac{x'^{\frac{3}{2}}}{\mu'^{\frac{1}{2}}}, \tag{45}$$

where x, x' are any two corresponding distances; *e.g.* they may be the initial distances, both particles being supposed to start from rest. The consideration of dimensions was introduced by J. B. Fourier (1822) in connexion with the conduction of heat.

§ 13. *General Motion of a Particle.*—Let P, Q be the positions of a moving point at times t, $t + \delta t$ respectively. A vector $\overrightarrow{OU}$ drawn parallel to PQ, of length proportional to $PQ/\delta t$ on any convenient scale, will represent the *mean velocity* in the interval δt, *i.e.* a point moving with a constant velocity having the magnitude and direction indicated by this vector would experience the same resultant displacement $\overrightarrow{PQ}$ in the same time. As δt is indefinitely diminished, the vector $\overrightarrow{OU}$ will tend to a definite limit $\overrightarrow{OV}$; this is adopted as the definition

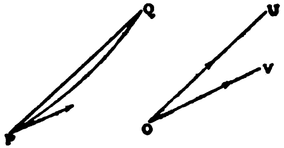


FIG. 64.

of the *velocity* of the moving point at the instant t. Obviously $\overrightarrow{OV}$ is parallel to the tangent to the path at P, and its magnitude is ds/dt, where s is the arc. If we project $\overrightarrow{OV}$ on the co-ordinate axes (rectangular or oblique) in the usual manner, the projections u, v, w are called the *component velocities* parallel to the axes. If x, y, z be the co-ordinates of P it is easily proved that

$$u=\frac{dx}{dt},\ v=\frac{dy}{dt},\ w=\frac{dz}{dt}. \tag{1}$$

The momentum of a particle is the vector obtained by multiplying the velocity by the mass m. The *impulse* of a force in any infinitely small interval of time δt is the product of the force into δt; it is to be regarded as a vector. The total impulse in any finite interval of time is the integral of the impulses corresponding to the infinitesimal elements δt into which the interval may be subdivided; the summation of which the integral is the limit is of course to be understood in the vectorial sense.

Newton's Second Law asserts that change of momentum is equal to the impulse; this is a statement as to equality of vectors and so implies identity of direction as well as of magnitude. If X, Y, Z are the components of force, then considering the changes in an infinitely short time δt we have, by projection on the co-ordinate axes, $\delta(mu)=\mathrm{X}\delta t$, and so on, or

$$m\frac{du}{dt}=\mathrm{X},\ m\frac{dv}{dt}=\mathrm{Y},\ m\frac{dw}{dt}=\mathrm{Z}. \tag{2}$$

For example, the path of a particle projected anyhow under gravity will obviously be confined to the vertical plane through the initial direction of motion. Taking this as the plane xy, with the axis of x drawn horizontally, and that of y vertically upwards, we have $\mathrm{X}=0$, $\mathrm{Y}=-mg$; so that

$$\frac{d^2x}{dt^2}=0,\ \frac{d^2y}{dt^2}=-g. \tag{3}$$

The solution is

$$x=\mathrm{A}t+\mathrm{B},\quad y=-\tfrac{1}{2}gt^2+\mathrm{C}t+\mathrm{D}. \tag{4}$$

If the initial values of x, y, $\dot{x}$, $\dot{y}$ are given, we have four conditions to determine the four arbitrary constants A, B, C, D. Thus if the particle start at time $t=0$ from the origin, with the component velocities u_0, v_0, we have

$$x=u_0t,\quad y=v_0t-\tfrac{1}{2}gt^2. \tag{5}$$

Eliminating t we have the equation of the path, viz.

$$y=\frac{v_0}{u_0}x-\frac{gx^2}{2u_0^2}. \tag{6}$$

This is a parabola with vertical axis, of latus-rectum $2u_0^2/g$. The range on a horizontal plane through O is got by putting $y=0$, *viz.* it is $2u_0v_0/g$. If we denote the resultant velocity at any instant by $\dot{s}$ we have

$$\dot{s}^2=\dot{x}^2+\dot{y}^2=\dot{s}_0^2-2gy. \tag{7}$$

Another important example is that of a particle subject to an acceleration which is directed always towards a fixed point O and is proportional to the distance from O. The motion will evidently be in one plane, which we take as the plane $z=0$. If μ be the acceleration at unit distance, the component accelerations parallel to axes of x and y through O as origin will be $-\mu x$, $-\mu y$, whence

$$\frac{d^2x}{dt^2}=-\mu x,\ \frac{d^2y}{dt^2}=-\mu y. \tag{8}$$

The solution is

$$x=\mathrm{A}\cos nt+\mathrm{B}\sin nt,\quad y=\mathrm{C}\cos nt+\mathrm{D}\sin nt, \tag{9}$$

where $n=\sqrt{\mu}$. If P be the initial position of the particle, we may conveniently take OP as axis of x, and draw Oy parallel to the direction of motion at P. If $\mathrm{OP}=a$, and $\dot{s}_0$ be the velocity at P, we have, initially, $x=a$, $y=0$, $x=0$, $\dot{y}=\dot{s}_0$; whence

$$x=a\cos nt,\quad y=b\sin nt, \tag{10}$$

if $b=\dot{s}_0/n$. The path is therefore an ellipse of which a, b are conjugate semi-diameters, and is described in the period $2\pi/\sqrt{\mu}$; moreover, the velocity at any point P is equal to $\sqrt{\mu}\cdot\mathrm{OD}$, where OD is the semi-diameter conjugate to OP. This type of motion is called *elliptic harmonic*. If the co-ordinate axes are the principal axes of the ellipse, the angle nt in (10) is identical with the "excentric angle." The motion of the bob of a "spherical pendulum," *i.e.* a simple pendulum whose oscillations are not confined to one vertical plane, is of this character, provided the extreme inclination of the string to the vertical be small. The acceleration is towards the vertical through the point of suspension, and is equal to gr/l, approximately, if r denote distance from this vertical. Hence the path is approximately an ellipse, and the period is $2\pi\sqrt{(l/g)}$.

The above problem is identical with that of the oscillation of a particle in a smooth spherical bowl, in the neighbourhood of the lowest point. If the bowl has any other shape, the axes Ox, Oy may be taken tangential to the lines of curvature at the lowest point O; the equations of small motion then are

$$\frac{d^2x}{dt^2}=-g\frac{x}{\rho_1},\ \frac{d^2y}{dt^2}=-g\frac{y}{\rho_2}, \tag{11}$$

where ρ_1, ρ_2, are the principal radii of curvature at O. The motion is therefore the resultant of two simple vibrations in perpendicular directions, of periods $2\pi\sqrt{(\rho_1/g)}$, $2\pi\sqrt{(\rho_2/g)}$. The circumstances are realized in "Blackburn's pendulum," which consists of a weight P hanging from a point C of a string ACB whose ends A, B are fixed. If E be the point in which the line of the string meets AB, we have $\rho_1=\mathrm{CP}$, $\rho_2=\mathrm{EP}$. Many contrivances for actually drawing the resulting curves have been devised.

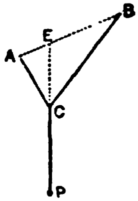


FIG. 65.

It is sometimes convenient to resolve the accelerations in directions having a more intrinsic relation to the path. Thus, in a plane path, let P,Q be two consecutive positions, corresponding to the times t, $t+\delta t$; and let the normals at P, Q meet in C, making an angle $\delta\psi$. Let v $(=\dot{s})$ be the velocity at P, $v+\delta v$ that at Q. In the time δt the velocity parallel to the tangent at P changes from v to $v+\delta v$, ultimately, and the tangential acceleration at P is therefore dv/dt or $\ddot{s}$. Again, the velocity parallel to the normal at P changes from 0 to $v\delta\psi$, ultimately, so that the normal acceleration is $v\,d\psi/dt$. Since

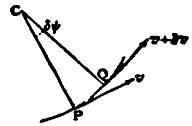


FIG. 66.

$$\frac{dv}{dt}=\frac{dv}{ds}\frac{ds}{dt}=v\frac{dv}{ds},\quad v\frac{d\psi}{dt}=v\frac{d\psi}{ds}\frac{ds}{dt}=\frac{v^2}{\rho}, \tag{12}$$

where ρ is the radius of curvature of the path at P, the tangential and normal accelerations are also expressed by $v\,dv/ds$ and v^2/ρ, respectively. Take, for example, the case of a particle moving on a smooth curve in a vertical plane, under the action of gravity and the pressure R of the curve. If the axes of x and y be drawn horizontal and vertical (upwards), and if ψ be the inclination of the tangent to the horizontal, we have

$$mv\frac{dv}{ds}=-mg\sin\psi=-mg\frac{dy}{ds},\quad \frac{mv^2}{\rho}=-mg\cos\psi+\mathrm{R}. \tag{13}$$

The former equation gives

$$v^2=\mathrm{C}-2gy, \tag{14}$$

and the latter then determines R.

In the case of the pendulum the tension of the string takes the place of the pressure of the curve. If l be the length of the string, ψ its inclination to the downward vertical, we have $\delta s=l\delta\psi$, so that $v=l\,d\psi/dt$. The tangential resolution then gives

$$l\frac{d^2\psi}{dt^2}=-g\sin\psi. \tag{15}$$

If we multiply by $2d\psi/dt$ and integrate, we obtain

$$\left(\frac{d\psi}{dt}\right)^2=\frac{2g}{l}\cos\psi+\text{const.}, \tag{16}$$

which is seen to be equivalent to (14). If the pendulum oscillate between the limits $\psi=\pm\alpha$, we have

$$\left(\frac{\delta\psi}{dt}\right)^2=\frac{2g}{l}(\cos\psi-\cos\alpha)=\frac{4g}{l}(\sin^2\tfrac{1}{2}\alpha-\sin^2\tfrac{1}{2}\psi); \tag{17}$$

and, putting $\sin\tfrac{1}{2}\psi=\sin\tfrac{1}{2}\alpha.\sin\phi$, we find for the period (τ) of a complete oscillation

$$\tau=4\int_0^{\frac{1}{2}\pi}\frac{dt}{d\phi}d\phi=4\sqrt{\frac{l}{g}}\cdot\int_0^{\frac{1}{2}\pi}\frac{d\phi}{\sqrt{(1-\sin^2\frac{1}{2}\alpha.\sin^2\phi)}}$$

$$=4\sqrt{\frac{l}{g}}\cdot\mathrm{F}_1(\sin\tfrac{1}{2}\alpha). \tag{18}$$

in the notation of elliptic integrals. The function F_1 (sin β) was tabulated by A. M. Legendre for values of β ranging from 0° to 90°. The following table gives the period, for various amplitudes α, in terms of that of oscillation in an infinitely small arc [viz. $2\pi\sqrt{(l/g)}$] as unit.

α/π	τ	α/π	τ
·1	1·0062	·6	1·2817
·2	1·0253	·7	1·4283
·3	1·0585	·8	1·6551
·4	1·1087	·9	2·0724
·5	1·1804	1·0	∞

The value of τ can also be obtained as an infinite series, by expanding the integrand in (18) by the binomial theorem, and integrating term by term. Thus

$$\tau=2\pi\sqrt{\frac{l}{g}}\cdot\left\{1+\frac{1^2}{2^2}\sin^2\tfrac{1}{2}\alpha+\frac{1^2\cdot 3^2}{2^2\cdot 4^2}\sin^4\tfrac{1}{2}\alpha+\ ..\right\}. \tag{19}$$

If α be small, an approximation (usually sufficient) is

$$\tau=2\pi\sqrt{(l/g)}\ \ (1+\tfrac{1}{16}\alpha^2).$$

In the extreme case of $\alpha=\pi$, the equation (17) is immediately integrable; thus the time from the lowest position is

$$t=\sqrt{(l/g)}\,.\log\tan\left(\tfrac{1}{4}\pi+\tfrac{1}{4}\psi\right). \tag{20}$$

This becomes infinite for $\psi=\pi$, showing that the pendulum only tends asymptotically to the highest position.

The variation of period with amplitude was at one time a hindrance to the accurate performance of pendulum clocks, since the errors produced are cumulative. It was therefore sought to replace the circular pendulum by some other contrivance free from this defect. The equation of motion of a particle in any smooth path is

$$\frac{d^2s}{dt^2}=-g\sin\psi, \tag{21}$$

where ψ is the inclination of the tangent to the horizontal. If sin ψ were accurately and not merely approximately proportional to the arc s, say

$$s=k\sin\psi, \tag{22}$$

the equation (21) would assume the same form as § 12 (5). The motion along the arc would then be accurately simple-harmonic, and the period $2\pi\sqrt{(k/g)}$ would be the same for all amplitudes. Now equation (22) is the intrinsic equation of a cycloid; viz. the curve is that traced by a point on the circumference of a circle of radius $\tfrac{1}{4}k$ which rolls on the under side of a horizontal straight line. Since the evolute of a cycloid is an equal cycloid the object is attained by means of two metal cheeks, having the form of the evolute near the cusp, on which the string wraps itself alternately as the pendulum swings. The device has long been abandoned, the difficulty being met in other ways, but the problem, originally investigated by C. Huygens, is important in the history of mathematics.

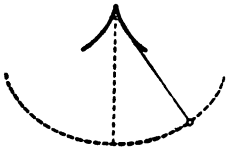


FIG. 67.

The component accelerations of a point describing a tortuous curve, in the directions of the tangent, the principal normal, and the binormal, respectively, are found as follows. If $\overrightarrow{OV}$, $\overrightarrow{OV'}$ be vectors representing the velocities at two consecutive points P, P′ of the path, the plane VOV′ is ultimately parallel to the osculating plane of the path at P; the resultant acceleration is therefore in the osculating plane. Also, the projections of $\overrightarrow{VV'}$ on OV and on a perpendicular to OV in the plane VOV′ are δv and $v\delta\epsilon$, where $\delta\epsilon$ is the angle between the directions of the tangents at P,P′. Since $\delta\epsilon=\delta s/\rho$, where $\delta s=\mathrm{PP'}=v\delta t$ and ρ is the radius of principal curvature at P, the component accelerations along the tangent and principal normal are dv/dt and $vd\epsilon/dt$, respectively, or vdv/ds and v^2/ρ. For example, if a particle moves on a smooth surface, under no forces except the reaction of the surface, v is constant, and the principal normal to the path will coincide with the normal to the surface. Hence the path is a "geodesic" on the surface.

If we resolve along the tangent to the path (whether plane or tortuous), the equation of motion of a particle may be written

$$mv\frac{dv}{ds}=\mathfrak{T}, \tag{23}$$

where $\mathfrak{T}$ is the tangential component of the force. Integrating with respect to s we find

$$\tfrac{1}{2}mv_1^2-\tfrac{1}{2}mv_0^2=\int_{s_0}^{s_1}\mathfrak{T}ds; \tag{24}$$

i.e. the increase of kinetic energy between any two positions is equal to the work done by the forces. The result follows also from the Cartesian equations (2); viz. we have

$$m(\dot{x}\ddot{x}+\dot{y}\ddot{y}+\dot{z}\ddot{z})=X\dot{x}+Y\dot{y}+Z\dot{z}, \tag{25}$$

whence, on integration with respect to t,

$$\begin{aligned}\tfrac{1}{2}m(\dot{x}^2+\dot{y}^2+\dot{z}^2)&=\int(X\dot{x}+Y\dot{y}+Z\dot{z})dt+\text{const.}\\&=\int(Xdx+Ydy+Zdz)+\text{const.}\end{aligned} \tag{26}$$

If the axes be rectangular, this has the same interpretation as (24).

Suppose now that we have a constant field of force; *i.e.* the force acting on the particle is always the same at the same place. The work which must be done by forces extraneous to the field in order to bring the particle from rest in some standard position A to rest in any other position P will not necessarily be the same for all paths between A and P. If it is different for different paths, then by bringing the particle from A to P by one path, and back again from P to A by another, we might secure a gain of work, and the process could be repeated indefinitely. If the work required is the same for all paths between A and P, and therefore zero for a closed circuit, the field is said to be *conservative*. In this case the work required to bring the particle from rest at A to rest at P is called the *potential energy* of the particle in the position P; we denote it by V. If PP′ be a linear element δs drawn in any direction from P, and S be the force due to the field, resolved in the direction PP′, we have $\delta V=-S\delta s$ or

$$S=-\frac{\partial V}{\partial s}. \tag{27}$$

In particular, by taking PP′ parallel to each of the (rectangular) co-ordinate axes in succession, we find

$$X=-\frac{\partial V}{\partial x},\ Y=-\frac{\partial V}{\partial y},\ Z=-\frac{\partial V}{\partial z}. \tag{28}$$

The equation (24) or (26) now gives

$$\tfrac{1}{2}mv_1^2+V_1=\tfrac{1}{2}mv_0^2+V_0; \tag{29}$$

i.e. the sum of the kinetic and potential energies is constant when no work is done by extraneous forces. For example, if the field be that due to gravity we have $V=\int mgdy=mgy+$ const., if the axis of y be drawn vertically upwards; hence

$$\tfrac{1}{2}mv^2+mgy=\text{const.} \tag{30}$$

This applies to motion on a smooth curve, as well as to the free motion of a projectile; cf. (7), (14). Again, in the case of a force Kr towards O, where r denotes distance from O we have $V=\int Krdr=\tfrac{1}{2}Kr^2+$const., whence

$$\tfrac{1}{2}mv^2+\tfrac{1}{2}Kr^2=\text{const.} \tag{31}$$

It has been seen that the orbit is in this case an ellipse; also that if we put $\mu=K/m$ the velocity at any point P is $v=\sqrt{\mu}$. OD, where OD is the semi-diameter conjugate to OP. Hence (31) is consistent with the known property of the ellipse that OP^2+OD^2 is constant.

The forms assumed by the dynamical equations when the axes of reference are themselves in motion will be considered in § 21. At present we take only the case where the rectangular axes Ox, Oy rotate in their own plane, with angular velocity ω about Oz, which is fixed. In the interval δt the projections of the line joining the origin to any point (x, y, z) on the directions of the co-ordinate axes at time t are changed from x, y, z to $(x+\delta x)\cos\omega\delta t-(y+\delta y)\sin\omega\delta t$, $(x+\delta x)\sin\omega\delta t+(y+\delta y)\cos\omega\delta t$, z respectively. Hence the component velocities parallel to the instantaneous positions of the co-ordinate axes at time t are

$$u=\dot{x}-\omega y,\ v=\dot{y}+\omega x,\ \ w=\dot{z}. \tag{32}$$

In the same way we find that the component accelerations are

$$\dot{u}-\omega v,\ \dot{v}+\omega u,\ \dot{w}. \tag{33}$$

Hence if ω be constant the equations of motion take the forms

$$m(\ddot{x}-2\omega\dot{y}-\omega^2x)=X,\ m(\ddot{y}+2\omega\dot{x}-\omega^2y)=Y,\ m\ddot{z}=Z. \tag{34}$$

These become identical with the equations of motion relative to fixed axes provided we introduce a fictitious force $m\omega^2r$ acting outwards from the axis of z, where $r=\sqrt{(x^2+y^2)}$, and a second fictitious force $2m\omega v$ at right angles to the path, where v is the component of the relative velocity parallel to the plane xy. The former force is called by French writers the *force centrifuge ordinaire*, and the latter the *force centrifuge composée*, or *force de Coriolis*. As an application of (34) we may take the case of a symmetrical Blackburn's pendulum hanging from a horizontal bar which is made to rotate about a vertical axis half-way between the points of attachment of the upper string. The equations of small motion are then of the type

$$\ddot{x}-2\omega\dot{y}-\omega^2x=-p^2x,\ \ddot{y}+2\omega\dot{x}-\omega^2y=-q^2y. \tag{35}$$

This is satisfied by

$$x=\mathrm{A}\cos(\sigma t+\epsilon),\ y=\mathrm{B}\sin(\sigma t+\epsilon), \tag{36}$$

provided

$$\left.\begin{aligned}(\sigma^2+\omega^2-p^2)\mathrm{A}+2\sigma\omega\mathrm{B}=0,\\ 2\sigma\omega\mathrm{A}+(\sigma^2+\omega^2-q^2)\mathrm{B}=0.\end{aligned}\right\} \tag{37}$$

Eliminating the ratio A:B we have

$$(\sigma^2+\omega^2-p^2)(\sigma^2+\omega^2-q^2)-4\sigma^2\omega^2=0. \tag{38}$$

It is easily proved that the roots of this quadratic in σ^2 are always real, and that they are moreover both positive unless ω^2 lies between p^2 and q^2. The ratio B/A is determined in each case by either of the equations (37); hence each root of the quadratic gives a solution of the type (36), with two arbitrary constants A, ϵ. Since the equations (35) are linear, these two solutions are to be superposed. If the quadratic (38) has a negative root, the trigonometrical functions in (36) are to be replaced by real exponentials, and the position $x=0$, $y=0$ is unstable. This occurs only when the period $(2\pi/\omega)$ of revolution of the arm lies between the two periods $(2\pi/p, 2\pi/q)$ of oscillation when the arm is fixed.

§ 14. *Central Forces. Hodograph.*—The motion of a particle subject to a force which passes always through a fixed point O is necessarily in a plane orbit. For its investigation we require two equations; these may be obtained in a variety of forms.

Since the impulse of the force in any element of time δt has zero moment about O, the same will be true of the additional momentum generated. Hence the moment of the momentum (considered as a localized vector) about O will be constant. In symbols, if v be the velocity and p the perpendicular from O to the tangent to the path,

$$pv=h, \tag{1}$$

where h is a constant. If δs be an element of the path, $p\delta s$ is twice the area enclosed by δs and the radii drawn to its extremities from O. Hence if $\delta\mathrm{A}$ be this area, we have $\delta\mathrm{A}=\frac{1}{2}p\delta s=\frac{1}{2}h\delta t$, or

$$\frac{d\mathrm{A}}{dt}=\tfrac{1}{2}h. \tag{2}$$

Hence equal areas are swept over by the radius vector in equal times.

If P be the acceleration towards O, we have

$$v\frac{dv}{ds}=-\mathrm{P}\frac{dr}{ds}, \tag{3}$$

since dr/ds is the cosine of the angle between the directions of r and δs. We will suppose that P is a function of r only; then integrating (3) we find

$$\tfrac{1}{2}v^2=-\int\mathrm{P}dr+\text{const.}, \tag{4}$$

which is recognized as the equation of energy. Combining this with (1) we have

$$\frac{h^2}{p^2}=\mathrm{C}-2\int\mathrm{P}dr, \tag{5}$$

which completely determines the path except as to its orientation with respect to O.

If the law of attraction be that of the inverse square of the distance, we have $\mathrm{P}=\mu/r^2$, and

$$\frac{h^2}{p^2}=\mathrm{C}+\frac{2\mu}{r}. \tag{6}$$

Now in a conic whose focus is at O we have

$$\frac{l}{p^2}=\frac{2}{r}\mp\frac{1}{a}, \tag{7}$$

where l is half the latus-rectum, a is half the major axis, and the upper or lower sign is to be taken according as the conic is an ellipse or hyperbola. In the intermediate case of the parabola we have $a=\infty$ and the last term disappears. The equations (6) and (7) are identified by putting

$$l=h^2/\mu,\ a=\mp\mu/\mathrm{C}. \tag{8}$$

Since

$$v^2=\frac{h^2}{p^2}=\mu\left(\frac{2}{r}\mp\frac{1}{a}\right), \tag{9}$$

it appears that the orbit is an ellipse, parabola or hyperbola, according as v^2 is less than, equal to, or greater than $2\mu/r$. Now it appears from (6) that $2\mu/r$ is the square of the velocity which would be acquired by a particle falling from rest at infinity to the distance r. Hence the character of the orbit depends on whether the velocity at any point is less than, equal to, or greater than the *velocity from infinity*, as it is called. In an elliptic orbit the area πab is swept over in the time

$$\tau=\frac{\pi ab}{\frac{1}{2}h}=\frac{2\pi a^{\frac{3}{2}}}{\sqrt{\mu}}, \tag{10}$$

since $h=\mu^{\frac{1}{2}}l^{\frac{1}{2}}=\mu^{\frac{1}{2}}ba^{-\frac{1}{2}}$ by (8).

The converse problem, to determine the law of force under which a given orbit can be described about a given pole, is solved by differentiating (5) with respect to r; thus

$$\mathrm{P}=\frac{h^2dp}{p^3dr}. \tag{11}$$

In the case of an ellipse described about the centre as pole we have

$$\frac{a^2b^2}{p^2}=a^2+b^2-r^2; \tag{12}$$

hence $\mathrm{P}=\mu r$, if $\mu=h^2/a^2b^2$. This merely shows that a particular ellipse may be described under the law of the direct distance provided the circumstances of projection be suitably adjusted. But since an ellipse can always be constructed with a given centre so as to touch a given line at a given point, and to have a given value of $ab(=h/\sqrt{\mu})$ we infer that the orbit will be elliptic whatever the initial circumstances. Also the period is $2\pi ab/h=2\pi/\sqrt{\mu}$, as previously found.

Again, in the equiangular spiral we have $p=r\sin\alpha$, and therefore $\mathrm{P}=\mu/r^3$, if $\mu=h^2/\sin^2\alpha$. But since an equiangular spiral having a given pole is completely determined by a given point and a given tangent, this type of orbit is not a general one for the law of the inverse cube. In order that the spiral may be described it is necessary that the velocity of projection should be adjusted to make $h=\sqrt{\mu}.\sin\alpha$. Similarly, in the case of a circle with the pole on the circumference we have $p^2=r^2/2a$, $\mathrm{P}=\mu/r^5$, if $\mu=8h^2a^2$; but this orbit is not a general one for the law of the inverse fifth power.

In astronomical and other investigations relating to central forces it is often convenient to use polar co-ordinates with the centre of force as pole.

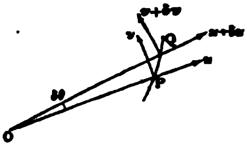


FIG. 68.

Let P, Q be the positions of a moving point at times t, $t+\delta t$, and write $\mathrm{OP}=r$, $\mathrm{OQ}=r+\delta r$, $\angle\mathrm{POQ}=\delta\theta$, O being any fixed origin. If u, v be the component velocities at P along and perpendicular to OP (in the direction of θ increasing), we have

$$u=\lim.\frac{\delta r}{\delta t}=\frac{dr}{dt},\ v=\lim.\frac{r\delta\theta}{\delta t}=r\frac{d\theta}{dt}. \tag{13}$$

Again, the velocities parallel and perpendicular to OP change in the time δt from u, v to $u-v\delta\theta$, $v+u\delta\theta$, ultimately. The component accelerations at P in these directions are therefore

$$\left.\begin{aligned}\frac{du}{dt}-v\frac{d\theta}{dt}=\frac{d^2r}{dt^2}-r\left(\frac{d\theta}{dt}\right)^2,\\ \frac{dv}{dt}+u\frac{d\theta}{dt}=\frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right),\end{aligned}\right\} \tag{14}$$

respectively.

In the case of a central force, with O as pole, the transverse acceleration vanishes, so that

$$r^2d\theta/dt=h, \tag{15}$$

where h is constant; this shows (again) that the radius vector sweeps over equal areas in equal times. The radial resolution gives

$$\frac{d^2r}{dt^2}-r\left(\frac{d\theta}{dt}\right)^2=-\mathrm{P}, \tag{16}$$

where P, as before, denotes the acceleration towards O. If in this we put $r=1/u$, and eliminate t by means of (15), we obtain the general differential equation of central orbits, viz.

$$\frac{d^2u}{d\theta^2}+u=\frac{\mathrm{P}}{h^2u^2}. \tag{17}$$

If, for example, the law be that of the inverse square, we have $\mathrm{P}=\mu u^2$, and the solution is of the form

$$u=\frac{\mu}{h^2}\{1+e\cos(\theta-\alpha)\}, \tag{18}$$

where e, α are arbitrary constants. This is recognized as the polar equation of a conic referred to the focus, the half latus-rectum being h^2/μ.

The law of the inverse cube $P=\mu u^3$ is interesting by way of contrast. The orbits may be divided into two classes according as $h^2 \gtrless \mu$, *i.e.* according as the transverse velocity (hu) is greater or less than the velocity $\sqrt{\mu}.u$ appropriate to a circular orbit at the same distance. In the former case the equation (17) takes the form

$$\frac{d^2u}{d\theta^2}+m^2u=0, \tag{19}$$

the solution of which is

$$au=\sin m\,(\theta-\alpha). \tag{20}$$

The orbit has therefore two asymptotes, inclined at an angle π/m. In the latter case the differential equation is of the form

$$\frac{d^2u}{d\theta^2}=m^2u, \tag{21}$$

so that

$$u=Ae^{m\theta}+Be^{-m\theta} \tag{22}$$

If A, B have the same sign, this is equivalent to

$$au=\cosh m\theta, \tag{23}$$

if the origin of θ be suitably adjusted; hence r has a maximum value a, and the particle ultimately approaches the pole asymptotically by an infinite number of convolutions. If A, B have opposite signs the form is

$$au=\sinh m\theta, \tag{24}$$

this has an asymptote parallel to $\theta=0$, but the path near the origin has the same general form as in the case of (23). If A or B vanish we have an equiangular spiral, and the velocity at infinity is zero. In the critical case of $h^2=\mu$, we have $d^2u/d\theta^2=0$, and

$$u=A\theta+B; \tag{25}$$

the orbit is therefore a "reciprocal spiral," except in the special case of $A=0$, when it is a circle. It will be seen that unless the conditions be exactly adjusted for a circular orbit the particle will either recede to infinity or approach the pole asymptotically. This problem was investigated by R. Cotes (1682–1716), and the various curves obtained are known as *Cotes's spirals*.

A point on a central orbit where the radial velocity (dr/dt) vanishes is called an *apse*, and the corresponding radius is called an *apse-line*. If the force is always the same at the same distance any apse-line will divide the orbit symmetrically, as is seen by imagining the velocity at the apse to be reversed. It follows that the angle between successive apse-lines is constant; it is called the *apsidal angle* of the orbit.

If in a central orbit the velocity is equal to the velocity from infinity, we have, from (5),

$$\frac{h^2}{p^2}=2\int_r^\infty P\,dr; \tag{26}$$

this determines the form of the *critical orbit*, as it is called. If $P=\mu/r^n$, its polar equation is

$$r^m\cos m\theta=a^m, \tag{27}$$

where $m=\frac{1}{2}(3-n)$, except in the case $n=3$, when the orbit is an equiangular spiral. The case $n=2$ gives the parabola as before.

If we eliminate $d\theta/dt$ between (15) and (16) we obtain

$$\frac{d^2r}{dt^2}-\frac{h^2}{r^3}=-P=-f(r),$$

say. We may apply this to the investigation of the stability of a circular orbit. Assuming that $r=a+x$, where x is small, we have, approximately,

$$\frac{d^2x}{dt^2}-\frac{h^2}{a^3}\left(1-\frac{3x}{a}\right)=-f(a)-xf'(a).$$

Hence if h and a be connected by the relation $h^2=a^3f(a)$ proper to a circular orbit, we have

$$\frac{d^2x}{dt^2}+\left\{f'(a)+\frac{3}{a}f(a)\right\}x=0. \tag{28}$$

If the coefficient of x be positive the variations of x are simple-harmonic, and x can remain permanently small; the circular orbit is then said to be stable. The condition for this may be written

$$\frac{d}{da}\{a^3f(a)\}>0, \tag{29}$$

i.e. the intensity of the force in the region for which $r=a$, nearly, must diminish with increasing distance less rapidly than according to the law of the inverse cube. Again, the half-period of x is $\pi/\sqrt{\{f'(a)+3a^{-1}f(a)\}}$, and since the angular velocity in the orbit is h/a^2, approximately, the apsidal angle is, ultimately,

$$\pi\sqrt{\left\{\frac{f(a)}{af'(a)+3f(a)}\right\}}, \tag{30}$$

or, in the case of $f(a)=\mu/r^n$, $\pi/\sqrt{(3-n)}$. This is in agreement with the known results for $n=2$, $n=-1$.

We have seen that under the law of the inverse square all finite orbits are elliptical. The question presents itself whether there then is any other law of force, giving a finite velocity from infinity, under which all finite orbits are necessarily closed curves. If this is the case, the apsidal angle must evidently be commensurable with π, and since it cannot vary discontinuously the apsidal angle in a nearly circular orbit must be constant. Equating the expression (30) to π/m, we find that $f(a)=C/a^n$, where $n=3-m^2$. The force must therefore vary as a power of the distance, and n must be less than 3. Moreover, the case $n=2$ is the only one in which the critical orbit (27) can be regarded as the limiting form of a closed curve. Hence the only law of force which satisfies the conditions is that of the inverse square.

At the beginning of § 13 the velocity of a moving point P was represented by a vector $\overrightarrow{OV}$ drawn from a fixed origin O. The locus of the point V is called the *hodograph* (*q.v.*); and it appears that the velocity of the point V along the hodograph represents in magnitude and in direction the acceleration in the original orbit. Thus in the case of a plane orbit, if v be the velocity of P, ψ the inclination of the direction of motion to some fixed direction, the polar co-ordinates of V may be taken to be v, ψ; hence the velocities of V along and perpendicular to OV will be dv/dt and $v\,d\psi/dt$. These expressions therefore give the tangential and normal accelerations of P; cf. § 13 (12).

In the motion of a projectile under gravity the hodograph is a vertical line described with constant velocity. In elliptic harmonic motion the velocity of P is parallel and proportional to the semi-diameter CD which is conjugate to the radius CP; the hodograph is therefore an ellipse similar to the actual orbit. In the case of a central orbit described under the law of the inverse square we have $v=h/SY=h.\,SZ/b^2$, where S is the centre of force, SY is the perpendicular to the tangent at P, and Z is the point where YS meets the auxiliary circle again. Hence the hodograph is similar and similarly situated to the locus of Z (the auxiliary circle) turned about S through a right angle. This applies to an elliptic or hyperbolic orbit; the case of the parabolic orbit may be examined separately or treated as a limiting case. The annexed fig. 70 exhibits the various cases, with the hodograph in its proper orientation. The pole O of the hodograph is inside on or outside the circle, according as the orbit is an ellipse, parabola or hyperbola. In any case of a central orbit the hodograph (when turned through a right angle) is similar and similarly situated to the "reciprocal polar" of the orbit with respect to the centre of force. Thus for a circular orbit with the centre of force at an excentric point, the hodograph is a conic with the pole as focus. In the case of a particle oscillating under gravity on a smooth cycloid from rest at the cusp the hodograph is a circle through the pole, described with constant velocity.

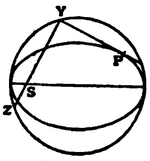


FIG. 69.

§ 15. *Kinetics of a System of Discrete Particles.*—The momenta of the several particles constitute a system of localized vectors which, for purposes of resolving and taking moments, may be reduced like a system of forces in statics (§ 8). Thus taking any point O as base, we have first a *linear momentum* whose components referred to rectangular axes through O are

$$\Sigma(m\dot{x}),\ \Sigma(m\dot{y}),\ \Sigma(m\dot{z}); \tag{1}$$

its representative vector is the same whatever point O be chosen. Secondly, we have an *angular momentum* whose components are

$$\Sigma\{m(y\dot{z}-z\dot{y})\},\ \Sigma\{m(z\dot{x}-x\dot{z})\},\ \Sigma\{m(x\dot{y}-y\dot{x})\}, \tag{2}$$

these being the sums of the moments of the momenta of the several particles about the respective axes. This is subject to the same relations as a couple in statics; it may be represented by a vector which will, however, in general vary with the position of O.

The linear momentum is the same as if the whole mass were concentrated at the centre of mass G, and endowed with the velocity of this point. This follows at once from equation (8) of § 11, if we imagine the two configurations of the system there referred to to be those corresponding to the instants t, $t+\delta t$. Thus

$$\Sigma\left(m.\frac{\overrightarrow{PP'}}{\delta t}\right)=\Sigma(m).\frac{\overrightarrow{GG'}}{\delta t}. \tag{3}$$

Analytically we have

$$\Sigma(m\dot{x})=\frac{d}{dt}\Sigma(mx)=\Sigma(m).\frac{d\bar{x}}{dt}. \tag{4}$$

with two similar formulae.

Again, if the instantaneous position of G be taken as base, the angular momentum of the absolute motion is the same as the angular momentum of the motion relative to G. For the velocity of a particle m at P may be replaced by two components one of which ($\bar v$) is identical in magnitude and direction with the velocity of G, whilst the other (v) is the velocity relative to G.

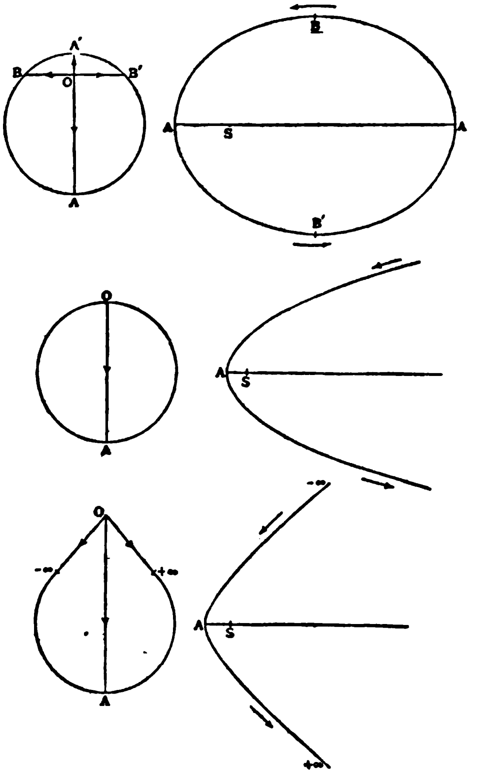


FIG. 70.

The aggregate of the components $m\bar v$ of momentum is equivalent to a single localized vector $\Sigma(m).\bar v$ in a line through G, and has therefore zero moment about any axis through G; hence in taking moments about such an axis we need only regard the velocities relative to G. In symbols, we have

$$\Sigma\{m(y\dot z-z\dot y)\}=\Sigma(m).\left(\bar y\frac{d\bar z}{dt}-\bar z\frac{d\bar y}{dt}\right)+\Sigma\{m(\eta\dot\zeta-\zeta\dot\eta)\}. \tag{5}$$

since $\Sigma(m\xi)=0$, $\Sigma(m\dot\xi)=0$, and so on, the notation being as in § 11. This expresses that the moment of momentum about any fixed axis (*e.g.* Ox) is equal to the moment of momentum of the motion relative to G about a parallel axis through G, together with the moment of momentum of the whole mass supposed concentrated at G and moving with this point. If in (5) we make O coincide with the instantaneous position of G, we have $\bar x$, $\bar y$, $\bar z=0$, and the theorem follows.

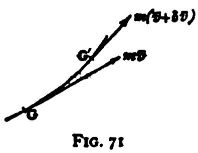


FIG. 71

Finally, the rates of change of the components of the angular momentum of the motion relative to G referred to G as a moving base, are equal to the rates of change of the corresponding components of angular momentum relative to a fixed base coincident with the instantaneous position of G. For let G′ be a consecutive position of G. At the instant $t+\delta t$ the momenta of the system are equivalent to a linear momentum represented by a localized vector $\Sigma(m).(\bar v+\delta\bar v)$ in a line through G′ tangential to the path of G′, together with a certain angular momentum. Now the moment of this localized vector with respect to any axis through G is zero, to the first order of δt, since the perpendicular distance of G from the tangent line at G′ is of the order $(\delta t)^2$. Analytically we have from (5),

$$\frac{d}{dt}\Sigma\{m(y\dot z-z\dot y)\}=\Sigma(m).\left(\bar y\frac{d^2\bar z}{dt^2}-\bar z\frac{d^2\bar y}{dt^2}\right)+\frac{d}{dt}\Sigma\{m(\eta\dot\zeta-\zeta\dot\eta)\}. \tag{6}$$

If we put $\bar x, \bar y, \bar z=0$, the theorem is proved as regards axes parallel to Ox.

Next consider the kinetic energy of the system. If from a fixed point O we draw vectors $\overrightarrow{OV_1}$, $\overrightarrow{OV_2}$ . . . to represent the velocities of the several particles $m_1, m_2, \ldots$, and if we construct the vector

$$\overrightarrow{OK}=\frac{\Sigma(m.\overrightarrow{OV})}{\Sigma(m)} \tag{7}$$

this will represent the velocity of the mass-centre, by (3). We find, exactly as in the proof of Lagrange's First Theorem (§ 11), that

$$\tfrac{1}{2}\Sigma(m.OV^2)=\tfrac{1}{2}\Sigma(m).OK^2+\tfrac{1}{2}\Sigma(m.KV^2); \tag{8}$$

i.e. the total kinetic energy is equal to the kinetic energy of the whole mass supposed concentrated at G and moving with this point, together with the kinetic energy of the motion relative to G. The latter may be called the *internal kinetic energy* of the system. Analytically we have

$$\tfrac{1}{2}\Sigma\{m(\dot x^2+\dot y^2+\dot z^2)\}=\tfrac{1}{2}\Sigma(m)\cdot\left\{\left(\frac{d\bar x}{dt}\right)^2+\left(\frac{d\bar y}{dt}\right)^2+\left(\frac{d\bar z}{dt}\right)^2\right\}+\tfrac{1}{2}\Sigma\{m(\dot\xi^2+\dot\eta^2+\dot\zeta^2)\}. \tag{9}$$

There is also an analogue to Lagrange's Second Theorem, viz.

$$\tfrac{1}{2}\Sigma(m.KV^2)=\tfrac{1}{2}\frac{\Sigma\Sigma(m_pm_q.V_pV_q^2)}{\Sigma(m)}, \tag{10}$$

which expresses the internal kinetic energy in terms of the relative velocities of the several pairs of particles. This formula is due to Möbius.

The preceding theorems are purely kinematical. We have now to consider the effect of the forces acting on the particles. These may be divided into two categories; we have first, the *extraneous forces* exerted on the various particles from without, and, secondly, the mutual or *internal forces* between the various pairs of particles. It is assumed that these latter are subject to the law of equality of action and reaction. If the equations of motion of each particle be formed separately, each such internal force will appear twice over, with opposite signs for its components, viz. as affecting the motion of each of the two particles between which it acts. The full working out is in general difficult, the comparatively simple problem of "three bodies," for instance, in gravitational astronomy being still unsolved, but some general theorems can be formulated.

The first of these may be called the *Principle of Linear Momentum*. If there are no extraneous forces, the resultant linear momentum is constant in every respect. For consider any two particles at P and Q, acting on one another with equal and opposite forces in the line PQ. In the time δt a certain impulse is given to the first particle in the direction (say) from P to Q, whilst an equal and opposite impulse is given to the second in the direction from Q to P. Since these impulses produce equal and opposite momenta in the two particles, the resultant linear momentum of the system is unaltered. If extraneous forces act, it is seen in like manner that the resultant linear momentum of the system is in any given time modified by the geometric addition of the total impulse of the extraneous forces. It follows, by the preceding kinematic theory, that the mass-centre G of the system will move exactly as if the whole mass were concentrated there and were acted on by the extraneous forces applied parallel to their original directions. For example, the mass-centre of a system free from extraneous force will describe a straight line with constant velocity. Again, the mass-centre of a chain of particles connected by strings, projected anyhow under gravity, will describe a parabola.

The second general result is the *Principle of Angular Momentum*. If there are no extraneous forces, the moment of momentum about any fixed axis is constant. For in time δt the mutual action between two particles at P and Q produces equal and opposite momenta in the line PQ, and these will have equal and opposite moments about the fixed axis. If extraneous forces act, the total angular momentum about any fixed axis is in time δt increased by the total extraneous impulse about that axis. The kinematical relations above explained now lead to the conclusion that in calculating the effect of extraneous forces in an infinitely short time δt we may take moments about an axis passing through the instantaneous position of G exactly as if G were fixed; moreover, the result will be the same whether in this process we employ the true velocities of the particles or merely their velocities relative to G. If there are no extraneous forces, or if the extraneous forces have zero moment about any axis through G, the vector which represents the resultant angular momentum relative to G is constant in every respect. A plane through G perpendicular to this vector has a fixed direction in space, and is called the *invariable plane*; it may sometimes be conveniently used as a plane of reference.

For example, if we have two particles connected by a string, the invariable plane passes through the string, and if ω be the angular velocity in this plane, the angular momentum relative to G is

$$m_1\omega_1 r_1 . r_1 + m_2\omega r_2 . r_2 = (m_1 r_1^2 + m_2 r_2^2)\omega,$$

where r_1, r_2 are the distances of m_1, m_2 from their mass-centre G. Hence if the extraneous forces (*e.g.* gravity) have zero moment about G, ω will be constant. Again, the tension R of the string is given by

$$R = m_1\omega^2 r_1 = \frac{m_1 m_2}{m_1 + m_2}\omega^2 a,$$

where $a = r_1 + r_2$. Also by (10) the internal kinetic energy is

$$\tfrac{1}{2}\frac{m_1 m_2}{m_1 + m_2}\omega^2 a^2.$$

The increase of the kinetic energy of the system in any interval of time will of course be equal to the total work done by all the forces acting on the particles. In many questions relating to systems of discrete particles the internal force R_{pq} (which we will reckon positive when attractive) between any two particles m_p, m_q is a function only of the distance r_{pq} between them. In this case the work done by the internal forces will be represented by

$$-\Sigma\int R_{pq}\,dr_{pq},$$

when the summation includes every pair of particles, and each integral is to be taken between the proper limits. If we write

$$V = \Sigma\int R_{pq}\,dr_{pq}, \qquad (11)$$

when r_{pq} ranges from its value in some standard configuration A of the system to its value in any other configuration P, it is plain that V represents the work which would have to be done in order to bring the system from rest in the configuration A to rest in the configuration P. Hence V is a definite function of the configuration P; it is called the *internal potential energy*. If T denote the kinetic energy, we may say then that the sum T + V is in any interval of time increased by an amount equal to the work done by the extraneous forces. In particular, if there are no extraneous forces T + V is constant. Again, if some of the extraneous forces are due to a conservative field of force, the work which they do may be reckoned as a diminution of the potential energy relative to the field as in § 13.

§ 16. *Kinetics of a Rigid Body. Fundamental Principles.*—When we pass from the consideration of discrete particles to that of continuous distributions of matter, we require some physical postulate over and above what is contained in the Laws of Motion, in their original formulation. This additional postulate may be introduced under various forms. One plan is to assume that any body whatever may be treated as if it were composed of material particles, *i.e.* mathematical points endowed with inertia coefficients, separated by finite intervals, and acting on one another with forces in the lines joining them subject to the law of equality of action and reaction. In the case of a rigid body we must suppose that those forces adjust themselves so as to preserve the mutual distances of the various particles unaltered. On this basis we can predicate the principles of linear and angular momentum, as in § 15.

An alternative procedure is to adopt the principle first formally enunciated by J. Le R. d'Alembert and since known by his name. If x, y, z be the rectangular co-ordinates of a mass-element m, the expressions $m\ddot{x}$, $m\ddot{y}$, $m\ddot{z}$ must be equal to the components of the total force on m, these forces being partly extraneous and partly forces exerted on m by other mass elements of the system. Hence $(m\ddot{x}, m\ddot{y}, m\ddot{z})$ is called the actual or *effective* force on m. According to d'Alembert's formulation, the extraneous forces together with the *effective forces reversed* fulfil the statical conditions of equilibrium. In other words, the whole assemblage of effective forces is statically equivalent to the extraneous forces. This leads, by the principles of § 8, to the equations

$$\left.\begin{array}{c}\Sigma(m\ddot{x}) = X,\ \Sigma(m\ddot{y}) = Y,\ \Sigma(m\ddot{z}) = Z,\\ \Sigma\{m(y\ddot{z} - z\ddot{y})\} = L,\ \Sigma\{m(z\ddot{x} - x\ddot{z})\} = M,\ \Sigma\{m(x\ddot{y} - y\ddot{x})\} = N,\end{array}\right\} \qquad (1)$$

where (X, Y, Z) and (L, M, N) are the force—and couple—constituents of the system of extraneous forces, referred to O as base, and the summations extend over all the mass-elements of the system. These equations may be written

$$\left.\begin{array}{c}\frac{d}{dt}\Sigma(m\dot{x}) = X,\ \frac{d}{dt}\Sigma(m\dot{y}) = Y,\ \frac{d}{dt}\Sigma(m\dot{z}) = Z,\\ \frac{d}{dt}\Sigma\{m(y\dot{z} - z\dot{y})\} = L,\ \frac{d}{dt}\Sigma\{m(z\dot{x} - x\dot{z})\} = M,\ \frac{d}{dt}\Sigma\{m(x\dot{y} - y\dot{x})\} = N,\end{array}\right\} \qquad (2)$$

and so express that the rate of change of the linear momentum in any fixed direction (*e.g.* that of Ox) is equal to the total extraneous force in that direction, and that the rate of change of the angular momentum about any fixed axis is equal to the moment of the extraneous forces about that axis. If we integrate with respect to t between fixed limits, we obtain the principles of linear and angular momentum in the form previously given. Hence, whichever form of postulate we adopt, we are led to the principles of linear and angular momentum, which form in fact the basis of all our subsequent work. It is to be noticed that the preceding statements are not intended to be restricted to rigid bodies; they are assumed to hold for all material systems whatever. The peculiar status of rigid bodies is that the principles in question are in most cases sufficient for the complete determination of the motion, the dynamical equations (1 or 2) being equal in number to the degrees of freedom (six) of a rigid solid, whereas in cases where the freedom is greater we have to invoke the aid of other supplementary physical hypotheses (cf. ELASTICITY; HYDROMECHANICS).

The increase of the kinetic energy of a rigid body in any interval of time is equal to the work done by the extraneous forces acting on the body. This is an immediate consequence of the fundamental postulate, in either of the forms above stated, since the internal forces do on the whole no work. The statement may be extended to a system of rigid bodies, provided the mutual reactions consist of the stresses in inextensible links, or the pressures between smooth surfaces, or the reactions at rolling contacts (§ 9).

§ 17. *Two-dimensional Problems.*—In the case of rotation about a fixed axis, the principles take a very simple form. The position of the body is specified by a single co-ordinate, viz. the angle θ through which some plane passing through the axis and fixed in the body has turned from a standard position in space. Then $d\theta/dt, = \omega$ say, is the *angular velocity* of the body. The angular momentum of a particle m at a distance r from the axis is $m\omega r . r$, and the total angular momentum is $\Sigma(mr^2) . \omega$, or Iω, if I denote the moment of inertia (§ 11) about the axis. Hence if N be the moment of the extraneous forces about the axis, we have

$$\frac{d}{dt}(I\omega) = N. \qquad (1)$$

This may be compared with the equation of rectilinear motion of a particle, viz. $d/dt.(Mu) = X$; it shows that I measures the inertia of the body as regards rotation, just as M measures its inertia as regards translation. If N = 0, ω is constant.

As a first example, suppose we have a flywheel free to rotate about a horizontal axis, and that a weight m hangs by a vertical string from the circumferences of an axle of radius b (fig. 72). Neglecting frictional resistance we have, if R be the tension of the string,

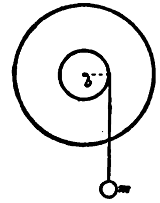


FIG. 72.

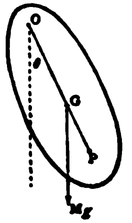


FIG. 73.

$$I\dot{\omega} = Rb,\quad m\dot{\omega} = mg - R,$$

whence

$$b\dot{\omega} = \frac{mb^2}{I + mb^2}\,g. \tag{2}$$

This gives the acceleration of m as modified by the inertia of the wheel.

A "compound pendulum" is a body of any form which is free to rotate about a fixed horizontal axis, the only extraneous force (other than the pressures of the axis) being that of gravity. If M be the total mass, k the radius of gyration (§ 11) about the axis, we have

$$\frac{d}{dt}\left(Mk^2\frac{d\theta}{dt}\right) = -Mgh\sin\theta, \tag{3}$$

where θ is the angle which the plane containing the axis and the centre of gravity G makes with the vertical, and h is the distance of G from the axis. This coincides with the equation of motion of a simple pendulum [§ 13 (15)] of length l, provided $l = k^2/h$. The plane of the diagram (fig. 73) is supposed to be a plane through G perpendicular to the axis, which it meets in O. If we produce OG to P, making $OP = l$, the point P is called the *centre of oscillation*; the bob of a simple pendulum of length OP suspended from O will keep step with the motion of P, if properly started. If κ be the radius of gyration about a parallel axis through G, we have $k^2 = \kappa^2 + h^2$ by § 11 (16), and therefore $l = h + \kappa^2/h$, whence

$$GO\,.\,GP = \kappa^2. \tag{4}$$

This shows that if the body were swung from a parallel axis through P the new centre of oscillation would be at O. For different parallel axes, the period of a small oscillation varies as $\sqrt{l}$, or $\sqrt{(GO+OP)}$; this is least, subject to the condition (4), when $GO = GP = \kappa$. The reciprocal relation between the centres of suspension and oscillation is the basis of Kater's method of determining g experimentally. A pendulum is constructed with two parallel knife-edges as nearly as possible in the same plane with G, the position of one of them being adjustable. If it could be arranged that the period of a small oscillation should be exactly the same about either edge, the two knife-edges would in general occupy the positions of conjugate centres of suspension and oscillation; and the distances between them would be the length l of the equivalent simple pendulum. For if $h_1 + \kappa^2/h_1 = h_2 + \kappa^2/h_2$, then unless $h_1 = h_2$, we must have $\kappa^2 = h_1h_2$, $l = h_1 + h_2$. Exact equality of the two observed periods (τ_1, τ_2, say) cannot of course be secured in practice, and a modification is necessary. If we write $l_1 = h_1 + \kappa^2/h_1$, $l_2 = h_2 + \kappa^2/h_2$, we find, on elimination of κ,

$$\tfrac{1}{2}\,\frac{l_1 + l_2}{h_1 + h_2} + \tfrac{1}{2}\,\frac{l_1 - l_2}{h_1 - h_2} = 1,$$

whence

$$\frac{4\pi^2}{g} = \frac{\tfrac{1}{2}(\tau_1^2 + \tau_2^2)}{h_1 + h_2} + \frac{\tfrac{1}{2}(\tau_1^2 - \tau_2^2)}{h_1 - h_2}. \tag{5}$$

The distance $h_1 + h_2$, which occurs in the first term on the right hand can be measured directly. For the second term we require the values of h_1, h_2 separately, but if τ_1, τ_2 are nearly equal whilst h_1, h_2 are distinctly unequal this term will be relatively small, so that an approximate knowledge of h_1, h_2 is sufficient.

As a final example we may note the arrangement, often employed in physical measurements, where a body performs small oscillations about a vertical axis through its mass-centre G, under the influence of a couple whose moment varies as the angle of rotation from the equilibrium position. The equation of motion is of the type

$$I\,\ddot{\theta} = -K\theta, \tag{6}$$

and the period is therefore $\tau = 2\pi\sqrt{(I/K)}$. If by the attachment of another body of known moment of inertia I′, the period is altered from τ to τ', we have $\tau' = 2\pi\sqrt{\{(I+I')/K\}}$. We are thus enabled to determine both I and K, viz.

$$I/I' = \tau^2/(\tau'^2 - \tau^2),\quad K = 4\pi^2\tau^2 I/(\tau'^2 - \tau^2). \tag{7}$$

The couple may be due to the earth's magnetism, or to the torsion of a suspending wire, or to a "bifilar" suspension. In the latter case, the body hangs by two vertical threads of equal length l in a plane through G. The motion being assumed to be small, the tensions of the two strings may be taken to have their statical values $Mgb/(a+b)$, $Mga/(a+b)$, where a, b are the distances of G from the two threads. When the body is twisted through an angle θ the threads make angles $a\theta/l$, $b\theta/l$ with the vertical, and the moment of the tensions about the vertical through G is accordingly $-K\theta$, where $K = M\,gab/l$.

For the determination of the motion it has only been necessary to use one of the dynamical equations. The remaining equations serve to determine the reactions of the rotating body on its bearings. Suppose, for example, that there are no extraneous forces. Take rectangular axes, of which Oz coincides with the axis of rotation. The angular velocity being constant, the effective force on a particle m at a distance r from Oz is $m\omega^2 r$ towards this axis, and its components are accordingly $-\omega^2 mx$, $-\omega^2 my$, O. Since the reactions on the bearings must be statically equivalent to the whole system of effective forces, they will reduce to a force (X Y Z) at O and a couple (L M N) given by

$$X = -\omega^2\Sigma(mx) = -\omega^2\Sigma(m)\,\bar{x},\ Y = -\omega^2\Sigma(my) = -\omega^2\Sigma(m)\,\bar{y},\ Z = 0,$$
$$L = \omega^2\Sigma(myz),\ M = -\omega^2\Sigma(mzx),\ N = 0, \tag{8}$$

where $\bar{x}$, $\bar{y}$ refer to the mass-centre G. The reactions do not therefore reduce to a single force at O unless $\Sigma(myz) = 0$, $\Sigma(mzx) = 0$, *i.e.* unless the axis of rotation be a principal axis of inertia (§ 11) at O. In order that the force may vanish we must also have $\bar{x}, \bar{y} = 0$, *i.e.* the mass-centre must lie in the axis of rotation. These considerations are important in the "balancing" of machinery. We note further that if a body be free to turn about a fixed point O, there are three mutually perpendicular lines through this point about which it can rotate steadily, without further constraint. The theory of principal or "permanent" axes was first investigated from this point of view by J. A. Segner (1755). The origin of the name "deviation moment" sometimes applied to a product of inertia is also now apparent.

Proceeding to the general motion of a rigid body in two dimensions we may take as the three co-ordinates of the body the rectangular Cartesian co-ordinates x, y of the mass-centre G and the angle θ through which the body has turned from some standard position. The components of linear momentum are then $M\dot{x}$, $M\dot{y}$, and the angular momentum relative to G as base is $I\dot{\theta}$, where M is the mass and I the moment of inertia about G. If the extraneous forces be reduced to a force (X, Y) at G and a couple N, we have

$$M\ddot{x} = X,\ M\ddot{y} = Y,\ I\ddot{\theta} = N. \tag{9}$$

If the extraneous forces have zero moment about G the angular velocity $\dot{\theta}$ is constant. Thus a circular disk projected under gravity in a vertical plane spins with constant angular velocity, whilst its centre describes a parabola.

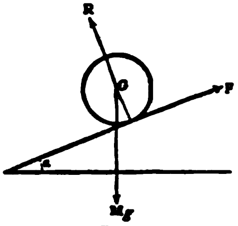


FIG. 74.

We may apply the equations (9) to the case of a solid of revolution rolling with its axis horizontal on a plane of inclination α. If the axis of x be taken parallel to the slope of the plane, with x increasing downwards, we have

$$M\ddot{x} = Mg\sin\alpha - F,\ 0 = Mg\cos\alpha - R,\ M\kappa^2\ddot{\theta} = Fa \tag{10}$$

where κ is the radius of gyration about the axis of symmetry, a is the constant distance of G from the plane, and R, F are the normal and tangential components of the reaction of the plane, as shown in fig. 74. We have also the kinematical relation $\dot{x} = a\dot{\theta}$. Hence

$$\ddot{x} = \frac{a^2}{\kappa^2 + a^2}\,g\sin\alpha,\ R = Mg\cos\alpha,\ F = \frac{\kappa^2}{\kappa^2 + a^2}\,Mg\sin\alpha. \tag{11}$$

The acceleration of G is therefore less than in the case of frictionless sliding in the ratio $a^2/(\kappa^2 + a^2)$. For a homogeneous sphere this ratio is $\frac{5}{7}$, for a uniform circular cylinder or disk $\frac{2}{3}$, for a circular hoop or a thin cylindrical shell $\frac{1}{2}$.

The equation of energy for a rigid body has already been stated (in effect) as a corollary from fundamental assumptions.

It may also be deduced from the principles of linear and angular momentum as embodied in the equations (9). We have

$$M(\ddot{x}\dot{x}+\ddot{y}\dot{y})+I\ddot{\theta}\dot{\theta}+X\dot{x}+Y\dot{y}+N\dot{\theta}, \tag{12}$$

whence, integrating with respect to t,

$$\tfrac{1}{2}M(\dot{x}^2+\dot{y}^2)+\tfrac{1}{2}I\dot{\theta}^2=\int(Xdx+Ydy+Nd\theta)+\text{const.} \tag{13}$$

The left-hand side is the kinetic energy of the whole mass, supposed concentrated at G and moving with this point, together with the kinetic energy of the motion relative to G (§ 15); and the right-hand member represents the integral work done by the extraneous forces in the successive infinitesimal displacements into which the motion may be resolved.

The formula (13) may be easily verified in the case of the compound pendulum, or of the solid rolling down an incline. As another example, suppose we have a circular cylinder whose mass-centre is at an excentric point, rolling on a horizontal plane. This includes the case of a compound pendulum in which the knife-edge is replaced by a cylindrical pin. If a be the radius of the cylinder, h the distance of G from its axis (O), κ the radius of gyration about a longitudinal axis through G, and θ the inclination of OG to the vertical, the kinetic energy is $\frac{1}{2}M\kappa^2\dot{\theta}^2+\frac{1}{2}M\,.\,CG^2\,.\,\dot{\theta}^2$, by § 3, since the body is turning about the line of contact (C) as instantaneous axis, and the potential energy is $-Mgh\cos\theta$. The equation of energy is therefore

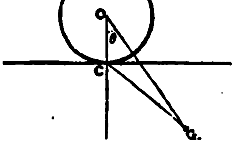


FIG. 75.

$$\tfrac{1}{2}M(\kappa^2+a^2+h^2-2\,ah\cos\theta)\,\dot{\theta}^2-Mgh\cos\theta=\text{const.} \tag{14}$$

Whenever, as in the preceding examples, a body or a system of bodies, is subject to constraints which leave it virtually only one degree of freedom, the equation of energy is sufficient for the complete determination of the motion. If q be any variable co-ordinate defining the position or (in the case of a system of bodies) the configuration, the velocity of each particle at any instant will be proportional to $\dot{q}$, and the total kinetic energy may be expressed in the form $\frac{1}{2}A\dot{q}^2$, where A is in general a function of q [cf. equation (14)]. This coefficient A is called the *coefficient of inertia*, or the *reduced inertia* of the system, referred to the co-ordinate q.

Thus in the case of a railway truck travelling with velocity u the kinetic energy is $\frac{1}{2}(M+m\kappa^2/a^2)u^2$, where M is the total mass, a the radius and κ the radius of gyration of each wheel, and m is the sum of the masses of the wheels; the reduced inertia is therefore $M+m\kappa^2/a^2$. Again, take the system composed of the flywheel, connecting rod, and piston of a steam-engine. We have here a limiting case of three-bar motion (§ 3), and the instantaneous centre J of the connecting-rod PQ will have the position shown in the figure. The velocities of P and Q will be in the ratio of JP to JQ, or OR to OQ; the velocity of the piston is therefore $y\dot{\theta}$, where $y=OR$. Hence if, for simplicity, we neglect the inertia of the connecting-rod, the kinetic energy will be $\frac{1}{2}(I+My^2)\dot{\theta}^2$, where I is the moment of inertia of the flywheel, and M is the mass of the piston. The effect of the mass of the piston is therefore to increase the apparent moment of inertia of the flywheel by the variable amount My^2. If, on the other hand, we take OP ($=x$) as our variable, the kinetic energy is $\frac{1}{2}(M+I/y^2)\dot{x}^2$. We may also say, therefore, that the effect of the flywheel is to increase the apparent mass of the piston by the amount I/y^2; this becomes infinite at the "dead-points" where the crank is in line with the connecting-rod.

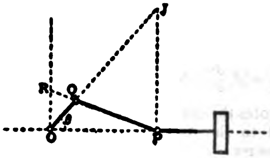


FIG. 76.

If the system be "conservative," we have

$$\tfrac{1}{2}A\dot{q}^2+V=\text{const.}, \tag{15}$$

where V is the potential energy. If we differentiate this with respect to t, and divide out by $\dot{q}$, we obtain

$$A\ddot{q}+\tfrac{1}{2}\frac{dA}{dq}\dot{q}^2+\frac{dV}{dq}=0 \tag{16}$$

as the equation of motion of the system with the unknown reactions (if any) eliminated. For equilibrium this must be satisfied by $\dot{q}=0$; this requires that $dV/dq=0$, *i.e.* the potential energy must be "stationary." To examine the effect of a small disturbance from equilibrium we put $V=f(q)$, and write $q=q_0+\eta$, where q_0 is a root of $f'(q_0)=0$ and η is small. Neglecting terms of the second order in η we have $dV/dq=f'(q)=f''(q_0).\eta$, and the equation (16) reduces to

$$A\ddot{\eta}+f''(q_0)\eta=0, \tag{17}$$

where A may be supposed to be constant and to have the value corresponding to $q=q_0$. Hence if $f''(q_0)>0$, *i.e.* if V is a minimum in the configuration of equilibrium, the variation of η is simple-harmonic, and the period is $2\pi\surd\{A/f''(q_0)\}$. This depends only on the constitution of the system, whereas the amplitude and epoch will vary with the initial circumstances. If $f''(q_0)<0$, the solution of (17) will involve real exponentials, and η will in general increase until the neglect of the terms of the second order is no longer justified. The configuration $q=q_0$, is then unstable.

As an example of the method, we may take the problem to which equation (14) relates. If we differentiate, and divide by $\dot{\theta}$, and retain only the terms of the first order in θ, we obtain

$$\{\kappa^2+(h-a)^2\}\ddot{\theta}+gh\theta=0, \tag{18}$$

as the equation of small oscillations about the position $\theta=0$. The length of the equivalent simple pendulum is $\{\kappa^2+(h-a)^2\}/h$.

The equations which express the change of motion (in two dimensions) due to an instantaneous impulse are of the forms

$$M(u'-u)=\xi,\quad M(v'-v)=\eta,\quad I(\omega'-\omega)=\nu. \tag{19}$$

Here u', v' are the values of the component velocities of G just before, and u, v their values just after, the impulse, whilst ω', ω denote the corresponding angular velocities. Further, ξ, η are the time-integrals of the forces parallel to the co-ordinate axes, and ν is the time-integral of their moment about G. Suppose, for example, that a rigid lamina at rest, but free to move, is struck by an instantaneous impulse F in a given line. Evidently G will begin to move parallel to the line of F; let its initial velocity be u', and let ω' be the initial angular velocity. Then $Mu'=F$, $I\omega'=F.GP$, where GP is the perpendicular from G to the line of F. If PG be produced to any point C, the initial velocity of the point C of the lamina will be

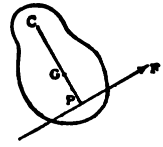


FIG. 77.

$$u'-\omega'.GC=(F/M).(1-GC.CP/\kappa^2),$$

where κ^2 is the radius of gyration about G. The initial centre of rotation will therefore be at C, provided $GC\,.\,GP=\kappa^2$. If this condition be satisfied there would be no impulsive reaction at C even if this point were fixed. The point P is therefore called the *centre of percussion* for the axis at C. It will be noted that the relation between C and P is the same as that which connects the centres of suspension and oscillation in the compound pendulum.

§ 18. *Equations of Motion in Three Dimensions.*—It was proved in § 7 that a body moving about a fixed point O can be brought from its position at time t to its position at time $t+\delta t$ by an infinitesimal rotation ϵ about some axis through O; and the limiting position of this axis, when δt is infinitely small, was called the "instantaneous axis." The limiting value of the ratio $\epsilon/\delta t$ is called the *angular velocity* of the body; we denote it by ω. If ξ, η, ζ are the components of ϵ about rectangular co-ordinate axes through O, the limiting values of $\xi/\delta t$, $\eta/\delta t$, $\zeta/\delta t$ are called the *component angular velocities*; we denote them by p, q, r. If l, m, n be the direction-cosines of the instantaneous axis we have

$$p=l\omega,\ q=m\omega,\ r=n\omega, \tag{1}$$
$$p^2+q^2+r^2=\omega^2. \tag{2}$$

If we draw a vector OJ to represent the angular velocity, then J traces out a certain curve in the body, called the *polhode*, and a certain curve in space, called the *herpolhode*. The cones generated by the instantaneous axis in the body and in space are called the polhode and herpolhode cones, respectively; in the actual motion the former cone rolls on the latter (§7).

The special case where both cones are right circular and ω is constant is important in astronomy and also in mechanism (theory of bevel wheels). The "precession of the equinoxes" is due to the fact that the earth performs a motion of this kind about its centre, and the whole class of such motions has therefore been termed *precessional*. In fig. 78, which shows the various cases, OZ is the axis of the fixed and OC that of the rolling cone, and J is the point of contact of the polhode and herpolhode, which are of course both circles. If α be the semi-angle of the rolling cone, β the constant inclination of OC to OZ, and $\dot\psi$ the angular velocity with which the plane ZOC revolves about OZ, then, considering the velocity of a point in OC at unit distance from O, we have

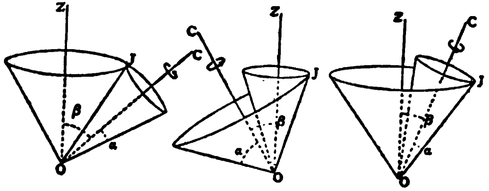


FIG. 78.

$$\omega \sin \alpha = \pm \dot\psi \sin \beta, \tag{3}$$

where the lower sign belongs to the third case. The earth's precessional motion is of this latter type, the angles being $\alpha = \cdot 0087''$, $\beta = 23° \, 28'$.

If m be the mass of a particle at P, and PN the perpendicular to the instantaneous axis, the kinetic energy T is given by

$$2\mathrm{T} = \Sigma\{m(\omega . \mathrm{PN})^2\} = \omega^2 . \Sigma(m.\mathrm{PN}^2) = \mathrm{I}\omega^2, \tag{4}$$

where I is the moment of inertia about the instantaneous axis. With the same notation for moments and products of inertia as in § 11 (38), we have

$$\mathrm{I} = \mathrm{A}l^2 + \mathrm{B}m^2 + \mathrm{C}n^2 - 2\mathrm{F}mn - 2\mathrm{G}nl - 2\mathrm{H}lm,$$

and therefore by (1),

$$2\mathrm{T} = \mathrm{A}p^2 + \mathrm{B}q^2 + \mathrm{C}r^2 - 2\mathrm{F}qr - 2\mathrm{G}rp - 2\mathrm{H}pq. \tag{5}$$

Again, if x, y, z be the co-ordinates of P, the component velocities of m are

$$qz - ry, \; rx - pz, \; py - qx, \tag{6}$$

by § 7 (5); hence, if λ, μ, ν be now used to denote the component angular momenta about the co-ordinate axes, we have $\lambda = \Sigma\{m(py - qx)y - m(rx - pz)z\}$, with two similar formulae, or

$$\left.\begin{aligned} \lambda &= \quad \mathrm{A}p - \mathrm{H}q - \mathrm{G}r = \frac{\partial \mathrm{T}}{\partial p}, \\ \mu &= -\mathrm{H}p + \mathrm{B}q - \mathrm{F}r = \frac{\partial \mathrm{T}}{\partial q}, \\ \nu &= -\mathrm{G}p - \mathrm{F}q + \mathrm{C}r = \frac{\partial \mathrm{T}}{\partial r}. \end{aligned}\right\} \tag{7}$$

If the co-ordinate axes be taken to coincide with the principal axes of inertia at O, at the instant under consideration, we have the simpler formulae

$$2\mathrm{T} = \mathrm{A}p^2 + \mathrm{B}q^2 + \mathrm{C}r^2, \tag{8}$$

$$\lambda = \mathrm{A}p, \; \mu = \mathrm{B}q, \; \nu = \mathrm{C}r. \tag{9}$$

It is to be carefully noticed that the axis of resultant angular momentum about O does not in general coincide with the instantaneous axis of rotation. The relation between these axes may be expressed by means of the momental ellipsoid at O. The equation of the latter, referred to its principal axes, being as in § 11 (41), the co-ordinates of the point J where it is met by the instantaneous axis are proportional to p, q, r, and the direction-cosines of the normal at J are therefore proportional to Ap, Bq, Cr, or λ, μ, ν. The axis of resultant angular momentum is therefore normal to the tangent plane at J, and does not coincide with OJ unless the latter be a principal axis. Again, if Γ be the resultant angular momentum, so that

$$\lambda^2 + \mu^2 + \nu^2 = \Gamma^2, \tag{10}$$

the length of the perpendicular OH on the tangent plane at J is

$$\mathrm{OH} = \frac{\mathrm{A}p}{\Gamma} \cdot \frac{p}{\omega}\rho + \frac{\mathrm{B}q}{\Gamma} \cdot \frac{q}{\omega}\rho + \frac{\mathrm{C}r}{\Gamma} \cdot \frac{r}{\omega}\rho = \frac{2\mathrm{T}}{\Gamma} \cdot \frac{\rho}{\omega}, \tag{11}$$

where $\rho = $ OJ. This relation will be of use to us presently (§ 19).

The motion of a rigid body in the most general case may be specified by means of the component velocities u, v, w of any point O of it which is taken as base, and the component angular velocities p, q, r. The component velocities of any point whose co-ordinates relative to O are x, y, z are then

$$u + qz - ry, \; v + rx - pz, \; w + py - qx \tag{12}$$

by § 7 (6). It is usually convenient to take as our base-point the mass-centre of the body. In this case the kinetic energy is given by

$$2\mathrm{T} = \mathrm{M}_0(u^2 + v^2 + w^2) + \mathrm{A}p^2 + \mathrm{B}q^2 + \mathrm{C}r^2 - 2\mathrm{F}qr - 2\mathrm{G}rp - 2\mathrm{H}pq, \tag{13}$$

where M_0 is the mass, and A, B, C, F, G, H are the moments and products of inertia with respect to the mass-centre; cf. § 15 (9).

The components ξ, η, ζ of linear momentum are

$$\xi = \mathrm{M}_0 u = \frac{\partial \mathrm{T}}{\partial u}, \; \eta = \mathrm{M}_0 v \frac{\partial \mathrm{T}}{\partial v}, \; \zeta = \mathrm{M}_0 w = \frac{\partial \mathrm{T}}{\partial w}, \tag{14}$$

whilst those of the relative angular momentum are given by (7). The preceding formulae are sufficient for the treatment of instantaneous impulses. Thus if an impulse $(\xi, \eta, \zeta, \lambda, \mu, \nu)$ change the motion from (u, v, w, p, q, r) to (u', v', w', p', q', r') we have

$$\left.\begin{aligned} \mathrm{M}_0(u' - u) = \xi, \quad \mathrm{M}_0(v' - v) = \eta, \quad \mathrm{M}_0(w' - w) = \zeta, \\ \mathrm{A}(p' - p) = \lambda, \quad \mathrm{B}(q' - q) = \mu, \quad \mathrm{C}(r' - r) = \nu, \end{aligned}\right\} \tag{15}$$

where, for simplicity, the co-ordinate axes are supposed to coincide with the principal axes at the mass-centre. Hence the change of kinetic energy is

$$\begin{aligned} \mathrm{T}' - \mathrm{T} = \xi . \tfrac{1}{2}(u + u') + \eta . \tfrac{1}{2}(v + v') + \zeta . \tfrac{1}{2}(w + w'), \\ + \lambda . \tfrac{1}{2}(p + p') + \mu . \tfrac{1}{2}(q + q') + \nu . \tfrac{1}{2}(r + r'). \end{aligned} \tag{16}$$

The factors of $\xi, \eta, \zeta, \lambda, \mu, \nu$ on the right-hand side are proportional to the constituents of a possible infinitesimal displacement of the solid, and the whole expression is proportional (on the same scale) to the work done by the given system of impulsive forces in such a displacement. As in § 9 this must be equal to the total work done in such a displacement by the several forces, whatever they are, which make up the impulse. We are thus led to the following statement: the change of kinetic energy due to any system of impulsive forces is equal to the sum of the products of the several forces into the semi-sum of the initial and final velocities of their respective points of application, resolved in the directions of the forces. Thus in the problem of fig. 77 the kinetic energy generated is $\frac{1}{2}\mathrm{M}(\kappa^2 + \mathrm{C}q^2)\omega'^2$, if C be the instantaneous centre; this is seen to be equal to $\frac{1}{2}\mathrm{F}. \omega'. \mathrm{CP}$, where $\omega'. \mathrm{CP}$ represents the initial velocity of P.

The equations of continuous motion of a *solid* are obtained by substituting the values of $\xi, \eta, \zeta, \lambda, \mu, \nu$ from (14) and (7) in the general equations

$$\left.\begin{aligned} \frac{d\xi}{dt} = \mathrm{X}, \; \frac{d\eta}{dt} = \mathrm{Y}, \; \frac{d\zeta}{dt} = \mathrm{Z}, \\ \frac{d\lambda}{dt} = \mathrm{L}, \; \frac{d\mu}{dt} = \mathrm{M}, \; \frac{d\nu}{dt} = \mathrm{N}, \end{aligned}\right\} \tag{17}$$

where (X, Y, Z, L, M, N) denotes the system of extraneous forces referred (like the momenta) to the mass-centre as base, the co-ordinate axes being of course fixed in direction. The resulting equations are not as a rule easy of application, owing to the fact that the moments and products of inertia A, B, C, F, G, H are not constants but vary in consequence of the changing orientation of the body with respect to the co-ordinate axes.

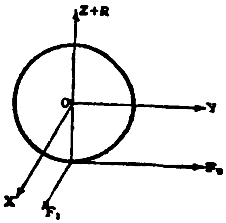


FIG. 79.

An exception occurs, however, in the case of a solid which is kinetically symmetrical (§ 11) about the mass-centre, *e.g.* a uniform sphere. The equations then take the forms

$$\begin{aligned} \mathrm{M}_0\dot u = \mathrm{X}, \; \mathrm{M}_0\dot v = \mathrm{Y}, \; \mathrm{M}_0\dot w = \mathrm{Z}, \\ \mathrm{C}\dot p = \mathrm{L}, \quad \mathrm{C}\dot q = \mathrm{M}, \quad \mathrm{C}\dot r = \mathrm{N}, \end{aligned} \tag{18}$$

where C is the constant moment of inertia about any axis through the mass-centre. Take, for example, the case of a sphere rolling on a plane; and let the axes Ox, Oy be drawn through the centre parallel to the plane, so that the equation of the latter is $z=-a$. We will suppose that the extraneous forces consist of a known force (X, Y, Z) at the centre, and of the reactions (F_1, F_2, R) at the point of contact. Hence

$$\left.\begin{aligned} M_0\dot{u}=X+F_1,\ M_0\dot{v}=Y+F_2,\quad 0=Z+R,\\ C\dot{p}=F_2a,\ C\dot{q}=-F_1a,\ C\dot{r}=0.\end{aligned}\right\}\tag{19}$$

The last equation shows that the angular velocity about the normal to the plane is constant. Again, since the point of the sphere which is in contact with the plane is instantaneously at rest, we have the geometrical relations

$$u+qa=0,\ v+pa=0,\ w=0,\tag{20}$$

by (12). Eliminating p, q, we get

$$(M_0+Ca^{-2})\dot{u}=X,\ (M_0+Ca^{-2})\dot{v}=Y.\tag{21}$$

The acceleration of the centre is therefore the same as if the plane were smooth and the mass of the sphere were increased by C/a^2. Thus the centre of a sphere rolling under gravity on a plane of inclination α describes a parabola with an acceleration

$$g\sin\alpha/(1+C/Ma^2)$$

parallel to the lines of greatest slope.

Take next the case of a sphere rolling on a fixed spherical surface. Let a be the radius of the rolling sphere, c that of the spherical surface which is the locus of its centre, and let x, y, z be the co-ordinates of this centre relative to axes through O, the centre of the fixed sphere. If the only extraneous forces are the reactions (P, Q, R) at the point of contact, we have

$$\left.\begin{aligned} M_0\ddot{x}=P,\ M_0\ddot{y}=Q,\ M_0\ddot{z}=R,\\ C\dot{p}=-\frac{a}{c}(yR-zQ),\ C\dot{q}=-\frac{a}{c}(zP-xR),\ C\dot{r}=-\frac{a}{c}(xQ-yP),\end{aligned}\right\}\tag{22}$$

the standard case being that where the rolling sphere is outside the fixed surface. The opposite case is obtained by reversing the sign of a. We have also the geometrical relations

$$\dot{x}=(a/c)(qz-ry),\ \dot{y}=(a/c)(rx-pz),\ \dot{z}=(a/c)(py-qx).\tag{23}$$

If we eliminate P, Q, R from (22), the resulting equations are integrable with respect to t; thus

$$p=-\frac{M_0a}{Cc}(y\dot{z}-z\dot{y})+\alpha,\ q=-\frac{M_0a}{Cc}(z\dot{x}-x\dot{z})+\beta,$$
$$r=-\frac{M_0a}{Cc}(x\dot{y}-y\dot{x})+\gamma,\tag{24}$$

where α, β, γ are arbitrary constants. Substituting in (23) we find

$$\left(1+\frac{M_0a^2}{C}\right)\dot{x}=\frac{a}{c}(\beta z-\gamma y),\ \left(1+\frac{M_0a^2}{C}\right)\dot{y}=\frac{a}{c}(\gamma x-\alpha z),$$
$$\left(1+\frac{M_0a^2}{C}\right)\dot{z}=\frac{a}{c}(\alpha y-\beta x).\tag{25}$$

Hence $\alpha\dot{x}+\beta\dot{y}+\gamma\dot{z}=0$, or

$$\alpha x+\beta y+\gamma z=\text{const.};\tag{26}$$

which shows that the centre of the rolling sphere describes a circle. If the axis of z be taken normal to the plane of this circle we have $\alpha=0$, $\beta=0$, and

$$\left(1+\frac{M_0a^2}{C}\right)\dot{x}=-\gamma\frac{a}{c}y,\quad \left(1+\frac{M_0a^2}{C}\right)\dot{y}=\gamma\frac{a}{c}x,\tag{27}$$

The solution of these equations is of the type

$$x=b\cos(\sigma t+\epsilon),\ y=b\sin(\sigma t+\epsilon),\tag{28}$$

where b, ϵ are arbitrary, and

$$\sigma=\frac{\gamma a/c}{1+M_0a^2/C}.\tag{29}$$

The circle is described with the constant angular velocity σ.

When the gravity of the rolling sphere is to be taken into account the preceding method is not in general convenient, unless the whole motion of G is small. As an example of this latter type, suppose that a sphere is placed on the highest point of a fixed sphere and set spinning about the vertical diameter with the angular velocity n; it will appear that under a certain condition the motion of G consequent on a slight disturbance will be oscillatory. If Oz be drawn vertically upwards, then in the beginning of the disturbed motion the quantities x, y, p, q, P, Q will all be small. Hence, omitting terms of the second order, we find

$$\left.\begin{aligned} M_0\ddot{x}=P,\ M_0\ddot{y}=Q,\ R=M_0g,\\ C\dot{p}=-(M_0ga/c)y+aQ,\ C\dot{q}=(M_0ga/c)x-aP,\ C\dot{r}=0.\end{aligned}\right\}\tag{30}$$

The last equation shows that the component r of the angular velocity retains (to the first order) the constant value n. The geometrical relations reduce to

$$\dot{x}=aq-(na/c)y,\ \dot{y}=-ap+(na/c)x.\tag{31}$$

Eliminating p, q, P, Q, we obtain the equations

$$\left.\begin{aligned} (C+M_0a^2)\ddot{x}+(Cna/c)\dot{y}-(M_0ga^2/c)x=0,\\ (C+M_0a^2)\ddot{y}-(Cna/c)\dot{x}-(M_0ga^2/c)y=0,\end{aligned}\right\}\tag{32}$$

which are both contained in

$$\left\{(C+M_0a^2)\frac{d^2}{dt^2}-i\frac{Cna}{c}\frac{d}{dt}-\frac{M_0ga^2}{c}\right\}(x+iy)=0.\tag{33}$$

This has two solutions of the type $x+iy=ae^{i(\sigma t+\epsilon)}$, where a, ϵ are arbitrary, and σ is a root of the quadratic

$$(C+M_0a^2)\sigma^2-(Cna/c)\sigma+M_0ga^2/c=0.\tag{34}$$

If

$$n^2>(4Mgc/C)(1+M_0a^2/C),\tag{35}$$

both roots are real, and have the same sign as n. The motion of G then consists of two superposed circular vibrations of the type

$$x=a\cos(\sigma t+\epsilon),\ y=a\sin(\sigma t+\epsilon),\tag{36}$$

in each of which the direction of revolution is the same as that of the initial spin of the sphere. It follows therefore that the original position is stable provided the spin n exceed the limit defined by (35). The case of a sphere spinning about a vertical axis at the lowest point of a spherical bowl is obtained by reversing the signs of a and c. It appears that this position is always stable.

It is to be remarked, however, that in the first form of the problem the stability above investigated is practically of a limited or temporary kind. The slightest frictional forces—such as the resistance of the air—even if they act in lines through the centre of the rolling sphere, and so do not directly affect its angular momentum, will cause the centre gradually to descend in an ever-widening spiral path.

§ 19. *Free Motion of a Solid.*—Before proceeding to further problems of motion under extraneous forces it is convenient to investigate the free motion of a solid relative to its mass-centre O, in the most general case. This is the same as the motion about a fixed point under the action of extraneous forces which have zero moment about that point. The question was first discussed by Euler (1750); the geometrical representation to be given is due to Poinsot (1851).

The kinetic energy T of the motion relative to O will be constant. Now $T=\frac{1}{2}I\omega^2$, where ω is the angular velocity and I is the moment of inertia about the instantaneous axis. If ρ be the radius-vector OJ of the momental ellipsoid

$$Ax^2+By^2+Cz^2=M\epsilon^4\tag{1}$$

drawn in the direction of the instantaneous axis, we have $I=M\epsilon^4/\rho^2$ (§ 11); hence ω varies as ρ. The locus of J may therefore be taken as the "polhode" (§ 18). Again, the vector which represents the angular momentum with respect to O will be constant in every respect. We have seen (§ 18) that this vector coincides in direction with the perpendicular OH to the tangent plane of the momental ellipsoid at J; also that

$$OH=\frac{2T}{\Gamma}\cdot\frac{\rho}{\omega},\tag{2}$$

where T is the resultant angular momentum about O. Since ω varies as ρ, it follows that OH is constant, and the tangent plane at J is therefore fixed in space. The motion of the body relative to O is therefore completely represented if we imagine the momental ellipsoid at O to roll without sliding on a plane fixed in space, with an angular velocity proportional at each instant to the radius-vector of the point of contact. The fixed plane is parallel to the invariable plane at O, and the line OH is called the *invariable line*. The trace of the point of contact J on the fixed plane is the "herpolhode."

If p, q, r be the component angular velocities about the principal axes at O, we have

$$(A^2p^2+B^2q^2+C^2r^2)/\Gamma^2=(Ap^2+Bq^2+Cr^2)/2T,\tag{3}$$

each side being in fact equal to unity. At a point on the polhode cone $x:y:z=p:q:r$, and the equation of this cone is therefore

$$A^2\left(1-\frac{\Gamma^2}{2AT}\right)x^2+B^2\left(1-\frac{\Gamma^2}{2BT}\right)y^2+C^2\left(1-\frac{\Gamma^2}{2CT}\right)z^2=0.\tag{4}$$

Since $2AT-\Gamma^2=B(A-B)q^2+C(A-C)r^2$, it appears that if $A>B>C$ the coefficient of x^2 in (4) is positive, that of z^2 is negative, whilst that of y^2 is positive or negative according as $2BT \gtrless T^2$. Hence the polhode cone surrounds the axis of greatest or least moment according as $2BT \gtrless \Gamma^2$. In the critical case of $2BT=\Gamma^2$ it breaks up into two planes through the axis of mean moment (Oy). The herpolhode curve in the fixed plane is obviously confined between two concentric circles which it alternately touches; it is not in general a re-entrant curve. It has been shown by De Sparre that, owing to the limitation imposed on the possible forms of the momental ellipsoid by the relation $B+C>A$, the curve has no points of inflexion. The invariable line OH describes another cone in the body, called the *invariable cone.* At any point of this we have $x : y : z = Ap . Bq : Cr$, and the equation is therefore

$$\left(1-\frac{\Gamma^2}{2AT}\right)x^2+\left(1-\frac{\Gamma^2}{2BT}\right)y^2+\left(1-\frac{\Gamma^2}{2CT}\right)z^2=0. \qquad (5)$$

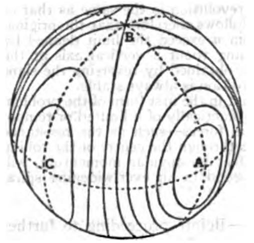


FIG. 80.

The signs of the coefficients follow the same rule as in the case of (4). The possible forms of the invariable cone are indicated in fig. 80 by means of the intersections with a concentric spherical surface. In the critical case of $2BT = \Gamma^2$ the cone degenerates into two planes. It appears that if the body be sightly disturbed from a state of rotation about the principal axis of greatest or least moment, the invariable cone will closely surround this axis, which will therefore never deviate far from the invariable line. If, on the other hand, the body be slightly disturbed from a state of rotation about the mean axis a wide deviation will take place. Hence a rotation about the axis of greatest or least moment is reckoned as stable, a rotation about the mean axis as unstable. The question is greatly simplified when two of the principal moments are equal, say $A = B$. The polhode and herpolhode cones are then right circular, and the motion is "precessional" according to the definition of § 18. If α be the inclination of the instantaneous axis to the axis of symmetry, β the inclination of the latter axis to the invariable line, we have

$$\Gamma\cos\beta = C\omega\cos\alpha,\ \Gamma\sin\beta = A\omega\sin\alpha, \qquad (6)$$

whence

$$\tan\beta = \frac{A}{C}\tan\alpha. \qquad (7)$$

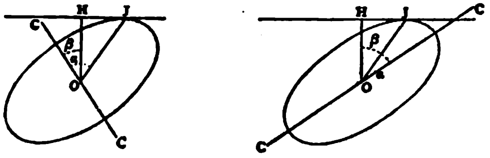


FIG. 81.

Hence $\beta \gtrless \alpha$, and the circumstances are therefore those of the first or second case in fig. 78, according as $A \gtrless C$. If $\dot\psi$ be the rate at which the plane HOJ revolves about OH, we have

$$\dot\psi = \frac{\sin\alpha}{\sin\beta}\omega = \frac{C\cos\alpha}{A\cos\beta}\omega, \qquad (8)$$

by § 18 (3). Also if $\dot\chi$ be the rate at which J describes the polhode, we have $\dot\psi\sin(\beta-\alpha) = \dot\chi\sin\beta$, whence

$$\dot\chi = \frac{\sin(\alpha-\beta)}{\sin\alpha}\omega. \qquad (9)$$

If the instantaneous axis only deviate slightly from the axis of symmetry the angles α, β are small, and $\dot\chi = (A-C)\ A\ .\omega$; the instantaneous axis therefore completes its revolution in the body in the period

$$\frac{2\pi}{\dot\chi} = \frac{A-C}{A}\omega. \qquad (10)$$

In the case of the earth it is inferred from the independent phenomenon of luni-solar precession that $(C-A)/A = \cdot 00313$. Hence if the earth's axis of rotation deviates slightly from the axis of figure, it should describe a cone about the latter in 320 sidereal days. This would cause a periodic variation in the latitude of any place on the earth's surface, as determined by astronomical methods. There appears to be evidence of a slight periodic variation of latitude, but the period would seem to be about fourteen months. The discrepancy is attributed to a defect of rigidity in the earth. The phenomenon is known as the *Eulerian nutation*, since it is supposed to come under the free rotations first discussed by Euler.

§ 20. *Motion of a Solid of Revolution.*—In the case of a solid of revolution, or (more generally) whenever there is kinetic symmetry about an axis through the mass-centre, or through a fixed point O, a number of interesting problems can be treated almost directly from first principles. It frequently happens that the extraneous forces have zero moment about the axis of symmetry, as *e.g.* in the case of the flywheel of a gyroscope if we neglect the friction at the bearings. The angular velocity (r) about this axis is then constant. For we have seen that r is constant when there are no extraneous forces; and r is evidently not affected by an instantaneous impulse which leaves the angular momentum Cr, about the axis of symmetry, unaltered. And a continuous force may be regarded as the limit of a succession of infinitesimal instantaneous impulses.

Suppose, for example, that a flywheel is rotating with angular velocity n about its axis, which is (say) horizontal, and that this axis is made to rotate with the angular velocity $\dot\psi$ in the horizontal plane. The components of angular momentum about the axis of the flywheel and about the vertical will be Cn and $A\dot\psi$ respectively, where A is the moment of inertia about any axis through the mass-centre (or through the fixed point O) perpendicular to that of symmetry. If $\overrightarrow{OK}$ be the vector representing the former component at time t, the vector which represents it at time $t+\delta t$ will be $\overrightarrow{OK'}$. equal to $\overrightarrow{OK}$ in magnitude and making with it an angle $\delta\psi$. Hence $\overrightarrow{KK'}$ $(=Cn\delta\psi)$ will represent the change in this component due to the extraneous forces. Hence, so far as this component is concerned, the extraneous forces must supply a couple of moment $Cn\dot\psi$ in a vertical plane through the axis of the flywheel. If this couple be absent, the axis will be tilted out of the horizontal plane in such a sense that the direction of the spin n approximates to that of the azimuthal rotation $\dot\psi$. The remaining constituent of the extraneous forces is a couple $A\ddot\psi$ about the vertical; this vanishes if $\dot\psi$ is constant. If the axis of the flywheel make an angle θ with the vertical, it is seen in like manner that the required couple in the vertical plane through the axis is $Cn\sin\theta\dot\psi$. This matter can be strikingly illustrated with an ordinary gyroscope, *e.g.* by making the larger movable ring in fig. 37 rotate about its vertical diameter.

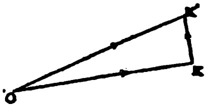


FIG. 82.

If the direction of the axis of kinetic symmetry be specified by means of the angular co-ordinates θ, ψ of § 7, then considering the component velocities of the point C in fig. 83, which are $\dot\theta$ and $\sin\theta\dot\psi$ along and perpendicular to the meridian ZC, we see that the component angular velocities about the lines OA′, OB′ are $-\sin\theta\ \dot\psi$ and $\dot\theta$ respectively. Hence if the principal moments of inertia at O be A, A, C, and if n be the constant angular velocity about the axis OC, the kinetic energy is given by

$$2T = A(\dot\theta^2+\sin^2\theta\ \dot\psi^2)+Cn^2. \qquad (1)$$

Again, the components of angular momentum about OC, OA′ are $Cn, -A\sin\theta\dot\psi$, and therefore the angular momentum (μ, say) about OZ is

$$\mu = A\sin^2\theta\ \dot\psi + Cn\cos\theta. \qquad (2)$$

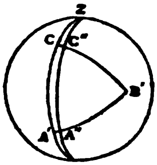


FIG. 83.

We can hence deduce the condition of steady precessional motion in a top. A solid of revolution is supposed to be free to turn about a fixed point O on its axis of symmetry, its mass-centre G being in this axis at a distance h from O. In fig. 83 OZ is supposed to be vertical, and OC is the axis of the solid drawn in the direction OG. If θ is constant the points C, A′ will in time δt come to positions C″, A″ such that $CC'' = \sin\theta\ \delta\psi$, $A'A'' = \cos\theta\ \delta\psi$, and the angular momentum about OB′ will become $Cn\sin\theta\ \delta\psi - A\sin\theta\ \dot\psi . \cos\theta\ \delta\psi$. Equating this to $Mgh\sin\theta\ \delta t$, and dividing out by $\sin\theta$, we obtain

$$A\cos\theta\ \dot\psi^2 - Cn\dot\psi + Mgh = 0, \qquad (3)$$

as the condition in question. For given values of n and θ we have two possible values of $\dot\psi$ provided n exceed a certain limit. With a very rapid spin, or (more precisely) with Cn large in comparison with $\sqrt{(4AMgh\cos\theta)}$, one value of $\dot\psi$ is small and the other large, viz. the two values are Mgh/Cn and $Cn/A\cos\theta$ approximately. The absence of g from the latter expression indicates that the circumstances of the rapid precession are very nearly those of a free Eulerian rotation (§ 19), gravity playing only a subordinate part.

Again, take the case of a circular disk rolling in steady motion on a horizontal plane. The centre O of the disk is supposed to describe a horizontal circle of radius c with the constant angular velocity $\dot\psi$, whilst its plane preserves a constant inclination θ to the horizontal. The components of the reaction of the horizontal lane will be $\mathrm{M}c\dot\psi^2$ at right angles to the tangent line at the point of contact and Mg vertically upwards, and the moment of these about the horizontal diameter of the disk, which corresponds to OB′ in fig. 83, is $\mathrm{M}c\dot\psi^2 . a \sin\theta - \mathrm{M}ga\cos\theta$, where a is the radius of the disk. Equating this to the rate of increase of the angular momentum about OB′, investigated as above, we find

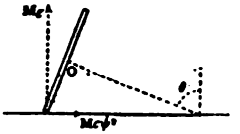


FIG. 84.

$$\left(\mathrm{C}+\mathrm{M}a^2+\mathrm{A}\frac{a}{c}\cos\theta\right)\dot\psi^2=\mathrm{M}g\,\frac{a^2}{c}\cot\theta, \tag{4}$$

where use has been made of the obvious relation $na=c\dot\psi$. If c and θ be given this formula determines the value of $\dot\psi$ for which the motion will be steady.

In the case of the top, the equation of energy and the condition of constant angular momentum (μ) about the vertical OZ are sufficient to determine the motion of the axis. Thus, we have

$$\tfrac{1}{2}\mathrm{A}(\dot\theta^2+\sin^2\theta\,\dot\psi^2)+\tfrac{1}{2}\mathrm{C}n^2+\mathrm{M}gh\cos\theta=\text{const.}, \tag{5}$$

$$\mathrm{A}\sin^2\theta\,\dot\psi+\nu\cos\theta=\mu, \tag{6}$$

where ν is written for Cn. From these $\dot\psi$ may be eliminated, and on differentiating the resulting equation with respect to t we obtain

$$\mathrm{A}\ddot\theta-\frac{(\mu-\nu\cos\theta)(\mu\cos\theta-\nu)}{\mathrm{A}\sin^3\theta}-\mathrm{M}gh\sin\theta=0. \tag{7}$$

If we put $\ddot\theta=0$ we get the condition of steady precessional motion in a form equivalent to (3). To find the small oscillation about a state of steady precession in which the axis makes a constant angle α with the vertical, we write $\theta=\alpha+\chi$, and neglect terms of the second order in χ. The result is of the form

$$\ddot\chi+\sigma^2\chi=0, \tag{8}$$

where

$$\sigma^2=\{(\mu-\nu\cos\alpha)^2+2(\mu-\nu\cos\alpha)(\mu\cos\alpha-\nu)\cos\alpha+(\mu\cos\alpha-\nu)^2\}/\mathrm{A}^2\sin^4\alpha. \tag{9}$$

When ν is large we have, for the "slow" precession $\sigma=\nu/\mathrm{A}$, and for the "rapid" precession $\sigma=\mathrm{A}/\nu\cos\alpha=\dot\psi$, approximately. Further, on examining the small variation in $\dot\psi$, it appears that in a slightly disturbed slow precession the motion of any point of the axis consists of a rapid circular vibration superposed on the steady precession, so that the resultant path has a trochoidal character. This is a type of motion commonly observed in a top spun in the ordinary way, although the successive undulations of the trochoid may be too small to be easily observed. In a slightly disturbed rapid precession the superposed vibration is elliptic-harmonic, with a period equal to that of the precession itself. The ratio of the axes of the ellipse is sec α, the longer axis being in the plane of θ. The result is that the axis of the top describes a circular cone about a fixed line making a small angle with the vertical. This is, in fact, the "invariable line" of the free Eulerian rotation with which (as already remarked) we are here virtually concerned. For the more general discussion of the motion of a top see GYROSCOPE.

§ 21. *Moving Axes of Reference.*—For the more general treatment of the kinetics of a rigid body it is usually convenient to adopt a system of moving axes. In order that the moments and products of inertia with respect to these axes may be constant, it is in general necessary to suppose them fixed in the solid.

We will assume for the present that the origin O is fixed. The moving axes Ox, Oy, Oz form a rigid frame of reference whose motion at time t may be specified by the three component angular velocities p, q, r. The components of angular momentum about Ox, Oy, Oz will be denoted as usual by λ, μ, ν. Now consider a system of fixed axes Ox', Oy', Oz' chosen so as to coincide at the instant t with the moving system Ox, Oy, Oz. At the instant $t+\delta t$, Ox, Oy, Oz will no longer coincide with Ox', Oy', Oz'; in particular they will make with Ox' angles whose cosines are, to the first order, $1, -r\delta t, q\delta t$, respectively. Hence the altered angular momentum about Ox' will be $\lambda+\delta\lambda+(\mu+\delta\mu)(-r\delta t)+(\nu+\delta\nu)q\delta t$. If L, M, N be the moments of the extraneous forces about Ox, Oy, Oz this must be equal to $\lambda+\mathrm{L}\delta t$. Hence, and by symmetry, we obtain

$$\left.\begin{aligned}\frac{d\lambda}{dt}-r\mu+q\nu&=\mathrm{L},\\ \frac{d\mu}{dt}-p\nu+r\lambda&=\mathrm{M},\\ \frac{d\nu}{dt}-q\lambda+p\mu&=\mathrm{N}.\end{aligned}\right\} \tag{1}$$

These equations are applicable to any dynamical system whatever. If we now apply them to the case of a rigid body moving about a fixed point O, and make Ox, Oy, Oz coincide with the principal axes of inertia at O, we have $\lambda, \mu, \nu=\mathrm{A}p, \mathrm{B}q, \mathrm{C}r$, whence

$$\left.\begin{aligned}\mathrm{A}\frac{dp}{dt}-(\mathrm{B}-\mathrm{C})qr&=\mathrm{L},\\ \mathrm{B}\frac{dq}{dt}-(\mathrm{C}-\mathrm{A})rp&=\mathrm{M},\\ \mathrm{C}\frac{dr}{dt}-(\mathrm{A}-\mathrm{B})pq&=\mathrm{N}.\end{aligned}\right\} \tag{2}$$

If we multiply these by p, q, r and add, we get

$$\frac{d}{dt}\cdot\tfrac{1}{2}(\mathrm{A}p^2+\mathrm{B}q^2+\mathrm{C}r^2)=\mathrm{L}p+\mathrm{M}q+\mathrm{N}r, \tag{3}$$

which is (virtually) the equation of energy.

As a first application of the equations (2) take the case of a solid constrained to rotate with constant angular velocity ω about a fixed axis (l, m, n). Since p, q, r are then constant, the requisite constraining couple is

$$\mathrm{L}=(\mathrm{C}-\mathrm{B})mn\omega^2,\ \mathrm{M}=(\mathrm{A}-\mathrm{C})nl\omega^2,\ \mathrm{N}=(\mathrm{B}-\mathrm{A})lm\omega^2. \tag{4}$$

If we reverse the signs, we get the "centrifugal couple" exerted by the solid on its bearings. This couple vanishes when the axis of rotation is a principal axis at O, and in no other case (cf. § 17).

If in (2) we put, L, M, N = 0 we get the case of free rotation; thus

$$\left.\begin{aligned}\mathrm{A}\frac{dp}{dt}&=(\mathrm{B}-\mathrm{C})qr,\\ \mathrm{B}\frac{dq}{dt}&=(\mathrm{C}-\mathrm{A})rp,\\ \mathrm{C}\frac{dr}{dt}&=(\mathrm{A}-\mathrm{B})pq.\end{aligned}\right\} \tag{5}$$

These equations are due to Euler, with whom the conception of moving axes, and the application to the problem of free rotation, originated. If we multiply them by p, q, r, respectively, or again by Ap, Bq, Cr respectively, and add, we verify that the expressions $\mathrm{A}p^2+\mathrm{B}q^2+\mathrm{C}r^2$ and $\mathrm{A}^2p^2+\mathrm{B}^2q^2+\mathrm{C}^2r^2$ are both constant. The former is, in fact, equal to 2T, and the latter to Γ^2, where T is the kinetic energy and Γ the resultant angular momentum.

To complete the solution of (2) a third integral is required; this involves in general the use of elliptic functions. The problem has been the subject of numerous memoirs; we will here notice only the form of solution given by Rueb (1834), and at a later period by G. Kirchhoff (1875). If we write

$$u=\int_0^\phi\frac{d\phi}{\Delta\phi},\quad \Delta\phi=\surd(1-k^2\sin^2\phi),$$

we have, in the notation of elliptic functions, $\phi=\text{am }u$. If we assume

$$p=p_0\cos\text{am}(\sigma t+\epsilon),\ q=q_0\sin\text{am}(\sigma t+\epsilon),\ r=r_0\Delta\,\text{am}(\sigma t+\epsilon), \tag{7}$$

we find

$$\dot p=-\frac{\sigma p_0}{q_0r_0}qr,\ \dot q=\frac{\sigma q_0}{r_0p_0}rp,\ \dot r=-\frac{k^2\sigma r_0}{p_0q_0}pq. \tag{8}$$

Hence (5) will be satisfied, provided

$$\frac{-\sigma p_0}{q_0r_0}=\frac{\mathrm{B}-\mathrm{C}}{\mathrm{A}},\ \frac{\sigma q_0}{r_0p_0}=\frac{\mathrm{C}-\mathrm{A}}{\mathrm{B}},\ \frac{-k^2\sigma r_0}{p_0q_0}=\frac{\mathrm{A}-\mathrm{B}}{\mathrm{C}}. \tag{9}$$

These equations, together with the arbitrary initial values of p, q, r, determine the six constants which we have denoted by $p_0, q_0, r_0, k^2, \sigma, \epsilon$. We will suppose that A > B > C. From the form of the polhode curves referred to in §19 it appears that the angular velocity q about the axis of mean moment must vanish periodically. If we adopt one of these epochs as the origin of t, we have $\epsilon=0$, and p_0, r_0 will become identical with the initial values of p, r. The conditions (9) then lead to

$$q_0^2=\frac{\mathrm{A}(\mathrm{A}-\mathrm{C})}{\mathrm{B}(\mathrm{B}-\mathrm{C})}p_0^2,\ \sigma^2=\frac{(\mathrm{A}-\mathrm{C})(\mathrm{B}-\mathrm{C})}{\mathrm{AB}}r_0^2,\ k^2=\frac{\mathrm{A}(\mathrm{A}-\mathrm{B})}{\mathrm{C}(\mathrm{B}-\mathrm{C})}\cdot\frac{p_0^2}{r_0^2}. \tag{10}$$

For a real solution we must have $k^2 < 1$, which is equivalent to $2BT > \Gamma^2$. If the initial conditions are such as to make $2BT < \Gamma^2$, we must interchange the forms of p and r in (7). In the present case the instantaneous axis returns to its initial position in the body whenever ϕ increases by 2π, *i.e.* whenever t increases by $4K/\sigma$, when K is the "complete" elliptic integral of the first kind with respect to the modulus k.

The elliptic functions degenerate into simpler forms when $k^2 = 0$ or $k^2 = 1$. The former case arises when two of the principal moments are equal; this has been sufficiently dealt with in §19. If $k^2 = 1$, we must have $2BT = \Gamma^2$. We have seen that the alternative $2BT \lesseqgtr \Gamma^2$ determines whether the polhode cone surrounds the principal axis of least or greatest moment. The case of $2BT = \Gamma^2$, exactly, is therefore a critical case; it may be shown that the instantaneous axis either coincides permanently with the axis of mean moment or approaches it asymptotically.

When the origin of the moving axes is also in motion with a velocity whose components are u, v, w, the dynamical equations are

$$\frac{d\xi}{dt} - r\eta + q\zeta = X,\ \frac{d\eta}{dt} - p\zeta + r\xi = Y,\ \frac{d\zeta}{dt} - q\xi + p\eta = Z, \tag{11}$$

$$\left.\begin{array}{c}\dfrac{d\lambda}{dt} - r\mu + q\nu - w\eta + v\zeta = L,\ \dfrac{d\mu}{dt} - p\nu + r\lambda - u\zeta + w\xi = M,\\ \dfrac{d\nu}{dt} - q\lambda + p\mu - v\xi + u\eta = N.\end{array}\right\} \tag{12}$$

To prove these, we may take fixed axes $O'x'$, $O'y'$, $O'z'$ coincident with the moving axes at time t, and compare the linear and angular momenta $\xi+\delta\xi$, $\eta+\delta\eta$, $\zeta+\delta\zeta$, $\lambda+\delta\lambda$, $\mu+\delta\mu$, $\nu+\delta\nu$ relative to the new position of the axes, Ox, Oy, Oz at time $t+\delta t$ with the original momenta $\xi, \eta, \zeta, \lambda, \mu, \nu$ relative to $O'x'$, $O'y'$, $O'z'$ at time t. As in the case of (2), the equations are applicable to any dynamical system whatever. If the moving origin coincide always with the mass-centre, we have $\xi, \eta, \zeta = M_0u, M_0v, M_0w$, where M_0 is the total mass, and the equations simplify.

When, in any problem, the values of u, v, w, p, q, r have been determined as functions of t, it still remains to connect the moving axes with some fixed frame of reference. It will be sufficient to take the case of motion about a fixed point O; the angular co-ordinates θ, ϕ, ψ of Euler may then be used for the purpose. Referring to fig. 36 we see that the angular velocities p, q, r of the moving lines, OA, OB, OC about their instantaneous positions are

$$\left.\begin{array}{c}p = \dot\theta\sin\phi - \sin\theta\cos\phi\,\dot\psi,\ q = \dot\theta\cos\phi + \sin\theta\sin\phi\,\dot\psi,\\ r = \dot\phi + \cos\theta\dot\psi,\end{array}\right\} \tag{13}$$

by § 7 (3), (4). If OA, OB, OC be principal axes of inertia of a solid, and if A, B, C denote the corresponding moments of inertia, the kinetic energy is given by

$$\left.\begin{array}{c}2T = A(\dot\theta\sin\phi - \sin\theta\cos\phi\dot\psi)^2 + B(\dot\theta\cos\phi + \sin\theta\sin\theta\dot\psi)^2\\ +C(\dot\phi + \cos\theta\,\dot\psi)^2.\end{array}\right\} \tag{14}$$

If A = B this reduces to

$$2T = A(\dot\theta^2 + \sin^2\theta\,\dot\psi^2) + C(\dot\phi + \cos\theta\,\dot\psi)^2; \tag{15}$$

cf. § 20 (1).

§ 22. *Equations of Motion in Generalized Co-ordinates.*—Suppose we have a dynamical system composed of a finite number of material particles or rigid bodies, whether free or constrained in any way, which are subject to mutual forces and also to the action of any given extraneous forces. The configuration of such a system can be completely specified by means of a certain number (n) of independent quantities, called the generalized co-ordinates of the system. These co-ordinates may be chosen in an endless variety of ways, but their number is determinate, and expresses the number of *degrees of freedom* of the system. We denote these co-ordinates by $q_1, q_2, \ldots q_n$. It is implied in the above description of the system that the Cartesian co-ordinates x, y, z of any particle of the system are known functions of the q's, varying in form (of course) from particle to particle. Hence the kinetic energy T is given by

$$\begin{aligned}2T &= \Sigma\{m(\dot x^2 + \dot y^2 + \dot z^2)\}\\ &= a_{11}\dot q_1^2 + a_{22}\dot q_2^2 + \ldots + 2a_{12}\dot q_1\dot q_2 + \ldots,\end{aligned} \tag{1}$$

where

$$\left.\begin{array}{l}a_{rr} = \Sigma\left[m\left\{\left(\dfrac{\partial x}{\partial q_r}\right)^2 + \left(\dfrac{\partial y}{\partial q_r}\right)^2 + \left(\dfrac{\partial z}{\partial q_r}\right)^2\right\}\right],\\ a_{rs} = \Sigma\left\{m\left(\dfrac{\partial x}{\partial q_r}\dfrac{\partial x}{\partial q_s} + \dfrac{\partial y}{\partial q_r}\dfrac{\partial y}{\partial q_s} + \dfrac{\partial z}{\partial q_r}\dfrac{\partial z}{\partial q_s}\right)\right\} = a_{sr}.\end{array}\right\} \tag{2}$$

Thus T is expressed as a homogeneous quadratic function of the quantities $\dot q_1, \dot q_2, \ldots \dot q_n$, which are called the *generalized components of velocity*. The coefficients a_{rr}, a_{rs} are called the *coefficients of inertia*; they are not in general constants, being functions of the q's and so variable with the configuration. Again, if (X, Y, Z) be the force on m, the work done in an infinitesimal change of configuration is

$$\Sigma(X\delta x + Y\delta y + Z\delta z) = Q_1\delta q_1 + Q_2\delta q_2 + \ldots + Q_n\delta q_n, \tag{3}$$

where

$$Q_r = \Sigma\left(X\frac{\partial x}{\partial q_r} + Y\frac{\partial y}{\partial q_r} + Z\frac{\partial z}{\partial q_r}\right). \tag{4}$$

The quantities Q_r are called the *generalized components of force.*

The equations of motion of m being

$$m\ddot x = X,\ m\ddot y = Y,\ m\ddot z = Z, \tag{5}$$

we have

$$\Sigma\left\{m\left(\ddot x\frac{\partial x}{\partial q_r} + \ddot y\frac{\partial y}{\partial q_r} + \ddot z\frac{\partial z}{\partial q_r}\right)\right\} = Q_r, \tag{6}$$

Now

$$\dot x = \frac{\partial x}{\partial q_1}\dot q_1 + \frac{\partial x}{\partial q_2}\dot q_2 + \ldots + \frac{\partial x}{\partial q_n}\dot q_n, \tag{7}$$

whence

$$\frac{\partial \dot x}{\partial \dot q_r} = \frac{\partial x}{\partial q_r}. \tag{8}$$

Also

$$\frac{d}{dt}\left(\frac{\partial x}{\partial q_r}\right) = \frac{\partial^2 x}{\partial q_1\partial q_r}\dot q_1 + \frac{\partial^2 x}{\partial q_2\partial q_r}\dot q_2 + \ldots + \frac{\partial^2 x}{\partial q_n\partial q_r}\dot q_n = \frac{\partial \dot x}{\partial q_r}. \tag{9}$$

Hence

$$\ddot x\frac{\partial x}{\partial q_r} = \frac{d}{dt}\left(\dot x\frac{\partial x}{\partial q_r}\right) - \dot x\frac{d}{dt}\left(\frac{\partial x}{\partial q_r}\right) = \frac{d}{dt}\left(\dot x\frac{\partial \dot x}{\partial \dot q_r}\right) - \dot x\frac{\partial \dot x}{\partial q_r}. \tag{10}$$

By these and the similar transformations relating to y and z the equation (6) takes the form

$$\frac{d}{dt}\left(\frac{\partial T}{\partial \dot q_r}\right) - \frac{\partial T}{\partial q_r} = Q_r. \tag{11}$$

If we put $r = 1, 2, \ldots n$ in succession, we get the n independent equations of motion of the system. These equations are due to Lagrange, with whom indeed the first conception, as well as the establishment, of a general dynamical method applicable to all systems whatever appears to have originated. The above proof was given by Sir W. R. Hamilton (1835). Lagrange's own proof will be found under DYNAMICS, § *Analytical.* In a conservative system free from extraneous force we have

$$\Sigma(X\delta x + Y\delta y + Z\delta z) = -\delta V, \tag{12}$$

where V is the potential energy. Hence

$$Q_r = -\frac{\partial V}{\partial q_r}, \tag{13}$$

and

$$\frac{d}{dt}\left(\frac{\partial T}{\partial \dot q_r}\right) - \frac{\partial T}{\partial q_r} = -\frac{\partial V}{\partial q_r}. \tag{14}$$

If we imagine any given state of motion $(\dot q_1, \dot q_2, \ldots \dot q_n)$ through the configuration $(q_1, q_2, \ldots q_n)$ to be generated instantaneously from rest by the action of suitable impulsive forces, we find on integrating (11) with respect to t over the infinitely short duration of the impulse

$$\frac{\partial T}{\partial \dot q_r} = Q_r', \tag{15}$$

where Q_r' is the time integral of Q_r and so represents a *generalized component of impulse.* By an obvious analogy, the expressions $\partial T/\partial \dot q_r$ may be called the *generalised components of momentum*; they are usually denoted by p_r, thus

$$p_r = \partial T/\partial \dot q_r = a_{1r}\dot q_1 + a_{2r}\dot q_2 + \ldots + a_{nr}\dot q_n. \tag{16}$$

Since T is a homogeneous quadratic function of the velocities $\dot q_1, \dot q_2, \ldots \dot q_n$, we have

$$2T = \frac{\partial T}{\partial \dot q_1}\dot q_1 + \frac{\partial T}{\partial \dot q_2}\dot q_2 + \ldots + \frac{\partial T}{\partial \dot q_n}\dot q_n = p_1\dot q_1 + p_2\dot q_2 + \ldots + p_n\dot q_n. \tag{17}$$

Hence

$$\left.\begin{aligned}2\frac{dT}{dt} &= \dot p_1\dot q_1 + \dot p_2\dot q_2 + \ldots + \dot p_n\dot q_n\\ &\quad + p_1\ddot q_1 + p_2\ddot q_2 + \ldots + p_n\ddot q_n\\ &= \left(\frac{\partial T}{\partial q_1} + Q_1\right)\dot q_1 + \left(\frac{\partial T}{\partial q_2} + Q_2\right)\dot q_2 + \ldots + \left(\frac{\partial T}{\partial q_n} + Q_n\right)\dot q_n\\ &\quad + \frac{\partial T}{\partial \dot q_1}\ddot q_1 + \frac{\partial T}{\partial \dot q_2}\ddot q_2 + \ldots + \frac{\partial T}{\partial \dot q_n}\ddot q_n\\ &= \frac{dT}{dt} + Q_1\dot q_1 + Q_2\dot q_2 + \ldots + Q_n\dot q_n\end{aligned}\right\} \tag{18}$$

or

$$\frac{dT}{dt} = Q_1\dot q_1 + Q_2\dot q_2 + \ldots + Q_n\dot q_n \tag{19}$$

This equation expresses that the kinetic energy is increasing at a rate equal to that at which work is being done by the forces. In the case of a conservative system free from extraneous force it becomes the equation of energy

$$\frac{d}{dt}(T+V)=0, \text{ or } T+V=\text{const.}, \tag{20}$$

in virtue of (13).

As a first application of Lagrange's formula (11) we may form the equations of motion of a particle in spherical polar co-ordinates. Let r be the distance of a point P from a fixed origin O, θ the angle which OP makes with a fixed direction OZ, ψ the azimuth of the plane ZOP relative to some fixed plane through OZ. The displacements of P due to small variations of these co-ordinates are δr along OP, $r\delta\theta$ perpendicular to OP in the plane ZOP, and $r\sin\theta\,\delta\psi$ perpendicular to this plane. The component velocities in these directions are therefore $\dot r$, $r\dot\theta$, $r\sin\theta\,\dot\psi$, and if m be the mass of a moving particle at P we have

$$2T = m(\dot r^2 + r^2\dot\theta^2 + r^2\sin^2\theta\,\dot\psi^2). \tag{21}$$

Hence the formula (11) gives

$$\left.\begin{aligned} m(\ddot r - r\dot\theta^2 - r\sin^2\theta\,\dot\psi^2) &= R,\\ \frac{d}{dt}(mr^2\dot\theta) - mr^2\sin\theta\cos\theta\,\dot\psi^2 &= \Theta,\\ \frac{d}{dt}(mr^2\sin^2\theta\,\dot\psi) &= \Psi. \end{aligned}\right\} \tag{22}$$

The quantities R, Θ, Ψ are the coefficients in the expression $R\delta r + \Theta\delta\theta + \Psi\delta\psi$ for the work done in an infinitely small displacement; viz. R is the radial component of force, Θ is the moment about a line through O perpendicular to the plane ZOP, and Ψ is the moment about OZ. In the case of the spherical pendulum we have $r=l$, $\Theta = -mgl\sin\theta$, $\Psi=0$, if OZ be drawn vertically downwards, and therefore

$$\left.\begin{aligned} \ddot\theta - \sin\theta\cos\theta\,\dot\psi^2 &= -\frac{g}{l}\sin\theta,\\ \sin^2\theta\,\dot\psi &= h, \end{aligned}\right\} \tag{23}$$

where h is a constant. The latter equation expresses that the angular momentum $ml^2\sin^2\theta\,\dot\psi$ about the vertical OZ is constant. By elimination of $\dot\psi$ we obtain

$$\ddot\theta - h^2\cos^2\theta/\sin^3\theta = -\frac{g}{l}\sin\theta. \tag{24}$$

If the particle describes a horizontal circle of angular radius α with constant angular velocity Ω, we have $\ddot\theta=0$, $h=\Omega^2\sin\alpha$, and therefore

$$\Omega^2 = \frac{g}{l}\cos\alpha, \tag{25}$$

as is otherwise evident from the elementary theory of uniform circular motion. To investigate the small oscillations about this state of steady motion we write $\theta=\alpha+\chi$ in (24) and neglect terms of the second order in χ. We find, after some reductions,

$$\ddot\chi + (1+3\cos^2\alpha)\,\Omega^2\chi = 0; \tag{26}$$

this shows that the variation of χ is simple-harmonic, with the period

$$2\pi/\sqrt{(1+3\cos^2\alpha)}\,.\,\Omega$$

As regards the most general motion of a spherical pendulum, it is obvious that a particle moving under gravity on a smooth sphere cannot pass through the highest or lowest point unless it describes a vertical circle. In all other cases there must be an upper and a lower limit to the altitude. Again, a vertical plane passing through O and a point where the motion is horizontal is evidently a plane of symmetry as regards the path. Hence the path will be confined between two horizontal circles which it touches alternately, and the direction of motion is never horizontal except at these circles. In the case of disturbed steady motion, just considered, these circles are nearly coincident. When both are near the lowest point the horizontal projection of the path is approximately an ellipse, as shown in § 13; a closer investigation shows that the ellipse is to be regarded as revolving about its centre with the angular velocity $\frac{3}{8}ab\Omega/l^2$, where a, b are the semi-axes.

To apply the equations (11) to the case of the top we start with the expression (15) of § 21 for the kinetic energy, the simplified form (1) of § 20 being for the present purpose inadmissible, since it is essential that the generalized co-ordinates employed should be competent to specify the position of every particle. If λ, μ, ν be the components of momentum, we have

$$\left.\begin{aligned} \lambda &= \frac{\partial T}{\partial\dot\theta} = A\dot\theta,\\ \mu &= \frac{\partial T}{\partial\dot\psi} = A\sin^2\theta\,\dot\psi + C(\dot\phi+\cos\theta\,\dot\psi)\cos\theta,\\ \nu &= \frac{\partial T}{\partial\dot\phi} = C(\dot\phi+\cos\theta\,\dot\psi). \end{aligned}\right\} \tag{27}$$

The meaning of these quantities is easily recognized; thus λ is the angular momentum about a horizontal axis normal to the plane of θ, μ is the angular momentum about the vertical OZ, and ν is the angular momentum about the axis of symmetry. If M be the total mass, the potential energy is $V=Mgh\cos\theta$, if OZ be drawn vertically upwards. Hence the equations (11) become

$$\left.\begin{aligned} &A\ddot\theta - A\sin\theta\cos\theta\,\dot\psi^2 + C(\dot\phi+\cos\theta\,\dot\psi)\dot\psi\sin\theta = Mgh\sin\theta,\\ &d/dt\,.\,\{A\sin^2\theta\,\dot\psi + C(\dot\phi+\cos\theta\,\dot\psi)\cos\theta\} = 0,\\ &d/dt\,.\,\{C(\dot\phi+\cos\theta\,\dot\psi)\} = 0, \end{aligned}\right\} \tag{28}$$

of which the last two express the constancy of the momenta μ, ν. Hence

$$\left.\begin{aligned} A\ddot\theta - A\sin\theta\cos\theta\,\dot\psi^2 + \nu\sin\theta\,\dot\psi &= Mgh\sin\theta,\\ A\sin^2\theta\,\dot\psi + \nu\cos\theta &= \mu. \end{aligned}\right\} \tag{29}$$

If we eliminate $\dot\psi$ we obtain the equation (7) of § 20. The theory of disturbed precessional motion there outlined does not give a convenient view of the oscillations of the axis about the vertical position. If θ be small the equations (29) may be written

$$\left.\begin{aligned} \ddot\theta - \theta\dot\omega^2 &= -\frac{\nu^2-4AMgh}{4A^2}\theta,\\ \theta^2\dot\omega &= \text{const.}, \end{aligned}\right\} \tag{30}$$

where

$$\omega = \psi - \frac{\nu}{2A}t. \tag{31}$$

Since θ, ω are the polar co-ordinates (in a horizontal plane) of a point on the axis of symmetry, relative to an initial line which revolves with constant angular velocity $\nu/2A$, we see by comparison with § 14 (15) (16) that the motion of such a point will be elliptic-harmonic superposed on a uniform rotation $\nu/2A$, provided $\nu^2>4AMgh$. This gives (in essentials) the theory of the "gyroscopic pendulum."

§ 23. *Stability of Equilibrium. Theory of Vibrations.*—If, in a conservative system, the configuration $(q_1, q_2, \dots q_n)$ be one of equilibrium, the equations (14) of § 22 must be satisfied by $\dot q_1, \dot q_2, \dots \dot q_n = 0$, whence

$$\partial V/\partial q_r = 0. \tag{1}$$

A necessary and sufficient condition of equilibrium is therefore that the value of the potential energy should be stationary for infinitesimal variations of the co-ordinates. If, further, V be a minimum, the equilibrium is necessarily stable, as was shown by P. G. L. Dirichlet (1846). In the motion consequent on any slight disturbance the total energy T+V is constant, and since T is essentially positive it follows that V can never exceed its equilibrium value by more than a slight amount, depending on the energy of the disturbance. This implies, on the present hypothesis, that there is an upper limit to the deviation of each co-ordinate from its equilibrium value; moreover, this limit diminishes indefinitely with the energy of the original disturbance. No such simple proof is available to show without qualification that the above condition is *necessary*. If, however, we recognize the existence of dissipative forces called into play by any motion whatever of the system, the conclusion can be drawn as follows. However slight these forces may be, the total energy T+V must continually diminish so long as the velocities $\dot q_1, \dot q_2, \dots \dot q_n$ differ from zero. Hence if the system be started from rest in a configuration for which V is less than in the equilibrium configuration considered, this quantity must still further decrease (since T cannot be negative), and it is evident that either the system will finally come to rest in some other equilibrium configuration, or V will in the long run diminish indefinitely. This argument is due to Lord Kelvin and P. G. Tait (1879).

In discussing the small oscillations of a system about a configuration of stable equilibrium it is convenient so to choose the generalized co-ordinates $q_1, q_2, \dots q_n$ that they shall vanish in the configuration in question. The potential energy is then given with sufficient approximation by an expression of the form

$$2V = c_{11}q_1^2 + c_{22}q_2^2 + \dots + 2c_{12}q_1q_2 + \dots, \tag{2}$$

a constant term being irrelevant, and the terms of the first order being absent since the equilibrium value of V is stationary. The coefficients c_{rr}, c_{rs} are called *coefficients of stability*. We may further treat the coefficients of inertia a_{rr}, a_{rs} of § 22 (1) as constants. The Lagrangian equations of motion are then of the type

$$a_{1r}\ddot q_1 + a_{2r}\ddot q_2 + \dots + a_{nr}\ddot q_n + c_{1r}q_1 + c_{2r}q_2 + \dots + c_{nr}q_n = Q_r, \tag{3}$$

where Q_r now stands for a component of extraneous force. In a *free oscillation* we have $Q_1, Q_2, \dots Q_n = 0$, and if we assume

$$q_r = A_r e^{i\sigma t}, \tag{4}$$

we obtain n equations of the type

$$(c_{1r} - \sigma^2 a_{1r})A_1 + (c_{2r} - \sigma^2 a_{2r})A_2 + \dots + (c_{nr} - \sigma^2 a_{nr})A_n = 0. \tag{5}$$

Eliminating the $n-1$ ratios $A_1:A_2:\ldots:A_n$ we obtain the determinantal equation

$$\Delta(\sigma^2)=0, \tag{6}$$

where

$$\Delta(\sigma^2)=\begin{vmatrix} c_{11}-\sigma^2a_{11}, & c_{21}-\sigma^2a_{21}, & \ldots, & c_{n1}-\sigma^2a_{n1} \\ c_{12}-\sigma^2a_{12}, & c_{22}-\sigma^2a_{22}, & \ldots, & c_{n2}-\sigma^2a_{n2} \\ \vdots & \vdots & \vdots\vdots & \vdots \\ c_{1n}-\sigma^2a_{1n}, & c_{2n}-\sigma^2a_{2n}, & \ldots, & c_{nn}-\sigma^2a_{nn} \end{vmatrix} \tag{7}$$

The quadratic expression for T is essentially positive, and the same holds with regard to V in virtue of the assumed stability. It may be shown algebraically that under these conditions the n roots of the above equation in σ^2 are all real and positive. For any particular root, the equations (5) determine the ratios of the quantities $A_1, A_2, \ldots A_n$, the absolute values being alone arbitrary; these quantities are in fact proportional to the minors of any one row in the determinate $\Delta(\sigma^2)$. By combining the solutions corresponding to a pair of equal and opposite values of σ we obtain a solution in real form:

$$q_r=Ca_r\cos(\sigma t+\epsilon), \tag{8}$$

where $a_1, a_2 \ldots a_r$ are a determinate series of quantites having to one another the above-mentioned ratios, whilst the constants C, ϵ are arbitrary. This solution, taken by itself, represents a motion in which each particle of the system (since its displacements parallel to Cartesian co-ordinate axes are linear functions of the q's) executes a simple vibration of period $2\pi/\sigma$. The amplitudes of oscillation of the various particles have definite ratios to one another, and the phases are in agreement, the absolute amplitude (depending on C) and the phase-constant (ϵ) being alone arbitrary. A vibration of this character is called a *normal mode* of vibration of the system; the number n of such modes is equal to that of the degrees of freedom possessed by the system. These statements require some modification when two or more of the roots of the equation (6) are equal. In the case of a multiple root the minors of $\Delta(\sigma^2)$ all vanish, and the basis for the determination of the quantities a_r disappears. Two or more normal modes then become to some extent indeterminate, and elliptic vibrations of the individual particles are possible. An example is furnished by the spherical pendulum (§ 13).

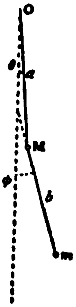


FIG. 85.

As an example of the method of determination of the normal modes we may take the "double pendulum." A mass M hangs from a fixed point by a string of length a, and a second mass m hangs from M by a string of length b. For simplicity we will suppose that the motion is confined to one vertical plane. If θ, ϕ be the inclinations of the two strings to the vertical, we have, approximately,

$$\left.\begin{aligned} 2T&=Ma^2\dot\theta^2+m(a\dot\theta+b\dot\phi)^2, \\ 2V&=Mga\theta^2+mg(a\theta^2+b\phi^2). \end{aligned}\right\} \tag{9}$$

The equations (3) take the forms

$$\left.\begin{aligned} a\ddot\theta+\mu b\ddot\phi+g\theta=0, \\ a\ddot\theta+b\ddot\phi+g\phi=0. \end{aligned}\right\} \tag{10}$$

where $\mu=m/(M+m)$. Hence

$$\left.\begin{aligned} (\sigma^2-g/a)a\theta+\mu\sigma^2b\phi=0, \\ \sigma^2a\theta+(\sigma^2-g/b)b\phi=0. \end{aligned}\right\} \tag{11}$$

The frequency equation is therefore

$$(\sigma^2-g/a)(\sigma^2-g/b)-\mu\sigma^4=0. \tag{12}$$

The roots of this quadratic in σ^2 are easily seen to be real and positive. If M be large compared with m, μ is small, and the roots are g/a and g/b, approximately. In the normal mode corresponding to the former root, M swings almost like the bob of a simple pendulum of length a, being comparatively uninfluenced by the presence of m, whilst m executes a "forced" vibration (§12) of the corresponding period. In the second mode, M is nearly at rest [as appears from the second of equations (11)], whilst m swings almost like the bob of a simple pendulum of length b. Whatever the ratio M/m, the two values of σ^2 can never be exactly equal, but they are approximately equal if a, b are nearly equal and μ is very small. A curious phenomenon is then to be observed; the motion of each particle, being made up (in general) of two superposed simple vibrations of nearly equal period, is seen to fluctuate greatly in extent, and if the amplitudes be equal we have periods of approximate rest, as in the case of "beats" in acoustics. The vibration then appears to be transferred alternately from m to M at regular intervals. If, on the other hand, M is small compared with m, μ is nearly equal to unity, and the roots of (12) are $\sigma^2=g/(a+b)$ and $\sigma^2=mg/M.(a+b)/ab$, approximately. The former root makes $\theta=\phi$, nearly; in the corresponding normal mode m oscillates like the bob of a simple pendulum of length $a+b$. In the second mode $a\theta+b\phi=0$, nearly, so that m is approximately at rest. The oscillation of M then resembles that of a particle at a distance a from one end of a string of length $a+b$ fixed at the ends and subject to a tension mg.

The motion of the system consequent on arbitrary initial conditions may be obtained by superposition of the n normal modes with suitable amplitudes and phases. We have then

$$q_r=a_r\theta+a_r'\theta'+a_r''\theta''+\ldots, \tag{13}$$

where

$$\theta=C\cos(\sigma t+\epsilon),\ \theta'=C'\cos(\sigma' t+\epsilon),\ \theta''=C''\cos(\sigma'' t+\epsilon),\ \ldots \tag{14}$$

provided $\sigma^2, \sigma'^2, \sigma''^2, \ldots$ are the n roots of (6). The coefficients of θ, θ', θ'', $\ldots$ in (13) satisfy the *conjugate* or *orthogonal* relations

$$a_{11}a_1a_1'+a_{22}a_2a_2'+\ldots+a_{12}(a_1a_2'+a_2a_1')+\ldots=0, \tag{15}$$

$$c_{11}a_1a_1'+c_{22}a_2a_2'+\ldots+c_{12}(a_1a_2'+a_2a_1')+\ldots=0, \tag{16}$$

provided the symbols a_r, a_r' correspond to two distinct roots σ^2, σ'^2 of (6). To prove these relations, we replace the symbols $A_1, A_2, \ldots A_n$ in (5) by $a_1, a_2, \ldots a_n$ respectively, multiply the resulting equations by $a_1', a_2', \ldots a_n'$, in order, and add. The result, owing to its symmetry, must still hold if we interchange accented and unaccented Greek letters, and by comparison we deduce (15) and (16), provided σ^2 and σ'^2 are unequal. The actual determination of C, C′, C″, . . . and $\epsilon, \epsilon', \epsilon''$, . . . in terms of the initial conditions is as follows. If we write

$$C\cos\epsilon=H,\ -C\sin\epsilon=K, \tag{17}$$

we must have

$$\left.\begin{aligned} a_rH+a_r'H'+a_r''H''+\ldots&=[q_r]_0, \\ \sigma a_rH+\sigma'a_r'H'+\sigma''a_r''H''+\ldots&=[\dot q_r]_0, \end{aligned}\right\} \tag{18}$$

where the zero suffix indicates initial values. These equations can be at once solved for H, H′, H″, . . . and K, K′, K″, . . . by means of the orthogonal relations (15).

By a suitable choice of the generalized co-ordinates it is possible to reduce T and V simultaneously to sums of squares. The transformation is in fact effected by the assumption (13), in virtue of the relations (15) (16), and we may write

$$\left.\begin{aligned} 2T&=a\dot\theta^2+a'\dot\theta'^2+a''\dot\theta''^2+\ldots, \\ 2V&=c\theta^2+c'\theta'^2+c''\theta''^2+\ldots. \end{aligned}\right\} \tag{19}$$

The new co-ordinates $\theta, \theta', \theta''$ . . . are called the *normal* co-ordinates of the system; in a normal mode of vibration one of these varies alone. The physical characteristics of a normal mode are that an impulse of a particular normal type generates an initial velocity of that type only, and that a constant extraneous force of a particular normal type maintains a displacement of that type only. The normal modes are further distinguished by an important "stationary" property, as regards the frequency. If we imagine the system reduced by frictionless constraints to one degree of freedom, so that the co-ordinates $\theta, \theta', \theta''$, . . . have prescribed ratios to one another, we have, from (19),

$$\sigma^2=\frac{c\theta^2+c'\theta'^2=c''\theta''^2+\ldots}{a\theta^2+a'\theta'^2+a''\theta''^2+\ldots}, \tag{20}$$

This shows that the value of σ^2 for the constrained mode is intermediate to the greatest and least of the values $c/a, c'/a', c''/a''$, . . . proper to the several normal modes. Also that if the constrained mode differs little from a normal mode of free vibration (*e.g.* if θ', θ'', . . . are small compared with θ), the change in the frequency is of the second order. This property can often be utilized to estimate the frequency of the gravest normal mode of a system, by means of an assumed approximate type, when the exact determination would be difficult. It also appears that an estimate thus obtained is necessarily too high.

From another point of view it is easily recognized that the equations (5) are exactly those to which we are led in the ordinary process of finding the stationary values of the function

$$\frac{V(q_1, q_2, \ldots q_n)}{T(q_1, q_2, \ldots q_n)},$$

where the denominator stands for the same homogeneous quadratic function of the q's that T is for the $\dot q$'s. It is easy to construct in this connexion a proof that the n values of σ^2 are all real and positive.

The case of three degrees of freedom is instructive on account of the geometrical analogies. With a view to these we may write

$$\begin{aligned}2\mathrm{T}&=a\dot{x}^2+b\dot{y}^2+c\dot{z}^2+2f\dot{y}\dot{z}+2g\dot{z}\dot{x}+2h\dot{x}\dot{y},\\ 2\mathrm{V}&=\mathrm{A}x^2+\mathrm{B}y^2+\mathrm{C}z^2+2\mathrm{F}yz+2\mathrm{G}zx+2\mathrm{H}xy.\end{aligned}\tag{21}$$

It is obvious that the ratio

$$\frac{\mathrm{V}\,(x,y,z)}{\mathrm{T}\,(x,y,z)}\tag{22}$$

must have a least value, which is moreover positive, since the numerator and denominator are both essentially positive. Denoting this value by σ_1^2, we have

$$\left.\begin{aligned}\mathrm{A}x_1+\mathrm{H}y_1+\mathrm{G}z_1&=\sigma_1^2(ax_1+hy_1+gz_1),\\ \mathrm{H}x_1+\mathrm{B}y_1+\mathrm{F}z_1&=\sigma_1^2(hx_1+by_1+\ fz_1),\\ \mathrm{G}x_1+\mathrm{F}y_1+\mathrm{C}z_1&=\sigma_1^2(gx_1+fy_1+\ cz_1),\end{aligned}\right\}\tag{23}$$

provided $x_1:y_1:z_1$ be the corresponding values of the ratios $x:y:z$. Again, the expression (22) will also have a least value when the ratios $x:y:z$ are subject to the condition

$$x_1\frac{\partial\mathrm{V}}{\partial x}+y_1\frac{\partial\mathrm{V}}{\partial y}+z_1\frac{\partial\mathrm{V}}{\partial z}=0;\tag{24}$$

and if this be denoted by σ_2^2 we have a second system of equations similar to (23). The remaining value σ_3^2 is the value of (22) when $x:y:z$ are chosen so as to satisfy (24) and

$$x_2\frac{\partial\mathrm{V}}{\partial x}+y_2\frac{\partial\mathrm{V}}{\partial y}+z_2\frac{\partial\mathrm{V}}{\partial z}=0.\tag{25}$$

The problem is identical with that of finding the common conjugate diameters of the ellipsoids $\mathrm{T}(x,\ y,\ z)=$const., $\mathrm{V}(x,\ y,\ z)=$const. If in (21) we imagine that x, y, z denote infinitesimal rotations of a solid free to turn about a fixed point in a given field of force, it appears that the three normal modes consist each of a rotation about one of the three diameters aforesaid, and that the values of σ are proportional to the ratios of the lengths of corresponding diameters of the two quadrics.

We proceed to the *forced vibrations* of the system. The typical case is where the extraneous forces are of the simple-harmonic type $\cos(\sigma t+\epsilon)$; the most general law of variation with time can be derived from this by superposition, in virtue of Fourier's theorem. Analytically, it is convenient to put Q_r equal to $e^{i\sigma t}$ multiplied by a complex coefficient; owing to the linearity of the equations the factor $e^{i\sigma t}$ will run through them all, and need not always be exhibited. For a system of one degree of freedom we have

$$a\ddot{q}+cq=\mathrm{Q},\tag{26}$$

and therefore on the present supposition as to the nature of Q

$$q=\frac{\mathrm{Q}}{c-\sigma^2a}.\tag{27}$$

This solution has been discussed to some extent in § 12, in connexion with the forced oscillations of a pendulum. We may note further that when σ is small the displacement q has the "equilibrium value" Q/c, the same as would be produced by a steady force equal to the instantaneous value of the actual force, the inertia of the system being inoperative. On the other hand, when σ^2 is great q tends to the value $-\mathrm{Q}/\sigma^2a$, the same as if the potential energy were ignored. When there are n degrees of freedom we have from (3)

$$(c_{1r}-\sigma^2a_{1r})q_1+(c_{2r}-\sigma^2a_{2r})q_2+\ .\ .\ .\ +(c_{nr}-\sigma^2a_{nr})q_n=\mathrm{Q}_r,\tag{28}$$

and therefore

$$\Delta\,(\sigma^2)\,.\,q_r=\alpha_{1r}\mathrm{Q}_1+\alpha_{2r}\mathrm{Q}_2+\ldots+\alpha_{nr}\mathrm{Q}_n,\tag{29}$$

where α_{1r}, α_{2r}, . . . α_{nr} are the minors of the rth row of the determinant (7). Every particle of the system executes in general a simple vibration of the imposed period $2\pi/\sigma$, and all the particles pass simultaneously through their equilibrium positions. The amplitude becomes very great when σ^2 approximates to a root of (6), *i.e.* when the imposed period nearly coincides with one of the free periods. Since $\alpha_{rs}=\alpha_{sr}$, the coefficient of Q_s in the expression for q_r is identical with that of Q_r in the expression for q_s. Various important "reciprocal theorems" formulated by H. Helmholtz and Lord Rayleigh are founded on this relation. Free vibrations must of course be superposed on the forced vibrations given by (29) in order to obtain the complete solution of the dynamical equations.

In practice the vibrations of a system are more or less affected by dissipative forces. In order to obtain at all events a qualitative representation of these it is usual to introduce into the equations frictional terms proportional to the velocities. Thus in the case of one degree of freedom we have, in place of (26),

$$a\ddot{q}+b\dot{q}+cq=\mathrm{Q},\tag{30}$$

where a, b, c are positive. The solution of this has been sufficiently discussed in § 12. In the case of multiple freedom, the equations of small motion when modified by the introduction of terms proportional to the velocities are of the type

$$\frac{d}{dt}\frac{\partial\mathrm{T}}{\partial\dot{q}_r}+\mathrm{B}_{1r}\dot{q}_1+\mathrm{B}_{2r}\dot{q}_2+\ .\ .\ .\ +\mathrm{B}_{nr}\dot{q}_n+\frac{\partial\mathrm{V}}{\partial q_r}=\mathrm{Q}_r.\tag{31}$$

If we put

$$b_{rs}=b_{sr}=\tfrac{1}{2}(\mathrm{B}_{rs}+\mathrm{B}_{sr}),\quad \beta_{rs}=-\beta_{sr}=\tfrac{1}{2}(\mathrm{B}_{rs}-\mathrm{B}_{sr}),\tag{32}$$

this may be written

$$\frac{d}{dt}\frac{\partial\mathrm{T}}{\partial\dot{q}_r}+\frac{\partial\mathrm{F}}{\partial\dot{q}_r}+\beta_{1r}\dot{q}_1+\beta_{2r}\dot{q}_2+\ .\ .\ .\ +\beta_{nr}\dot{q}_n+\frac{\partial\mathrm{V}}{\partial q_r}=\mathrm{Q}_r,\tag{33}$$

provided

$$2\mathrm{F}=b_{11}\dot{q}_1^2+b_{22}\dot{q}_2^2+\ .\ .\ .\ +\ 2b_{12}\dot{q}_1\dot{q}_2+\ .\ .\ .\tag{34}$$

The terms due to F in (33) are such as would arise from frictional resistances proportional to the absolute velocities of the particles, or to mutual forces of resistance proportional to the relative velocities; they are therefore classed as *frictional* or *dissipative* forces. The terms affected with the coefficients β_{rs} on the other hand are such as occur in "cyclic" systems with latent motion (DYNAMICS, § *Analytical*); they are called the *gyrostatic terms*. If we multiply (33) by $\dot{q}_r$ and sum with respect to r from 1 to n, we obtain, in virtue of the relations $\beta_{rs}=-\beta_{sr}$, $\beta_{rr}=0$,

$$\frac{d}{dt}(\mathrm{T}+\mathrm{V})=-2\mathrm{F}+\mathrm{Q}_1\dot{q}_1+\mathrm{Q}_2\dot{q}_2+\ldots+\mathrm{Q}_n\dot{q}_n.\tag{35}$$

This shows that mechanical energy is lost at the rate 2 F per unit time. The function F is therefore called by Lord Rayleigh the *dissipation function.*

If we omit the gyrostatic terms, and write $q_r=\mathrm{C}_re^{\lambda t}$, we find, for a free vibration,

$$\begin{aligned}(a_{1r}\lambda^2+b_{1r}\lambda+c_{1r})\mathrm{C}_1+(a_{2r}\lambda^2+b_{2r}\lambda+c_{2r})\mathrm{C}_2+\ldots\\ +(a_{nr}\lambda^2+b_{nr}\lambda+\mathrm{C}_{nr})\,\mathrm{C}_n=0.\end{aligned}\tag{36}$$

This leads to a determinantal equation in λ whose $2n$ roots are either real and negative, or complex with negative real parts, on the present hypothesis that the functions T, V, F are all essentially positive. If we combine the solutions corresponding to a pair of conjugate complex roots, we obtain, in real form,

$$q_r=\mathrm{C}a_re^{-t/\tau}\cos(\sigma t+\epsilon-\epsilon_r),\tag{37}$$

where σ, τ, a_r, ϵ_r are determined by the constitution of the system, whilst C, ϵ are arbitrary, and independent of r. The n formulae of this type represent a normal mode of free vibration; the individual particles revolve as a rule in elliptic orbits which gradually contract according to the law indicated by the exponential factor. If the friction be relatively small, all the normal modes are of this character, and unless two or more values of σ are nearly equal the elliptic orbits are very elongated. The effect of friction on the period is moreover of the second order.

In a forced vibration of $e^{i\sigma t}$ the variation of each co-ordinate is simple-harmonic, with the prescribed period, but there is a retardation of phase as compared with the force. If the friction be small the amplitude becomes relatively very great if the imposed period approximate to a free period. The validity of the "reciprocal theorems" of Helmholtz and Lord Rayleigh, already referred to, is not affected by frictional forces of the kind here considered.

The most important applications of the theory of vibrations are to the case of continuous systems such as strings, bars, membranes, plates, columns of air, where the number of degrees of freedom is infinite. The series of equations of the type (3) is then replaced by a single linear partial differential equation, or by a set of two or three such equations, according to the number of dependent variables. These variables represent the whole assemblage of generalized co-ordinates q_r; they are continuous functions of the independent variables x, y, z whose range of variation corresponds to that of the index r, and of t. For example, in a one-dimensional system such as a string or a bar, we have one dependent variable, and two independent variables x and t. To determine the free oscillations we assume a time factor $e^{i\sigma t}$; the equations then become linear differential equations between the dependent variables of the problem and the independent variables x, or x, y, or x, y, z as the case may be. If the range of the independent variable or variables is unlimited, the value of σ is at our disposal, and the solution gives us the laws of wave-propagation (see WAVE). If, on the other hand, the body is finite, certain terminal conditions have to be satisfied. These limit the admissible values of σ, which are in general determined by a transcendental equation corresponding to the determinantal equation (6).

Numerous examples of this procedure, and of the corresponding treatment of forced oscillations, present themselves in theoretical acoustics. It must suffice here to consider the small oscillations of a chain hanging vertically from a fixed extremity. If x be measured upwards from the lower end, the horizontal component of the tension P at any point will be $P\partial y/\partial x$, approximately, if y denote the lateral displacement. Hence, forming the equation of motion of a mass-element, $\rho\delta x$, we have

$$\rho\delta x . \ddot{y} = \delta(P . \partial y/\partial x). \tag{38}$$

Neglecting the vertical acceleration we have $P = g\rho x$, whence

$$\frac{\partial^2 y}{\partial t^2} = g\frac{\partial}{\partial x}\left(x\frac{\partial y}{\partial x}\right). \tag{39}$$

Assuming that y varies as $e^{i\sigma t}$ we have

$$\frac{\partial}{\partial x}\left(x\frac{\partial y}{\partial x}\right) + ky = 0. \tag{40}$$

provided $k = \sigma^2/g$. The solution of (40) which is finite for $x = 0$ is readily obtained in the form of a series, thus

$$y = C\left(1 - \frac{kx}{1^2} + \frac{k^2x^2}{1^2 2^2} - \ldots\right) = CJ_0(z), \tag{41}$$

in the notation of Bessel's functions, if $z^2 = 4kx$. Since y must vanish at the upper end ($x = l$), the admissible values of σ are determined by

$$\sigma^2 = gz^2/4l, \quad J_0(z) = 0. \tag{42}$$

The function $J_0(z)$ has been tabulated; its lower roots are given by

$$z/\pi = \cdot 7655,\ 1\cdot 7571,\ 2\cdot 7546,\ \ldots,$$

approximately, where the numbers tend to the form $s - \frac{1}{4}$. The frequency of the gravest mode is to that of a uniform bar in the ratio ·9815. That this ratio should be less than unity agrees with the theory of "constrained types" already given. In the higher normal modes there are *nodes* or points of rest ($y = 0$); thus in the second mode there is a node at a distance $\cdot 190l$ from the lower end.

AUTHORITIES.—For indications as to the earlier history of the subject see W. W. R. Ball, *Short Account of the History of Mathematics*; M. Cantor, *Geschichte der Mathematik* (Leipzig, 1880 . . .); J. Cox, *Mechanics* (Cambridge, 1904); E. Mach, *Die Mechanik in ihrer Entwickelung* (4th ed., Leipzig, 1901; Eng. trans.). Of the classical treatises which have had a notable influence on the development of the subject, and which may still be consulted with advantage, we may note particularly, Sir I. Newton, *Philosophiae naturalis Principia Mathematica* (1st ed., London, 1687); J. L. Lagrange, *Mécanique analytique* (2nd ed., Paris, 1811–1815); P. S. Laplace, *Mécanique céleste* (Paris, 1799–1825); A. F. Möbius, *Lehrbuch der Statik* (Leipzig, 1837), and *Mechanik des Himmels*; L. Poinsot, *Éléments de statique* (Paris, 1804), and *Théorie nouvelle de la rotation des corps* (Paris, 1834).

Of the more recent general treatises we may mention Sir W. Thomson (Lord Kelvin) and P. G. Tait, *Natural Philosophy* (2nd ed., Cambridge, 1879–1883); E. J. Routh, *Analytical Statics* (2nd. ed., Cambridge, 1896), *Dynamics of a Particle* (Cambridge, 1898), *Rigid Dynamics* (6th ed., Cambridge 1905); G. Minchin, *Statics* (4th ed., Oxford, 1888); A. E. H. Love, *Theoretical Mechanics* (2nd ed., Cambridge, 1909); A. G. Webster, *Dynamics of Particles*, &c. (1904); E. T. Whittaker, *Analytical Dynamics* (Cambridge, 1904); L. Arnal, *Traité de mécanique* (1888–1898); P. Appell, *Mécanique rationelle* (Paris, vols. i. and ii., 2nd ed., 1902 and 1904; vol. iii., 1st ed., 1896); G. Kirchhoff, *Vorlesungen über Mechanik* (Leipzig, 1896); H. Helmholtz, *Vorlesungen über theoretische Physik*, vol. i. (Leipzig, 1898); J. Somoff, *Theoretische Mechanik* (Leipzig, 1878–1879).

The literature of graphical statics and its technical applications is very extensive. We may mention K. Culmann, *Graphische Statik* (2nd ed., Zürich, 1895); A. Föppl, *Technische Mechanik*, vol. ii. (Leipzig, 1900); L. Henneberg, *Statik des starren Systems* (Darmstadt, 1886); M. Lévy, *La statique graphique* (2nd ed., Paris, 1886–1888); H. Müller-Breslau, *Graphische Statik* (3rd ed., Berlin, 1901). Sir R. S. Ball's highly original investigations in kinematics and dynamics were published in collected form under the title *Theory of Screws* (Cambridge, 1900).

Detailed accounts of the developments of the various branches of the subject from the beginning of the 19th century to the present time, with full bibliographical references, are given in the fourth volume (edited by Professor F. Klein) of the *Encyclopädie der mathematischen Wissenschaften* (Leipzig). There is a French translation of this work. (See also DYNAMICS.) (H. LB.)

II.—APPLIED MECHANICS[1]

§ 1. The practical application of mechanics may be divided into two classes, according as the assemblages of material objects to which they relate are intended to remain fixed or to move relatively to each other—the former class being comprehended under the term "Theory of Structures" and the latter under the term "Theory of Machines."

PART I.—OUTLINE OF THE THEORY OF STRUCTURES

§ 2. *Support of Structures.*—Every structure, as a whole, is maintained in equilibrium by the joint action of its own *weight*, of the *external load* or pressure applied to it from without and tending to displace it, and of the *resistance* of the material which supports it. A structure is supported either by resting on the solid crust of the earth, as buildings do, or by floating in a fluid, as ships do in water and balloons in air. The principles of the support of a floating structure form an important part of Hydromechanics (*q.v.*). The principles of the support, as a whole, of a structure resting on the land, are so far identical with those which regulate the equilibrium and stability of the several parts of that structure that the only principle which seems to require special mention here is one which comprehends in one statement the power both of liquids and of loose earth to support structures. This was first demonstrated in a paper "On the Stability of Loose Earth," read to the Royal Society on the 19th of June 1856 (Phil. *Trans.* 1856), as follows:—

Let E represent the weight of the portion of a horizontal stratum of earth which is displaced by the foundation of a structure, S the utmost weight of that structure consistently with the power of the earth to resist displacement, ϕ the angle of repose of the earth; then

$$\frac{S}{E} = \left(\frac{1 + \sin\phi}{1 - \sin\phi}\right)^2.$$

To apply this to liquids ϕ must be made zero, and then $S/E = 1$, as is well known. For a proof of this expression see Rankine's *Applied Mechanics*, 17th ed., p. 219.

§ 3. *Composition of a Structure, and Connexion of its Pieces.*—A structure is composed of *pieces*,—such as the stones of a building in masonry, the beams of a timber frame-work, the bars, plates and bolts of an iron bridge. Those pieces are connected at their *joints* or surfaces of mutual contact, either by simple pressure and friction (as in masonry with moist mortar or without mortar), by pressure and adhesion (as in masonry with cement or with hardened mortar, and timber with glue), or by the resistance of *fastenings* of different kinds, whether made by means of the form of the joint (as dovetails, notches, mortices and tenons) or by separate fastening pieces (as trenails, pins, spikes, nails, holdfasts, screws, bolts, rivets, hoops, straps and sockets.

§ 4. *Stability, Stiffness and Strength.*—A structure may be damaged or destroyed in three ways:—first, by *displacement* of its pieces from their proper positions relatively to each other or to the earth; secondly by disfigurement of one or more of those pieces, owing to their being unable to preserve their proper shapes under the pressures to which they are subjected; thirdly, by *breaking* of one or more of those pieces. The power of resisting displacement constitutes stability, the power of each piece to resist disfigurement is its *stiffness*; and its power to resist breaking, its *strength*.

§ 5. *Conditions of Stability.*—The principles of the stability of a structure can be to a certain extent investigated independently of the stiffness and strength, by assuming, in the first instance, that each piece has strength sufficient to be safe against being broken, and stiffness sufficient to prevent its being disfigured to an extent inconsistent with the purposes of the structure, by the greatest forces which are to be applied to it. The condition that each piece of the structure is to be maintained in equilibrium by having its gross load, consisting of its own weight and of the external pressure applied to it, balanced by the *resistances* or pressures exerted between it and the contiguous pieces, furnishes the means of determining the magnitude, position and direction of the resistances required at each joint in order to produce equilibrium; and the *conditions of stability* are, first, that the *position*, and, secondly, that the *direction*, of the resistance required at each joint shall, under all the variations to which the load is subject, be such as the joint is capable of exerting—conditions which are fulfilled by suitably adjusting the figures and positions of the joints, and the *ratios* of the gross loads of the pieces. As for the *magnitude* of the resistance, it is limited by conditions, not of stability, but of strength and stiffness.

§ 6. *Principle of Least Resistance.*—Where more than one system of resistances are alike capable of balancing the same system of loads applied to a given structure, the *smallest* of those alternative systems, as was demonstrated by the Rev. Henry Moseley in his *Mechanics of Engineering and Architecture*, is that which will actually be exerted—

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[1] In view of the great authority of the author, the late Professor Macquorn Rankine, it has been thought desirable to retain the greater part of this article as it appeared in the 9th edition of the *Encyclopaedia Britannica*. Considerable additions, however, have been introduced in order to indicate subsequent developments of the subject; the new sections are numbered continuously with the old, but are distinguished by an asterisk. Also, two short chapters which concluded the original article have been omitted—ch. iii., "On Purposes and Effects of Machines," which was really a classification of machines, because the classification of Franz Reuleaux is now usually followed, and ch. iv., "Applied Energetics, or Theory of Prime Movers," because its subject matter is now treated in various special articles, *e.g.* HYDRAULICS, STEAM ENGINE, GAS ENGINE, OIL ENGINE, and fully developed in Rankine's *The Steam Engine and Other Prime Movers* (London, 1902). (ED. *E.B.*)

because the resistances to displacement are the effect of a strained state of the pieces, which strained state is the effect of the load, and when the load is applied the strained state and the resistances produced by it increase until the resistances acquire just those magnitudes which are sufficient to balance the load, after which they increase no further.

This principle of least resistance renders determinate many problems in the statics of structures which were formerly considered indeterminate.

§ 7. *Relations between Polygons of Loads and of Resistances.*—In a structure in which each piece is supported at two joints only, the well-known laws of statics show that the directions of the gross load on each piece and of the two resistances by which it is supported must lie in one plane, must either be parallel or meet in one point, and must bear to each other, if not parallel, the proportions of the sides of a triangle respectively parallel to their directions, and, if parallel, such proportions that each of the three forces shall be proportional to the distance between the other two,—all the three distances being measured along one direction.

Considering, in the first place, the case in which the load and the two resistances by which each piece is balanced meet in one point, which may be called the *centre of load*, there will be as many such points of intersection, or centres of load, as there are pieces in the structure; and the directions and positions of the resistances or mutual pressures exerted between the pieces will be represented by the sides of a polygon joining those points, as in fig. 86 where P_1, P_2, P_3, P_4 represent the centres of load in a structure of four pieces, and the sides of the *polygon of resistances* $P_1 P_2 P_3 P_4$ represent respectively the directions and positions of the resistances exerted at the joints.

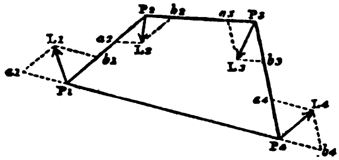

FIG. 86.

Further, at any one of the centres of load let PL represent the magnitude and direction of the gross load, and P*a*, P*b* the two resistances by which the piece to which that load is applied is supported; then will those three lines be respectively the diagonal and sides of a parallelogram; or, what is the same thing, they will be equal to the three sides of a triangle; and they must be in the same plane, although the sides of the polygon of resistances may be in different planes.

According to a well-known principle of statics, because the loads or external pressures P_1L_1, &c., balance each other, they must be proportional to the sides of a closed polygon drawn respectively parallel to their directions. In fig. 87 construct such a *polygon of loads* by drawing the lines L_1, &c., parallel and proportional to, and joined end to end in the order of, the gross loads on the pieces of the structure. Then from the proportionality and parallelism of the load and the two resistances applied to each piece of the structure to the three sides of a triangle, there results the following theorem (originally due to Rankine):—

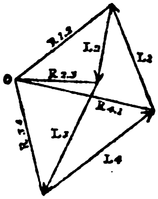

FIG. 87.

If from the angles of the polygon of loads there be drawn lines (R_1, R_2, &c.), *each of which is parallel to the resistance* (as P_1P_2, &c.) *exerted at the joint between the pieces to which the two loads represented by the contiguous sides of the polygon of loads (such as* L_1, L_2, &c.) *are applied; then will all those lines meet in one point* (O), *and their lengths, measured from that point to the angles of the polygon, will represent the magnitudes of the resistances to which they are respectively parallel.*

When the load on one of the pieces is parallel to the resistances which balance it, the polygon of resistances ceases to be closed, two of the sides becoming parallel to each other and to the load in question, and extending indefinitely. In the polygon of loads the direction of a load sustained by parallel resistances traverses the point O.[1]

§ 8. *How the Earth's Resistance is to be treated*...When the pressure exerted by a structure on the earth (to which the earth's resistance is equal and opposite) consists either of one pressure, which is necessarily the resultant of the weight of the structure and of all the other forces applied to it, or of two or more parallel vertical forces, whose amount can be determined at the outset of the investigation, the resistance of the earth can be treated as one or more *upward loads* applied to the structure. But in other cases the earth is to be treated as *one of the pieces of the structure*, loaded with a force equal and opposite in direction and position to the resultant of the weight of the structure and of the other pressures applied to it.

§ 9. *Partial Polygons of Resistance.*—In a structure in which there are pieces supported at more than two joints, let a polygon be constructed of lines connecting the centres of load of any continuous series of pieces. This may be called a *partial polygon of resistances*. In considering its properties, the *load* at each centre of load is to be held to *include* the resistances of those joints which are *not* comprehended in the partial polygon of resistances, to which the theorem of § 7 will then apply in every respect. By constructing several partial polygons, and computing the relations between the loads and resistances which are determined by the application of that theorem to each of them, with the aid, if necessary, of Moseley's principle of the least resistance, the whole of the relations amongst the loads and resistances may be found.

§ 10. *Line of Pressures—Centres and Line of Resistance.*—The *line of pressures* is a line to which the directions of all the resistances in one polygon are tangents. The *centre of resistance* at any joint is the point where the line representing the total resistance exerted at that joint intersects the joint. The *line of resistance* is a line traversing all the centres of resistance of a series of joints,—its form, in the positions intermediate between the actual joints of the structure, being determined by supposing the pieces and their loads to be subdivided by the introduction of intermediate joints *ad infinitum*, and finding the continuous line, curved or straight, in which the intermediate centres of resistance are all situated, however great their number. The difference between the line of resistance and the line of pressures was first pointed out by Moseley.

§ 11*. The principles of the two preceding sections may be illustrated by the consideration of a particular case of a buttress of blocks forming a continuous series of pieces (fig. 88), where *aa*, *bb*, *cc*, *dd* represent plane joints. Let the centre of pressure C at the first joint *aa* be known, and also the pressure P acting at C in direction and magnitude. Find R_1 the resultant of this pressure, the weight of the block *aabb* acting through its centre of gravity, and any other external force which may be acting on the block, and produce its line of action to cut the joint *bb* in C_1. C_1 is then the centre of pressure for the joint *bb*, and R_1 is the total force acting there. Repeating this process for each block in succession there will be found the centres of pressure C_2, C_3, &c., and also the resultant pressures R_2, R_3, &c., acting at these respective centres. The centres of pressure at the joints are also called *centres of resistance*, and the curve passing through these points is called a *line of resistance*. Let all the resultants acting at the several centres of resistance be produced until they cut one another in a series of points so as to form an unclosed polygon. This polygon is the *partial polygon of resistance*. A curve tangential to all the sides of the polygon is the *line of pressures*.

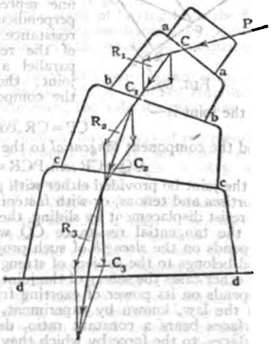

FIG. 88.

§ 12. *Stability of Position, and Stability of Friction.*—The resistances at the several joints having been determined by the principles set forth in §§ 6, 7, 8, 9 and 10, not only under the ordinary load of the structure, but under all the variations to which the load is subject as to amount and distribution, the joints are now to be placed and shaped so that the pieces shall not suffer relative displacement under any of those loads. The relative displacement of the two pieces which abut against each other at a joint may take place either by turning or by sliding. Safety against displacement by turning is called *stability of position*; safety against displacement by sliding, *stability of friction*.

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[1] Since the relation discussed in § 7 was enunciated by Rankine, an enormous development has taken place in the subject of Graphic Statics, the first comprehensive textbook on the subject being *Die Graphische Statik* by K. Culmann, published at Zürich in 1866. Many of the graphical methods therein given have now passed into the textbooks usually studied by engineers. One of the most beautiful graphical constructions regularly used by engineers and known as "the method of reciprocal figures" is that for finding the loads supported by the several members of a braced structure, having given a system of external loads. The method was discovered by Clerk Maxwell, and the complete theory is discussed and exemplified in a paper "On Reciprocal Figures, Frames and Diagrams of Forces," *Trans. Roy. Soc. Ed.*, vol. xxvi. (1870). Professor M. W. Crofton read a paper on "Stress-Diagrams in Warren and Lattice Girders" at the meeting of the Mathematical Society (April 13, 1871), and Professor O. Henrici illustrated the subject by a simple and ingenious notation. The application of the method of reciprocal figures was facilitated by a system of notation published in *Economics of Construction in relation to framed Structures*, by Robert H. Bow (London, 1873). A notable work on the general subject is that of Luigi Cremona, translated from the Italian by Professor T. H. Beare (Oxford, 1890), and a discussion of the subject of reciprocal figures from the special point of view of the engineering student is given in *Vectors and Rotors* by Henrici and Turner (London, 1903) See also above under "*Theoretical Mechanics*," Part I § 5.

§ 13. *Condition of Stability of Position.*—If the materials of a structure were infinitely stiff and strong, stability of position at any joint would be insured simply by making the centre of resistance fall within the joint under all possible variations of load. In order to allow for the finite stiffness and strength of materials, the least distance of the centre of resistance inward from the nearest edge of the joint is made to bear a definite proportion to the depth of the joint measured in the same direction, which proportion is fixed, sometimes empirically, sometimes by theoretical deduction from the laws of the strength of materials. That least distance is called by Moseley the *modulus of stability*. The following are some of the ratios of the modulus of stability to the depth of the joint which occur in practice:—

Retaining walls, as designed by British engineers	1 : 8
Retaining walls, as designed by French engineers	1 : 5
Rectangular piers of bridges and other buildings, and arch-stones	1 : 3
Rectangular foundations, firm ground	1 : 3
Rectangular foundations, very soft ground	1 : 2
Rectangular foundations, intermediate kinds of ground	1 : 3 to 1 : 2
Thin, hollow towers (such as furnace chimneys exposed to high winds), square	1 : 6
Thin, hollow towers, circular	1 : 4
Frames of timber or metal, under their ordinary or average distribution of load	1 : 3
Frames of timber or metal, under the greatest irregularities of load	1 : 3

In the case of the towers, the *depth of the joint* is to be understood to mean the *diameter of the tower*.

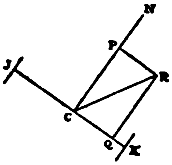


FIG. 89.

§ 14. *Condition of Stability of Friction.*—If the resistance to be exerted at a joint is always perpendicular to the surfaces which abut at and form that joint, there is no tendency of the pieces to be displaced by sliding. If the resistance be oblique, let JK (fig. 89) be the joint, C its centre of resistance, CR a line representing the resistance, CN a perpendicular to the joint at the centre of resistance. The angle NCR is the *obliquity* of the resistance. From R draw RP parallel and RQ perpendicular to the joint; then, by the principles of statics, the component of the resistance *normal* to the joint is—

$$CP = CR . \cos PCR;$$

and the component *tangential* to the joint is—

$$CQ = CR . \sin PCR = CP . \tan PCR.$$

If the joint be provided either with projections and recesses, such as mortises and tenons, or with fastenings, such as pins or bolts, so as to resist displacement by sliding, the question of the utmost amount of the tangential resistance CQ which it is capable of exerting depends on the *strength* of such projections, recesses, or fastenings; and belongs to the subject of strength, and not to that of stability. In other cases the safety of the joint against displacement by sliding depends on its power of exerting friction, and that power depends on the law, known by experiment, that the friction between two surfaces bears a constant ratio, depending on the nature of the surfaces, to the force by which they are pressed together. In order that the surfaces which abut at the joint JK may be pressed together, the resistance required by the conditions of equilibrium CR, must be a *thrust* and not a *pull*; and in that case the force by which the surfaces are pressed together is equal and opposite to the normal component CP of the resistance. The condition of stability of friction is that the tangential component CQ of the resistance required shall not exceed the friction due to the normal component; that is, that

$$CQ \not> f . CP,$$

where f denotes the *coefficient of friction* for the surfaces in question. The angle whose tangent is the coefficient of friction is called *the angle of repose*, and is expressed symbolically by—

$$\phi = \tan^{-1} f.$$

$$\text{Now } CQ = CP . \tan PCR;$$

consequently the condition of stability of friction is fulfilled if the angle PCR is not greater than ϕ; that is to say, if *the obliquity of the resistance required at the joint does not exceed the angle of repose*; and this condition ought to be fulfilled under all possible variations of the load.

It is chiefly in masonry and earthwork that stability of friction is relied on.

§ 15. *Stability of Friction in Earth.*—The grains of a mass of loose earth are to be regarded as so many separate pieces abutting against each other at joints in all possible positions, and depending for their stability on friction. To determine whether a mass of earth is stable at a given point, conceive that point to be traversed by planes in all possible positions, and determine which position gives the greatest obliquity to the total pressure exerted between the portions of the mass which abut against each other at the plane. The condition of stability is that this obliquity shall not exceed the angle of repose of the earth. The consequences of this principle are developed in a paper, "On the Stability of Loose Earth," already cited in § 2.

§ 16. *Parallel Projections of Figures.*—If any figure be referred to a system of co-ordinates, rectangular or oblique, and if a second figure be constructed by means of a second system of co-ordinates, rectangular or oblique, and either agreeing with or differing from the first system in rectangularity or obliquity, but so related to the co-ordinates of the first figure that for each point in the first figure there shall be a corresponding point in the second figure, the lengths of whose co-ordinates shall bear respectively to the three corresponding co-ordinates of the corresponding point in the first figure three ratios which are the same for every pair of corresponding points in the two figures, these corresponding figures are called *parallel projections* of each other. The properties of parallel projections of most importance to the subject of the present article are the following:—

(1) A parallel projection of a straight line is a straight line.

(2) A parallel projection of a plane is a plane.

(3) A parallel projection of a straight line or a plane surface divided in a given ratio is a straight line or a plane surface divided in the same ratio.

(4) A parallel projection of a pair of equal and parallel straight lines, or plain surfaces, is a pair of equal and parallel straight lines, or plane surfaces; whence it follows

(5) That a parallel projection of a parallelogram is a parallelogram, and

(6) That a parallel projection of a parallelepiped is a parallelepiped.

(7) A parallel projection of a pair of solids having a given ratio is a pair of solids having the same ratio.

Though not essential for the purposes of the present article, the following consequence will serve to illustrate the principle of parallel projections:—

(8) A parallel projection of a curve, or of a surface of a given algebraical order, is a curve or a surface of the same order.

For example, all ellipsoids referred to co-ordinates parallel to any three conjugate diameters are parallel projections of each other and of a sphere referred to rectangular co-ordinates.

§ 17. *Parallel Projections of Systems of Forces.*—If a balanced system of forces be represented by a system of lines, then will every parallel projection of that system of lines represent a balanced system of forces.

For the condition of equilibrium of forces not parallel is that they shall be represented in direction and magnitude by the sides and diagonals of certain parallelograms, and of parallel forces that they shall divide certain straight lines in certain ratios; and the parallel projection of a parallelogram is a parallelogram, and that of a straight line divided in a given ratio is a straight line divided in the same ratio.

The resultant of a parallel projection of any system of forces is the projection of their resultant; and the centre of gravity of a parallel projection of a solid is the projection of the centre of gravity of the first solid.

§ 18. *Principle of the Transformation of Structures.*—Here we have the following theorem: If a structure of a given figure have stability of position under a system of forces represented by a given system of lines, then will any structure whose figure is a parallel projection of that of the first structure have stability of position under a system of forces represented by the corresponding projection of the first system of lines.

For in the second structure the weights, external pressures, and resistances will balance each other as in the first structure; the weights of the pieces and all other parallel systems of forces will have the same ratios as in the first structure; and the several centres of resistance will divide the depths of the joints in the same proportions as in the first structure.

If the first structure have stability of friction, the second structure will have stability of friction also, so long as the effect of the projection is not to increase the obliquity of the resistance at any joint beyond the angle of repose.

The lines representing the forces in the second figure show their *relative* directions and magnitudes. To find their *absolute* directions and magnitudes, a vertical line is to be drawn in the first figure, of such a length as to represent the weight of a particular portion of the structure. Then will the projection of that line in the projected figure indicate the vertical direction, and represent the weight of the part of the second structure corresponding to the before-mentioned portion of the first structure.

The foregoing "principle of the transformation of structures" was first announced, though in a somewhat less comprehensive form, to the Royal Society on the 6th of March 1856. It is useful in practice, by enabling the engineer easily to deduce the conditions of equilibrium and stability of structures of complex and unsymmetrical figures from those of structures of simple and symmetrical figures. By its aid, for example, the whole of the properties of elliptical arches, whether square or skew, whether level or sloping in their span, are at once deduced by projection from those of symmetrical circular arches, and the properties of ellipsoidal and elliptic-conoidal domes from those of hemispherical and circular-conoidal domes; and the figures of arches fitted to resist the thrust of earth, which is less horizontally than vertically in a certain given ratio, can be deduced by a projection from those of arches fitted to resist the thrust of a liquid, which is of equal intensity, horizontally and vertically.

§ 19. *Conditions of Stiffness and Strength.*—After the arrangement of the pieces of a structure and the size and figure of their joints or surfaces of contact have been determined so as to fulfil the conditions of *stability*,—conditions which depend mainly on the position and direction of the *resultant* or *total* load on each piece, and the *relative* magnitude of the loads on the different pieces—the dimensions of each piece singly have to be adjusted so as to fulfil the conditions of *stiffness* and *strength*—conditions which depend not only on the *absolute* magnitude of the load on each piece, and of the resistances by which it is balanced, but also on the *mode of distribution* of the load over the piece, and of the resistances over the joints.

The effect of the pressures applied to a piece, consisting of the load and the supporting resistances, is to force the piece into a state of *strain* or disfigurement, which increases until the elasticity, or resistance to strain, of the material causes it to exert a *stress*, or effort to recover its figure, equal and opposite to the system of applied pressures. The condition of *stiffness* is that the strain or disfigurement shall not be greater than is consistent with the purposes of the structure; and the condition of *strength* is that the stress shall be within the limits of that which the material can bear with safety against breaking. The ratio in which the utmost stress before breaking exceeds the safe working stress is called the *factor of safety*, and is determined empirically. It varies from three to twelve for various materials and structures. (See STRENGTH OF MATERIALS.)

PART II. THEORY OF MACHINES

§ 20. *Parts of a Machine: Frame and Mechanism.*—The parts of a machine may be distinguished into two principal divisions,—the *frame*, or fixed parts, and the *mechanism*, or moving parts. The frame is a structure which supports the pieces of the mechanism, and to a certain extent determines the nature of their motions.

The form and arrangement of the pieces of the frame depend upon the arrangement and the motions of the mechanism; the dimensions of the pieces of the frame required in order to give it stability and strength are determined from the pressures applied to it by means of the mechanism. It appears therefore that in general the mechanism is to be designed first and the frame afterwards, and that the designing of the frame is regulated by the principles of the stability of structures and of the strength and stiffness of materials,—care being taken to adapt the frame to the most severe load which can be thrown upon it at any period of the action of the mechanism.

Each independent piece of the mechanism also is a structure, and its dimensions are to be adapted, according to the principles of the strength and stiffness of materials, to the most severe load to which it can be subjected during the action of the machine.

§ 21 *Definition and Division of the Theory of Machines.*—From what has been said in the last section it appears that the department of the art of designing machines which has reference to the stability of the frame and to the stiffness and strength of the frame and mechanism is a branch of the art of construction. It is therefore to be separated from the *theory of machines*, properly speaking, which has reference to the action of machines considered as moving

In the action of a machine the following three things take place:—

Firstly, Some natural source of energy communicates motion and force to a piece or pieces of the mechanism, called the *receiver of power* or *prime mover*.

Secondly, The motion and force are transmitted from the prime mover through the *train of mechanism* to the *working piece* or *pieces*, and during that transmission the motion and force are modified in amount and direction, so as to be rendered suitable for the purpose to which they are to be applied.

Thirdly, The working piece or pieces by their motion, or by their motion and force combined, produce some useful effect

Such are the phenomena of the action of a machine, arranged in the order of *causation*. But in studying or treating of the theory of machines, the order of *simplicity* is the best; and in this order the first branch of the subject is the modification of motion and force by the train of mechanism; the next is the effect or purpose of the machine; and the last, or most complex, is the action of the prime mover.

The modification of motion and the modification of force take place together, and are connected by certain laws; but in the study of the theory of machines, as well as in that of pure mechanics, much advantage has been gained in point of clearness and simplicity by first considering alone the principles of the modification of motion, which are founded upon what is now known as Kinematics, and afterwards considering the principles of the combined modification of motion and force, which are founded both on geometry and on the laws of dynamics. The separation of kinematics from dynamics is due mainly to G. Monge, Ampère and R. Willis.

The theory of machines in the present article will be considered under the following heads:—

I PURE MECHANISM, or APPLIED KINEMATICS; being the theory of machines considered simply as modifying motion.

II. APPLIED DYNAMICS, being the theory of machines considered as modifying both motion and force.

CHAP I ON PURE MECHANISM

§ 22 *Division of the Subject.*—Proceeding in the order of simplicity, the subject of Pure Mechanism, or Applied Kinematics, may be thus divided:—

Division 1.—Motion of a point.
Division 2.—Motion of the surface of a fluid.
Division 3.—Motion of a rigid solid.
Division 4.—Motions of a pair of connected pieces, or of an "elementary combination" in mechanism.
Division 5.—Motions of trains of pieces of mechanism.
Division 6.—Motions of sets of more than two connected pieces, or of "aggregate combinations."

A point is the boundary of a line, which is the boundary of a surface, which is the boundary of a volume. Points, lines and surfaces have no independent existence, and consequently those divisions of this chapter which relate to their motions are only preliminary to the subsequent divisions, which relate to the motions of bodies.

Division 1. *Motion of a Point.*

§ 23. *Comparative Motion.*—The comparative motion of two points is the relation which exists between their motions, without having regard to their absolute amounts. It consists of two elements,—the *velocity ratio*, which is the ratio of any two magnitudes bearing to each other the proportions of the respective velocities of the two points at a given instant, and the *directional relation*, which is the relation borne to each other by the respective directions of the motions of the two points at the same given instant.

It is obvious that the motions of a pair of points may be varied in any manner, whether by direct or by lateral deviation, and yet that their *comparative motion* may remain constant, in consequence of the deviations taking place in the same proportions, in the same directions and at the same instants for both points.

Robert Willis (1800–1875) has the merit of having been the first to simplify considerably the theory of pure mechanism, by pointing out that that branch of mechanics relates wholly to comparative motions.

The comparative motion of two points at a given instant is capable of being completely expressed by one of Sir William Hamilton's Quaternions,—the "tensor" expressing the velocity ratio, and the "versor" the directional relation.

Graphical methods of analysis founded on this way of representing velocity and acceleration were developed by R. H. Smith in a paper communicated to the Royal Society of Edinburgh in 1885, and illustrations of the method will be found below.

Division 2. *Motion of the Surface of a Fluid Mass.*

§ 24. *General Principle.*—A mass of fluid is used in mechanism to transmit motion and force between two or more movable portions (called *pistons* or *plungers*) of the solid envelope or vessel in which the fluid is contained; and, when such transmission is the sole action, or the only appreciable action of the fluid mass, its volume is either absolutely constant, by reason of its temperature and pressure being maintained constant, or not sensibly varied.

Let a represent the area of the section of a piston made by a plane perpendicular to its direction of motion, and v its velocity, which is to be considered as positive when outward, and negative when inward. Then the variation of the cubic contents of the vessel in a unit of time by reason of the motion of one piston is va. The condition that the volume of the fluid mass shall remain unchanged requires that there shall be more than one piston, and that the velocities and areas of the pistons shall be connected by the equation—

$$\Sigma . va = 0. \tag{1}$$

§ 25. *Comparative Motion of Two Pistons.*—If there be but two pistons, whose areas are a_1 and a_2, and their velocities v_1 and v_2, their comparative motion is expressed by the equation—

$$v_2/v_1 = -a_1/a_2; \tag{2}$$

that is to say, their velocities are opposite as to inwardness and outwardness and inversely proportional to their areas.

§ 26 *Applications: Hydraulic Press: Pneumatic Power-Transmitter.*—In the hydraulic press the vessel consists of two cylinders, viz. the pump-barrel and the press-barrel, each having its piston, and of a passage connecting them having a valve opening towards the press-barrel. The action of the enclosed water in transmitting motion takes place during the inward stroke of the pump-plunger, when the above-mentioned valve is open; and at that time the press-plunger moves outwards with a velocity which is less than the inward velocity of the pump-plunger, in the same ratio that the area of the pump-plunger is less than the area of the press-plunger. (See HYDRAULICS.)

In the pneumatic power-transmitter the motion of one piston is transmitted to another at a distance by means of a mass of air contained in two cylinders and an intervening tube. When the pressure and temperature of the air can be maintained constant, this machine fulfils equation (2), like the hydraulic press. The amount and effect of the variations of pressure and temperature undergone by the air depend on the principles of the mechanical action of heat, or THERMODYNAMICS (*q.v.*), and are foreign to the subject of pure mechanism.

Division 3. Motion of a Rigid Solid.

§ 27. *Motions Classed.*—In problems of mechanism, each solid piece of the machine is supposed to be so stiff and strong as not to undergo any sensible change of figure or dimensions by the forces applied to it—a supposition which is realized in practice if the machine is skilfully designed.

This being the case, the various possible motions of a rigid solid body may all be classed under the following heads: (1) *Shifting or Translation*; (2) *Turning or Rotation*; (3) *Motions compounded of Shifting and Turning*.

The most common forms for the paths of the points of a piece of mechanism, whose motion is simple shifting, are the straight line and the circle.

Shifting in a straight line is regulated either by straight fixed guides, in contact with which the moving piece slides, or by combinations of link-work, called *parallel motions*, which will be described in the sequel. Shifting in a straight line is usually *reciprocating*; that is to say, the piece, after shifting through a certain distance, returns to its original position by reversing its motion.

Circular shifting is regulated by attaching two or more points of the shifting piece to ends of equal and parallel rotating cranks, or by combinations of wheel-work to be afterwards described. As an example of circular shifting may be cited the motion of the coupling rod, by which the parallel and equal cranks upon two or more axles of a locomotive engine are connected and made to rotate simultaneously. The coupling rod remains always parallel to itself, and all its points describe equal and similar circles relatively to the frame of the engine, and move in parallel directions with equal velocities at the same instant.

§ 28. *Rotation about a Fixed Axis: Lever, Wheel and Axle.*—The fixed axis of a turning body is a line fixed relatively to the body and relatively to the fixed space in which the body turns. In mechanism it is usually the central line either of a rotating shaft or axle having journals, gudgeons, or pivots turning in fixed bearings, or of a fixed spindle or dead centre round which a rotating bush turns; but it may sometimes be entirely beyond the limits of the turning body. For example, if a sliding piece moves in circular fixed guides, that piece rotates about an ideal fixed axis traversing the centre of those guides.

Let the angular velocity of the rotation be denoted by $\alpha = d\theta/dt$, then the linear velocity of any point A at the distance r from the axis is αr; and the path of that point is a circle of the radius r described about the axis.

This is the principle of the modification of motion by the lever, which consists of a rigid body turning about a fixed axis called a fulcrum, and having two points at the same or different distances from that axis, and in the same or different directions, one of which receives motion and the other transmits motion, modified in direction and velocity according to the above law.

In the wheel and axle, motion is received and transmitted by two cylindrical surfaces of different radii described about their common fixed axis of turning, their velocity-ratio being that of their radii.

§ 29. *Velocity Ratio of Components of Motion.*—As the distance between any two points in a rigid body is invariable, the projections of their velocities upon the line joining them must be equal. Hence it follows that, if A in fig. 90 be a point in a rigid body CD, rotating round the fixed axis F, the component of the velocity of A in any direction AP parallel to the plane of rotation is equal to the total velocity of the point m, found by letting fall Fm perpendicular to AP; that is to say, is equal to

$$\alpha \cdot \mathrm{F}m.$$

Hence also the ratio of the components of the velocities of two points A and B in the directions AP and BW respectively, both in the plane of rotation, is equal to the ratio of the perpendiculars Fm and Fn.

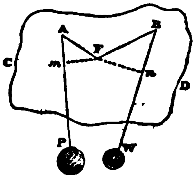


FIG. 90.

§ 30. *Instantaneous Axis of a Cylinder rolling on a Cylinder.*—Let a cylinder *bbb*, whose axis of figure is B and angular velocity γ, roll on a fixed cylinder *aaa*, whose axis of figure is A, either outside (as in fig. 91), when the rolling will be towards the same hand as the rotation, or inside (as in fig. 92), when the rolling will be towards the opposite hand; and at a given instant let T be the line of contact of the two cylindrical surfaces, which is at their common intersection with the plane AB traversing the two axes of figure.

The line T on the surface *bbb* has for the instant no velocity in a direction perpendicular to AB; because for the instant it touches, without sliding, the line T on the fixed surface *aaa*.

The line T on the surface *bbb* has also for the instant no velocity in the plane AB; for it has just ceased to move towards the fixed surface *aaa*, and is just about to begin to move away from that surface.

The line of contact T, therefore, on the surface of the cylinder *bbb*, is *for the instant* at rest, and is the "instantaneous axis" about which the cylinder *bbb* turns, together with any body rigidly attached to that cylinder.

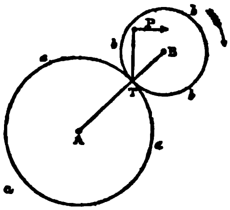


FIG. 91.

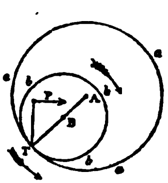


FIG. 92.

To find, then, the direction and velocity at the given instant of any point P, either in or rigidly attached to the rolling cylinder T, draw the plane PT; the direction of motion of P will be perpendicular to that plane, and towards the right or left hand according to the direction of the rotation of *bbb*; and the velocity of P will be

$$v_P = \gamma \cdot \mathrm{PT}, \tag{3}$$

PT denoting the perpendicular distance of P from T. The path of P is a curve of the kind called *epitrochoids*. If P is in the circumference of *bbb*, that path becomes an *epicycloid*.

The velocity of any point in the axis of figure B is

$$v_B = \gamma \cdot \mathrm{TB}; \tag{4}$$

and the path of such a point is a circle described about A with the radius AB, being for outside rolling the sum, and for inside rolling the difference, of the radii of the cylinders.

Let α denote the angular velocity with which the *plane of axes* AB rotates about the fixed axis A. Then it is evident that

$$v = \alpha \cdot \mathrm{AB}, \tag{5}$$

and consequently that $\alpha = \gamma \cdot \mathrm{TB/AB}$ (6)

For internal rolling, as in fig. 92, AB is to be treated as negative, which will give a negative value to α, indicating that in this case the rotation of AB round A is contrary to that of the cylinder *bbb*.

The angular velocity of the rolling cylinder, *relatively to the plane of axes* AB, is obviously given by the equation—

$$\left.\begin{array}{r}\beta = \gamma - \alpha \\ \text{whence } \beta = \gamma \cdot \mathrm{TA/AB}\end{array}\right\}, \tag{7}$$

care being taken to attend to the sign of α, so that when that is negative the arithmetical values of γ and α are to be added in order to give that of β.

The whole of the foregoing reasonings are applicable, not merely when *aaa* and *bbb* are actual cylinders, but also when they are the osculating cylinders of a pair of cylindroidal surfaces of varying curvature, A and B being the axes of curvature of the parts of those surfaces which are in contact for the instant under consideration.

§ 31. *Instantaneous Axis of a Cone rolling on a Cone.*—Let Oaa (fig. 93) be a fixed cone, OA its axis, O*bb* a cone rolling on it. OB the axis of the rolling cone, OT the line of contact of the two cones at the instant under consideration. By reasoning similar to that of § 30, it appears that OT is the instantaneous axis of rotation of the rolling cone.

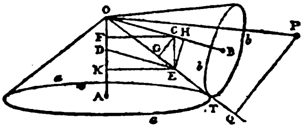


FIG. 93.

Let γ denote the total angular velocity of the rotation of the cone B about the instantaneous axis, β its angular velocity about the axis OB *relatively* to the plane AOB, and α the angular velocity with which the plane AOB turns round the axis OA. It is required to find the ratios of those angular velocities.

Solution.—In OT take any point E, from which draw EC parallel to OA, and ED parallel to OB, so as to construct the parallelogram OCED. Then

$$\mathrm{OD} : \mathrm{OC} : \mathrm{OE} :: \alpha : \beta : \gamma. \tag{8}$$

Or because of the proportionality of the sides of triangles to the sines of the opposite angles,

$$\sin \mathrm{TOB} : \sin \mathrm{TOA} : \sin \mathrm{AOB} :: \alpha : \beta : \gamma. \tag{8 A}$$

that is to say, the angular velocity about each axis is proportional to the sine of the angle between the other two.

Demonstration.—From C draw CF perpendicular to OA, and CG perpendicular to OE

$$\text{Then } CF = 2\times\frac{\text{area ECO}}{CE},$$

$$\text{and } CG = 2\times\frac{\text{area ECO}}{OE};$$

$$\therefore CG : CF :: CE = OD : OE.$$

Let v_c denote the linear velocity of the point C. Then

$$v_C = \alpha \,.\, CF = \gamma \,.\, CG$$

$$\therefore \gamma : \alpha :: CF : CG :: OE : OD,$$

which is one part of the solution above stated. From E draw EH perpendicular to OB, and EK to OA. Then it can be shown as before that

$$EK : EH :: OC : OD.$$

Let v_E be the linear velocity of the point E *fixed in the plane of axes* AOB. Then

$$v_E = \alpha \,.\, EK.$$

Now, as the line of contact OT is for the instant at rest on the rolling cone as well as on the fixed cone, the linear velocity of the point E fixed to the plane AOB relatively to the rolling cone is the same with its velocity relatively to the fixed cone. That is to say,

$$\beta \,.\, EH = v_E = \alpha \,.\, EK;$$

therefore $\alpha : \beta :: EH : EK :: OD : OC,$

which is the remainder of the solution.

The path of a point P in or attached to the rolling cone is a spherical epitrochoid traced on the surface of a sphere of the radius OP. From P draw PQ perpendicular to the instantaneous axis. Then the motion of P is perpendicular to the plane OPQ, and its velocity is

$$v_P = \gamma \,.\, PQ. \tag{9}$$

The whole of the foregoing reasonings are applicable, not merely when A and B are actual regular cones, but also when they are the osculating regular cones of a pair of irregular conical surfaces, having a common apex at O.

§ 32. *Screw-like or Helical Motion.*—Since any displacement in a plane can be represented in general by a rotation, it follows that the only combination of translation and rotation, in which a complex movement which is not a mere rotation is produced, occurs when there is a translation *perpendicular to the plane and parallel to the axis* of rotation.

Such a complex motion is called *screw-like* or *helical* motion; for each point in the body describes a *helix* or *screw* round the axis of rotation, fixed or instantaneous as the case may be. To cause a body to move in this manner it is usually made of a helical or screw-like figure, and moves in a guide of a corresponding figure. Helical motion and screws adapted to it are said to be right- or left-handed according to the appearance presented by the rotation to an observer looking towards the direction of the translation. Thus the screw G in fig. 94 is right-handed.

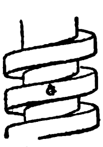


FIG. 94.

The translation of a body in helical motion is called its *advance*. Let v_x denote the velocity of advance at a given instant, which of course is common to all the particles of the body; α the angular velocity of the rotation at the same instant; $2\pi = 6{\cdot}2832$ nearly, the circumference of a circle of the radius unity. Then

$$T = 2\pi/\alpha \tag{10}$$

is the time of one turn at the rate α; and

$$p = v_x T = 2\pi v_x/\alpha \tag{11}$$

is the *pitch* or *advance per turn*—a length which expresses the *comparative motion* of the translation and the rotation.

The pitch of a screw is the distance, measured parallel to its axis, between two successive turns of the same *thread* or helical projection.

Let r denote the perpendicular distance of a point in a body moving helically from the axis. Then

$$v_r = \alpha r \tag{12}$$

is the component of the velocity of that point in a plane perpendicular to the axis, and its total velocity is

$$v = \sqrt{\{v_x^2 + v_r^2\}}. \tag{13}$$

The ratio of the two components of that velocity is

$$v_x/v_r = p/2\pi r = \tan\theta. \tag{14}$$

where θ denotes the angle made by the helical path of the point with a plane perpendicular to the axis.

Division 4. Elementary Combinations in Mechanism

§ 33. *Definitions.*—An *elementary combination* in mechanism consists of two pieces whose kinds of motion are determined by their connexion with the frame, and their comparative motion by their connexion with each other—that connexion being effected either by direct contact of the pieces, or by a connecting piece, which is not connected with the frame, and whose motion depends entirely on the motions of the pieces which it connects.

The piece whose motion is the cause is called the *driver*; the piece whose motion is the effect, the *follower*.

The connexion of each of those two pieces with the frame is in general such as to determine the path of every point in it. In the investigation, therefore, of the comparative motion of the driver and follower, in an elementary combination, it is unnecessary to consider relations of angular direction, which are already fixed by the connexion of each piece with the frame; so that the inquiry is confined to the determination of the velocity ratio, and of the directional relation, so far only as it expresses the connexion between *forward* and *backward* movements of the driver and follower. When a continuous motion of the driver produces a continuous motion of the follower, forward or backward, and a reciprocating motion a motion reciprocating at the same instant, the directional relation is said to be *constant*. When a continuous motion produces a reciprocating motion, or vice versa, or when a reciprocating motion produces a motion not reciprocating at the same instant, the directional relation is said to be *variable*.

The *line of action* or *of connexion* of the driver and follower is a line traversing a pair of points in the driver and follower respectively, which are so connected that the component of their velocity relatively to each other, resolved along the line of connexion, is null. There may be several or an indefinite number of lines of connexion, or there may be but one; and a line of connexion may connect either the same pair of points or a succession of different pairs.

§ 34. *General Principle.*—From the definition of a line of connexion it follows that *the components of the velocities of a pair of connected points along their line of connexion are equal*. And from this, and from the property of a rigid body, already stated in § 29, it follows, that *the components along a line of connexion of all the points traversed by that line, whether in the driver or in the follower, are equal*; and consequently, *that the velocities of any pair of points traversed by a line of connexion are to each other inversely as the cosines, or directly as the secants, of the angles made by the paths of those points with the line of connexion.*

The general principle stated above in different forms serves to solve every problem in which—the mode of connexion of a pair of pieces being given—it is required to find their comparative motion at a given instant, or vice versa.

§ 35. *Application to a Pair of Shifting Pieces.*—In fig. 95, let P_1P_2 be the line of connexion of a pair of pieces, each of which has a motion of translation or shifting. Through any point T in that line draw TV_1, TV_2, respectively parallel to the simultaneous direction of motion of the pieces; through any other point A in the line of connexion draw a plane perpendicular to that line, cutting TV_1, TV_2 in V_1, V_2; then, velocity of piece 1 : velocity of piece 2 :: $TV_1 : TV_2$. Also TA represents the equal components of the velocities of the pieces parallel to their line of connexion, and the line V_1V_2 represents their velocity relatively to each other.

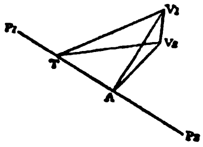


FIG. 95.

§ 36. *Application to a Pair of Turning Pieces.*—Let α_1, α_2 be the angular velocities of a pair of turning pieces; θ_1, θ_2 the angles which their line of connexion makes with their respective planes of rotation; r_1, r_2 the common perpendiculars let fall from the line of connexion upon the respective axes of rotation of the pieces. Then the equal components, along the line of connexion, of the velocities of the points where those perpendiculars meet that line are—

$$\alpha_1 r_1 \cos\theta_1 = \alpha_2 r_2 \cos\theta_2;$$

consequently, the comparative motion of the pieces is given by the equation

$$\frac{\alpha_2}{\alpha_1} = \frac{r_1\cos\theta_1}{r_2\cos\theta_2}. \tag{15}$$

§ 37. *Application to a Shifting Piece and a Turning Piece.*—Let a shifting piece be connected with a turning piece, and at a given instant let α_1 be the angular velocity of the turning piece, r_1 the common perpendicular of its axis of rotation and the line of connexion, θ_1 the angle made by the line of connexion with the plane of rotation, θ_2 the angle made by the line of connexion with the direction of motion of the shifting piece, v_2 the linear velocity of that piece. Then

$$\alpha_1 r_1 \cos\theta_1 = v_2 \cos\theta_2; \tag{16}$$

which equation expresses the comparative motion of the two pieces.

§ 38 *Classification of Elementary Combinations in Mechanism.*—The first systematic classification of elementary combinations in mechanism was that founded by Monge, and fully developed by Lanz and Bétancourt, which has been generally received, and has been adopted in most treatises on applied mechanics. But that classification is founded on the absolute instead of the comparative motions of the pieces, and is, for that reason, defective, as Willis pointed out in his admirable treatise *On the Principles of Mechanism.* Willis's classification is founded, in the first place, on comparative motion, as expressed by velocity ratio and directional relation, and in the second place, on the mode of connexion of the driver and follower. He divides the elementary combinations in mechanism into three classes, of which the characters are as follows:—

Class A: Directional relation constant; velocity ratio constant.
Class B: Directional relation constant; velocity ratio varying.
Class C: Directional relation changing periodically; velocity ratio constant or varying.

Each of those classes is subdivided by Willis into five divisions, of which the characters are as follows:—

Division A: Connexion by rolling contact.
„ B: „ „ sliding contact.
„ C: „ „ wrapping connectors.
„ D: „ „ link-work.
„ E: „ „ reduplication.

In the Reuleaux system of analysis of mechanisms the principle of comparative motion is generalized, and mechanisms apparently very diverse in character are shown to be founded on the same sequence of elementary combinations forming a kinematic chain. A short description of this system is given in §80, but in the present article the principle of Willis's classification is followed mainly. The arrangement is, however, modified by taking the *mode of connexion* as the basis of the primary classification, and by removing the subject of connexion by reduplication to the section of aggregate combinations. This modified arrangement is adopted as being better suited than the original arrangement to the limits of an article in an encyclopaedia; but it is not disputed that the original arrangement may be the best for a separate treatise.

§ 39. *Rolling Contact: Smooth Wheels and Racks.*—In order that two pieces may move in *rolling contact*, it is necessary that each pair of points in the two pieces which touch each other should at the instant of contact be moving in the same direction with the same velocity. In the case of two *shifting* pieces this would involve equal and parallel velocities for all the points of each piece, so that there could be no rolling, and, in fact, the two pieces would move like one; hence, in the case of rolling contact, either one or both of the pieces must rotate.

The direction of motion of a point in a turning piece being perpendicular to a plane passing through its axis, the condition that each pair of points in contact with each other must move in the same direction leads to the following consequences:—

I. That, when both pieces rotate, their axes, and all their points of contact, lie in the same plane.

II. That, when one piece rotates, and the other shifts, the axis of the rotating piece, and all the points of contact, lie in a plane perpendicular to the direction of motion of the shifting piece.

The condition that the velocity of each pair of points of contact must be equal leads to the following consequences:—

III. That the angular velocities of a pair of turning pieces in rolling contact must be inversely as the perpendicular distances of any pair of points of contact from the respective axes.

IV. That the linear velocity of a shifting piece in rolling contact with a turning piece is equal to the product of the angular velocity of the turning piece by the perpendicular distance from its axis to a pair of points of contact.

The *line of contact* is that line in which the points of contact are all situated. Respecting this line, the above Principles III. and IV. lead to the following conclusions:—

V. That for a pair of turning pieces with parallel axes, and for a turning piece and a shifting piece, the line of contact is straight, and parallel to the axes or axis; and hence that the rolling surfaces are either plane or cylindrical (the term "cylindrical" including all surfaces generated by the motion of a straight line parallel to itself).

VI. That for a pair of turning pieces with intersecting axes the line of contact is also straight, and traverses the point of intersection of the axes; and hence that the rolling surfaces are conical, with a common apex (the term "conical" including all surfaces generated by the motion of a straight line which traverses a fixed point).

Turning pieces in rolling contact are called *smooth* or *toothless wheels.* Shifting pieces in rolling contact with turning pieces may be called *smooth* or *toothless racks.*

VII. In a pair of pieces in rolling contact every straight line traversing the line of contact is a line of connexion.

§ 40. *Cylindrical Wheels and Smooth Racks.*—In designing cylindrical wheels and smooth racks, and determining their comparative motion, it is sufficient to consider a section of the pair of pieces made by a plane perpendicular to the axis or axes.

The points where axes intersect the plane of section are called *centres*; the point where the line of contact intersects it, the *point of contact*, or *pitch-point*; and the wheels are described as *circular*, *elliptical*, &c., according to the forms of their sections made by that plane.

When the point of contact of two wheels lies between their centres, they are said to be in *outside gearing*; when beyond their centres, in *inside gearing*, because the rolling surface of the larger wheel must in this case be turned inward or towards its centre.

From Principle III. of § 39 it appears that the angular velocity-ratio of a pair of wheels is the inverse ratio of the distances of the point of contact from the centres respectively.

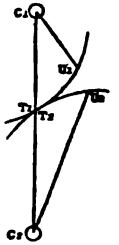


FIG. 96.

For outside gearing that ratio is *negative*, because the wheels turn contrary ways; for inside gearing it is *positive*, because they turn the same way.

If the velocity ratio is to be constant, as in Willis's Class A, the wheels must be circular; and this is the most common form for wheels.

If the velocity ratio is to be variable, as in Willis's Class B, the figures of the wheels are a pair of *rolling curves*, subject to the condition that the distance between their *poles* (which are the centres of rotation) shall be constant.

The following is the geometrical relation which must exist between such a pair of curves:—

Let C_1, C_2 (fig. 96) be the poles of a pair of rolling curves; T_1, T_2 any pair of points of contact; U_1, U_2 any other pair of points of contact. Then, for every possible pair of points of contact, the two following equations must be simultaneously fulfilled:—

$$\text{Sum of radii, } C_1U_1+C_2U_2=C_1T_1+C_2T_2 = \text{constant};$$
$$\text{arc, } T_2U_2 = T_1U_1. \tag{17}$$

A condition equivalent to the above, and necessarily connected with it, is, that at each pair of points of contact the inclinations of the curves to their radii-vectores shall be equal and contrary; or, denoting by r_1, r_2 the radii-vectores at any given pair of points of contact, and s the length of the equal arcs measured from a certain fixed pair of points of contact—

$$dr_2/ds = -dr_1/ds; \tag{18}$$

which is the differential equation of a pair of rolling curves whose poles are at a constant distance apart.

For full details as to rolling curves, see Willis's work, already mentioned, and Clerk Maxwell's paper on Rolling Curves, *Trans. Roy. Soc. Edin.*, 1849.

A rack, to work with a circular wheel, must be straight. To work with a wheel of any other figure, its section must be a rolling curve, subject to the condition that the perpendicular distance from the pole or centre of the wheel to a straight line parallel to the direction of the motion of the rack shall be constant. Let r_1 be the radius-vector of a point of contact on the wheel, x_2 the ordinate from the straight line before mentioned to the corresponding point of contact on the rack. Then

$$dx_2/ds = -dr_1/ds \tag{19}$$

is the differential equation of the pair of rolling curves.

To illustrate this subject, it may be mentioned that an ellipse rotating about one focus rolls completely round in outside gearing with an equal and similar ellipse also rotating about one focus, the distance between the axes of rotation being equal to the major axis of the ellipses, and the velocity ratio varying from $\frac{1+\text{eccentricity}}{1-\text{eccentricity}}$ to $\frac{1-\text{eccentricity}}{1+\text{eccentricity}}$; an hyperbola rotating about its further focus rolls in inside gearing, through a limited arc, with an equal and similar hyperbola rotating about its nearer focus, the distance between the axes of rotation being equal to the axis of the hyperbolas, and the velocity ratio varying between $\frac{\text{eccentricity}+1}{\text{eccentricity}-1}$ and unity; and a parabola rotating about its focus rolls with an equal and similar parabola, shifting parallel to its directrix.

§ 41. *Conical or Bevel and Disk Wheels.*—From Principles III. and VI. of § 39 it appears that the angular velocities of a pair of wheels whose axes meet in a point are to each other inversely as the sines of the angles which the axes of the wheels make with the line of contact. Hence we have the following construction (figs. 97 and 98).—Let O be the apex or point of intersection of the two axes OC_1, OC_2. The angular velocity ratio being given, it is required to find the line of contact. On OC_1, OC_2 take lengths OA_1, OA_2, respectively proportional to the angular velocities of the pieces on whose axes they are taken. Complete the parallelogram OA_1EA_2; the diagonal OET will be the line of contact required.

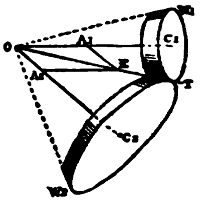


FIG. 97.

When the velocity ratio is variable, the line of contact will shift its position in the plane C_1OC_2, and the wheels will be cones, with eccentric or irregular bases. In every case which occurs in practice, however, the velocity ratio is constant; the line of contact is constant in position, and the rolling surfaces of the wheels are regular circular cones (when they are called *bevel wheels*); or one of a pair of wheels may have a flat disk for its rolling surface, as W_2 in fig. 98, in which case it is a *disk wheel*. The rolling surfaces of actual wheels consist of frusta or zones of the complete cones or disks, as shown by W_1, W_2 in figs. 97 and 98.

§ 42. *Sliding Contact (lateral): Skew-Bevel Wheels.*—An hyperboloid of revolution is a surface resembling a sheaf or a dice box, generated by the rotation of a straight line round an axis from which it is at a constant distance, and to which it is inclined at a constant angle. If two such hyperboloids E, F, equal or unequal, be placed in the closest possible contact, as in fig. 99, they will touch each other along one of the generating straight lines of each, which will form their line of contact, and will be inclined to the axes AG, BH in opposite directions. The axes will *not* be parallel, nor will they intersect each other.

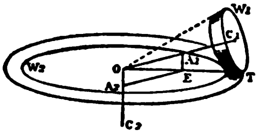


FIG. 98.

The motion of two such hyperboloids, turning in contact with each other, has hitherto been classed amongst cases of rolling contact; but that classification is not strictly correct, for, although the component velocities of a pair of points of contact in a direction at right angles to the line of contact are equal, still, as the axes are parallel neither to each other nor to the line of contact, the velocities of a pair of points of contact have components along the line of contact which are unequal, and their difference constitutes a *lateral sliding*.

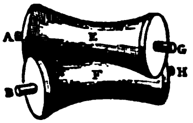


FIG. 99.

The directions and positions of the axes being given, and the required angular velocity ratio, the following construction serves to determine the line of contact, by whose rotation round the two axes respectively the hyperboloids are generated:—

In fig. 100, let B_1C_1. B_2C_2 be the two axes; B_1B_2 their common perpendicular. Through any point O in this common perpendicular draw OA_1 parallel to B_1C_1 and OA_2 parallel to B_2C_2; make those lines proportional to the angular velocities about the axes to which they are respectively parallel; complete the parallelogram OA_1EA_2, and draw the diagonal OE; divide B_1B_2 in D into two parts, *inversely* proportional to the angular velocities about the axes which they respectively adjoin; through D parallel to OE draw DT. This will be the line of contact.

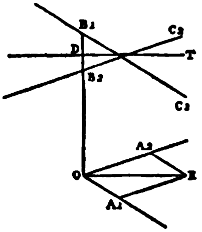


FIG. 100.

A pair of thin frusta of a pair of hyperboloids are used in practice to communicate motion between a pair of axes neither parallel nor intersecting, and are called *skew-bevel wheels*.

In skew-bevel wheels the properties of a line of connexion are not possessed by every line traversing the line of contact, but only by every line traversing the line of contact at right angles.

If the velocity ratio to be communicated were variable, the point D would alter its position, and the line DT its direction, at different periods of the motion, and the wheels would be hyperboloids of an eccentric or irregular cross-section; but forms of this kind are not used in practice.

§ 43. *Sliding Contact (circular): Grooved Wheels.*—As the adhesion or friction between a pair of smooth wheels is seldom sufficient to prevent their slipping on each other, contrivances are used to increase their mutual hold. One of those consists in forming the rim of each wheel into a series of alternate ridges and grooves parallel to the plane of rotation; it is applicable to cylindrical and bevel wheels, but not to skew-bevel wheels. The comparative motion of a pair of wheels so ridged and grooved is the same as that of a pair of smooth wheels in rolling contact, whose cylindrical or conical surfaces lie midway between the tops of the ridges and bottoms of the grooves, and those ideal smooth surfaces are called the *pitch surfaces* of the wheels.

The relative motion of the faces of contact of the ridges and grooves is a *rotatory sliding* or *grinding* motion, about the line of contact of the pitch-surfaces as an instantaneous axis.

Grooved wheels have hitherto been but little used.

§ 44. *Sliding Contact (direct): Teeth of Wheels, their Number and Pitch.*—The ordinary method of connecting a pair of wheels, or a wheel and a rack, and the only method which ensures the exact maintenance of a given numerical velocity ratio, is by means of a series of alternate ridges and hollows parallel or nearly parallel to the successive lines of contact of the ideal smooth wheels whose velocity ratio would be the same with that of the toothed wheels. The ridges are called *teeth*; the hollows, *spaces*. The teeth of the driver push those of the follower before them, and in so doing sliding takes place between them in a direction across their lines of contact.

The *pitch-surfaces* of a pair of toothed wheels are the ideal smooth surfaces which would have the same comparative motion by rolling contact that the actual wheels have by the sliding contact of their teeth. The *pitch-circles* of a pair of circular toothed wheels are sections of their pitch-surfaces, made for *spur-wheels* (that is, for wheels whose axes are parallel) by a plane at right angles to the axes, and for bevel wheels by a sphere described about the common apex. For a pair of skew-bevel wheels the pitch-circles are a pair of contiguous rectangular sections of the pitch-surfaces. The *pitch-point* is the point of contact of the pitch-circles.

The pitch-surface of a wheel lies intermediate between the points of the teeth and the bottoms of the hollows between them. That part of the acting surface of a tooth which projects beyond the pitch-surface is called the *face*; that part which lies within the pitch-surface, the *flank*.

Teeth, when not otherwise specified, are understood to be made in one piece with the wheel, the material being generally cast-iron, brass or bronze. Separate teeth, fixed into mortises in the rim of the wheel, are called *cogs*. A *pinion* is a small toothed wheel; a *trundle* is a pinion with cylindrical *staves* for teeth.

The radius of the pitch-circle of a wheel is called the *geometrical radius*; a circle touching the ends of the teeth is called the *addendum circle*, and its radius the *real radius*; the difference between these radii, being the projection of the teeth beyond the pitch-surface, is called the *addendum*.

The distance, measured along the pitch-circle, from the face of one tooth to the face of the next, is called the *pitch*. The pitch and the number of teeth in wheels are regulated by the following principles:—

I. In wheels which rotate continuously for one revolution or more, it is obviously necessary *that the pitch should be an aliquot part of the circumference.*

In wheels which reciprocate without performing a complete revolution this condition is not necessary. Such wheels are called *sectors.*

II. In order that a pair of wheels, or a wheel and a rack, may work correctly together, it is in all cases essential *that the pitch should be the same in each.*

III. Hence, in any pair of circular wheels which work together, the numbers of teeth in a complete circumference are directly as the radii and inversely as the angular velocities.

IV. Hence also, in any pair of circular wheels which rotate continuously for one revolution or more, the ratio of the numbers of teeth and its reciprocal the angular velocity ratio must be expressible in whole numbers.

From this principle arise problems of a kind which will be referred to in treating of *Trains of Mechanism.*

V. Let n, N be the respective numbers of teeth in a pair of wheels, N being the greater. Let t, T be a pair of teeth in the smaller and larger wheel respectively, which at a particular instant work together. It is required to find, first, how many pairs of teeth must pass the line of contact of the pitch-surfaces before t and T work together again (let this number be called a); and, secondly, with how many different teeth of the larger wheel the tooth t will work at different times (let this number be called b); thirdly, with how many different teeth of the smaller wheel the tooth T will work at different times (let this be called c)

CASE 1. If n is a divisor of N,

$$a = \mathrm{N};\ b = \mathrm{N}/n;\ c = 1. \qquad (20)$$

CASE 2. If the greatest common divisor of N and n be d, a number less than n, so that $n = md$, $\mathrm{N} = \mathrm{M}d$; then

$$a = m\mathrm{N} = \mathrm{M}n = \mathrm{M}md;\ b = \mathrm{M};\ c = m. \qquad (21)$$

CASE 3. If N and n be prime to each other,

$$a = n\mathrm{N};\ b = \mathrm{N};\ c = n. \qquad (22)$$

It is considered desirable by millwrights, with a view to the preservation of the uniformity of shape of the teeth of a pair of wheels, that each given tooth in one wheel should work with as many different teeth in the other wheel as possible. They therefore study that the numbers of teeth in each pair of wheels which work together shall either be prime to each other, or shall have their greatest common divisor as small as is consistent with a velocity ratio suited for the purposes of the machine.

§ 45. *Sliding Contact: Forms of the Teeth of Spur-wheels and Racks.*—A line of connexion of two pieces in sliding contact is a line perpendicular to their surfaces at a point where they touch. Bearing this in mind, the principle of the comparative motion of a pair of teeth belonging to a pair of spur-wheels, or to a spur-wheel and a rack, is found by applying the principles stated generally in §§ 36 and 37 to the case of parallel axes for a pair of spur-wheels, and to the case of an axis perpendicular to the direction of shifting for a wheel and a rack.

In fig. 101, let C_1, C_2 be the centres of a pair of spur-wheels; B_1IB_1', B_2IB_2' portions of their pitch-circles, touching at I, the pitch-point. Let the wheel 1 be the driver, and the wheel 2 the follower.

Let $D_1TB_1A_1$, $D_2TB_2A_2$ be the positions, at a given instant, of the acting surfaces of a pair of teeth in the driver and follower respectively, touching each other at T; the line of connexion of those teeth is P_1P_2, perpendicular to their surfaces at T. Let C_1P_1, C_2P_2 be perpendiculars let fall from the centres of the wheels on the line of contact. Then, by § 36, the angular velocity-ratio is

$$\alpha_2/\alpha_1 = C_1P_1/C_2P_2. \qquad (23)$$

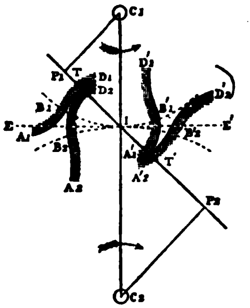


FIG. 101.

The following principles regulate the forms of the teeth and their relative motions:—

I. The angular velocity ratio due to the sliding contact of the teeth will be the same with that due to the rolling contact of the pitch-circles, if the line of connexion of the teeth cuts the line of centres at the pitch-point.

For, let P_1P_2 cut the line of centres at I; then, by similar triangles,

$$\alpha_1 : \alpha_2 :: C_2P_2 : C_1P_1 :: IC_2 :: IC_1; \qquad (24)$$

which is also the angular velocity ratio due to the rolling contact of the circles B_1IB_1', B_2IB_2'.

This principle determines the *forms* of all teeth of spur-wheels. It also determines the forms of the teeth of straight racks, if one of the centres be removed, and a straight line EIE′, parallel to the direction of motion of the rack, and perpendicular to C_1IC_2, be substituted for a pitch-circle.

II. The component of the velocity of the point of contact of the teeth T along the line of connexion is

$$\alpha_1 . C_1P_1 = \alpha_2 . C_2P_2. \qquad (25)$$

III. The relative velocity perpendicular to P_1P_2 of the teeth at their point of contact—that is, their *velocity of sliding* on each other—is found by supposing one of the wheels, such as 1, to be fixed, the line of centres C_1C_2 to rotate backwards round C_1 with the angular velocity α_1, and the wheel 2 to rotate round C_2 as before, with the angular velocity α_2 relatively to the line of centres C_1C_2, so as to have the same motion as if its pitch-circle *rolled* on the pitch-circle of the first wheel. Thus the *relative* motion of the wheels is unchanged; but 1 is considered as fixed, and 2 has the *total motion*, that is, a rotation about the instantaneous axis I, with the angular velocity $\alpha_1+\alpha_2$. Hence the *velocity of sliding* is that due to this rotation about I, with the radius IT; that is to say, its value is

$$(\alpha_1+\alpha_2) . IT; \qquad (26)$$

so that it is greater the farther the point of contact is from the line of centres; and at the instant when that point passes the line of centres, and coincides with the *pitch-point*, the velocity of sliding is null, and the action of the teeth is, for the instant, that of rolling contact.

IV. The *path of contact* is the line traversing the various positions of the point T. If the line of connexion preserves always the same position, the path of contact coincides with it, and is straight; in other cases the path of contact is curved.

It is divided by the pitch-point I into two parts—the *arc* or *line of approach* described by T in approaching the line of centres, and the *arc* or *line of recess* described by T after having passed the line of centres.

During the *approach*, the *flank* D_1B_1 of the driving tooth drives the *face* D_2B_2 of the following tooth, and the teeth are sliding *towards* each other. During the *recess* (in which the position of the teeth is exemplified in the figure by curves marked with accented letters), the *face* $B_1'A_1'$ of the driving tooth drives the *flank* $B_2'A_2'$ of the following tooth, and the teeth are sliding *from* each other.

The path of contact is bounded where the approach commences by the addendum-circle of the follower, and where the recess terminates by the addendum-circle of the driver. The length of the path of contact should be such that there shall always be at least one pair of teeth in contact; and it is better still to make it so long that there shall always be at least two pairs of teeth in contact.

V. The *obliquity* of the action of the teeth is the angle $EIT = IC_1P_1 = IC_2P_2$.

In practice it is found desirable that the mean value of the obliquity of action during the contact of teeth should not exceed 15°, nor the maximum value 30°.

It is unnecessary to give separate figures and demonstrations for inside gearing. The only modification required in the formulae is, that in equation (26) the *difference* of the angular velocities should be substituted for their sum.

§ 46. *Involute Teeth.*—The simplest form of tooth which fulfils the conditions of § 45 is obtained in the following manner (see fig. 102). Let C_1, C_2 be the centres of two wheels, B_1IB_1', B_2IB_2' their pitch-circles, I the pitch-point; let the obliquity of action of the teeth be constant, so that the same straight line P_1IP_2 shall represent at once the constant line of connexion of teeth and the path of contact. Draw C_1P_1, C_2P_2 perpendicular to P_1IP_2, and with those lines as radii describe about the centres of the wheels the circles D_1D_1', D_2D_2', called *base-circles*. It is evident that the radii of the base-circles bear to each other the same proportions as the radii of the pitch-circles, and also that

$$\left. \begin{aligned} C_1P_1 &= IC_1 . \cos \text{obliquity} \\ C_2P_2 &= IC_2 . \cos \text{obliquity} \end{aligned} \right\} \qquad (27)$$

(The obliquity which is found to answer best in practice is about 14½°; its cosine is about $\frac{31}{32}$, and its sine about $\frac{1}{4}$. These values though not absolutely exact, are near enough to the truth for practical purposes.)

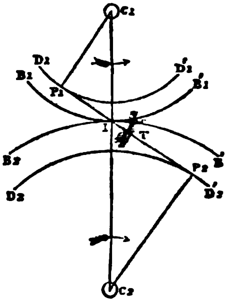


FIG. 102.

Suppose the base-circles to be a pair of circular pulleys connected by means of a cord whose course from pulley to pulley is P_1IP_2. As the line of connexion of those pulleys is the same as that of the proposed teeth, they will rotate with the required velocity ratio. Now, suppose a tracing point T to be fixed to the cord, so as to be carried along the path of contact P_1IP_2, that point will trace on a plane rotating along with the wheel 1 part of the involute of the base-circle D_1D_1', and on a plane rotating along with the wheel 2 part of the involute of the base-circle D_2D_2'; and the two curves so traced will always touch each other in the required point of contact T, and will therefore fulfil the condition required by Principle I. of § 45.

Consequently, one of the forms suitable for the teeth of wheels is the involute of a circle; and the obliquity of the action of such teeth is the angle whose cosine is the ratio of the radius of their base-circle to that of the pitch-circle of the wheel.

All involute teeth of the same pitch work smoothly together.

To find the length of the path of contact on either side of the pitch-point I, it is to be observed that the distance between the fronts of two successive teeth, as measured along P_1IP_2, is less than the pitch in the ratio of cos obliquity : 1; and consequently that, if distances equal to the pitch be marked off either way from I towards P_1 and P_2 respectively, as the extremities of the path of contact, and if, according to Principle IV. of § 45, the addendum-circles be described through the points so found, there will always be at least two pairs of teeth in action at once. In practice it is usual to make the path of contact somewhat longer, viz. about 2·4 times the pitch; and with this length of path, and the obliquity already mentioned of 14½°, the addendum is about 3·1 of the pitch.

The teeth of a *rack*, to work correctly with wheels having involute teeth, should have plane surfaces perpendicular to the line of connexion, and consequently making with the direction of motion of the rack angles equal to the complement of the obliquity of action.

§ 47. *Teeth for a given Path of Contact: Sang's Method.*—In the preceding section the form of the teeth is found by assuming a figure for the path of contact, viz. the straight line. Any other convenient figure may be assumed for the path of contact, and the corresponding forms of the teeth found by determining what curves a point T, moving along the assumed path of contact, will trace on two disks rotating round the centres of the wheels with angular velocities bearing that relation to the component velocity of T along TI, which is given by Principle II. of § 45, and by equation (25). This method of finding the forms of the teeth of wheels forms the subject of an elaborate and most interesting treatise by Edward Sang.

All wheels having teeth of the same pitch, traced from the same path of contact, work correctly together, and are said to belong to the *same set*.

§ 48. *Teeth traced by Rolling Curves.*—If any curve R (fig. 103) be rolled on the inside of the pitch-circle BB of a wheel, it appears, from § 30, that the instantaneous axis of the rolling curve at any instant will be at the point I, where it touches the pitch-circle for the moment, and that consequently the line AT, traced by a tracing-point T, fixed to the rolling curve upon the plane of the wheel, will be everywhere perpendicular to the straight line TI; so that the traced curve AT will be suitable for the flank of a tooth, in which T is the point of contact corresponding to the position I of the pitch-point. If the

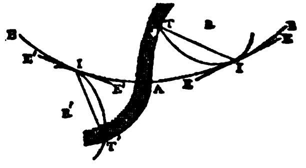


FIG. 103.

same rolling curve R, with the same tracing-point T, be rolled on the *outside* of any other pitch-circle, it will have the *face* of a tooth suitable to work with the *flank* AT.

In like manner, if either the same or any other rolling curve R′ be rolled the opposite way, on the *outside* of the pitch-circle BB, so that the tracing point T′ shall start from A, it will trace the *face* AT′ of a tooth suitable to work with a *flank* traced by rolling the same curve R′ with the same tracing-point T′ *inside* any other pitch-circle.

The figure of the *path of contact* is that traced on a fixed plane by the tracing-point, when the rolling curve is rotated in such a manner as always to touch a fixed straight line EIE (or E′I′E′, as the case may be) at a fixed point I (or I′).

If the same rolling curve and tracing-point be used to trace both the faces and the flanks of the teeth of a number of wheels of different sizes but of the same pitch, all those wheels will work correctly together, and will form a *set*. The teeth of a *rack*, of the same set, are traced by rolling the rolling curve on both sides of a straight line.

The teeth of wheels of any figure, as well as of circular wheels, may be traced by rolling curves on their pitch-surfaces; and all teeth of the same pitch, traced by the same rolling curve with the same tracing-point, will work together correctly if their pitch-surfaces are in rolling contact.

§ 49. *Epicycloidal Teeth.*—The most convenient rolling curve is the circle. The path of contact which it traces is identical with itself; and the flanks of the teeth are internal and their faces external epicycloids for wheels, and both flanks and faces are cycloids for a rack.

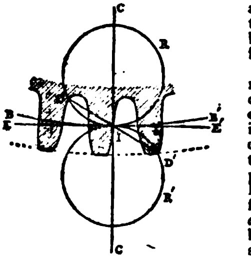


FIG. 104.

For a pitch-circle of twice the radius of the rolling or *describing* circle (as it is called) the internal epicycloid is a straight line, being, in fact, a diameter of the pitch-circle, so that the flanks of the teeth for such a pitch-circle are planes radiating from the axis. For a smaller pitch-circle the flanks would be convex and *incurved* or *under-cut*, which would be inconvenient; therefore the smallest wheel of a set should have its pitch-circle of twice the radius of the describing circle, so that the flanks may be either straight or concave.

In fig. 104 let BB′ be part of the pitch-circle of a wheel with epicycloidal teeth; CIC′ the line of centres; I the pitch-point; EIE′ a straight tangent to the pitch-circle at that point; R the internal and R′ the equal external describing circles, so placed as to touch the pitch-circle and each other at I. Let DID′ be the path of contact, consisting of the arc of approach DI and the arc of recess ID′. In order that there may always be at least two pairs of teeth in action, each of those arcs should be equal to the pitch.

The obliquity of the action in passing the line of centres is nothing; the maximum obliquity is the angle EID = E′ID; and the mean obliquity is one-half of that angle.

It appears from experience that the mean obliquity should not exceed 15°; therefore the maximum obliquity should be about 30°; therefore the equal arcs DI and ID′ should each be one-sixth of a circumference; therefore the circumference of the describing circle should be *six times the pitch*.

It follows that the smallest pinion of a set in which pinion the flanks are straight should have twelve teeth.

§ 50. *Nearly Epicycloidal Teeth: Willis's Method.*—To facilitate the drawing of epicycloidal teeth in practice, Willis showed how to approximate to their figure by means of two circular arcs—one concave, for the flank, and the other convex, for the face—and each having for its radius the *mean* radius of curvature of the epicycloidal arc. Willis's formulae are founded on the following properties of epicycloids:—

Let R be the radius of the pitch-circle; r that of the describing circle; θ the angle made by the normal TI to the epicycloid at a given point T, with a tangent to the circle at I—that is, the obliquity of the action at T.

Then the radius of curvature of the epicycloid at T is—

$$\left.\begin{aligned}&\text{For an internal epicycloid, } \rho = 4r\sin\theta\,\frac{R-r}{R-2r}\\ &\text{For an external epicycloid, } \rho' = 4r\sin\theta\,\frac{R+r}{R+2r}\end{aligned}\right\} \quad (28)$$

Also, to find the position of the centres of curvature relatively to the pitch-circle, we have, denoting the chord of the describing circle TI by c, $c = 2r\sin\theta$; and therefore

$$\left.\begin{aligned}&\text{For the flank, } \rho - c = 2r\sin\theta\,\frac{R}{R-2r}\\ &\text{For the face, } \rho' - c = 2r\sin\theta\,\frac{R}{R+2r}\end{aligned}\right\} \quad (29)$$

For the proportions approved of by Willis, $\sin\theta = \frac{1}{4}$ nearly; $r = p$ (the pitch) nearly; $c = \frac{1}{2}p$ nearly; and, if N be the number of teeth in the wheel, $r/R = 6/N$ nearly; therefore, approximately,

$$\left.\begin{aligned}\rho - c &= \frac{p}{2}\cdot\frac{N}{N-12}\\ \rho' - c &= \frac{p}{2}\cdot\frac{N}{N+12}\end{aligned}\right\} \quad (30)$$

Hence the following construction (fig. 105). Let BB be part of the pitch-circle, and a the point where a tooth is to cross it. Set off $ab = ac = \frac{1}{2}p$. Draw radii bd, ce; draw fb, cg, making angles of $75\frac{1}{2}$° with those radii. Make $bf = \rho' - c$, $cg = \rho - c$. From f, with the radius fa, draw the circular arc ah; from g, with the radius ga, draw the circular arc ak. Then ah is the face and ak the flank of the tooth required.

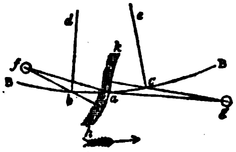


FIG. 105.

To facilitate the application of this rule, Willis published tables of $\rho - c$ and $\rho' - c$, and invented an instrument called the "odontograph."

§ 51. *Trundles and Pin-Wheels.*—If a wheel or trundle have cylindrical pins or staves for teeth, the faces of the teeth of a wheel suitable for driving it are described by first tracing external epicycloids, by rolling the pitch-circle of the pin-wheel or trundle on the pitch-circle of the driving-wheel, with the centre of a stave for a tracing-point, and then drawing curves parallel to, and within the epicycloids, at a distance from them equal to the radius of a stave. Trundles having only six staves will work with large wheels.

§ 52. *Backs of Teeth and Spaces.*—Toothed wheels being in general intended to rotate either way, the *backs* of the teeth are made similar to the fronts. The *space* between two teeth, measured on the pitch-circle, is made about $\frac{1}{5}$th part wider than the thickness of the tooth on the pitch-circle—that is to say,

Thickness of tooth = $\frac{5}{11}$ pitch;
Width of space = $\frac{6}{11}$ pitch.

The difference of $\frac{1}{11}$ of the pitch is called the *back-lash*. The clearance allowed between the points of teeth and the bottoms of the spaces between the teeth of the other wheel is about one-tenth of the pitch.

§ 53. *Stepped and Helical Teeth.*—R. J. Hooke invented the making of the fronts of teeth in a series of steps with a view to increase the smoothness of action. A wheel thus formed resembles in shape a series of equal and similar toothed disks placed side by side, with the teeth of each a little behind those of the preceding disk. He also invented, with the same object, teeth whose fronts, instead of being parallel to the line of contact of the pitch-circles, cross it obliquely, so as to be of a screw-like or helical form. In wheel-work of this kind the contact of each pair of teeth commences at the foremost end of the helical front, and terminates at the aftermost end; and the helix is of such a pitch that the contact of one pair of teeth shall not terminate until that of the next pair has commenced.

Stepped and helical teeth have the desired effect of increasing the smoothness of motion, but they require more difficult and expensive workmanship than common teeth; and helical teeth are, besides, open to the objection that they exert a laterally oblique pressure, which tends to increase resistance, and unduly strain the machinery.

§ 54. *Teeth of Bevel-Wheels.*—The acting surfaces of the teeth of bevel-wheels are of the conical kind, generated by the motion of a line passing through the common apex of the pitch-cones, while its extremity is carried round the outlines of the cross section of the teeth made by a sphere described about that apex.

The operations of describing the exact figures of the teeth of bevel-wheels, whether by involutes or by rolling curves, are in every respect analogous to those for describing the figures of the teeth of spur-wheels, except that in the case of bevel-wheels all those operations are to be performed on the surface of a sphere described about the apex instead of on a plane, substituting *poles* for *centres*, and *great circles* for *straight lines*.

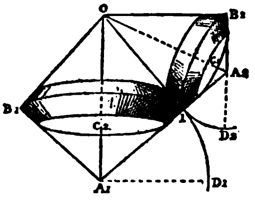


FIG. 106.

In consideration of the practical difficulty, especially in the case of large wheels, of obtaining an accurate spherical surface, and of drawing upon it when obtained, the following approximate method, proposed originally by Tredgold, is generally used:—

Let O (fig. 106) be the common apex of a pair of bevel-wheels; OB_1I, OB_2I their pitch cones; OC_1, OC_2 their axes; OI their line of contact. Perpendicular to OI draw A_1IA_2, cutting the axes in A_1, A_2; make the outer rims of the patterns and of the wheels portions of the cones A_1B_1I, A_2B_2I, of which the narrow zones occupied by the teeth will be sufficiently near to a spherical surface described about O for practical purposes. To find the figures of the teeth, draw on a flat surface circular arcs ID_1, ID_2, with the radii A_1I, A_2I; those arcs will be the *developments* of arcs of the pitch-circles B_1I, B_2I, when the conical surfaces A_1B_1I, A_2B_2I are spread out flat. Describe the figures of teeth for the developed arcs as for a pair of spur-wheels; then wrap the developed arcs on the cones, so as to make them coincide with the pitch-circles, and trace the teeth on the conical surfaces.

§ 55. *Teeth of Skew-Bevel Wheels.*—The crests of the teeth of a skew-bevel wheel are parallel to the generating straight line of the hyperboloidal pitch-surface; and the transverse sections of the teeth at a given pitch-circle are similar to those of the teeth of a bevel-wheel whose pitch surface is a cone touching the hyperboloidal surface at the given circle.

§ 56. *Cams.*—A *cam* is a single tooth, either rotating continuously or oscillating, and driving a sliding or turning piece either constantly or at intervals. All the principles which have been stated in § 45 as being applicable to teeth are applicable to cams; but in designing cams it is not usual to determine or take into consideration the form of the ideal pitch-surface, which would give the same comparative motion by rolling contact that the cam gives by sliding contact.

§ 57. *Screws.*—The figure of a screw is that of a convex or concave cylinder, with one or more helical projections, called *threads*, winding round it. Convex and concave screws are distinguished technically by the respective names of *male* and *female*; a short concave screw is called a *nut*; and when a *screw* is spoken of without qualification a *convex* screw is usually understood.

The relation between the *advance* and the *rotation*, which compose the motion of a screw working in contact with a fixed screw or helical guide, has already been demonstrated in § 32; and the same relation exists between the magnitudes of the rotation of a screw about a fixed axis and the advance of a shifting nut in which it rotates. The advance of the nut takes place in the opposite direction to that of the advance of the screw in the case in which the nut is fixed. The *pitch* or *axial pitch* of a screw has the meaning assigned to it in that section, viz. the distance, measured parallel to the axis, between the corresponding points in two successive turns of the *same thread*. If, therefore, the screw has several equidistant threads, the true pitch is equal to the *divided axial pitch*, as measured between two adjacent threads, multiplied by the number of threads.

If a helix be described round the screw, crossing each turn of the thread at right angles, the distance between two corresponding points on two successive turns of the same thread, measured along this *normal helix*, may be called the *normal pitch*; and when the screw has more than one thread the normal pitch from thread to thread may be called the *normal divided pitch*.

The distance from thread to thread, measured on a circle described about the axis of the screw, called the pitch-circle, may be called the *circumferential pitch*; for a screw of one thread it is one circumference; for a screw of n threads, $\dfrac{\text{one circumference}}{n}$.

Let r denote the radius of the pitch circle;
n the number of threads;
θ the obliquity of the threads to the pitch circle, and of the normal helix to the axis;

$$\left.\begin{array}{r} P_a \\ \dfrac{P_a}{n} = p_a \end{array}\right\} \text{the axial} \left\{\begin{array}{l} \text{pitch,} \\ \text{divided pitch;} \end{array}\right.$$

$$\left.\begin{array}{r} P_n \\ \dfrac{P_n}{n} = p_n \end{array}\right\} \text{the normal} \left\{\begin{array}{l} \text{pitch,} \\ \text{divided pitch;} \end{array}\right.$$

P_c the circumferential pitch;

then

$$\left.\begin{array}{l} p_c = p_a \cot\theta = p_n \cos\theta = \dfrac{2\pi r}{n}, \\ p_a = p_n \sec\theta = p_c \tan\theta = \dfrac{2\pi r \tan\theta}{n}, \\ p_n = p_c \sin\theta = p_a \cos\theta = \dfrac{2\pi r \sin\theta}{n}. \end{array}\right\} \quad (31)$$

If a screw rotates, the number of threads which pass a fixed point in one revolution is the number of threads in the screw.

A pair of convex screws, each rotating about its axis, are used as an elementary combination to transmit motion by the sliding contact of their threads. Such screws are commonly called *endless screws*. At the point of contact of the screws their threads must be parallel; and their line of connexion is the common perpendicular to the acting surfaces of the threads at their point of contact. Hence the following principles:—

I. If the screws are both right-handed or both left-handed, the angle between the directions of their axes is the sum of their obliquities; if one is right-handed and the other left-handed, that angle is the difference of their obliquities.

II. The normal pitch for a screw of one thread, and the normal divided pitch for a screw of more than one thread, must be the same in each screw.

III. The angular velocities of the screws are inversely as their numbers of threads.

Hooke's wheels with oblique or helical teeth are in fact screws of many threads, and of large diameters as compared with their lengths.

The ordinary position of a pair of endless screws is with their axes at right angles to each other. When one is of considerably greater diameter than the other, the larger is commonly called in practice a *wheel*, the name *screw* being applied to the smaller only; but they are nevertheless both screws in fact.

To make the teeth of a pair of endless screws fit correctly and work smoothly, a hardened steel screw is made of the figure of the smaller screw, with its thread or threads notched so as to form a cutting tool; the larger screw, or "wheel," is cast approximately of the required figure; the larger screw and the steel screw are fitted up in their proper relative position, and made to rotate in contact with each other by turning the steel screw, which cuts the threads of the larger screw to their true figure.

§ 58. *Coupling of Parallel Axes—Oldham's Coupling.*—A *coupling* is a mode of connecting a pair of shafts so that they shall rotate in the same direction with the same mean angular velocity. If the axes of the shafts are in the same straight line, the coupling consists in so connecting their contiguous ends that they shall rotate as one piece; but if the axes are not in the same straight line combinations of mechanism are required. A coupling for parallel shafts which acts by *sliding contact* was invented by Oldham, and is represented in fig. 107. C_1, C_2 are the axes of the two parallel shafts; D_1, D_2 two disks facing each other, fixed on the ends of the two shafts respectively; E_1E_1 a bar sliding in a diametral groove in the face of D_1; E_2E_2 a bar sliding in a diametral groove in the face of D_2: those bars are fixed together at A, so as to form a rigid cross. The angular velocities of the two disks and of the cross are all equal at every instant; the middle point of the cross, at A, revolves in the dotted circle described upon the line of centres C_1C_2 as a diameter twice for each turn of the disks and cross; the instantaneous axis of rotation of the cross at any instant is at I, the point in the circle C_1C_2 diametrically opposite to A.

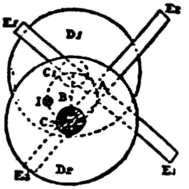


FIG. 107.

Oldham's coupling may be used with advantage where the axes of the shafts are intended to be as nearly in the same straight line as is possible, but where there is some doubt as to the practicability or permanency of their exact continuity.

§ 59. *Wrapping Connectors—Belts, Cords and Chains.*—Flat belts of leather or of gutta percha, round cords of catgut, hemp or other material, and metal chains are used as wrapping connectors to transmit rotatory motion between pairs of pulleys and drums.

Belts (the most frequently used of all wrapping connectors) require nearly cylindrical pulleys. A belt tends to move towards that part of a pulley whose radius is greatest; pulleys for belts, therefore, are slightly swelled in the middle, in order that the belt may remain on the pulley, unless forcibly shifted. A belt when in motion is shifted off a pulley, or from one pulley on to another of equal size alongside of it, by pressing against that part of the belt which is moving *towards* the pulley.

Cords require either cylindrical drums with ledges or grooved pulleys.

Chains require pulleys or drums, grooved, notched and toothed, so as to fit the links of the chain.

Wrapping connectors for communicating continuous motion are endless.

Wrapping connectors for communicating reciprocating motion have usually their ends made fast to the pulleys or drums which they connect, and which in this case may be sectors.

The line of connexion of two pieces connected by a wrapping connector is the centre line of the belt, cord or chain; and the comparative motions of the pieces are determined by the principles of § 36 if both pieces turn, and of § 37 if one turns and the other shifts, in which latter case the motion must be reciprocating.

The *pitch-line* of a pulley or drum is a curve to which the line of connexion is always a tangent—that is to say, it is a curve parallel to the acting surface of the pulley or drum, and distant from it by half the thickness of the wrapping connector.

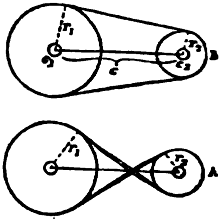


FIG. 108.

Pulleys and drums for communicating a constant velocity ratio are circular. The *effective radius*, or radius of the pitch-circle of a circular pulley or drum, is equal to the real radius added to half the thickness of the connector. The angular velocities of a pair of connected circular pulleys or drums are inversely as the effective radii.

A *crossed* belt, as in fig. 108, A, reverses the direction of the rotation communicated; an *uncrossed* belt, as in fig. 108, B, preserves that direction.

The *length* L of an endless belt connecting a pair of pulleys whose effective radii are r_1, r_2, with parallel axes whose distance apart is c, is given by the following formulae, in each of which the first term, containing the radical, expresses the length of the straight parts of the belt, and the remainder of the formula the length of the curved parts.

For a crossed belt:—

$$L = 2\sqrt{c^2-(r_1+r_2)^2}+(r_1+r_2)\left(\pi-2\sin^{-1}\frac{r_1+r_2}{c}\right); \qquad (32\,A)$$

and for an uncrossed belt:—

$$L = 2\sqrt{\{c^2-(r_1-r_2)^2\}}+\pi(r_1+r_2+2(r_1-r_2)\sin^{-1}\frac{r_1-r_2}{c}; \qquad (32\,B)$$

in which r_1 is the greater radius, and r_2 the less.

When the axes of a pair of pulleys are not parallel, the pulleys should be so placed that the part of the belt which is *approaching* each pulley shall be in the plane of the pulley.

§ 60. *Speed-Cones.*—A pair of speed-cones (fig. 109) is a contrivance for varying and adjusting the velocity ratio communicated between a pair of parallel shafts by means of a belt. The speed-cones are either continuous cones or conoids, as A, B, whose velocity ratio can be varied gradually while they are in motion by shifting the belt, or sets of pulleys whose radii vary by steps, as C, D, in which case the velocity ratio can be changed by shifting the belt from one pair of pulleys to another.

In order that the belt may fit accurately in every possible position on a pair of speed-cones, the quantity L must be constant, in equations (32 A) or (32 B), according as the belt is crossed or uncrossed.

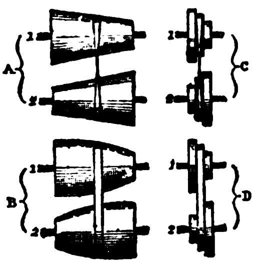


FIG. 109.

For a *crossed* belt, as in A and C, fig. 109, L depends solely on c and on r_1+r_2. Now c is constant because the axes are parallel; therefore the *sum of the radii* of the pitch-circles connected in every position of the belt is to be constant. That condition is fulfilled by a pair of continuous cones generated by the revolution of two straight lines inclined opposite ways to their respective axes at equal angles.

For an uncrossed belt, the quantity L in equation (32 B) is to be made constant. The exact fulfilment of this condition requires the solution of a transcendental equation; but it may be fulfilled with accuracy sufficient for practical purposes by using, instead of (32 B) the following *approximate* equation:—

$$L \text{ nearly} = 2c+\pi(r_1+r_2)+(r_1-r_2)^2/c. \qquad (33)$$

The following is the most convenient practical rule for the application of this equation:—

Let the speed-cones be equal and similar conoids, as in B, fig. 109, but with their large and small ends turned opposite ways. Let r_1 be the radius of the large end of each, r_2 that of the small end, r_0 that of the middle; and let v be the *sagitta*, measured perpendicular to the axes, of the arc by whose revolution each of the conoids is generated, or, in other words, the *bulging* of the conoids in the middle of their length. Then

$$v = r_0-(r_1+r_2)/2 = (r_1-r_2)^2/2\pi c. \qquad (34)$$

$2\pi = 6{\cdot}2832$; but 6 may be used in most practical cases without sensible error.

The radii at the middle and end being thus determined, make the generating curve an arc either of a circle or of a parabola.

§ 61. *Linkwork in General.*—The pieces which are connected by linkwork, if they rotate or oscillate, are usually called *cranks*, *beams* and *levers*. The *link* by which they are connected is a rigid rod or bar, which may be straight or of any other figure; the straight figure being the most favourable to strength, is always used when there is no special reason to the contrary. The link is known by various names in various circumstances, such as *coupling-rod*, *connecting-rod*, *crank-rod*, *eccentric-rod*, &c. It is attached to the pieces which it connects by two pins, about which it is free to turn. The effect of the link is to maintain the distance between the axes of those pins invariable; hence the common perpendicular of the axes of the pins is *the line of connexion*, and its extremities may be called the *connected points*. In a turning piece, the perpendicular let fall from its connected point upon its axis of rotation is the *arm* or *crank-arm*.

The axes of rotation of a pair of turning pieces connected by a link are almost always parallel, and perpendicular to the line of connexion in which case the angular velocity ratio at any instant is the reciprocal of the ratio of the common perpendiculars let fall from the line of connexion upon the respective axes of rotation.

If at any instant the direction of one of the crank-arms coincides with the line of connexion, the common perpendicular of the line of connexion and the axis of that crank-arm vanishes, and the directional relation of the motions becomes indeterminate. The position of the connected point of the crank-arm in question at such an instant is called a *dead-point*. The velocity of the other connected point at such an instant is null, unless it also reaches a dead-point at the same instant, so that the line of connexion is in the plane of the two axes of rotation, in which case the velocity ratio is indeterminate. Examples of dead-points, and of the means of preventing the inconvenience which they tend to occasion, will appear in the sequel.

§ 62. *Coupling of Parallel Axes.*—Two or more parallel shafts (such as those of a locomotive engine, with two or more pairs of driving wheels) are made to rotate with constantly equal angular velocities by having equal cranks, which are maintained parallel by a coupling-rod of such a length that the line of connexion is equal to the distance between the axes. The cranks pass their dead-points simultaneously. To obviate the unsteadiness of motion which this tends to cause, the shafts are provided with a second set of cranks at right angles to the first, connected by means of a similar coupling-rod, so that one set of cranks pass their dead points at the instant when the other set are farthest from theirs.

§ 63. *Comparative Motion of Connected Points.*—As the link is a rigid body, it is obvious that its action in communicating motion may be determined by finding the comparative motion of the connected points, and this is often the most convenient method of proceeding.

If a connected point belongs to a turning piece, the direction of its motion at a given instant is perpendicular to the plane containing the axis and crank-arm of the piece. If a connected point belongs to a shifting piece, the direction of its motion at any instant is given, and a plane can be drawn perpendicular to that direction.

The line of intersection of the planes perpendicular to the paths of the two connected points at a given instant is the *instantaneous axis of the link* at that instant; and the *velocities of the connected points are directly as their distances from that axis.*

In drawing on a plane surface, the two planes perpendicular to the paths of the connected points are represented by two lines (being their sections by a plane normal to them), and the instantaneous axis by a point (fig. 110); and, should the length of the two lines render it impracticable to produce them until they actually intersect, the velocity ratio of the connected points may be found by the principle that it is equal to the ratio of the segments which a line parallel to the line of connexion cuts off from any two lines drawn from a given point, perpendicular respectively to the paths of the connected points.

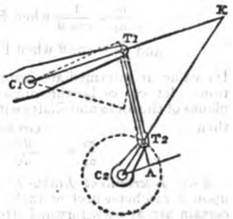


FIG. 110.

To illustrate this by one example. Let C_1 be the axis, and T_1 the connected point of the beam of a steam-engine; T_1T_2 the connecting or crank-rod; T_2 the other connected point, and the centre of the crank-pin; C_2 the axis of the crank and its shaft. Let v_1 denote the velocity of T_1 at any given instant; v_2 that of T_2. To find the ratio of these velocities, produce C_1T_1, C_2T_2 till they intersect in K; K is the instantaneous axis of the connecting rod, and the velocity ratio is

$$v_1 : v_2 :: KT_1 : KT_2. \qquad (35)$$

Should K be inconveniently far off, draw any triangle with its sides respectively parallel to C_1T_1, C_2T_2 and T_1T_2; the ratio of the two sides first mentioned will be the velocity ratio required. For example, draw C_2A parallel to C_1T_1, cutting T_1T_2 in A; then

$$v_1 : v_2 :: C_2A : C_2T_2. \qquad (36)$$

§ 64. *Eccentric.*—An eccentric circular disk fixed on a shaft, and used to give a reciprocating motion to a rod, is in effect a crank-pin of sufficiently large diameter to surround the shaft, and so to avoid the weakening of the shaft which would arise from bending it so as to form an ordinary crank. The centre of the eccentric is its connected point; and its eccentricity, or the distance from that centre to the axis of the shaft, is its crank-arm.

An eccentric may be made capable of having its eccentricity altered by means of an adjusting screw, so as to vary the extent of the reciprocating motion which it communicates.

§ 65. *Reciprocating Pieces—Stroke—Dead-Points.*—The distance between the extremities of the path of the connected point in a reciprocating piece (such as the piston of a steam-engine) is called the *stroke* or *length of stroke* of that piece. When it is connected with a continuously turning piece (such as the crank of a steam-engine) the ends of the stroke of the reciprocating piece correspond to the *dead-points* of the path of the connected point of the turning piece, where the line of connexion is continuous with or coincides with the crank-arm.

Let S be the length of stroke of the reciprocating piece, L the length of the line of connexion, and R the crank-arm of the continuously turning piece. Then, if the two ends of the stroke be in one straight line with the axis of the crank,

$$S = 2R; \tag{37}$$

and if these ends be not in one straight line with that axis, then S, L − R, and L+R, are the three sides of a triangle, having the angle opposite S at that axis; so that, if θ be the supplement of the arc between the dead-points,

$$\left.\begin{aligned} S^2 &= 2(L^2+R^2) - 2(L^2-R^2)\cos\theta, \\ \cos\theta &= \frac{2L^2+2R^2-S^2}{2(L^2-R^2)} \end{aligned}\right\} \tag{38}$$

§ 66. *Coupling of Intersecting Axes—Hooke's Universal Joint.*—Intersecting axes are coupled by a contrivance of Hooke's, known as the "universal joint," which belongs to the class of linkwork (see fig. 111). Let O be the point of intersection of the axes OC_1, OC_2, and θ their angle of inclination to each other. The pair of shafts C_1, C_2 terminate in a pair of forks F_1, F_2 in bearings at the extremities of which turn the gudgeons at the ends of the arms of a rectangular cross, having its centre at O. This cross is the link; the connected points are the centres of the bearings F_1, F_2. At each instant each of those points moves at right angles to the central plane of its shaft and fork, therefore the line of intersection of the central planes of the two forks at any instant is the instantaneous axis of the cross, and the *velocity ratio* of the points F_1, F_2 (which, as the forks are equal, is also the *angular velocity ratio* of the shafts) is equal to the ratio of the distances of those points from that instantaneous axis. The *mean* value of that velocity ratio is that of equality, for each successive *quarter-turn* is made by both shafts in the same time; but its actual value fluctuates between the limits:—

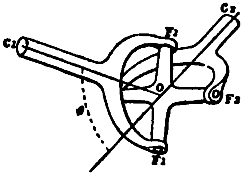


FIG. 111.

$$\left.\begin{aligned} \frac{\alpha_2}{\alpha_1} &= \frac{1}{\cos\theta} \text{ when } F_1 \text{ is the plane of } OC_1C_2 \\ \text{and } \frac{\alpha_2}{\alpha_1} &= \cos\theta \text{ when } F_2 \text{ is in that plane.} \end{aligned}\right\} \tag{39}$$

Its value at intermediate instants is given by the following equations: let ϕ_1, ϕ_2 be the angles respectively made by the central planes of the forks and shafts with the plane OC_1C_2 at a given instant; then

$$\left.\begin{aligned} \cos\theta &= \tan\phi_1 \tan\phi_2, \\ \frac{\alpha_2}{\alpha_1} &= -\frac{d\phi_2}{d\phi_1} = \frac{\tan\phi_1+\cot\phi_1}{\tan\phi_2+\cot\phi_2}. \end{aligned}\right\} \tag{40}$$

§ 67. *Intermittent Linkwork—Click and Ratchet.*—A *click* acting upon a ratchet-wheel or rack, which it pushes or pulls through a certain arc at each forward stroke and leaves at rest at each backward stroke, is an example of intermittent linkwork. During the forward stroke the action of the click is governed by the principles of linkwork; during the backward stroke that action ceases. A *catch* or *pall*, turning on a fixed axis, prevents the ratchet-wheel or rack from reversing its motion.

Division 5.—Trains of Mechanism.

§ 68. *General Principles.—A train of mechanism* consists of a series of pieces each of which is follower to that which drives it and driver to that which follows it.

The comparative motion of the first driver and last follower is obtained by combining the proportions expressing by their terms the velocity ratios and by their signs the directional relations of the several elementary combinations of which the train consists.

§ 69. *Trains of Wheelwork.*—Let A_1, A_2, A_3, &c., A_{m-1}, A_m denote a series of axes, and α_1, α_2, α_3, &c., α_{m-1}, α_m their angular velocities. Let the axis A_1 carry a wheel of N_1 teeth, driving a wheel of n_2 teeth on the axis A_2, which carries also a wheel of N_2 teeth, driving a wheel of n_3 teeth on the axis A_3, and so on; the numbers of teeth in drivers being denoted by N's, and in followers by *n*'s, and the axes to which the wheels are fixed being denoted by numbers. Then the resulting velocity ratio is denoted by

$$\frac{\alpha_m}{\alpha_1} = \frac{\alpha_2}{\alpha_1} \cdot \frac{\alpha_3}{\alpha_2} \cdot \text{\&c.} \ldots \frac{\alpha_m}{\alpha_{m-1}} = \frac{N_1 \,.\, N_2 \,.\,.\, \text{\&c.} \ldots N_{m-1}}{n_2 \,.\, n_3 \,.\,.\, \text{\&c.} \ldots n_m}; \tag{41}$$

that is to say, the velocity ratio of the last and first axes is the ratio of the product of the numbers of teeth in the drivers to the product of the numbers of teeth in the followers.

Supposing all the wheels to be in outside gearing, then, as each elementary combination reverses the direction of rotation, and as the number of elementary combinations $m-1$ is one less than the number of axes m, it is evident that if m is odd the direction of rotation is preserved, and if even reversed.

It is often a question of importance to determine the number of teeth in a train of wheels best suited for giving a determinate velocity ratio to two axes. It was shown by Young that, to do this with the *least total number of teeth*, the velocity ratio of each elementary combination should approximate as nearly as possible to 3·59. This would in many cases give too many axes; and, as a useful practical rule, it may be laid down that from 3 to 6 ought to be the limit of the velocity ratio of an elementary combination in wheelwork. The smallest number of teeth in a pinion for epicycloidal teeth ought to be *twelve* (see § 49)—but it is better, for smoothness of motion, not to go below *fifteen*; and for involute teeth the smallest number is about *twenty-four*.

Let B/C be the velocity ratio required, reduced to its least terms, and let B be greater than C. If B/C is not greater than 6, and C lies between the prescribed minimum number of teeth (which may be called t) and its double $2t$, then one pair of wheels will answer the purpose, and B and C will themselves be the numbers required. Should B and C be inconveniently large, they are, if possible, to be resolved into factors, and those factors (or if they are too small, multiples of them) used for the number of teeth. Should B or C, or both, be at once inconveniently large and prime, then, instead of the exact ratio B/C some ratio approximating to that ratio, and capable of resolution into convenient factors, is to be found by the method of continued fractions.

Should B/C be greater than 6, the best number of elementary combinations $m-1$ will lie between

$$\frac{\log B - \log C}{\log 6} \text{ and } \frac{\log B - \log C}{\log 3}.$$

Then, if possible, B and C themselves are to be resolved each into $m-1$ factors (counting 1 as a factor), which factors, or multiples of them, shall be not less than t nor greater than $6t$; or if B and C contain inconveniently large prime factors, an approximate velocity ratio, found by the method of continued fractions, is to be substituted for B/C as before.

So far as the resultant velocity ratio is concerned, the *order* of the drivers N and of the followers n is immaterial: but to secure equable wear of the teeth, as explained in § 44, the wheels ought to be so arranged that, for each elementary combination, the greatest common divisor of N and n shall be either 1, or as small as possible.

§ 70. *Double Hooke's Coupling.*—It has been shown in § 66 that the velocity ratio of a pair of shafts coupled by a universal joint fluctuates between the limits $\cos\theta$ and $1/\cos\theta$. Hence one or both of the shafts must have a vibratory and unsteady motion, injurious to the mechanism and framework. To obviate this evil a short intermediate shaft is introduced, making equal angles with the first and last shaft, coupled with each of them by a Hooke's joint, and having its own two forks in the same plane. Let α_1, α_2, α_3 be the angular velocities of the first, intermediate, and last shaft in this *train of two Hooke's couplings*. Then, from the principles of § 60 it is evident that at each instant $\alpha_2/\alpha_1 = \alpha_2/\alpha_3$, and consequently that $\alpha_3 = \alpha_1$; so that the fluctuations of angular velocity ratio caused by the first coupling are exactly neutralized by the second, and the first and last shafts have equal angular velocities at each instant.

§ 71. *Converging and Diverging Trains of Mechanism.*—Two or more trains of mechanism may *converge* into one—as when the two pistons of a pair of steam-engines, each through its own connecting-rod, act upon one crank-shaft. One train of mechanism may *diverge* into two or more—as when a single shaft, driven by a prime mover, carries several pulleys, each of which drives a different machine. The principles of comparative motion in such converging and diverging trains are the same as in simple trains.

Division 6.—Aggregate Combinations.

§ 72. *General Principles.*—Willis designated as "aggregate combinations" those assemblages of pieces of mechanism in which the motion of one follower is the *resultant* of component motions impressed on it by more than one driver. Two classes of aggregate combinations may be distinguished which, though not different in their actual nature, differ in the *data* which they present to the designer, and in the method of solution to be followed in questions respecting them.

Class I. comprises those cases in which a piece A is not carried directly by the frame C, but by another piece B, *relatively* to which the motion of A is given—the motion of the piece B relatively to the frame C being also given. Then the motion of A relatively to the frame C is the *resultant* of the motion of A relatively to B and of B relatively to C; and that resultant is to be found by the principles already explained in Division 3 of this Chapter §§ 27-32.

Class II. comprises those cases in which the motions of three points in one follower are determined by their connexions with two or with three different drivers.

This classification is founded on the kinds of problems arising from the combinations. Willis adopts another classification founded on the *objects* of the combinations, which objects he divides into two classes, viz. (1) to produce *aggregate velocity*, or a velocity which is the resultant of two or more components in the same path, and (2) to produce *an aggregate path*—that is, to make a given point in a rigid body move in an assigned path by communicating certain motions to other points in that body.

It is seldom that one of these effects is produced without at the same time producing the other; but the classification of Willis depends upon which of those two effects, even supposing them to occur together, is the practical object of the mechanism.

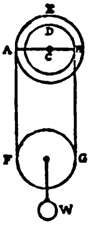


FIG. 112.

§ 73. *Differential Windlass.*—The axis C (fig. 112) carries a larger barrel AE and a smaller barrel DB, rotating as one piece with the angular velocity α_1 in the direction AE. The pulley or *sheave* FG has a weight W hung to its centre. A cord has one end made fast to and wrapped round the barrel AE; it passes from A under the sheave FG, and has the other end wrapped round and made fast to the barrel BD. Required the relation between the velocity of translation v_2 of W and the angular velocity α_1 of the *differential barrel*.

In this case v_2 is an *aggregate velocity*, produced by the joint action of the two drivers AE and BD, transmitted by wrapping connectors to FG, and combined by that sheave so as to act on the follower W, whose motion is the same with that of the centre of FG.

The velocity of the point F is $\alpha_1 . \mathrm{AC}$, *upward* motion being considered positive. The velocity of the point G is $-\alpha_1 . \mathrm{CB}$, *downward* motion being negative. Hence the instantaneous axis of the sheave FG is in the diameter FG, at the distance

$$\frac{\mathrm{FG}}{2} \cdot \frac{\mathrm{AC}-\mathrm{BC}}{\mathrm{AC}+\mathrm{BC}}$$

from the centre towards G; the angular velocity of the sheave is

$$\alpha_2 = \alpha_1 \cdot \frac{\mathrm{AC}+\mathrm{BC}}{\mathrm{FG}};$$

and, consequently, the velocity of its centre is

$$v_2 = \alpha_2 \cdot \frac{\mathrm{FG}}{2} \cdot \frac{\mathrm{AC}-\mathrm{BC}}{\mathrm{AC}+\mathrm{BC}} = \frac{\alpha_1(\mathrm{AC}-\mathrm{BC})}{2}, \qquad (42)$$

or the *mean between the velocities of the two vertical parts of the cord*.

If the cord be fixed to the framework at the point B, instead of being wound on a barrel, the velocity of W is half that of AF.

A case containing several sheaves is called a *block*. A *fall-block* is attached to a fixed point; a *running-block* is movable to and from a fall-block, with which it is connected by two or more plies of a rope. The whole combination constitutes a *tackle* or *purchase*. (See PULLEYS for practical applications of these principles.)

§ 74. *Differential Screw.*—On the same axis let there be two screws of the respective pitches p_1 and p_2, made in one piece, and rotating with the angular velocity α. Let this piece be called B. Let the first screw turn in a fixed nut C, and the second in a sliding nut A. The velocity of advance of B relatively to C is (according to § 32) αp_1, and of A relatively to B (according to § 57) $-\alpha p_2$; hence the velocity of A relatively to C is

$$\alpha(p_1-p_2), \qquad (46)$$

being the same with the velocity of advance of a screw of the pitch p_1-p_2. This combination, called *Hunter's* or the *differential screw*, combines the strength of a large thread with the slowness of motion due to a small one.

§ 75. *Epicyclic Trains.*—The term *epicyclic train* is used by Willis to denote a train of wheels carried by an arm, and having certain rotations relatively to that arm, which itself rotates. The arm may either be driven by the wheels or assist in driving them. The comparative motions of the wheels and of the arm, and the *aggregate paths* traced by points in the wheels, are determined by the principles of the composition of rotations, and of the description of rolling curves, explained in §§ 30, 31.

§ 76. *Link Motion.*—A slide valve operated by a link motion receives an aggregate motion from the mechanism driving it. (See STEAM-ENGINE for a description of this and other types of mechanism of this class.)

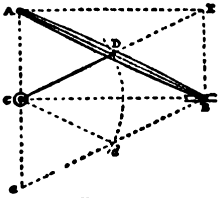


FIG 113.

§ 77. *Parallel Motions.*—A *parallel motion* is a combination of turning pieces in mechanism designed to guide the motion of a reciprocating piece either exactly or approximately in a straight line, so as to avoid the friction which arises from the use of straight guides for that purpose.

Fig. 113 represents an exact parallel motion, first proposed, it is believed, by Scott Russell. The arm CD turns on the axis C, and is jointed at D to the middle of the bar ADB, whose length is double of that of CD, and one of whose ends B is jointed to a slider, sliding in straight guides along the line CB. Draw BE perpendicular to CB, cutting CD produced in E, then E is the instantaneous axis of the bar ADB; and the direction of motion of A is at every instant perpendicular to EA—that is, along the straight line AC*a*. While the stroke of A is AC*a*, extending to equal distances on either side of C, and equal to twice the chord of the arc D*d*, the stroke of B is only equal to twice the sagitta; and thus A is guided through a comparatively long stroke by the sliding of B through a comparatively short stroke, and by rotatory motions at the joints C, D, B.

§ 78.* An example of an approximate straight-line motion composed of three bars fixed to a frame is shown in fig. 114. It is due to P. L. Tchebichev of St Petersburg. The links AB and CD are equal in length and are centred respectively at A and C. The ends D and B are joined by a link DB. If the respective lengths are made in the proportions AC:CD:DB=1:1·3:0·4 the middle point P of DB will describe an approximately straight line parallel to AC within limits of length about equal to AC. C. N. Peaucellier, a French engineer officer, was the first, in 1864, to invent a linkwork with which an exact straight line could be drawn. The linkwork is shown in fig. 115, from which it will be seen that it consists of a rhombus of four equal bars ABCD, jointed at opposite corners with two equal bars BE and DE. The seventh link AF is equal in length to half the distance EA when the mechanism is in its central position. The points E and F are fixed. It can be proved that the point C always moves in a straight line at right angles to the line EF. The more general property of the mechanism corresponding to proportions between the lengths FA and EF other than that of equality is that the curve described by the point C is the inverse of the curve described by A. There are other arrangements of bars giving straight-line motions, and these arrangements together with the general properties of mechanisms of this kind are discussed in *How to Draw a Straight Line* by A. B. Kempe (London, 1877).

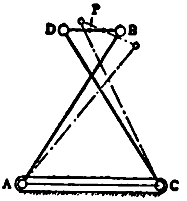


FIG. 114.

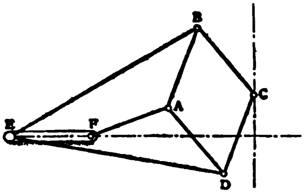


FIG. 115.

§ 79.* *The Pantograph.*—If a parallelogram of links (fig. 116), be fixed at any one point *a* in any one of the links produced in either direction, and if any straight line be drawn from this point to cut the links in the points *b* and *c*, then the points *a*, *b*, *c* will be in a straight line for all positions of the mechanism, and if the point *b* be guided in any curve whatever, the point *c* will trace a similar curve to a scale enlarged in the ratio *ab* : *ac*. This property of the parallelogram is utilized in the construction of the pantograph, an instrument used for obtaining a copy of a map or drawing on a different scale. Professor J. J. Sylvester discovered that this property of the parallelogram is not confined to points lying in one line with the fixed point. Thus if *b* (fig. 117) be any point on the link CD, and if a point *c* be taken on the link DE such that the triangles C*b*D and D*c*E are similar and similarly situated with regard to their respective links, then the ratio of the distances *ab* and *ac* is constant, and the angle *bac* is constant for all positions of the mechanism; so that, if *b* is guided in any curve, the point *c* will describe a similar curve turned through an angle *bac*, the scales of the curves being in the ratio *ab* to *ac*. Sylvester called an instrument based on this property a plagiograph or a skew pantograph.

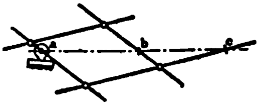


FIG. 116.

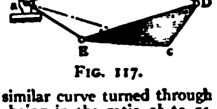


FIG. 117.

The combination of the parallelogram with a straight-line motion, for guiding one of the points in a straight line, is illustrated in Watt's parallel motion for steam-engines. (See STEAM-ENGINE.)

§ 80.* *The Reuleaux System of Analysis.*—If two pieces, A and B. (fig. 118) are jointed together by a pin, the pin being fixed, say, to A the only relative motion possible between the pieces is one of turning about the axis of the pin. Whatever motion the pair of pieces may have as a whole each separate piece shares in common, and this common motion in no way affects the relative motion of A and B. The motion of one piece is said to be completely constrained relatively to the other piece. Again, the pieces A and B (fig. 119) are paired together as a slide, and the only relative motion possible between them now is that of sliding, and therefore the motion of one relatively to the other is completely constrained. The pieces may be paired together as a screw and nut, in which case the relative motion is compounded of turning with sliding.

These combinations of pieces are known individually as ***kinematic pairs of elements***, or briefly ***kinematic pairs***. The three pairs mentioned above have each the peculiarity that contact between the two pieces forming the pair is distributed over a surface. Kinematic pairs which have surface contact are classified as *lower pairs*. Kinematic pairs in which contact takes place along a line only are classified as *higher pairs*. A pair of spur wheels in gear is an example of a higher pair, because the wheels have contact between their teeth along lines only.

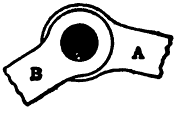


FIG. 118.

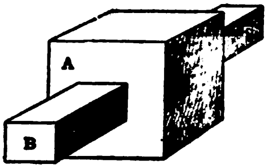


FIG. 119.

A ***kinematic link*** of the simplest form is made by joining up the halves of two kinematic pairs by means of a rigid link. Thus if A_1B_1 represent a turning pair, and A_2B_2 a second turning pair, the rigid link formed by joining B_1 to B_2 is a kinematic link. Four links of this kind are shown in fig. 120 joined up to form a ***closed kinematic chain***.

In order that a kinematic chain may be made the basis of a mechanism, every point in any link of it must be completely constrained with regard to every other link. Thus in fig. 120 the motion of a point *a* in the link A_1A_2 is completely constrained with regard to the link B_1B_4 by the turning pair A_1B_1, and it can be proved that the motion of *a* relatively to the non-adjacent link A_3A_4 is completely constrained, and therefore the four-bar chain, as it is called, can be and is used as the basis of many mechanisms. Another way of considering the question of constraint is to imagine any one link of the chain fixed; then, however the chain be moved, the path of a point, as *a*, will always remain the same. In a five-bar chain, if *a* is a point in a link non-adjacent to a fixed link, its path is indeterminate. Still another way of stating the matter is to say that, if any one link in the chain be fixed, any point in the chain must have only one degree of freedom. In a five-bar chain a point, as *a*, in a link non-adjacent to the fixed link has two degrees of freedom and the chain cannot therefore be used for a mechanism. These principles may be applied to examine any possible combination of links forming a kinematic chain in order to test its suitability for use as a mechanism. Compound chains are formed by the super-position of two or more simple chains, and in these more complex chains links will be found carrying three, or even more, halves of kinematic pairs. The Joy valve gear mechanism is a good example of a compound kinematic chain.

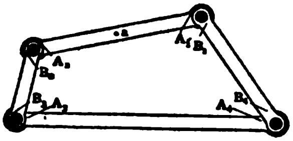


FIG. 120.

A chain built up of three turning pairs and one sliding pair, and known as the *slider crank chain*, is shown in fig. 121. It will be seen that the piece A_1 can only slide relatively to the piece B_1, and these two pieces therefore form the sliding pair. The piece A_1 carries the pin B_4, which is one half of the turning pair A_4 B_4. The piece A_1 together with the pin B_4 therefore form a kinematic link A_1B_4. The other links of the chain are, B_1A_2, B_2B_3, A_3A_4. In order to convert a chain into a mechanism it is necessary to fix one link in it. Any one of the links may be fixed. It follows therefore that there are as many possible mechanisms as there are links in the chain. For example, there is a well-known mechanism corresponding to the fixing of three of the four links of the slider crank chain (fig. 121). If the link *d* is fixed the chain at once becomes the mechanism of the ordinary steam engine; if the link *e* is fixed the mechanism obtained is that of the oscillating cylinder steam engine; if the link *c* is fixed the mechanism becomes either the Whitworth quick-return motion or the slot-bar motion, depending upon the proportion between the lengths of the links *c* and *e*. These different mechanisms are called *inversions* of the slider crank chain. What was the fixed framework of the mechanism in one case becomes a moving link in an inversion.

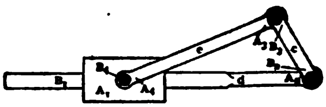


FIG. 121.

The Reuleaux system, therefore, consists essentially of the analysis of every mechanism into a kinematic chain, and since each link of the chain may be the fixed frame of a mechanism quite diverse mechanisms are found to be merely inversions of the same kinematic chain. Franz Reuleaux's *Kinematics of Machinery*, translated by Sir A. B. W. Kennedy (London, 1876), is the book in which the system is set forth in all its completeness. In *Mechanics of Machinery*, by Sir A. B. W. Kennedy (London, 1886), the system was used for the first time in an English textbook, and now it has found its way into most modern textbooks relating to the subject of mechanism.

§ 81.* *Centrodes, Instantaneous Centres, Velocity Image, Velocity Diagram.*—Problems concerning the relative motion of the several parts of a kinematic chain may be considered in two ways, in addition to the way hitherto used in this article and based on the principle of § 34. The first is by the method of instantaneous centres, already exemplified in § 63, and rolling centroids, developed by Reuleaux in connexion with his method of analysis. The second is by means of Professor R. H. Smith's method already referred to in § 23.

Method 1.—By reference to § 30 it will be seen that the motion of a cylinder rolling on a fixed cylinder is one of rotation about an instantaneous axis T, and that the velocity both as regards direction and magnitude is the same as if the rolling piece B were for the instant turning about a fixed axis coincident with the instantaneous axis. If the rolling cylinder B and its path A now be assumed to receive a common plane motion, what was before the velocity of the point P becomes the velocity of P relatively to the cylinder A, since the motion of B relatively to A still takes place about the instantaneous axis T. If B stops rolling, then the two cylinders continue to move as though they were parts of a rigid body. Notice that the shape of either rolling curve (fig. 91 or 92) may be found by considering each fixed in turn and then tracing out the locus of the instantaneous axis. These rolling cylinders are sometimes called axodes, and a section of an axode in a plane parallel to the plane of motion is called a centrode. The axode is hence the locus of the instantaneous axis, whilst the centrode is the locus of the instantaneous centre in any plane parallel to the plane of motion. There is no restriction on the shape of these rolling axodes; they may have any shape consistent with rolling (that is, no slipping is permitted), and the relative velocity of a point P is still found by considering it with regard to the instantaneous centre.

Reuleaux has shown that the relative motion of any pair of non-adjacent links of a kinematic chain is determined by the rolling together of two ideal cylindrical surfaces (cylindrical being used here in the general sense), each of which may be assumed to be formed by the extension of the material of the link to which it corresponds. These surfaces have contact at the instantaneous axis, which is now called the instantaneous axis of the two links concerned. To find the form of these surfaces corresponding to a particular pair of non-adjacent links, consider each link of the pair fixed in turn, then the locus of the instantaneous axis is the axode corresponding to the fixed link, or, considering a plane of motion only, the locus of the instantaneous centre is the centrode corresponding to the fixed link.

To find the instantaneous centre for a particular link corresponding to any given configuration of the kinematic chain, it is only necessary to know the direction of motion of any two points in the link, since lines through these points respectively at right angles to their directions of motion intersect in the instantaneous centre.

To illustrate this principle, consider the four-bar chain shown in fig. 122 made up of the four links, *a*, *b*, *c*, *d*. Let *a* be the fixed link, and consider the link *c*. Its extremities are moving respectively in directions at right angles to the links *b* and *d*; hence produce the links *b* and *d* to meet in the point O_{ac}. This point is the instantaneous centre of the motion of the link *c* relatively to the fixed link *a*, a fact indicated by the suffix *ac* placed after the letter O. The process being repeated for different values of the angle *θ* the curve through the several points O_{ac} is the centroid which may be imagined as formed by an extension of the material of the link *a*. To find the corresponding centroid for the link *c*, fix *c* and repeat the process. Again, imagine *d* fixed, then the instantaneous centre O_{bd} of *b* with regard to *d* is found by producing the links *c* and *a* to intersect in O_{bd}, and the shapes of the centroids belonging respectively to the links *b* and *d* can be found as before. The axis about which a pair of adjacent links turn is a permanent axis, and is of course the axis

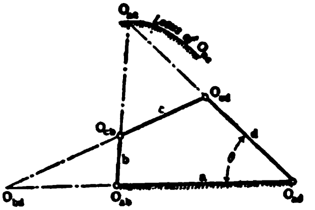


FIG. 122.

of the pin which forms the point. Adding the centres corresponding to these several axes to the figure, it will be seen that there are six centres in connexion with the four-bar chain of which four are permanent and two are instantaneous or virtual centres; and, further, that whatever be the configuration of the chain these centres group themselves into three sets of three, each set lying on a straight line. This peculiarity is not an accident or a special property of the four-bar chain, but is an illustration of a general law regarding the subject discovered by Aronhold and Sir A. B. W. Kennedy independently, which may be thus stated: If any three bodies, *a*, *b*, *c*, have plane motion their three virtual centres, O_{ab}, O_{bc}, O_{ac}, are three points on one straight line. A proof of this will be found in *The Mechanics of Machinery* quoted above. Having obtained the set of instantaneous centres for a chain, suppose *a* is the fixed link of the chain and *c* any other link; then O_{ac} is the instantaneous centre of the two links and may be considered for the instant as the trace of an axis fixed to an extension of the link *a* about which *c* is turning, and thus problems of instantaneous velocity concerning the link *c* are solved as though the link *c* were merely rotating for the instant about a fixed axis coincident with the instantaneous axis.

Method 2.—The second method is based upon the vector representation of velocity, and may be illustrated by applying it to the four-bar chain. Let AD (fig. 123) be the fixed link. Consider the link BC, and let it be required to find the velocity of the point B having given the velocity of the point C. The principle upon which the solution is based is that the only motion which B can have relatively to an axis through C fixed to the link CD is one of turning about C. Choose any pole O (fig. 124). From this pole set out O*c* to represent the velocity of the point C. The direction of this must be at right angles to the line CD, because this is the only direction possible to the point C. If the link BC moves without turning, O*c* will also represent the velocity of the point B; but, if the link is turning, B can only move about the axis C, and its direction of motion is therefore at right angles to the line CB. Hence set out the possible direction of B's motion in the velocity diagram, namely cb_1, at right angles to CB. But the point B must also move at right angles to AB in the case under consideration. Hence draw a line through O in the velocity diagram at right angles to AB to cut cb_1 in *b*. Then O*b* is the velocity of the point *b* in magnitude and direction, and *cb* is the tangential velocity of B relatively to C. Moreover, whatever be the actual magnitudes of the velocities, the instantaneous velocity ratio of the points C and B is given by the ratio O*c*/O*b*.

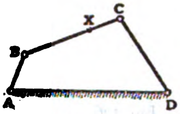


FIG. 123.

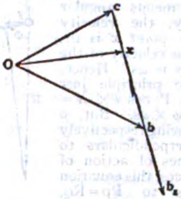


FIG. 124.

A most important property of the diagram (figs. 123 and 124) is the following: If points X and *x* are taken dividing the link BC and the tangential velocity *cb*, so that $cx : xb = CX : XB$, then O*x* represents the velocity of the point X in magnitude and direction. The line *cb* has been called the *velocity image* of the rod, since it may be looked upon as a scale drawing of the rod turned through 90° from the actual rod. Or, put in another way, if the link CB is drawn to scale on the new length *cb* in the velocity diagram (fig. 124), then a vector drawn from O to any point on the new drawing of the rod will represent the velocity of that point of the actual rod in magnitude and direction. It will be understood that there is a new velocity diagram for every new configuration of the mechanism, and that in each new diagram the image of the rod will be different in scale. Following the method indicated above for a kinematic chain in general, there will be obtained a velocity diagram similar to that of fig. 124 for each configuration of the mechanism, a diagram in which the velocity of the several points in the chain utilized for drawing the diagram will appear to the same scale, all radiating from the pole O. The lines joining the ends of these several velocities are the several tangential velocities, each being the velocity image of a link in the chain. These several images are not to the same scale, so that although the images may be considered to form collectively an image of the chain itself, the several members of this chain-image are to different scales in any one velocity diagram, and thus the chain-image is distorted from the actual proportions of the mechanism which it represents.

§ 82.* *Acceleration Diagram. Acceleration Image.*—Although it is possible to obtain the acceleration of points in a kinematic chain with one link fixed by methods which utilize the instantaneous centres of the chain, the vector method more readily lends itself to this purpose. It should be understood that the instantaneous centre considered in the preceding paragraphs is available only for estimating relative velocities; it cannot be used in a similar manner for questions regarding acceleration. That is to say, although the instantaneous centre is a centre of no velocity for the instant, it is not a centre of no acceleration, and in fact the centre of no acceleration is in general a quite different point. The general principle on which the method of drawing an acceleration diagram depends is that if a link CB (fig. 125) have plane motion and the acceleration of any point C be given in magnitude and direction, the acceleration of any other point B is the vector sum of the acceleration of C, the radial acceleration of B about C and the tangential acceleration of B about C. Let A be any origin, and let A*c* represent the acceleration of the point C, *ct* the radial acceleration of B about C which must be in a direction parallel to BC, and *tb* the tangential acceleration of B about C, which must of course be at right angles to *ct*; then the vector sum of these three magnitudes is A*b*, and this vector represents the acceleration of the point B. The directions of the radial and tangential accelerations of the point B are always known when the position of the link is assigned, since these are to be drawn respectively parallel to and at right angles to the link itself. The magnitude of the radial acceleration is given by the expression v^2/BC, v being the velocity of the point B about the point C. This velocity can always be found from the velocity diagram of the chain of which the link forms a part. If $d\omega/dt$ is the angular acceleration of the link, $d\omega/dt \times CB$ is the tangential acceleration of the point B about the point C. Generally this tangential acceleration is unknown in magnitude, and it becomes part of the problem to find it. An important property of the diagram is that if points X and *x* are taken dividing the link CB and the whole acceleration of B about C, namely, *cb* in the same ratio, then A*x* represents the acceleration of the point X in magnitude and direction; *cb* is called the acceleration image of the rod. In applying this principle to the drawing of an acceleration diagram for a mechanism, the velocity diagram of the mechanism must be first drawn in order to afford the means of calculating the several radial accelerations of the links. Then assuming that the acceleration of one point of a particular link of the mechanism is known together with the corresponding configuration of the mechanism, the two vectors A*c* and *ct* can be drawn. The direction of *tb*, the third vector in the diagram, is also known, so that the problem is reduced to the condition that *b* is somewhere on the line *tb*. Then other conditions consequent upon the fact that the link forms part of a kinematic chain operate to enable *b* to be fixed. These methods are set forth and exemplified in *Graphics*, by R. H. Smith (London, 1889). Examples, completely worked out, of velocity and acceleration diagrams for the slider crank chain, the four-bar chain, and the mechanism of the Joy valve gear will be found in ch. ix. of *Valves and Valve Gear Mechanism*, by W. E. Dalby (London, 1906).

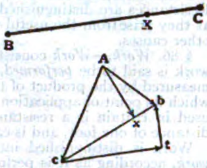


FIG. 125.

CHAPTER II. ON APPLIED DYNAMICS

§ 83. *Laws of Motion.*—The action of a machine in transmitting *force* and *motion* simultaneously, or performing *work*, is governed, in common with the phenomena of moving bodies in general, by two "laws of motion."

Division 1. Balanced Forces in Machines of Uniform Velocity.

§ 84. *Application of Force to Mechanism.*—Forces are applied in units of weight; and the unit most commonly employed in Britain is the *pound avoirdupois*. The action of a force applied to a body is always in reality distributed over some definite space, either a volume of three dimensions or a surface of two. An example of a force distributed throughout a volume is the *weight* of the body itself, which acts on every particle, however small. The *pressure* exerted between two bodies at their surface of contact, or between the two parts of one body on either side of an ideal surface of separation, is an example of a force distributed over a surface. The mode of distribution of a force applied to a solid body requires to be considered when its stiffness and strength are treated of; but, in questions respecting the action of a force upon a rigid body considered as a whole, the *resultant* of the distributed force, determined according to the principles of statics, and considered as acting in a *single line* and applied at a *single point*, may, for the occasion, be substituted for the force as really distributed. Thus, the weight of each separate piece in a machine is treated as acting wholly at its *centre of gravity*, and each pressure applied to it as acting at a point called the *centre of pressure* of the surface to which the pressure is really applied.

§ 85. *Forces applied to Mechanism Classed.*—If θ be the *obliquity* of a force F applied to a piece of a machine—that is, the angle made by the direction of the force with the direction of motion of its point of application—then by the principles of statics, F may be resolved into two rectangular components, viz.:—

$$\left.\begin{aligned}\text{Along the direction of motion, } P&=F\cos\theta\\ \text{Across the direction of motion, } Q&=F\sin\theta\end{aligned}\right\} \tag{49}$$

If the component along the direction of motion acts *with* the motion, it is called an *effort*; if *against* the motion, a *resistance*. The component *across* the direction of motion is a *lateral pressure*; the unbalanced lateral pressure on any piece, or part of a piece, is *deflecting force*. A lateral pressure may increase resistance by causing friction; the friction so caused acts against the motion, and is a resistance, but the lateral pressure causing it is not a resistance. Resistances are distinguished into *useful* and *prejudicial*, according as they arise from the useful effect produced by the machine or from other causes.

§ 86. *Work.—Work* consists in moving against resistance. The work is said to be *performed*, and the resistance *overcome*. Work is measured by the product of the resistance into the distance through which its point of application is moved. The *unit of work* commonly used in Britain is a resistance of one pound overcome through a distance of one foot, and is called a *foot-pound*.

Work is distinguished into *useful work* and *prejudicial* or *lost work*, according as it is performed in producing the useful effect of the machine, or in overcoming prejudicial resistance.

§ 87. *Energy: Potential Energy.—Energy* means *capacity for performing work*. The *energy of an effort*, or *potential energy*, is measured by the product of the effort into the distance through which its point of application is *capable* of being moved. The unit of energy is the same with the unit of work.

When the point of application of an effort *has been moved* through a given distance, energy is said to have been *exerted* to an amount expressed by the product of the effort into the distance through which its point of application has been moved.

§ 88. *Variable Effort and Resistance.*—If an effort has different magnitudes during different portions of the motion of its point of application through a given distance, let each different magnitude of the effort P be multiplied by the length Δs of the corresponding portion of the path of the point of application; the sum

$$\Sigma\,.\,P\Delta s \qquad (50)$$

is the whole energy exerted. If the effort varies by insensible gradations, the energy exerted is the integral or limit towards which that sum approaches continually as the divisions of the path are made smaller and more numerous, and is expressed by

$$\int P ds. \qquad (51)$$

Similar processes are applicable to the finding of the work performed in overcoming a varying resistance.

The work done by a machine can be actually measured by means of a dynamometer (*q.v.*).

§ 89. *Principle of the Equality of Energy and Work.*—From the first law of motion it follows that in a machine whose pieces move with uniform velocities the efforts and resistances must balance each other. Now from the laws of statics it is known that, in order that a system of forces applied to a system of connected points may be in equilibrium, it is necessary that the sum formed by putting together the products of the forces by the respective distances through which their points of application are capable of moving simultaneously, each along the direction of the force applied to it, shall be zero,—products being considered positive or negative according as the direction of the forces and the possible motions of their points of application are the same or opposite.

In other words, the sum of the negative products is equal to the sum of the positive products. This principle, applied to a machine whose parts move with uniform velocities, is equivalent to saying that in any given interval of time *the energy exerted is equal to the work performed*.

The symbolical expression of this law is as follows: let efforts be applied to one or any number of points of a machine; let any one of these efforts be represented by P, and the distance traversed by its point of application in a given interval of time by ds; let resistances be overcome at one or any number of points of the same machine; let any one of these resistances be denoted by R, and the distance traversed by its point of application in the given interval of time by ds'; then

$$\Sigma\,.\,Pds = \Sigma\,.\,Rds'. \qquad (52)$$

The lengths ds, ds' are proportional to the velocities of the points to whose paths they belong, and the proportions of those velocities to each other are deducible from the construction of the machine by the principles of pure mechanism explained in Chapter I.

§ 90.* *Static Equilibrium of Mechanisms.*—The principle stated in the preceding section, namely, that the energy exerted is equal to the work performed, enables the ratio of the components of the forces acting in the respective directions of motion at two points of a mechanism, one being the point of application of the effort, and the other the point of application of the resistance, to be readily found. Removing the summation signs in equation (52) in order to restrict its application to two points and dividing by the common time interval during which the respective small displacements ds and ds' were made, it becomes $Pds/dt = Rds'/dt$, that is, $Pv = Rv'$, which shows that the force ratio is the inverse of the velocity ratio. It follows at once that any method which may be available for the determination of the velocity ratio is equally available for the determination of the force ratio, it being clearly understood that the forces involved are the components of the actual forces resolved in the direction of motion of the points. The relation between the effort and the resistance may be found by means of this principle for all kinds of mechanisms, when the friction produced by the components of the forces across the direction of motion of the two points is neglected. Consider the following example:—

A four-bar chain having the configuration shown in fig. 126 supports a load P at the point x. What load is required at the point y to maintain the configuration shown, both loads being supposed to act vertically? Find the instantaneous centre O_{bd}, and resolve each load in the respective directions of motion of the points x and y; thus there are obtained the components P cos θ and R cos ϕ. Let the mechanism have a small motion; then, for the instant, the link b is turning about its instantaneous centre O_{bd}, and, if ω is its instantaneous angular velocity, the velocity of the point x is ωr, and the velocity of the point y is ωs. Hence, by the principle just stated, $P \cos\theta \times \omega r = R \cos\phi \times \omega s$. But, p and q being respectively the perpendiculars to the lines of action of the forces, this equation reduces to $Pp = Rq$, which shows that the ratio of the two forces may be found by taking moments about the instantaneous centre of the link on which they act.

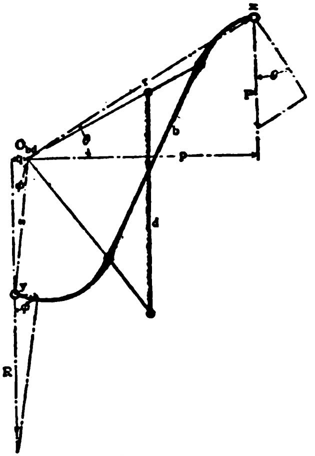


FIG. 126.

The forces P and R may, however, act on different links. The general problem may then be thus stated: Given a mechanism of which r is the fixed link, and s and t any other two links, given also a force f_s acting on the link s, to find the force f_t acting in a given direction on the link t, which will keep the mechanism in static equilibrium. The graphic solution of this problem may be effected thus:—

(1) Find the three virtual centres O_{rs}, O_{rt}, O_{st}, which must be three points in a line.

(2) Resolve f_s into two components, one of which, namely, f_q, passes through O_{rs}, and may be neglected, and the other f_p passes through O_{st}.

(3) Find the point M, where f_p joins the given direction of f_t, and resolve f_p into two components, of which one is in the direction MO_{rt} and may be neglected because it passes through O_{rt}, and the other is in the given direction of f_t and is therefore the force required.

This statement of the problem and the solution is due to Sir A. B. W. Kennedy, and is given in ch. 8 of his *Mechanics of Machinery*. Another general solution of the problem is given in the *Proc. Lond. Math. Soc.* (1878–1879), by the same author. An example of the method of solution stated above, and taken from the *Mechanics of Machinery*, is illustrated by the mechanism fig. 127, which is an epicyclic train of three wheels with the first wheel r fixed. Let it be required to find the vertical force which must act at the pitch radius of the last wheel t to balance exactly a force f_s acting vertically downwards on the arm at the point indicated in the figure. The two links concerned are the last wheel t and the arm s, the wheel r being the fixed link of the mechanism. The virtual centres O_{rs}, O_{st} are at the respective axes of the wheels r and t, and the centre O_{rt} divides the line through these two points externally in the ratio of the train of wheels. The figure sufficiently indicates the various steps of the solution.

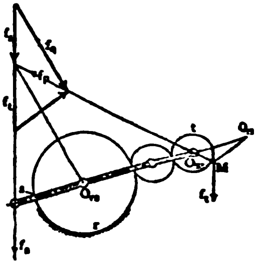


FIG. 127.

The relation between the effort and the resistance in a machine to include the effect of friction at the joints has been investigated in a paper by Professor Fleeming Jenkin, "On the application of graphic methods to the determination of the efficiency of machinery"

(*Trans. Roy. Soc. Ed.*, vol. 28). It is shown that a machine may at any instant be represented by a frame of links the stresses in which are identical with the pressures at the joints of the mechanism. This self-strained frame is called the *dynamic frame* of the machine. The driving and resisting efforts are represented by elastic links in the dynamic frame, and when the frame with its elastic links is drawn the stresses in the several members of it may be determined by means of reciprocal figures. Incidentally the method gives the pressures at every joint of the mechanism.

§ 91. *Efficiency.*—The *efficiency* of a machine is the ratio of the *useful* work to the *total* work—that is, to the energy exerted—and is represented by

$$\frac{\Sigma\,.\,\mathrm{R}_u ds'}{\Sigma\,.\,\mathrm{R}ds'}=\frac{\Sigma\,.\,\mathrm{R}_u ds'}{\Sigma\,.\,\mathrm{R}_u ds'+\Sigma\,.\,\mathrm{R}_p ds'}=\frac{\Sigma\,.\,\mathrm{R}_u ds'}{\Sigma\,.\,\mathrm{P}ds}=\frac{\mathrm{U}}{\mathrm{E}}. \tag{53}$$

R_u being taken to represent useful and R_p prejudicial resistances. The more nearly the efficiency of a machine approaches to unity the better is the machine.

§ 92. *Power and Effect.*—The *power* of a machine is the energy exerted, and the *effect* the useful work performed, in some interval of time of definite length, such as a second, an hour, or a day.

The unit of power, called conventionally a *horse-power*, is 550 foot-pounds per second, or 33,000 foot-pounds per minute, or 1,980,000 foot-pounds per hour.

§ 93. *Modulus of a Machine.*—In the investigation of the properties of a machine, the useful resistances to be overcome and the useful work to be performed are usually given. The prejudicial resistances are generally functions of the useful resistances of the weights of the pieces of the mechanism, and of their form and arrangement; and, having been determined, they serve for the computation of the *lost* work, which, being added to the useful work, gives the expenditure of energy required. The result of this investigation, expressed in the form of an equation between this energy and the useful work, is called by Moseley the *modulus* of the machine. The general form of the modulus may be expressed thus—

$$\mathrm{E}=\mathrm{U}+\phi(\mathrm{U},\,\mathrm{A})+\psi(\mathrm{A}), \tag{54}$$

where A denotes some quantity or set of quantities depending on the form, arrangement, weight and other properties of the mechanism. Moseley, however, has pointed out that in most cases this equation takes the much more simple form of

$$\mathrm{E}=(1+\mathrm{A})\mathrm{U}+\mathrm{B}, \tag{55}$$

where A and B are *constants*, depending on the form, arrangement and weight of the mechanism. The efficiency corresponding to the last equation is

$$\frac{\mathrm{U}}{\mathrm{E}}=\frac{1}{1+\mathrm{A}+\mathrm{B}/\mathrm{U}}. \tag{56}$$

§ 94. *Trains of Mechanism.*—In applying the preceding principles to a train of mechanism, it may either be treated as a whole, or it may be considered in sections consisting of single pieces, or of any convenient portion of the train—each section being treated as a machine driven by the effort applied to it and energy exerted upon it through its line of connexion with the preceding section, performing useful work by driving the following section, and losing work by overcoming its own prejudicial resistances. It is evident that *the efficiency of the whole train is the product of the efficiencies of its sections.*

§ 95. *Rotating Pieces: Couples of Forces.*—It is often convenient to express the energy exerted upon and the work performed by a turning piece in a machine in terms of the *moment* of the *couples of forces* acting on it, and of the angular velocity. The ordinary British unit of moment is a *foot-pound*; but it is to be remembered that this is a foot-pound of a different sort from the unit of energy and work.

If a force be applied to a turning piece in a line not passing through its axis, the axis will press against its bearings with an equal and parallel force, and the equal and opposite reaction of the bearings will constitute, together with the first-mentioned force, a couple whose arm is the perpendicular distance from the axis to the line of action of the first force.

A couple is said to be *right* or *left handed* with reference to the observer, according to the direction in which it tends to turn the body, and is a *driving* couple or a *resisting* couple according as its tendency is with or against that of the actual rotation.

Let dt be an interval of time, α the angular velocity of the piece; then αdt is the angle through which it turns in the interval dt, and $ds = vdt = r\alpha dt$ is the distance through which the point of application of the force moves. Let P represent an effort, so that Pr is a driving couple, then

$$\mathrm{P}ds=\mathrm{P}vdt=\mathrm{P}r\alpha dt=\mathrm{M}\alpha dt \tag{57}$$

is the energy exerted by the couple M in the interval dt; and a similar equation gives the work performed in overcoming a resisting couple. When several couples act on one piece, the resultant of their moments is to be multiplied by the common angular velocity of the whole piece.

§ 96. *Reduction of Forces to a given Point, and of Couples to the Axis of a given Piece.*—In computations respecting machines it is often convenient to substitute for a force applied to a given point, or a couple applied to a given piece, the *equivalent* force or couple applied to some other point or piece; that is to say, the force or couple, which, if applied to the other point or piece, would exert equal energy or employ equal work. The principles of this reduction are that the ratio of the given to the equivalent force is the reciprocal of the ratio of the velocities of their points of application, and the ratio of the given to the equivalent couple is the reciprocal of the ratio of the angular velocities of the pieces to which they are applied.

These velocity ratios are known by the construction of the mechanism, and are independent of the absolute speed.

§ 97. *Balanced Lateral Pressure of Guides and Bearings.*—The most important part of the lateral pressure on a piece of mechanism is the reaction of its guides, if it is a sliding piece, or of the bearings of its axis, if it is a turning piece; and the balanced portion of this reaction is equal and opposite to the resultant of all the other forces applied to the piece, its own weight included. There may be or may not be an unbalanced component in this pressure, due to the deviated motion. Its laws will be considered in the sequel.

§ 98. *Friction. Unguents.*—The most important kind of resistance in machines is the *friction* or *rubbing resistance* of surfaces which slide over each other. The *direction* of the resistance of friction is opposite to that in which the sliding takes place. Its *magnitude* is the product of the *normal pressure* or force which presses the rubbing surfaces together in a direction perpendicular to themselves into a specific constant already mentioned in § 14, as the *coefficient of friction*, which depends on the nature and condition of the surfaces of the unguent, if any, with which they are covered. The *total pressure* exerted between the rubbing surfaces is the resultant of the normal pressure and of the friction, and its *obliquity*, or inclination to the common perpendicular of the surfaces, is the *angle of repose* formerly mentioned in § 14, whose tangent is the coefficient of friction. Thus, let N be the normal pressure, R the friction, T the total pressure, f the coefficient of friction, and ϕ the angle of repose; then

$$\left.\begin{array}{r} f=\tan\phi \\ \mathrm{R}=f\mathrm{N}=\mathrm{N}\tan\phi=\mathrm{T}\sin\phi \end{array}\right\} \tag{58}$$

Experiments on friction have been made by Coulomb, Samuel Vince, John Rennie, James Wood, D. Rankine and others. The most complete and elaborate experiments are those of Morin, published in his *Notions fondamentales de mécanique*, and republished in Britain in the works of Moseley and Gordon.

The experiments of Beauchamp Tower ("Report of Friction Experiments," *Proc. Inst. Mech. Eng.*, 1883) showed that when oil is supplied to a journal by means of an oil bath the coefficient of friction varies nearly inversely as the load on the bearing, thus making the product of the load on the bearing and the coefficient of friction a constant. Mr Tower's experiments were carried out at nearly constant temperature. The more recent experiments of Lasche (*Zeitsch, Verein Deutsche Ingen.*, 1902, 46, 1881) show that the product of the coefficient of friction, the load on the bearing, and the temperature is approximately constant. For further information on this point and on Osborne Reynolds's theory of lubrication see BEARINGS and LUBRICATION.

§ 99. *Work of Friction. Moment of Friction.*—The work performed in a unit of time in overcoming the friction of a pair of surfaces is the product of the friction by the velocity of sliding of the surfaces over each other, if that is the same throughout the whole extent of the rubbing surfaces. If that velocity is different for different portions of the rubbing surfaces, the velocity of each portion is to be multiplied by the friction of that portion, and the results summed or integrated.

When the relative motion of the rubbing surfaces is one of rotation, the work of friction in a unit of time, for a portion of the rubbing surfaces at a given distance from the axis of rotation, may be found by multiplying together the friction of that portion, its distance from the axis, and the angular velocity. The product of the force of friction by the distance at which it acts from the axis of rotation is called the *moment of friction*. The total moment of friction of a pair of rotating rubbing surfaces is the sum or integral of the moments of friction of their several portions.

To express this symbolically, let du represent the area of a portion of a pair of rubbing surfaces at a distance r from the axis of their relative rotation; p the intensity of the normal pressure at du per unit of area; and f the coefficient of friction. Then the moment of friction of du is $fprdu$;

$$\left.\begin{array}{l} \text{the total moment of friction is } f\int pr.\,du\,; \\ \text{and the work performed in a unit of time in overcoming} \\ \text{friction, when the angular velocity is } \alpha\text{, is } \alpha f\int pr.\,du. \end{array}\right\} \tag{59}$$

It is evident that the moment of friction, and the work lost by being performed in overcoming friction, are less in a rotating piece as the bearings are of smaller radius. But a limit is put to the diminution of the radii of journals and pivots by the conditions of durability and of proper lubrication, and also by conditions of strength and stiffness.

§ 100. *Total Pressure between Journal and Bearing.*—A single piece rotating with a uniform velocity has four mutually balanced forces applied to it: (1) the effort exerted on it by the piece which drives it; (2) the resistance of the piece which follows it—which may be considered for the purposes of the present question as useful resistance; (3) its weight; and (4) the reaction of its own cylindrical bearings. There are given the following data:—

The direction of the effort.
The direction of the useful resistance.
The weight of the piece and the direction in which it acts.
The magnitude of the useful resistance.
The radius of the bearing r.
The angle of repose ϕ, corresponding to the friction of the journal on the bearing.

And there are required the following:—

The direction of the reaction of the bearing.
The magnitude of that reaction.
The magnitude of the effort.

Let the useful resistance and the weight of the piece be compounded by the principles of statics into one force, and let this be called *the given force*.

The directions of the effort and of the given force are either parallel or meet in a point. If they are parallel, the direction of the reaction of the bearing is also parallel to them; if they meet in a point, the direction of the reaction traverses the same point.

Also, let AAA, fig. 128, be a section of the bearing, and C its axis; then the direction of the reaction, at the point where it intersects the circle AAA, must make the angle ϕ with the radius of that circle; that is to say, it must be a line such as PT touching the smaller circle BB, whose radius is $r.\ \sin\phi$. The side on which it touches that circle is determined by the fact that the obliquity of the reaction is such as to oppose the rotation.

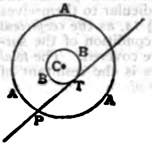


FIG. 128.

Thus is determined the direction of the reaction of the bearing; and the magnitude of that reaction and of the effort are then found by the principles of the equilibrium of three forces already stated in § 7.

The work lost in overcoming the friction of the bearing is the same as that which would be performed in overcoming at the circumference of the small circle BB a resistance equal to the whole pressure between the journal and bearing.

In order to diminish that pressure to the smallest possible amount, the effort, and the resultant of the useful resistance, and the weight of the piece (called above the "given force") ought to be opposed to each other as directly as is practicable consistently with the purposes of the machine.

An investigation of the forces acting on a bearing and journal lubricated by an oil bath will be found in a paper by Osborne Reynolds in the *Phil. Trans.*, pt. i. (1886). (See also BEARINGS.)

§ 101. *Friction of Pivots and Collars.*—When a shaft is acted upon by a force tending to shift it lengthways, that force must be balanced by the reaction of a bearing against a *pivot* at the end of the shaft; or, if that be impossible, against one or more *collars*, or rings *projecting* from the body of the shaft. The bearing of the pivot is called a *step* or *footstep*. Pivots require great hardness, and are usually made of steel. The *flat* pivot is a cylinder of steel having a plane circular end as a rubbing surface. Let N be the total pressure sustained by a flat pivot of the radius r; if that pressure be uniformly distributed, which is the case when the rubbing surfaces of the pivot and its step are both true planes, the *intensity* of the pressure is

$$p = \mathrm{N}/\pi r^2; \qquad (60)$$

and, introducing this value into equation 59, the *moment of friction of the flat pivot* is found to be

$$\tfrac{2}{3} f\mathrm{N}r \qquad (61)$$

or two-thirds of that of a cylindrical journal of the same radius under the same normal pressure.

The friction of a *conical* pivot exceeds that of a flat pivot of the same radius, and under the same pressure, in the proportion of the side of the cone to the radius of its base.

The moment of friction of a *collar* is given by the formula—

$$\tfrac{2}{3} f\mathrm{N}\frac{r^3 - r'^3}{r^2 - r'^2}, \qquad (62)$$

where r is the external and r' the internal radius.

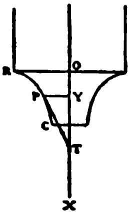


FIG. 129.

In the *cup and ball* pivot the end of the shaft and the step present two recesses facing each other, into which are fitted two shallow cups of steel or hard bronze. Between the concave spherical surfaces of those cups is placed a steel ball, being either a complete sphere or a lens having convex surfaces of a somewhat less radius than the concave surfaces of the cups. The moment of friction of this pivot is at first almost inappreciable from the extreme smallness of the radius of the circles of contact of the ball and cups, but, as they wear, that radius and the moment of friction increase.

It appears that the rapidity with which a rubbing surface wears away is proportional to the friction and to the velocity jointly, or nearly so. Hence the pivots already mentioned wear unequally at different points, and tend to alter their figures. Schiele has invented a pivot which preserves its original figure by wearing equally at all points in a direction parallel to its axis. The following are the principles on which this equality of wear depends:—

The rapidity of wear of a surface measured in an *oblique* direction is to the rapidity of wear measured normally as the secant of the obliquity is to unity. Let OX (fig. 129) be the axis of a pivot, and let RPC be a portion of a curve such that at any point P the secant of the obliquity to the normal of the curve of a line parallel to the axis is inversely proportional to the ordinate PY, to which the velocity of P is proportional. The rotation of that curve round OX will generate the form of pivot required. Now let PT be a tangent to the curve at P, cutting OX in T; PT = PY × *secant obliquity*, and this is to be a constant quantity; hence the curve is that known as the *tractory* of the straight line OX, in which PT = OR = constant. This curve is described by having a fixed straight-edge parallel to OX, along which slides a slider carrying a pin whose centre is T. On that pin turns an arm, carrying at a point P a tracing-point, pencil or pen. Should the pen have a nib of two jaws, like those of an ordinary drawing-pen, the plane of the jaws must pass through PT. Then, while T is slid along the axis from O towards X, P will be drawn after it from R towards C along the tractory. This curve, being an asymptote to its axis, is capable of being indefinitely prolonged towards X; but in designing pivots it should stop before the angle PTY becomes less than the angle of repose of the rubbing surfaces, otherwise the pivot will be liable to stick in its bearing. The moment of friction of "Schiele's anti-friction pivot," as it is called, is equal to that of a cylindrical journal of the radius OR = PT the constant tangent, under the same pressure.

Records of experiments on the friction of a pivot bearing will be found in the *Proc. Inst. Mech. Eng.* (1891), and on the friction of a collar bearing *ib.* May 1888.

§ 102. *Friction of Teeth.*—Let N be the normal pressure exerted between a pair of teeth of a pair of wheels; s the total distance through which they slide upon each other; n the number of pairs of teeth which pass the plane of axis in a unit of time; then

$$nf\mathrm{N}s \qquad (63)$$

is the work lost in unity of time by the friction of the teeth. The sliding s is composed of two parts, which take place during the approach and recess respectively. Let those be denoted by s_1 and s_2, so that $s = s_1 + s_2$. In § 45 the *velocity* of sliding at any instant has been given, viz. $u = c\ (\alpha_1 + \alpha_2)$, where u is that velocity, c the distance TI at any instant from the point of contact of the teeth to the pitch-point, and α_1, α_2 the respective angular velocities of the wheels.

Let v be the common velocity of the two pitch-circles, r_1, r_2, their radii; then the above equation becomes

$$u = cv\left(\frac{1}{r_1} + \frac{1}{r_2}\right).$$

To apply this to involute teeth, let c_1 be the length of the approach, c_2 that of the recess, u_1, the *mean* velocity of sliding during the approach, u_2 that during the recess; then

$$u_1 = \frac{c_1 v}{2}\left(\frac{1}{r_1} + \frac{1}{r_2}\right);\ u_2 = \frac{c_2 v}{2}\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$

also, let θ be the obliquity of the action; then the times occupied by the approach and recess are respectively

$$\frac{c_1}{v \cos\theta},\quad \frac{c_2}{v \cos\theta};$$

giving, finally, for the length of sliding between each pair of teeth,

$$s = s_1 + s_2 = \frac{c_1^2 + c_2^2}{2 \cos\theta}\left(\frac{1}{r_1} + \frac{1}{r_2}\right) \qquad (64)$$

which, substituted in equation (63), gives the work lost in a unit of time by the friction of involute teeth. This result, which is exact for involute teeth, is approximately true for teeth of any figure.

For inside gearing, if r_1 be the less radius and r_2 the greater, $\frac{1}{r_1} - \frac{1}{r_2}$ is to be substituted for $\frac{1}{r_1} + \frac{1}{r_2}$.

§ 103. *Friction of Cords and Belts.*—A flexible band, such as a cord, rope, belt or strap, may be used either to exert an effort or a resistance upon a pulley round which it wraps. In either case the tangential force, whether effort or resistance, exerted between the band and the pulley is their mutual friction, caused by and proportional to the normal pressure between them.

Let T_1 be the tension of the free part of the band at that side *towards* which it tends to draw the pulley, or *from* which the pulley tends to draw it; T_2 the tension of the free part at the other side; T the tension of the band at any intermediate point of its arc of contact with the pulley; θ the ratio of the length of that arc to the radius of the pulley; $d\theta$ the ratio of an indefinitely small element of that arc to the radius; $\mathrm{F} = \mathrm{T}_1 - \mathrm{T}_2$ the total friction between the band and the pulley; $d\mathrm{F}$ the elementary portion of that friction due to the elementary arc $d\theta$; f the coefficient of friction between the materials of the band and pulley.

Then, according to a well-known principle in statics, the normal pressure at the elementary arc $d\theta$ is $\mathrm{T}d\theta$, T being the mean tension of the band at that elementary arc; consequently the friction on that arc is $d\mathrm{F} = f\mathrm{T}d\theta$. Now that friction is also the difference tween the tensions of the band at the two ends of the elementary ; or $dT = dF = fT d\theta$; which equation, being integrated throughout entire arc of contact, gives the following formulae:—

$$\left.\begin{array}{l} \text{hyp log. } \dfrac{T_1}{T_2} = f\theta \\ \dfrac{T_1}{T_2} = e^{f\theta} \\ F = T_1 - T_2 = T_1(1 - e^{-f\theta}) = T_2(e^{f\theta} - 1) \end{array}\right\} \quad (65)$$

When a belt connecting a pair of pulleys has the tensions of its o sides originally equal, the pulleys being at rest, and when the lleys are next set in motion, so that one of them drives the other means of the belt, it is found that the advancing side of the lt is exactly as much tightened as the returning side is slackened, that the *mean* tension remains unchanged. Its value is given by is formula—

$$\frac{T_1 + T_2}{2} = \frac{e^{f\theta} + 1}{2(e^{f\theta} - 1)} \quad (66)$$

iich is useful in determining the original tension required to enable belt to transmit a given force between two pulleys.

The equations 65 and 66 are applicable to a kind of *brake* called *friction-strap*, used to stop or moderate the velocity of machines being tightened round a pulley. The strap is usually of iron, d the pulley of hard wood.

Let a denote the arc of contact expressed in *turns and fractions a turn*; then

$$\left.\begin{array}{l} \theta = 6\cdot2832a \\ e^{f\theta} = \text{number whose common logarithm is } 2\cdot7288fa \end{array}\right\} \quad (67)$$

See also DYNAMOMETER for illustrations of the use of what are sentially friction-straps of different forms for the measurement of e brake horse-power of an engine or motor.

§ 104. *Stiffness of Ropes.*—Ropes offer a resistance to being bent, d, when bent, to being straightened again, which arises from the utual friction of their fibres. It increases with the sectional area the rope, and is inversely proportional to the radius of the curve to which it is bent.

The *work lost* in pulling a given length of rope over a pulley is und by multiplying the length of the rope in feet by its stiffness pounds, that stiffness being the excess of the tension at the ading side of the rope above that at the following side, which is cessary to bend it into a curve fitting the pulley, and then to raighten it again.

The following empirical formulae for the stiffness of hempen ropes ive been deduced by Morin from the experiments of Coulomb:—

Let F be the stiffness in pounds avoirdupois; d the diameter of e rope in inches, $n = 48d^2$ for white ropes and $35d^2$ for tarred ropes; the *effective* radius of the pulley in inches; T the tension in pounds. hen

$$\left.\begin{array}{l} \text{For white ropes, } F = \dfrac{n}{r}(0\cdot0012 + 0\cdot001026n + 0\cdot0012T \\ \text{For tarred ropes, } F = \dfrac{n}{r}(0\cdot006 + 0\cdot001392n + 0\cdot00168T \end{array}\right\} \quad (68)$$

§ 105. *Friction-Couplings.*—Friction is useful as a means of comunicating motion where sudden changes either of force or velocity ke place, because, being limited in amount, it may be so adjusted to limit the forces which strain the pieces of the mechanism ithin the bounds of safety. Amongst contrivances for effecting is object are *friction-cones*. A rotating shaft carries upon a cylinrical portion of its figure a wheel or pulley turning loosely on it, nd consequently capable of remaining at rest when the shaft is motion. This pulley has fixed to one side, and concentric with , a short frustum of a hollow cone. At a small distance from the ulley the shaft carries a short frustum of a solid cone accurately rned to fit the hollow cone. This frustum is made always to turn long with the shaft by being fitted on a square portion of it, or by eans of a rib and groove, or otherwise, but is capable of a slight ngitudinal motion, so as to be pressed into, or withdrawn from, e hollow cone by means of a lever. When the cones are pressed gether or engaged, their friction causes the pulley to rotate along ith the shaft; when they are disengaged, the pulley is free to stand ill. The angle made by the sides of the cones with the axis should ot be less than the angle of repose. In the *friction-clutch*, a pulley ose on a shaft has a hoop or gland made to embrace it more or less ghtly by means of a screw; this hoop has short projecting arms or ars. A fork or *clutch* rotates along with the shaft, and is capable being moved longitudinally by a handle. When the clutch is oved towards the hoop, its arms catch those of the hoop, and ause the hoop to rotate and to communicate its rotation to the pulley y friction. There are many other contrivances of the same class, ut the two just mentioned may serve for examples.

§ 106. *Heat of Friction: Unguents.*—The work lost in friction is mployed in producing heat. This fact is very obvious, and has een known from a remote period; but the *exact* determination of he proportion of the work lost to the heat produced, and the experiental proof that that proportion is the same under all circumstances nd with all materials, solid, liquid and gaseous, are comparatively ecent achievements of J. P. Joule. The quantity of work which roduces a British unit of heat (or so much heat as elevates the temperature of one pound of pure water, at or near ordinary atmospheric temperatures, by 1° F.) is 772 foot-pounds. This constant, now designated as "Joule's equivalent," is the principal experimental datum of the science of thermodynamics.

A more recent determination (*Phil. Trans.*, 1897), by Osborne Reynolds and W. M. Moorby, gives 778 as the mean value of Joule's equivalent through the range of 32° to 212° F. See also the papers of Rowland in the *Proc. Amer. Acad.* (1879), and Griffiths, *Phil. Trans.* (1893).

The heat produced by friction, when moderate in amount, is useful in softening and liquefying thick unguents; but when excessive it is prejudicial, by decomposing the unguents, and sometimes even by softening the metal of the bearings, and raising their temperature so high as to set fire to neighbouring combustible matters.

Excessive heating is prevented by a constant and copious supply of a good unguent. The elevation of temperature produced by the friction of a journal is sometimes used as an experimental test of the quality of unguents. For modern methods of forced lubrication see BEARINGS.

§ 107. *Rolling Resistance.*—By the rolling of two surfaces over each other without sliding a resistance is caused which is called sometimes "rolling friction," but more correctly *rolling resistance.* It is of the nature of a *couple*, resisting rotation. Its *moment* is found by multiplying the normal pressure between the rolling surfaces by an *arm*, whose length depends on the nature of the rolling surfaces, and the work lost in a unit of time in overcoming it is the product of its moment by the *angular velocity* of the rolling surfaces relatively to each other. The following are approximate values of the arm in decimals of a foot:—

Oak upon oak	0·006 (Coulomb).
Lignum vitae on oak	0·004 "
Cast iron on cast iron	0·002 (Tredgold).

§ 108. *Reciprocating Forces: Stored and Restored Energy.*—When a force acts on a machine alternately as an effort and as a resistance, it may be called a *reciprocating force.* Of this kind is the weight of any piece in the mechanism whose centre of gravity alternately rises and falls; for during the rise of the centre of gravity that weight acts as a resistance, and energy is employed in lifting it to an amount expressed by the product of the weight into the vertical height of its rise; and during the fall of the centre of gravity the weight acts as an effort, and exerts in assisting to perform the work of the machine an amount of energy exactly equal to that which had previously been employed in lifting it. Thus that amount of energy is not lost, but has its operation deferred; and it is said to be *stored* when the weight is lifted, and *restored* when it falls.

In a machine of which each piece is to move with a uniform velocity, if the effort and the resistance be constant, the weight of each piece must be balanced on its axis, so that it may produce lateral pressure only, and not act as a reciprocating force. But if the effort and the resistance be alternately in excess, the uniformity of speed may still be preserved by so adjusting some moving weight in the mechanism that when the effort is in excess it may be lifted, and so balance and employ the excess of effort, and that when the resistance is in excess it may fall, and so balance and overcome the excess of resistance—thus *storing* the periodical excess of energy and *restoring* that energy to perform the periodical excess of work.

Other forces besides gravity may be used as reciprocating forces for storing and restoring energy—for example, the elasticity of a spring or of a mass of air.

In most of the delusive machines commonly called "perpetual motions," of which so many are patented in each year, and which are expected by their inventors to perform work without receiving energy, the fundamental fallacy consists in an expectation that some reciprocating force shall restore more energy than it has been the means of storing.

Division 2. Deflecting Forces.

§ 109. *Deflecting Force for Translation in a Curved Path.*—In machinery, deflecting force is supplied by the tenacity of some piece, such as a crank, which guides the deflected body in its curved path, and is *unbalanced*, being employed in producing deflexion, and not in balancing another force.

§ 110. *Centrifugal Force of a Rotating Body.*—*The centrifugal force exerted by a rotating body on its axis of rotation is the same in magnitude as if the mass of the body were concentrated at its centre of gravity, and acts in a plane passing through the axis of rotation and the centre of gravity of the body.*

The particles of a rotating body exert centrifugal forces on each other, which strain the body, and tend to tear it asunder, but these forces balance each other, and do not affect the resultant centrifugal force exerted on the axis of rotation.[1]

If the axis of rotation traverses the centre of gravity of the body, the centrifugal force exerted on that axis is nothing.

Hence, unless there be some reason to the contrary, each piece of a machine should be balanced on its axis of rotation; otherwise the centrifugal force will cause strains, vibration and increased friction, and a tendency of the shafts to jump out of their bearings.

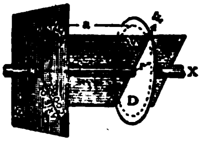
---

[1] This is a particular case of a more general principle, that *the motion of the centre of gravity of a body is not affected by the mutual actions of its parts.*

§ 111. *Centrifugal Couples of a Rotating Body.*—Besides the tendency (if any) of the combined centrifugal forces of the particles of a rotating body to *shift* the axis of rotation, they may also tend to *turn* it out of its original direction. The latter tendency is called *a centrifugal couple*, and vanishes for rotation about a principal axis.

It is essential to the steady motion of every rapidly rotating piece in a machine that its axis of rotation should not merely traverse its centre of gravity, but should be a permanent axis; for otherwise the centrifugal couples will increase friction, produce oscillation of the shaft and tend to make it leave its bearings.

The principles of this and the preceding section are those which regulate the adjustment of the weight and position of the *counterpoises* which are placed between the spokes of the driving-wheels of locomotive engines.



(From *Balancing of Engines*, by permission of Edward Arnold.)

FIG. 130.

§ 112.* *Method of computing the position and magnitudes of balance weights which must be added to a given system of arbitrarily chosen rotating masses in order to make the common axis of rotation a permanent axis.*—The method here briefly explained is taken from a paper by W. E. Dalby, "The Balancing of Engines with special reference to Marine Work," *Trans. Inst. Nav. Arch.* (1899). Let the weight (fig. 130), attached to a truly turned disk, be rotated by the shaft OX, and conceive that the shaft is held in a bearing at one point, O. The force required to constrain the weight to move in a circle, that is the deviating force, produces an equal and opposite reaction on the shaft, whose amount F is equal to the centrifugal force, Wa^2r/g lb, where r is the radius of the mass centre of the weight, and a is its angular velocity in radians per second. Transferring this force to the point O, it is equivalent to, (1) a force at O equal and parallel to F, and, (2) a centrifugal couple of Fa foot-pounds. In order that OX may be a permanent axis it is necessary that there should be a sufficient number of weights attached to the shaft and so distributed that when each is referred to the point O

$$\left.\begin{aligned}(1)\ \Sigma F &= 0\\ (2)\ \Sigma Fa &= 0\end{aligned}\right\}\qquad (a)$$

The plane through O to which the shaft is perpendicular is called the *reference plane*, because all the transferred forces act in that plane at the point O. The plane through the radius of the weight containing the axis OX is called the *axial plane* because it contains the forces forming the couple due to the transference of F to the reference plane. Substituting the values of F in (*a*) the two conditions become

$$\begin{aligned}&(1)\ (W_1r_1+W_2r_2+W_3r_3+\ldots)\frac{a^2}{g}=0\\ &(2)\ (W_1a_1r_1+W_2a_2r_2+\ldots)\frac{a^2}{g}=0\end{aligned}\qquad (b)$$

In order that these conditions may obtain, the quantities in the brackets must be zero, since the factor a^2/g is not zero. Hence finally the conditions which must be satisfied by the system of weights in order that the axis of rotation may be a permanent axis is

$$\left.\begin{aligned}(1)\ (W_1r_1+W_2r_2+W_3r_3)&=0\\ (2)\ (W_1a_1r_1+W_2a_2r_2+)&=0\end{aligned}\right\}\qquad (c)$$

It must be remembered that these are all directed quantities, and that their respective sums are to be taken by drawing vector polygons. In drawing these polygons the magnitude of the vector of the type Wr is the product Wr, and the direction of the vector is from the shaft outwards towards the weight W, parallel to the radius r. For the vector representing a couple of the type War, if the masses are all on the same side of the reference plane, the direction of drawing is from the axis outwards; if the masses are some on one side of the reference plane and some on the other side, the direction of drawing is from the axis outwards towards the weight for all masses on the one side, and from the mass inwards towards the axis for all weights on the other side, drawing always parallel to the direction defined by the radius r. The magnitude of the vector is the product War. The conditions (*c*) may thus be expressed: first, that the sum of the vectors Wr must form a closed polygon, and, second, that the sum of the vectors War must form a closed polygon. The general problem in practice is, given a system of weights attached to a shaft, to find the respective weights and positions of two balance weights or counterpoises which must be added to the system in order to make the shaft a permanent axis, the planes in which the balance weights are to revolve also being given. To solve this the reference plane must be chosen so that it coincides with the plane of revolution of one of the as yet unknown balance weights. The balance weight in this plane has therefore no couple corresponding to it. Hence by drawing a couple polygon for the given weights the vector which is required to close the polygon is at once found and from it the magnitude and position of the balance weight which must be added to the system to balance the couples follow at once. Then, transferring the product Wr corresponding with this balance weight to the reference plane, proceed to draw the force polygon. The vector required to close it will determine the second balance weight, the work may be checked by taking the reference plane to coincide with the plane of revolution of the second balance weight and then re-determining them, or by taking a reference plane anywhere and including the two balance weights trying if condition (*c*) is satisfied.

When a weight is reciprocated, the equal and opposite force required for its acceleration at any instant appears as an unbalanced force on the frame of the machine to which the weight belongs. In the particular case where the motion is of the kind known as "simple harmonic" the disturbing force on the frame due to the reciprocation of the weight is equal to the component of the centrifugal force in the line of stroke due to a weight equal to the reciprocating weight supposed concentrated at the crank pin. Using this principle the method of finding the balance weights to be added to a given system of reciprocating weights in order to produce a system of forces on the frame continuously in equilibrium is exactly the same as that just explained for a system of revolving weights, because for the purpose of finding the balance weights each reciprocating weight may be supposed attached to the crank pin which operates it, thus forming an equivalent revolving system. The balance weights found as part of the equivalent revolving system when reciprocated by their respective crank pins form the balance weights for the given reciprocating system. These conditions may be exactly realized by a system of weights reciprocated by slotted bars, the crank shaft driving the slotted bars rotating uniformly. In practice reciprocation is usually effected through a connecting rod, as in the case of steam engines. In balancing the mechanism of a steam engine it is often sufficiently accurate to consider the motion of the pistons as simple harmonic, and the effect on the framework of the acceleration of the connecting rod may be approximately allowed for by distributing the weight of the rod between the crank pin and the piston inversely as the centre of gravity of the rod divides the distance between the centre of the cross head pin and the centre of the crank pin. The moving parts of the engine are then divided into two complete and independent systems, namely, one system of revolving weights consisting of crank pins, crank arms, &c., attached to and revolving with the crank shaft, and a second system of reciprocating weights consisting of the pistons, cross-heads, &c., supposed to be moving each in its line of stroke with simple harmonic motion. The balance weights are to be separately calculated for each system, the one set being added to the crank shaft as revolving weights, and the second set being included with the reciprocating weights and operated by a properly placed crank on the crank shaft. Balance weights added in this way to a set of reciprocating weights are sometimes called bob-weights. In the case of locomotives the balance weights required to balance the pistons are added as revolving weights to the crank shaft system, and in fact are generally combined with the weights required to balance the revolving system so as to form one weight, the counterpoise referred to in the preceding section, which is seen between the spokes of the wheels of a locomotive. Although this method balances the pistons in the horizontal plane, and thus allows the pull of the engine on the train to be exerted without the variation due to the reciprocation of the pistons, yet the force balanced horizontally is introduced vertically and appears as a variation of pressure on the rail. In practice about two-thirds of the reciprocating weight is balanced in order to keep this variation of rail pressure within safe limits. The assumption that the pistons of an engine move with simple harmonic motion is increasingly erroneous as the ratio of the length of the crank r, to the length of the connecting rod l increases. A more accurate though still approximate expression for the force on the frame due to the acceleration of the piston whose weight is W is given by

$$\frac{W}{g}\omega^2r\left\{\cos\theta+\frac{r}{l}\cos 2\theta\right\}$$

The conditions regulating the balancing of a system of weights reciprocating under the action of accelerating forces given by the above expression are investigated in a paper by Otto Schlick, "On Balancing of Steam Engines," *Trans. Inst. Nav. Arch.* (1900), and in a paper by W. E. Dalby, "On the Balancing of the Reciprocating Parts of Engines, including the Effect of the Connecting Rod" (*ibid.*, 1901). A still more accurate expression than the above is obtained by expansion in a Fourier series, regarding which and its bearing on balancing engines see a paper by J. H. Macalpine, "A Solution of the Vibration Problem" (*ibid.*, 1901). The whole subject is dealt with in a treatise, *The Balancing of Engines*, by W. E. Dalby (London, 1906). Most of the original papers on this subject of engine balancing are to be found in the *Transactions* of the Institution of Naval Architects.

§ 113.* *Centrifugal Whirling of Shafts.*—When a system of revolving masses is balanced so that the conditions of the preceding section are fulfilled, the centre of gravity of the system lies on the axis of revolution. If there is the slightest displacement of the centre of gravity of the system from the axis of revolution a force acts on the shaft tending to deflect it, and varies as the deflexion and as the square of the speed. If the shaft is therefore to revolve stably, this force must be balanced at any instant by the elastic resistance of the shaft to deflexion. To take a simple case, suppose a shaft supported on two bearings to carry a disk of weight W at its centre, and let the centre of gravity of the disk be at a distance e from the axis of rotation, this small distance being due to imperfections of material or faulty construction. Neglecting the mass of the shaft itself, when the shaft rotates with an angular velocity a, the centrifugal force Wa^2e/g will act upon the shaft and cause its axis to deflect from the axis of rotation a distance, y say. The elastic resistance evoked by this deflexion is proportional to the deflexion, so that if c is a constant depending upon the form, material and method of support of the shaft, the following equality must hold if the shaft is to rotate stably at the stated speed—

$$\frac{W}{g}(y+e)a^2=cy,$$

from which $y=Wa^2e/(gc-Wa^2)$.

This expression shows that as a increases y increases until when $Wa^2=gc$, y becomes infinitely large. The corresponding value of a, namely $\sqrt{gc/W}$, is called the *critical velocity* of the shaft, and is the speed at which the shaft ceases to rotate stably and at which centrifugal whirling begins. The general problem is to find the value of a corresponding to all kinds of loadings on shafts supported in any manner. The question was investigated by Rankine in an article in the *Engineer* (April 9, 1869). Professor A. G. Greenhill treated the problem of the centrifugal whirling of an unloaded shaft with different supporting conditions in a paper "On the Strength of Shafting exposed both to torsion and to end thrust," *Proc. Inst. Mech. Eng.* (1883). Professor S. Dunkerley ("On the Whirling and Vibration of Shafts," *Phil. Trans.*, 1894) investigated the question for the cases of loaded and unloaded shafts, and, owing to the complication arising from the application of the general theory to the cases of loaded shafts, devised empirical formulae for the critical speeds of shafts loaded with heavy pulleys, based generally upon the following assumption, which is stated for the case of a shaft carrying one pulley: If N_1, N_2 be the separate speeds of whirl of the shaft and pulley on the assumption that the effect of one is neglected when that of the other is under consideration, then the resulting speed of whirl due to both causes combined may be taken to be of the form $N_1N_2\sqrt{(N^2{}_1+N_2{}^2)}$ where N means revolutions per minute. This form is extended to include the cases of several pulleys on the same shaft. The interesting and important part of the investigation is that a number of experiments were made on small shafts arranged in different ways and loaded in different ways, and the speed at which whirling actually occurred was compared with the speed calculated from formulae of the general type indicated above. The agreement between the observed and calculated values of the critical speeds was in most cases quite remarkable. In a paper by Dr C. Chree, "The Whirling and Transverse Vibrations of Rotating Shafts," *Proc. Phys. Soc. Lon.*, vol. 19 (1904); also *Phil. Mag.*, vol. 7 (1904), the question is investigated from a new mathematical point of view, and expressions for the whirling of loaded shafts are obtained without the necessity of any assumption of the kind stated above. An elementary presentation of the problem from a practical point of view will be found in *Steam Turbines*, by Dr A. Stodola (London, 1905).

§ 114. *Revolving Pendulum. Governors.*—In fig. 131 AO represents an upright axis or spindle; B a weight called a *bob*, suspended by rod OB from a horizontal axis at O, carried by the vertical axis. When the spindle is at rest the bob hangs close to it; when the spindle rotates, the bob, being made to revolve round it, diverges until the resultant of the centrifugal force and the weight of the bob is a force acting at O in the direction OB, and then it revolves steadily in a circle. This combination is called a *revolving*, *centrifugal*, or *conical pendulum*. Revolving pendulums are usually constructed with *pairs* of rods and bobs, as OB, O*b*, hung at opposite sides of the spindle, that the centrifugal forces exerted at the point O may balance each other.

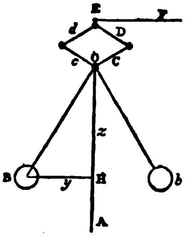


FIG. 131.

In finding the position in which the bob will revolve with a given angular velocity, a, for most practical cases connected with machinery the mass of the rod may be considered as insensible compared with that of the bob. Let the bob be a sphere, and from the centre of that sphere draw $BH=y$ perpendicular to OA. Let $OH=z$; let W be the weight of the bob, F its centrifugal force. Then the condition of its steady revolution is $W:F::z:y$; that is to say, $y/z=F/W=ya^2/g$; consequently

$$z=g/a^2 \tag{69}$$

Or, if $n=a/2\pi=a/6{\cdot}2832$ be the number of turns or fractions of a turn in a second,

$$\left.z=\frac{g}{4\pi^2n^2}=\frac{0{\cdot}8165\text{ ft.}}{n^2}=\frac{9{\cdot}79771\text{ in.}}{n^2}\right\} \tag{70}$$

z is called the *altitude of the pendulum.*

If the rod of a revolving pendulum be jointed, as in fig. 132, not to a point in the vertical axis, but to the end of a projecting arm C, the position in which the bob will revolve will be the same as if the rod were jointed to the point O, where its prolongation cuts the vertical axis.

A revolving pendulum is an essential part of most of the contrivances called *governors*, for regulating the speed of prime movers, for further particulars of which see STEAM ENGINE.

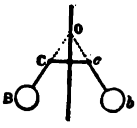


FIG. 132.

Division 3. Working of Machines of Varying Velocity.

§ 115. *General Principles.*—In order that the velocity of every piece of a machine may be uniform, it is necessary that the forces acting on each piece should be always exactly balanced. Also, in order that the forces acting on each piece of a machine may be always exactly balanced, it is necessary that the velocity of that piece should be uniform.

An excess of the effort exerted on any piece, above that which is necessary to balance the resistance, is accompanied with acceleration; a deficiency of the effort, with retardation.

When a machine is being started from a state of rest, and brought by degrees up to its proper speed, the effort must be in excess; when it is being retarded for the purpose of stopping it, the resistance must be in excess.

An excess of effort above resistance involves an excess of energy exerted above work performed; that excess of energy is employed in producing acceleration.

An excess of resistance above effort involves an excess of work performed above energy expended; that excess of work is performed by means of the retardation of the machinery.

When a machine undergoes alternate acceleration and retardation, so that at certain instants of time, occurring at the end of intervals called *periods* or *cycles*, it returns to its original speed, then in each of those periods or cycles the alternate excesses of energy and of work neutralize each other; and at the end of each cycle the principle of the equality of energy and work stated in § 87, with all its consequences, is verified exactly as in the case of machines of uniform speed.

At intermediate instants, however, other principles have also to be taken into account, which are deduced from the second law of motion, as applied to *direct deviation*, or acceleration and retardation:

§ 116. *Energy of Acceleration and Work of Retardation for a Shifting Body.*—Let w be the weight of a body which has a motion of translation in any path, and in the course of the interval of time Δt let its velocity be increased at a uniform rate of acceleration from v_1 to v_2. The rate of acceleration will be

$$dv/dt=\text{const.}=(v_2-v_1)\,\Delta t;$$

and to produce this acceleration a uniform effort will be required, expressed by

$$P=w(v_2-v_1)g\Delta t \tag{71}$$

(The product wv/g of the mass of a body by its velocity is called its *momentum*; so that the effort required is found by dividing the increase of momentum by the time in which it is produced.)

To find the *energy* which has to be exerted to produce the acceleration from v_1 to v_2, it is to be observed that the *distance* through which the effort P acts during the acceleration is

$$\Delta s=(v_2+v_1)\Delta t/2;$$

consequently, the *energy of acceleration* is

$$P\Delta s=w(v_2-v_1)(v_2+v_1)/2g=w(v_2{}^2-v_1{}^2)2g, \tag{72}$$

being proportional to the increase in the square of the velocity, and *independent of the time.*

In order to produce a *retardation* from the greater velocity v_2 to the less velocity v_1, it is necessary to apply to the body a *resistance* connected with the retardation and the time by an equation identical in every respect with equation (71), except by the substitution of a resistance for an effort; and in overcoming that resistance the body *performs work* to an amount determined by equation (72), putting $R ds$ for Pas.

§ 117. *Energy Stored and Restored by Deviations of Velocity.*—Thus a body alternately accelerated and retarded, so as to be brought back to its original speed, performs work during its retardation exactly equal in amount to the energy exerted upon it during its acceleration; so that that energy may be considered as *stored* during the acceleration, and *restored* during the retardation, in a manner analogous to the operation of a reciprocating force (§ 108).

Let there be given the mean velocity $V=\frac{1}{2}(v_2+v_1)$ of a body whose weight is w, and let it be required to determine the fluctuation of velocity v_2-v_1, and the extreme velocities v_1, v_2, which that body must have, in order alternately to store and restore an amount of energy E. By equation (72) we have

$$E=w(v_2{}^2-v_1{}^2)/2g$$

which, being divided by $V=\frac{1}{2}(v_2+v_1)$, gives

$$E/V=w(v_2-v_1)/g;$$

and consequently

$$v_2-v_1=gE/Vw \tag{73}$$

The ratio of this fluctuation to the mean velocity, sometimes called the *unsteadiness* of the motion of the body, is

$$(v_2-v_1)V = gE/V^2w. \qquad (74)$$

§ 118. *Actual Energy of a Shifting Body.*—The energy which must be exerted on a body of the weight w, to accelerate it from a state of rest up to a given velocity of translation v, and the equal amount of work which that body is capable of performing by overcoming resistance while being retarded from the same velocity of translation v to a state of rest, is

$$wv^2/2g. \qquad (75)$$

This is called the *actual energy* of the motion of the body, and is half the quantity which in some treatises is called *vis viva.*

The energy stored or restored, as the case may be, by the deviations of velocity of a body or a system of bodies, is the amount by which the actual energy is increased or diminished.

§ 119. *Principle of the Conservation of Energy in Machines.*—The following principle, expressing the general law of the action of machines with a velocity uniform or varying, includes the law of the equality of energy and work stated in § 89 for machines of uniform speed.

In any given interval during the working of a machine, the energy exerted added to the energy restored is equal to the energy stored added to the work performed.

§ 120. *Actual Energy of Circular Translation—Moment of Inertia.*—Let a small body of the weight w undergo translation in a circular path of the radius ρ, with the angular velocity of deflexion α, so that the common linear velocity of all its particles is $v=\alpha\rho$. Then the actual energy of that body is

$$wv^2/2g = w\alpha^2\rho^2/2g. \qquad (76)$$

By comparing this with the expression for the centrifugal force $(w\alpha^2\rho/g)$, it appears that the actual energy of a revolving body is equal to the potential energy $F\rho/2$ due to the action of the deflecting force along one-half of the radius of curvature of the path of the body.

The product $w\rho^2/g$, by which the half-square of the angular velocity is multiplied, is called the *moment of inertia* of the revolving body.

§ 121. *Flywheels.*—A flywheel is a rotating piece in a machine, generally shaped like a wheel (that is to say, consisting of a rim with spokes), and suited to store and restore energy by the periodical variations in its angular velocity.

The principles according to which variations of angular velocity store and restore energy are the same as those of § 117, only substituting *moment of inertia* for *mass*, and *angular* for *linear* velocity.

Let W be the weight of a flywheel, R its radius of gyration, α_2 its maximum, α_1 its minimum, and $A=\frac{1}{2}(\alpha_2+\alpha_1)$ its mean angular velocity. Let

$$1/S = (\alpha_2-\alpha_2)/A$$

denote the *unsteadiness* of the motion of the flywheel; the denominator S of this fraction is called the *steadiness*. Let e denote the quantity by which the energy exerted in each cycle of the working of the machine alternately exceeds and falls short of the work performed, and which has consequently to be alternately stored by acceleration and restored by retardation of the flywheel. The value of this *periodical excess* is—

$$e = R^2W(\alpha_2^2-a_1^2),\ 2g, \qquad (77)$$

from which, dividing both sides by A^2, we obtain the following equations:—

$$\left.\begin{array}{r} e/A^2 = R^2W/gS \\ R^2WA^2/2g = Se/2 \end{array}\right\}. \qquad (78)$$

The latter of these equations may be thus expressed in words: *The actual energy due to the rotation of the fly, with its mean angular velocity, is equal to one-half of the periodical excess of energy multiplied by the steadiness.*

In ordinary machinery S = about 32; in machinery for fine purposes S = from 50 to 60; and when great steadiness is required S = from 100 to 150.

The periodical excess e may arise either from variations in the effort exerted by the prime mover, or from variations in the resistance of the work, or from both these causes combined. When but one flywheel is used, it should be placed in as direct connexion as possible with that part of the mechanism where the greatest amount of the periodical excess originates; but when it originates at two or more points, it is best to have a flywheel in connexion with each of these points. For example, in a machine-work, the steam-engine, which is the prime mover of the various tools, has a flywheel on the crank-shaft to store and restore the periodical excess of energy arising from the variations in the effort exerted by the connecting-rod upon the crank; and each of the slotting machines, punching machines, riveting machines, and other tools has a flywheel of its own to store and restore energy, so as to enable the very different resistances opposed to those tools at different times to be overcome without too great unsteadiness of motion. For tools performing useful work at intervals, and having only their own friction to overcome during the intermediate intervals, e should be assumed equal to the whole work performed at each separate operation.

§ 122. *Brakes.*—A brake is an apparatus for stopping and diminishing the velocity of a machine by friction, such as the friction-strap already referred to in § 103. To find the distance s through which a brake, exerting the friction F, must rub in order to stop a machine having the total actual energy E at the moment when the brake begins to act, reduce, by the principles of § 96, the various efforts and other resistances of the machine which act at the same time with the friction of the brake to the rubbing surface of the brake, and let R be their resultant—*positive* if resistance, *negative* if effort preponderates. Then

$$s = E/(F+R). \qquad (79)$$

§ 123. *Energy distributed between two Bodies: Projection and Propulsion.*—Hitherto the effort by which a machine is moved has been treated as a force exerted between a movable body and a fixed body, so that the whole energy exerted by it is employed upon the movable body, and none upon the fixed body. This conception is sensibly realized in practice when one of the two bodies between which the effort acts is either so heavy as compared with the other, or has so great a resistance opposed to its motion, that it may, without sensible error, be treated as fixed. But there are cases in which the motions of both bodies are appreciable, and must be taken into account—such as the projection of projectiles, where the velocity of the *recoil* or backward motion of the gun bears an appreciable proportion to the forward motion of the projectile; and such as the propulsion of vessels, where the velocity of the water thrown backward by the paddle, screw or other propeller bears a very considerable proportion to the velocity of the water moved forwards and sideways by the ship. In cases of this kind the energy exerted by the effort is *distributed* between the two bodies between which the effort is exerted in shares proportional to the velocities of the two bodies during the action of the effort; and those velocities are to each other directly as the portions of the effort unbalanced by resistance on the respective bodies, and inversely as the weights of the bodies.

To express this symbolically, let W_1, W_2 be the weights of the bodies; P the effort exerted between them; S the distance through which it acts; R_1, R_2 the resistances opposed to the effort overcome by W_1, W_2 respectively; E_1, E_2 the shares of the whole energy E exerted upon W_1, W_2 respectively. Then

$$\left.\begin{array}{cccccc} & E & : & E_1 & : & E_2 \\ :: & \frac{W_2(P-R_1)+W_1(P-R_2)}{W_1W_2} & : & \frac{P-R_1}{W_1} & : & \frac{P-R_2}{W_2} \end{array}\right\}. \qquad (80)$$

If $R_1 = R_2$, which is the case when the resistance, as well as the effort, arises from the mutual actions of the two bodies, the above becomes,

$$\left.\begin{array}{rl} & E : E_1 : E_2 \\ :: & W_1+W_2 : W_2 : W_1 \end{array}\right\}, \qquad (81)$$

that is to say, the energy is exerted on the bodies in shares inversely proportional to their weights; and they receive accelerations inversely proportional to their weights, according to the principle of dynamics, already quoted in a note to § 110, that the mutual actions of a system of bodies do not affect the motion of their common centre of gravity.

For example, if the weight of a gun be 160 times that of its ball $\frac{159}{160}$ of the energy exerted by the powder in exploding will be employed in propelling the ball, and $\frac{1}{160}$ in producing the recoil of the gun, provided the gun up to the instant of the ball's quitting the muzzle meets with no resistance to its recoil except the friction of the ball.

§ 124. *Centre of Percussion.*—It is obviously desirable that the deviations or changes of motion of oscillating pieces in machinery should, as far as possible, be effected by forces applied at their centres of percussion.

If the deviation be a *translation*—that is, an equal change of motion of all the particles of the body—the centre of percussion is obviously the centre of gravity itself; and, according to the second law of motion, if dv be the deviation of velocity to be produced in the interval dt, and W the weight of the body, then

$$P = \frac{W}{g}\cdot\frac{dv}{dt} \qquad (82)$$

is the unbalanced effort required.

If the deviation be a rotation about an axis traversing the centre of gravity, there is no centre of percussion; for such a deviation can only be produced by a *couple* of forces, and not by any single force. Let $d\alpha$ be the deviation of angular velocity to be produced in the interval dt, and I the moment of the inertia of the body about an axis through its centre of gravity; then $\frac{1}{2}Id(\alpha^2) = I\alpha d\alpha$ is the variation of the body's actual energy. Let M be the moment of the unbalanced couple required to produce the deviation; then by equation 57, § 104, the energy exerted by this couple in the interval dt is $M\alpha dt$, which, being equated to the variation of energy, gives

$$M = I\frac{d\alpha}{dt} = \frac{R^2W}{g}\cdot\frac{d\alpha}{dt} \qquad (83)$$

R is called the radius of gyration of the body with regard to an axis through its centre of gravity.

Now (fig. 133) let the required deviation be a rotation of the body BB about an axis O, not traversing the centre of gravity G, da being, as before, the deviation of angular velocity to be produced in the interval dt. A rotation with the angular velocity α about an axis O may be considered as compounded of a rotation with the same angular velocity about an axis drawn through G parallel to O and a translation with the velocity α. OG, OG being the perpendicular distance between the two axes. Hence the required deviation may be regarded as compounded of a deviation of translation $dv = \text{OG}.\,d\alpha$, to produce which there would be required, according to equation (82), a force applied at G perpendicular to the plane OG—

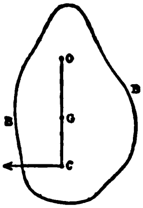


FIG. 133.

$$P = \frac{W}{g} \,.\, \text{OG} \,.\, \frac{d\alpha}{dt} \qquad (84)$$

and a deviation $d\alpha$ of rotation about an axis drawn through G parallel to O, to produce which there would be required a couple of the moment M given by equation (83). According to the principles of statics, the resultant of the force P, applied at G perpendicular to the plane OG, and the couple M is a force equal and parallel to P, but applied at a distance GC from G, in the prolongation of the perpendicular OG, whose value is

$$\text{GC} = M/P = R^2/\text{OG}. \qquad (85)$$

Thus is determined the position of the centre of percussion C, corresponding to the axis of rotation O. It is obvious from this equation that, for an axis of rotation parallel to O traversing C, the centre of percussion is at the point where the perpendicular OG meets O.

§ 125.* *To find the moment of inertia of a body about an axis through its centre of gravity experimentally.*—Suspend the body from any conveniently selected axis O (fig. 48) and hang near it a small plumb bob. Adjust the length of the plumb-line until it and the body oscillate together in unison. The length of the plumb-line, measured from its point of suspension to the centre of the bob, is for all practical purposes equal to the length OC, C being therefore the centre of percussion corresponding to the selected axis O. From equation (85)

$$R^2 = \text{CG} \times \text{OG} = (\text{OC} - \text{OG})\text{OG}.$$

The position of G can be found experimentally; hence OG is known, and the quantity R^2 can be calculated, from which and the ascertained weight W of the body the moment of inertia about an axis through G, namely, $W/g \times R^2$, can be computed.

§ 126.* *To find the force competent to produce the instantaneous acceleration of any link of a mechanism.*—In many practical problems it is necessary to know the magnitude and position of the forces acting to produce the accelerations of the several links of a mechanism. For a given link, this force is the resultant of all the accelerating forces distributed through the substance of the material of the link required to produce the requisite acceleration of each particle, and the determination of this force depends upon the principles of the two preceding sections. The investigation of the distribution of the forces through the material and the stress consequently produced belongs to the subject of the STRENGTH OF MATERIALS (*q. v.*). Let BK (fig. 134) be any link moving in any manner in a plane, and let G be its centre of gravity. Then its motion may be analysed into (1) a translation of its centre of gravity; and (2) a rotation about an axis through its centre of gravity perpendicular to its plane of motion. Let a be the acceleration of the centre of gravity and let A be the angular acceleration about the axis through the centre of gravity; then the force required to produce the translation of the centre of gravity is $F = Wa/g$, and the couple required to produce the angular acceleration about the centre of gravity is $M = IA/g$, W and I being respectively the reight and the moment of inertia of the link about the xis through the centre of gravity. The couple M may e produced by shifting the force F parallel to itself through distance x, such that $Fx = M$. When the link forms part of a nechanism the respective accelerations of two points in the link an be determined by means of the velocity and acceleration diarams described in § 82, it being understood that the motion of one nk in the mechanism is prescribed, for instance, in the steam-engine's nechanism that the crank shall revolve uniformly. Let the acceleraion of the two points B and K therefore be supposed known. The roblem is now to find the acceleration a and A. Take any pole O fig. 49), and set out Ob equal to the acceleration of B and Ok equal o the acceleration of K. Join bk and take the point g so that KG: GB = kg:gb. Og is then the acceleration of the centre of gravity and the force F can therefore be immediately calculated. To find the angular acceleration A, draw kt, bt respectively parallel to and at right angles to the link KB. Then tb represents the angular acceleration of the point B relatively to the point K and hence tb/KB is the value of A, the angular acceleration of the link. Its moment of inertia about G can be found experimentally by the method explained in § 125, and then the value of the couple M can be computed. The value of x is found immediately from the quotient M/F. Hence the magnitude F and the position of F relatively to the centre of gravity of the link, necessary to give rise to the couple M, are known, and this force is therefore the resultant force required.

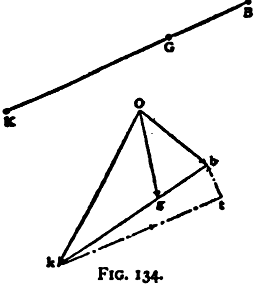


FIG. 134.

§ 127.* *Alternative construction for finding the position of F relatively to the centre of gravity of the link.*—Let B and K be any two points in the link which for greater generality are taken in fig. 135, so that the centre of gravity G is not in the line joining them. First find the value of R experimentally. Then produce the given directions of acceleration of B and K to meet in O; draw a circle through the three points B, K and O; produce the line joining O and G to cut the circle in Y; and take a point Z on the line OY so that $YG \times GZ = R^2$. Then Z is a point in the line of action of the force F. This useful theorem is due to G. T. Bennett, of Emmanuel College, Cambridge. A proof of it and three corollaries are given in appendix 4 of the second edition of Dalby's *Balancing of Engines* (London, 1906). It is to be noticed that only the directions of the accelerations of two points are required to find the point Z.

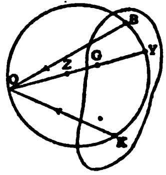


FIG. 135.

For an example of the application of the principles of the two preceding sections to a practical problem see *Valve and Valve Gear Mechanisms*, by W. E. Dalby (London, 1906), where the inertia stresses brought upon the several links of a Joy valve gear, belonging to an express passenger engine of the Lancashire & Yorkshire railway, are investigated for an engine-speed of 68 m. an hour.

§ 128.* *The Connecting Rod Problem.*—A particular problem of practical importance is the determination of the force producing the motion of the connecting rod of a steam-engine mechanism of the usual type. The methods of the two preceding sections may be used when the acceleration of two points in the rod are known. In this problem it is usually assumed that the crank pin K (fig. 136) moves with uniform velocity, so that if α is its angular velocity and r its radius, the acceleration is $\alpha^2 r$ in a direction along the crank arm from the crank pin to the centre of the shaft. Thus the acceleration of one point K is known completely. The acceleration of a second point, usually taken at the centre of the crosshead pin, can be found by the principles of § 82, but several special geometrical constructions have been devised for this purpose, notably the construction of Klein,[1] discovered also independently by Kirsch.[2] But probably the most convenient is the construction due to G. T. Bennett[3] which is as follows: Let OK be the crank and KB the connecting rod. On the connecting rod take a point L such that $KL \times KB = KO^2$. Then, the crank standing at any angle with the line of stroke, draw LP at right angles to the connecting rod, PN at right angles to the line of stroke OB and NA at right angles to the connecting rod; then AO is the acceleration of the point B to the scale on which KO represents the acceleration of the point K. The proof of this construction is given in *The Balancing of Engines*.

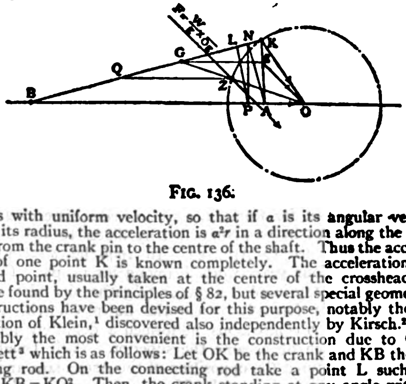


FIG. 136.

The finding of F may be continued thus: join AK, then AK is the acceleration image of the rod, OKA being the acceleration diagram. Through G, the centre of gravity of the rod, draw Gg parallel to the line of stroke, thus dividing the image at g in the proportion that the connecting rod is divided by G. Hence Og represents the acceleration of the centre of gravity and, the weight of the connecting rod being ascertained, F can be immediately calculated. To find a point in its line of action, take a point Q on the rod such that $KG \times GQ = R^2$, R having been determined experimentally by the method of § 125; join G with O and through Q draw a line parallel to BO to cut GO in Z. Z is a point in the line of action of the resultant force F; hence through Z draw a line parallel to Og. The force F acts in this line, and thus the problem is completely solved. The above construction for Z is a corollary of the general theorem given in § 127.

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[1] J. F. Klein, "New Constructions of the Force of Inertia of Connecting Rods and Couplers and Constructions of the Pressures on their Pins," *Journ. Franklin Inst.*, vol. 132 (Sept. and Oct., 1891).

[2] Prof. Kirsch, "Über die graphische Bestimmung der Kolbenbeschleunigung," *Zeitsch. Verein deutsche Ingen.* (1890), p. 1320.

[3] Dalby, *The Balancing of Engines* (London, 1906), app. 1.

§ 129. *Impact.* Impact or collision is a pressure of short duration exerted between two bodies.

The effects of impact are sometimes an alteration of the distribution of actual energy between the two bodies, and always a loss of a portion of that energy, depending on the imperfection of the elasticity of the bodies, in permanently altering their figures, and producing heat. The determination of the distribution of the actual energy after collision and of the loss of energy is effected by means of the following principles:—

I. The motion of the common centre of gravity of the two bodies is unchanged by the collision.

II The loss of energy consists of a certain proportion of that part of the actual energy of the bodies which is due to their motion relatively to their common centre of gravity.

Unless there is some special reason for using impact in machines, it ought to be avoided, on account not only of the waste of energy which it causes, but from the damage which it occasions to the frame and mechanism. (W. J. M. R.; W. E. D.)

MECHANICVILLE, a village of Saratoga county, New York, U.S.A., on the west bank of the Hudson River, about 20 m. N. of Albany; on the Delaware & Hudson and Boston & Maine railways. Pop. (1900), 4695 (702 foreign-born); (1905, state census), 5877; (1910) 6,634. It lies partly within Stillwater and partly within Half-Moon townships, in the bottom-lands at the mouth of the Anthony Kill, about 1½ m. S. of the mouth of the Hoosick River. On the north and south are hills reaching a maximum height of 200 ft. There is ample water power, and there are manufactures of paper, sash and blinds, fibre, &c. From a dam here power is derived for the General Electric Company at Schenectady. The first settlement in this vicinity was made in what is now Half-Moon township about 1680. Mechanicville (originally called Burrow) was chartered by the county court in 1859, and incorporated as a village in 1870. It was the birthplace of Colonel Ephraim Elmer Ellsworth (1837–1861), the first Federal officer to lose his life in the Civil War.

MECHITHARISTS, a congregation of Armenian monks in communion with the Church of Rome. The founder, Mechithar, was born at Sebaste in Armenia, 1676. He entered a monastery, but under the influence of Western missionaries he became possessed with the idea of propagating Western ideas and culture in Armenia, and of converting the Armenian Church from its monophysitism and uniting it to the Latin Church. Mechithar set out for Rome in 1695 to make his ecclesiastical studies there, but he was compelled by illness to abandon the journey and return to Armenia. In 1696 he was ordained priest and for four years worked among his people. In 1700 he went to Constantinople and began to gather disciples around him. Mechithar formally joined the Latin Church, and in 1701, with sixteen companions, he formed a definitely religious institute of which he became the superior. Their Uniat propaganda encountered the opposition of the Armenians and they were compelled to move to the Morea, at that time Venetian territory, and there built a monastery, 1706. On the outbreak of hostilities between the Turks and Venetians they migrated to Venice, and the island of St Lazzaro was bestowed on them, 1717. This has since been the headquarters of the congregation, and here Mechithar died in 1749, leaving his institute firmly established. The rule followed at first was that attributed to St Anthony, but when they settled in the West modifications from the Benedictine rule were introduced, and the Mechitharists are numbered among the lesser orders affiliated to the Benedictines. They have ever been faithful to their founder's programme. Their work has been fourfold: (1) they have brought out editions of important patristic works, some Armenian, others translated into Armenian from Greek and Syriac originals no longer extant; (2) they print and circulate Armenian literature among the Armenians, and thereby exercise a powerful educational influence; (3) they carry on schools both in Europe and Asia, in which Uniat Armenian boys receive a good secondary education; (4) they work as Uniat missioners in Armenia. The congregation is divided into two branches, the head houses being at St Lazzaro and Vienna. They have fifteen establishments in various places in Asia Minor and Europe. There are some 150 monks, all Armenians; they use the Armenian language and rite in the liturgy.

See *Vita del servo di Dio Mechitar* (Venice, 1901); E. Boré, *Saint-Lazare* (1835); Max Heimbucher, *Orden u. Kongregationen* (1907) I. § 37; and the articles in Wetzer u. Welte, *Kirchenlexicon* (ed. 2) and Herzog, *Realencyklopädie* (ed. 3), also articles by Sargisean, a Mechitharist, in *Rivista storica benedettina* (1906), "La Congregazione Mechitarista." (E. C. B.)

MECKLENBURG, a territory in northern Germany, on the Baltic Sea, extending from 53° 4′ to 54° 22′ N and from 10° 35′ to 13° 57′ E., unequally divided into the two grand duchies of Mecklenburg-Schwerin and Mecklenburg-Strelitz.

MECKLENBURG-SCHWERIN is bounded N. by the Baltic Sea, W by the principality of Ratzeburg and Schleswig-Holstein, S. by Brandenburg and Hanover, and E. by Pomerania and Mecklenburg-Strelitz. It embraces the duchies of Schwerin and Güstrow, the district of Rostock, the principality of Schwerin, and the barony of Wismar, besides several small enclaves (Ahrensberg, Rosson, Tretzeband, &c.) in the adjacent territories. Its area is 5080 sq. m. Pop. (1905), 625,045.

MECKLENBURG-STRELITZ consists of two detached parts, the duchy of Strelitz on the E. of Mecklenburg-Schwerin, and the principality of Ratzeburg on the W. The first is bounded by Mecklenburg-Schwerin, Pomerania and Brandenburg, the second by Mecklenburg-Schwerin, Lauenburg, and the territory of the free town of Lübeck. Their joint area is 1130 sq. m. Pop. (1905), 103,451.

Mecklenburg lies wholly within the great North-European plain, and its flat surface is interrupted only by one range of low hills, intersecting the country from south-east to north-west, and forming the watershed between the Baltic Sea and the Elbe. Its highest point, the Helpter Berg, is 587 ft. above sea-level. The coast-line runs for 65 m. along the Baltic (without including indentations), for the most part in flat sandy stretches covered with dunes. The chief inlets are Wismar Bay, the Salzhaff, and the roads of Warnemünde. The rivers are numerous though small; most of them are affluents of the Elbe, which traverses a small portion of Mecklenburg. Several are navigable, and the facilities for inland water traffic are increased by canals. Lakes are numerous; about four hundred, covering an area of 500 sq. m., are reckoned in the two duchies. The largest is Lake Müritz, 52 sq. m. in extent. The climate resembles that of Great Britain, but the winters are generally more severe; the mean annual temperature is 48° F., and the annual rainfall is about 28 in. Although there are long stretches of marshy moorland along the coast, the soil is on the whole productive. About 57% of the total area of Mecklenburg-Schwerin consists of cultivated land, 18% of forest, and 13% of heath and pasture. In Mecklenburg-Strelitz the corresponding figures are 47, 21 and 10%. Agriculture is by far the most important industry in both duchies. The chief crops are rye, oats, wheat, potatoes and hay. Smaller areas are devoted to maize, buckwheat, pease, rape, hemp, flax, hops and tobacco. The extensive pastures support large herds of sheep and cattle, including a noteworthy breed of merino sheep. The horses of Mecklenburg are of a fine sturdy quality and highly esteemed. Red deer, wild swine and various other game are found in the forests. The industrial establishments include a few iron-foundries, wool-spinning mills, carriage and machine factories, dye-works, tanneries, brick-fields, soap-works, breweries, distilleries, numerous limekilns and tar-boiling works, tobacco and cigar factories, and numerous mills of various kinds. Mining is insignificant, though a fair variety of minerals is represented in the district. Amber is found on and near the Baltic coast. Rostock, Warnemünde and Wismar are the principal commercial centres. The chief exports are grain and other agricultural produce, live stock, spirits, wood and wool; the chief imports are colonial produce, iron, coal, salt, wine, beer and tobacco. The horse and wool markets of Mecklenburg are largely attended by buyers from various parts of Germany. Fishing is carried on extensively in the numerous inland lakes.

In 1907 the grand dukes of both duchies promised a constitution to their subjects. The duchies had always been under a government of feudal character, the grand dukes having the executive entirely in their hands (though acting through ministers), while the duchies shared a diet (*Landtag*), meeting for a short session each year, and at other times represented by a committee, and consisting of the proprietors of knights' estates (*Rittergüter*), known as the *Ritterschaft*, and the *Landschaft* or burgomasters of certain towns

Mecklenburg-Schwerin returns six members to the Reichstag and Mecklenburg-Strelitz one member.

In Mecklenburg-Schwerin the chief towns are Rostock (with a university), Schwerin, and Wismar the capital. The capital of Mecklenburg-Strelitz is Neu-Strelitz. The peasantry of Mecklenburg retain traces of their Slavonic origin, especially in speech, but their peculiarities have been much modified by amalgamation with German colonists. The townspeople and nobility are almost wholly of Saxon strain. The slowness of the increase in population is chiefly accounted for by emigration.

History.—The Teutonic peoples, who in the time of Tacitus occupied the region now known as Mecklenburg, were succeeded in the 6th century by some Salvonic tribes, one of these being the Obotrites, whose chief fortress was Michilenburg, the modern Mecklenburg, near Wismar; hence the name of the country. Though partly subdued by Charlemagne towards the close of the 8th century, they soon regained their independence, and until the 10th century no serious effort was made by their Christian neighbours to subject them. Then the German king, Henry the Fowler, reduced the Slavs of Mecklenburg to obedience and introduced Christianity among them. During the period of weakness through which the German kingdom passed under the later Ottos, however, they wrenched themselves free from this bondage; the 11th and the early part of the 12th century saw the ebb and flow of the tide of conquest, and then came the effective subjugation of Mecklenburg by Henry the Lion, duke of Saxony. The Obotrite prince Niklot was killed in battle in 1160 whilst resisting the Saxons, but his son Pribislaus (d. 1178) submitted to Henry the Lion, married his daughter to the son of the duke, embraced Christianity, and was permitted to retain his office. His descendants and successors, the present grand dukes of Mecklenburg, are the only ruling princes of Slavonic origin in Germany. Henry the Lion introduced German settlers and restored the bishoprics of Ratzeburg and Schwerin; in 1170 the emperor Frederick I. made Pribislaus a prince of the empire. From 1214 to 1227 Mecklenburg was under the supremacy of Denmark; then, in 1229, after it had been regained by the Germans, there took place the first of the many divisions of territory which with subsequent reunions constitute much of its complicated history. At this time the country was divided between four princes, grandsons of duke Henry Borwin, who had died two years previously. But in less than a century the families of two of these princes became extinct, and after dividing into three branches a third family suffered the same fate in 1436. There then remained only the line ruling in Mecklenburg proper, and the princes of this family, in addition to inheriting the lands of their dead kinsmen, made many additions to their territory, including the counties of Schwerin and of Strelitz. In 1352 the two princes of this family made a division of their lands, Stargard being separated from the rest of the country to form a principality for John (d. 1393), but on the extinction of his line in 1471 the whole of Mecklenburg was again united under a single ruler. One member of this family, Albert (*c.* 1338–1412), was king of Sweden from 1364 to 1389. In 1348 the emperor Charles IV. had raised Mecklenburg to the rank of a duchy, and in 1418 the university of Rostock was founded.

The troubles which arose from the rivalry and jealousy of two or more joint rulers incited the prelates, the nobles and the burghers to form a union among themselves, and the results of this are still visible in the existence of the *Landesunion* for the whole country which was established in 1523. About the same time the teaching of Luther and the reformers was welcomed in Mecklenburg, although Duke Albert (d. 1547) soon reverted to the Catholic faith; in 1549 Lutheranism was recognized as the state religion; a little later the churches and schools were reformed and most of the monasteries were suppressed. A division of the land which took place in 1555 was of short duration, but a more important one was effected in 1611, although Duke John Albert I (d. 1576) had introduced the principle of primogeniture and had forbidden all further divisions of territory. By this partition John Albert's grandson Adolphus Frederick I. (d. 1658) received Schwerin, and another grandson John Albert II. (d. 1636) received Güstrow. The town of Rostock "with its university and high court of justice" was declared to be common property, while the Diet or *Landtag* also retained its joint character, its meetings being held alternately at Sternberg and at Malchin.

During the early part of the Thirty Years' War the dukes of Mecklenburg-Schwerin and Mecklenburg-Güstrow were on the Protestant side, but about 1627 they submitted to the emperor Ferdinand II. This did not prevent Ferdinand from promising their land to Wallenstein, who, having driven out the dukes, was invested with the duchies in 1629 and ruled them until 1631. In this year the former rulers were restored by Gustavus Adolphus of Sweden, and in 1635 they came to terms with the emperor and signed the peace of Prague, but their land continued to be ravaged by both sides until the conclusion of the war. In 1648 by the Treaty of Westphalia, Wismar and some other parts of Mecklenburg were surrendered to Sweden, the recompense assigned to the duchies including the secularized bishoprics of Schwerin and of Ratzeburg. The sufferings of the peasants in Mecklenburg during the Thirty Years' War were not exceeded by those of their class in any other part of Germany; most of them were reduced to a state of serfdom and in some cases whole villages vanished. Christian Louis who ruled Mecklenburg-Schwerin from 1658 until his death in 1692 was, like his father Adolphus Frederick, frequently at variance with the estates of the land and with members of his family. He was a Roman Catholic and a supporter of Louis XIV., and his country suffered severely during the wars waged by France and her allies in Germany.

In June 1692 when Christian Louis died in exile and without sons, a dispute arose about the succession to his duchy between his brother Adolphus Frederick and his nephew Frederick William. The emperor and the rulers of Sweden and of Brandenburg took part in this struggle which was intensified when, three years later, on the death of Duke Gustavus Adolphus, the family ruling over Mecklenburg-Güstrow became extinct. At length the partition Treaty of Hamburg was signed on the 8th of March 1701, and a new division of the country was made. Mecklenburg was divided between the two claimants, the shares given to each being represented by the existing duchies of Mecklenburg-Schwerin, the part which fell to Frederick William, and Mecklenburg-Strelitz, the share of Adolphus Frederick. At the same time the principle of primogeniture was again asserted, and the right of summoning the joint *Landtag* was reserved to the ruler of Mecklenburg-Schwerin.

Mecklenburg-Schwerin began its existence by a series of constitutional struggles between the duke and the nobles. The heavy debt incurred by Duke Charles Leopold (d. 1747), who had joined Russia in a war against Sweden, brought matters to a crisis; the emperor Charles VI. interfered and in 1728 the imperial court of justice declared the duke incapable of governing and his brother Christian Louis was appointed administrator of the duchy. Under this prince, who became ruler *de jure* in 1747, there was signed in April 1755 the convention of Rostock by which a new constitution was framed for the duchy. By this instrument all power was in the hands of the duke, the nobles and the upper classes generally, the lower classes being entirely unrepresented. During the Seven Years' War Duke Frederick (d. 1785) took up a hostile attitude towards Frederick the Great, and in consequence Mecklenburg was occupied by Prussian troops, but in other ways his rule was beneficial to the country. In the early years of the French revolutionary wars Duke Frederick Francis I. (1756–1837) remained neutral, and in 1803 he regained Wismar from Sweden, but in 1806 his land was overrun by the French and in 1808 he joined the Confederation of the Rhine. He was the first member of the confederation to abandon Napoleon, to whose armies he had sent a contingent, and in 1813–1814 he fought against France. In 1815 he joined the Germanic Confederation (Bund) and took the title of grand duke. In 1819 serfdom was abolished in his dominions. During the movement of 1848 the duchy witnessed a considerable agitation in favour of a more liberal constitution, but in the subsequent reaction all the concessions which had been made to the democracy were withdrawn and further restrictive measures were introduced in 1851 and 1852.

Mecklenburg-Strelitz adopted the constitution of the sister duchy by an act of September 1755. In 1806 it was spared the infliction of a French occupation through the good offices of the king of Bavaria; in 1808 its duke, Charles (d. 1816), joined the confederation of the Rhine, but in 1813 he withdrew therefrom. Having been a member of the alliance against Napoleon he joined the Germanic confederation in 1815 and assumed the title of grand duke.

In 1866 both the grand dukes of Mecklenburg joined the North German confederation and the *Zollverein*, and began to pass more and more under the influence of Prussia, who in the war with Austria had been aided by the soldiers of Mecklenburg-Schwerin. In the Franco-German War also Prussia received valuable assistance from Mecklenburg, Duke Frederick Francis II (1823–1883), an ardent advocate of German unity, holding a high command in her armies. In 1871 the two grand duchies became states of the German Empire. There was now a renewal of the agitation for a more democratic constitution, and the German Reichstag gave some countenance to this movement. In 1897 Frederick Francis IV. (b. 1882) succeeded his father Frederick Francis III. (1851–1897) as grand duke of Mecklenburg-Schwerin, and in 1904 Adolphus Frederick (b. 1848) a son of the grand duke Frederick William (1819–1904) and his wife Augusta Carolina, daughter of Adolphus Frederick, duke of Cambridge, became grand duke of Mecklenburg-Strelitz. The grand dukes still style themselves princes of the Wends.

See F. A. Rudloff, *Pragmatisches Handbuch der mecklenburgischen Geschichte* (Schwerin, 1780–1822); C. C. F. von Lützow, *Versuch einer pragmatischen Geschichte von Mecklenburg* (Berlin, 1827–1835); *Mecklenburgische Geschichte in Einzeldarstellungen*, edited by R. Beltz, C. Beyer, W. P. Graff and others; C. Hegel, *Geschichte der mecklenburgischen Landstände bis 1555* (Rostock, 1856); A. Mayer, *Geschichte des Grossherzogtums Mecklenburg-Strelitz 1816–1890* (New Strelitz, 1890); Tolzien, *Die Grossherzöge von Mecklenburg-Schwerin* (Wismar, 1904); Lehsten, *Der Adel Mecklenburgs seit dem landesgrundgesetzlichen Erbvergleich* (Rostock, 1864); the *Mecklenburgisches Urkundenbuch* in 21 vols. (Schwerin, 1873–1903); the *Jahrbücher des Vereins für mecklenburgische Geschichte und Altertumskunde* (Schwerin, 1836 fol.); and W. Raabe, *Mecklenburgische Vaterlandskunde* (Wismar, 1894–1896); von Hirschfeld, *Friedrich Franz II., Grossherzog von Mecklenburg-Schwerin und seine Vorgänger* (Leipzig, 1891); Volz, *Friedrich Franz II.* (Wismar, 1893); C. Schröder, *Friedrich Franz III.* (Schwerin, 1898); Bartold, *Friedrich Wilhelm, Grossherzog von Mecklenburg-Strelitz und Augusta Carolina* (New Strelitz, 1893); and H. Sachsse, *Mecklenburgische Urkunden und Daten* (Rostock, 1900).

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